# Abstract Volume

XVIth International Conference on Infant Studies

Vancouver, Canada
March 27–29, 2008

*Table of Contents*

## Oral Presentations, March 27

## Oral Presentations, March 28



## Oral Presentations, March 29

# Oral Presentations, March 27, 2008

## *New Functions of Infant-Directed Speech: Evidence from Word Learning and Categorization*

*(Regular Symposium, Communication and Language)*

**Chair:** *Michael Goldstein*

**Discussant:** *Peter Kaplan*

**Michael Goldstein**[1] Katharine Graf Estes[2] Kristin Atchison[3] **Peter Kaplan**[4]

*1. Cornell University, Ithaca, USA; 2. Univesity of California, Davis, USA; 3. University of Texas at Dallas, Richardson, USA; 4. University of Colorado at Denver and Health Sciences Center, Denver, USA*

**Background:** A prominent feature of adult-infant interaction is infant-directed speech (IDS), which has a higher fundamental frequency, slower rate, and more exaggerated prosody than speech directed to adults (ADS; Fernald, 1992). The typical functions ascribed to IDS are communication of emotional content (Fernald) and facilitation of associative learning (Kaplan et al., 2002). The proposed symposium will feature new research that has greatly expanded the range of functions attributable to IDS.

**Specific Aims:** Our symposium will add considerably to what is currently known about the role of IDS in cognitive and communicative development. For example, we will present the first evidence that IDS plays an important role in word learning. Katharine Graf Estes will present "Learning words from infant-directed speech", showing that IDS organizes attention in 17-month-olds and facilitates connections between sound and meaning. Michael Goldstein will present "Developmental changes in infants' use of infant-directed speech and motion when learning new words", demonstrating that 13-month-olds require IDS paired with synchronous motion to learn words, but IDS alone is sufficient for 15-month-olds to learn. IDS also facilitates infants' ability to categorize speech. Kristin Atchison will present "The Impact of Faces on Infants' Categorization of Infant-Directed Speech", showing that infants are sensitive to acoustic properties that differentiate IDS conveying comforting and approving communicative intent. Visual stimuli also influence infants' categorization of IDS patterns.

Our discussant will be Peter Kaplan. He conducts research on the role of IDS in associative learning, and was the first to demonstrate the impact of maternal depression on IDS and infant learning. His work has been published in Psychological Science and is highly cited.

In summary, given the new-found relevance for IDS in important cognitive tasks such as word learning and categorization, we feel that developmental psychologists could benefit from hearing more about the latest findings on IDS.

### Learning Words from Infant-Directed Speech

**Katharine Graf Estes**

*Univesity of California, Davis, USA*

**Background and Aims:** The exaggerated sing-song manner of infant-directed (ID) speech elicits infants' attention (Cooper & Aslin, 1990). However, there is surprisingly little evidence that ID speech facilitates learning in infants. In one demonstration, Thiessen et al. (2005) found that when ID and AD speech contained identical word boundary cues, ID prosody aided word segmentation. ID prosody may help infants attend to and learn from speech, even without supplying supplemental linguistic cues. We investigated whether ID prosody facilitates another key aspect of language development, word learning. We compared learning of ID and non-ID object labels when all labels were presented in isolation; thus the ID labels provided no additional word-teaching cues.

**Method:** Seventeen-month-olds were exposed to object labels in a word-object association task (Werker et al., 2002). Infants habituated to two objects paired with words (e.g., "timay," "dobu") presented in either ID (high pitch, exaggerated pitch range) or non-ID (lower pitch, consistent range) prosody. Testing compared looking time to "same" test trials that maintained the word-object pairs versus "switch" trials that violated the original pairs. Longer looking time on switch trials indicates successful learning of the original word-object associations.

**Results:** For non-ID words, infants failed to distinguish same versus switch trials ($t(20)= 1.5$, $p > .05$). For ID words, infants looked significantly longer on switch trials ($t(20)= 3.2$, $p < .01$). Only infants presented with ID prosody labels learned the word-object pairs.

**Conclusion:** These findings suggest one way that ID speech may facilitate word learning. ID prosody can recruit attention to support the linking of sound and meaning, even when words are presented in isolation and in a task with minimal social context. Future experiments will address which aspects of ID prosody aid learning - the elevated pitch, expanded and variable pitch range, or the emotion expressed.

### Developmental Changes in Infants' Use of Infant-Directed Speech and Motion when Learning New Words

**Michael Goldstein**, Jennifer Schwade

*Cornell University, Ithaca, USA*

When interacting with infants, parents modify how they speak and how they move objects. Infant-directed (ID) speech has a higher fundamental frequency and more exaggerated prosody than adult-directed (AD) speech (Fernald, 1992). Infant-directed motion ("motionese", Brand et al., 2002) is also more exaggerated. The present study manipulated speech and motion type in a novel word learning task.

Infants (13-month-olds, n=80; 15-month-olds,n=47) participated in face-to-face interactions with an experimenter. The experimenter labeled a novel object and a distracter object, using ID or AD speech. For half of the infants, the experimenter moved the objects in synchrony with her speech during labeling. For the remaining infants, objects were held still during labeling. Novel word comprehension was tested immediately and the next day.

Separate mixed ANOVAs (Speech x Motion x Session) were conducted on comprehension for each age. Thirteen-month-olds showed a Speech x Motion interaction, $F(1,76) =5.68$ $p=.02$. Follow-up tests of simple main effects revealed that for ID speech, comprehension was better in the motion condition than in the no motion condition, $F(1,48) =5.60$, $p=.022$. In the AD speech condition, there was no effect of Motion, $F(1,43) =.026$, $p=.87$. In contrast, 15-month-olds showed a Speech x Session interaction, $F(1,43) =4.49$, $p=.04$. Follow-up tests revealed no effect of Speech at Session 1, $F(1,45) =.08$, $p=.78$. At Session 2, infants who had heard the new label in ID speech remembered it better than infants who had heard it in AD speech, $F(1,45)=7.84$, $p=.007$.

Thus we show developmental shifts in infants' weighting of speech and motion when learning novel words. Synchronous motion facilitates word learning in younger infants, but only when paired with ID speech. For older infants, ID speech, not motion, improves memory for novel words. The findings illuminate developmental changes in infants' use of social information present in parent-infant interactions.

### The Impact of Faces on Infants' Categorization of Infant-Directed Speech

**Kristin Atchison**, Melanie Spence, Emily Touchstone
*University of Texas at Dallas, Richardson, USA*

**Background and Aims:** Four- and 6-month-old infants show differential responses to infant-directed speech (IDS) categorization tasks. When presented with a checkerboard, infants at 6, but not 4 months, categorized comforting and approving IDS (Spence and Moore, 2003). This difference is reversed when infants are presented female faces. A static female face or an unsynchronized video disrupt 6-month-olds' categorization, while 4-month-olds' performance is supported by a female, but not a male or scrambled face (Atchison and Spence, 2007; Spence, et al., 2004). This data along with results of ongoing work examining infants' IDS categorization of synchronous facial and vocal information will be discussed.

**Methods:** In all experiments described above, infants heard either approving or comforting female IDS during an infant-controlled habituation procedure, followed by four test trials. Control test trials presented two new utterances from the habituation IDS category, while experimental test trials presented two new utterances from the novel category.

**Results:** Increased fixation on experimental test vs. control trials provides evidence for categorization. Paired comparisons revealed that 4-month-olds increased fixation when viewing a female face ($p=0.04$), while 6-month-olds showed no categorization effects (all ps non-significant.) Results of ongoing studies examining IDS categorization of synchronous vs. asynchronous videos will also be presented. Current findings suggest that infants' IDS processing reorganizes as they become more proficient with matching faces and voices.

**Conclusion:** One potential function of IDS is communicating caregiver intent; adults' use of different IDS patterns in differing contexts may provide such opportunities. Yet in order for infants to comprehend IDS as meaningful signals, they must detect relevant similarities in physically different stimuli as a function of context and discriminate IDS patterns. IDS categorization may be prerequisite for this communicative function and it has implications for infants' developing social-communicative and linguistic competence.

---

## *Reading the Language of the Eyes: Neural Basis, Early Development, and Evolutionary Origins of Social Gaze Understanding* *(Regular Symposium, Cognitive Development)*

**Chairs:** *Jonathan Beier & Tobias Grossmann*
**Discussant:** *Elizabeth Spelke*

**Jonathan Beier**[1] **Tobias Grossmann**[2] Juliane Kaminski[3] **Elizabeth Spelke**[1]
*1. Department of Psychology, Harvard University, Cambridge, USA; 2. Centre for Brain and Cognitive Development, Birkbeck, University of London, London, UK; 3. Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany*

From birth through adulthood, humans are extraordinarily sensitive to the gaze of others. In this symposium, we present research on the neural basis, early development, and evolutionary origins of social gaze understanding. By providing these new perspectives on infants' reasoning about social gaze, we aim to highlight the variety of cognitive processes that are involved, and their continuity and changes over development.

First, Grossman will discuss the neural basis of eye contact detection in 4-month-old infants. Using EEG and infrared spectroscopy localization techniques, he measured neural activity following presentation of infant-directed and averted gaze across a variety of head orientations and angles. The pattern of findings affirms the early salience of infant-directed gaze made by dynamic, upright faces, which may reflect privileged processing for displays that encourage social communication.

Next, Beier will describe a developmental progression in infants' reasoning about mutual gaze expressed between other people. 10-month-old infants, but not 9-month-olds, discriminated mutual from averted gaze and displayed expectations for mutual gaze between two social partners. In light of much younger infants' sensitivity to gaze directed towards or away from them, these results suggest a distinction in infants' reasoning about first- versus third-person social events.

Finally, Kaminski will document gaze-following by goats and dogs. By demonstrating gaze-following in animals very distantly related to humans, this work raises questions about both the evolutionary origins of sensitivity to gaze and the mechanisms that underlie it. She proposes that gaze-following is an adaptive social behavior, but that it may not implicate an awareness of others' mental states in all species that display it.

Taken together, these presentations suggest that our rich sensitivity to social gaze is not based on a unitary process. Mechanisms evident early in phylogeny or ontogeny may have specific adaptive functions, while later-arising abilities may be built upon these and other sources of knowledge about the mental lives of other people.

### What is in a Gaze? Neural Mechanisms For Eye Contact Detection in Human Infants

**Tobias Grossmann**, Mark Johnson, Gergely Csibra
*Centre for Brain and Cognitive Development, Birkbeck, University of London, London, UK*

From birth, infants preferentially attend to faces that signal eye contact. This early sensitivity is believed to provide a vital foundation for social cognitive development, but its neural bases are unclear. Adult neuroimaging studies indicate that the right temporal cortex plays a general role in gaze monitoring and the medial prefrontal cortex is specifically engaged by the communicative intention conveyed through mutual gaze. This talk will bridge the gap between infant and adult work by asking how the behavioural sensitivity to mutual gaze is implemented in the infant brain, and to what extent the neural mechanisms are similar to those employed by adults.

In Experiment 1, gamma band oscillatory brain activity, which correlates with the hemodynamic response used in adult work, was measured in 4-month olds in response to upright and inverted faces directing their gaze at the infant (mutual gaze) or to the side (averted gaze). Only mutual gaze in upright faces elicited an induced gamma burst over prefrontal channels, indicating that infants and adults use similar neural mechanisms to detect communicative partners. Experiment 2 examined how the processing of mutual and averted gaze is influenced by head orientation. An induced gamma burst to mutual gaze was observed over right temporal but not prefrontal regions when the head was turned away, indicating that although infants discriminate between mutual and averted gaze, they do not recruit the neural mechanisms that identify static mutual gaze as a communicative signal. However, in Experiment 3, we found that dynamic gaze shifts do elicit right temporal followed by prefrontal gamma activity in response to mutual gaze. Preliminary findings using near infrared spectroscopy indicate that cortical sources sensitive to mutual gaze can be localized in right temporal and prefrontal regions.

Together, these findings suggest an early functional specialization of the cortical regions involved in gaze direction perception in general and eye contact detection in particular. We will discuss these results in a developmental framework emphasizing the importance of these brain mechanisms for social communication.

### Infants' Detection of, and Reasoning About, Mutual Gaze Between Social Partners

**Jonathan Beier**, Elizabeth Spelke

*Department of Psychology, Harvard University, Cambridge, USA*

Infants are sensitive to gaze direction in their own social interactions, but how do they understand gaze in the interactions of others? Here we identify the age at which infants discriminate mutual from averted gaze between others. Then we investigate whether infants who do so use the gaze of one social partner to infer the location of the other.

In Experiment 1, 9- and 10-month-old infants were habituated to a video of two actors turning towards each other and offering a short verbal greeting. The left and right positions of the actors alternated over successive habituation trials. At test, presentation of these mutual gaze videos alternated with averted gaze versions. At 10 months, but not 9 months, infants looked longer at averted gaze videos, demonstrating discrimination of the two video types. Experiment 2 used a violation-of-expectation procedure to test infants' expectations about mutual gaze within a social exchange. During familiarization, infants learned that a toy truck and an actor could each appear from behind either of two occluders. Next, infants viewed a centrally presented actor turn to one side, have a conversation with the hidden actor, and disappear. 10-month-old infants, but not 9-month-olds, looked longer when the truck and actor subsequently reappeared in an arrangement inconsistent with the direction of the central actor's earlier social gaze.

These studies indicate that 10-month-old infants use the gaze direction of another person to predict both the course of a social interaction and the location of a social partner. In contrast, 9-month-old infants appear not to consider mutual gaze in evaluating social interactions. Given young infants' sensitivity to gaze in their own social interactions, this finding suggests a developmental progression from reasoning about first-person to third-person interactions. Ongoing studies are investigating specifically social inferences about the relationships expressed by mutual gaze.

### Goats and Dogs Follow the Gaze of Their Social Partners: Reasoning About Others' Mental States or Adaptive Social Behaviour?

**Juliane Kaminski**[1] Anna Blinkowski[2] Josep Call[1] Michael Tomasello[1]

*1. Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany; 2. University of Cambridge, Cambridge, UK*

Gaze is an essential human social cue. By tracking the gaze direction of others, humans can make predictions about their attention, intentions, and desires. Research on other species' gaze-following abilities offers an important evolutionary perspective on our own sensitivity to gaze, and raises questions about the fundamental mechanisms underlying gaze-following behavior. Here we present evidence that goats (Capra hircus) and dogs (Canis familiaris), species very distantly related to humans, follow the gaze of their social partners. We suggest that gaze-following is a highly adaptive social behavior.

In Study 1, goats were tested for their ability to follow the gaze of their conspecifics. Goats looked more at an experimenter holding up food behind them after they saw a conspecific look towards the experimenter than when they were alone.

In Study 2, dogs were tested for their ability to track the gaze direction of a human, to an area to which they had no visual access. Dogs checked the area behind an opaque barrier more often when an experimenter looked behind it than when the experimenter gazed at the opposite wall.

In concert with data from other species, this evidence suggests that many non-human animals value gaze direction as an important social cue. This opens questions regarding the underlying mechanisms involved. While some animals, such as primates, seem to display a deeper understanding of the relationship between gaze and seeing, others may follow gaze by means of more reflexive processes. Here we argue that gaze-following has its evolutionary roots in being an adaptive social behaviour, which does not necessarily involve an understanding about others' mental states.

---

## *The Development of Memory Flexibility: Contributions of Brain Development and Experience*

*(Regular Symposium, Attention, Memory and Learning)*

**Chair:** *Jenny Richmond*

**Discussant:** *Nora Newcombe*

**Jenny Richmond**[1,2] Jane Herbert[3] Julien Gross[4] **Nora Newcombe**[5]

*1. Children's Hospital Boston, Boston, USA; 3. University of Sheffield, Sheffield, UK; 4. University of Otago, Dunedin, New Zealand; 5. Temple University, Philadelphia, USA; 2. Harvard Medical School, Boston, USA*

Infants' memories are extraordinarily specific; small changes to the cues or context available at retrieval disrupt infants' memory performance. With age, the constraints on memory retrieval gradually loosen, however, little is understood about the mechanisms by which this occurs. The maturation of the hippocampus has been cited to explain changes in flexibility during infancy, however, recent research has shown that experience also plays an important role. Here we aim to highlight the role of brain development and experience in age-related changes in memory flexibility and to stimulate discussion of the mechanisms of memory development.

To begin the symposium, Jane Herbert will present data demonstrating age-related changes in the effects of a distal context change on infants' visual recognition. Dr. Herbert has conducted much of the work using deferred imitation to study the effect of experience on infants' memory flexibility. Here she presents data solidifying the claim that age-related changes in flexibility occur irrespective of the memory task.

Brain development undoubtedly plays a critical role in memory development. Here, Jenny Richmond will present data from a new eye-tracking paradigm that may be used to infer the functional maturity of brain structures involved in memory flexibility. In her research, Dr. Richmond uses electrophysiology and eye tracking to study brain/behavioral relations during infancy. She will present data from 9-month-old infants and discuss the potential of eye-tracking paradigms as behavioral assays of brain development.

Finally, Julien Gross will present longitudinal data showing that infants' locomotor experience has a profound effect on their ability to imitate target actions under conditions in which the stimulus cues have changed. Dr. Gross uses the deferred imitation task to study age-related changes in encoding, retention, and retrieval during infancy.

Here she will discuss the mechanisms by which infants' crawling and walking experience may influence memory retrieval.

### Age-Related Changes in Recognition Memory Across Contexts

**Jane Herbert**, Emily Jones
*University of Sheffield, Sheffield, UK*

One of the most important functions of memory is to allow us to recognise people and objects across time and in new environments. Differences in how context has been defined, however, limit potential conclusions about when and how contextual flexibility emerges during infancy. Contextual details can include environmental aspects that are distant (the room) or close to the stimulus (a coloured backdrop), or could potentially be integrated with the stimulus (a background on which the stimulus is presented). The present study examined developmental changes in the effects of a room change on recognition memory using the visual paired comparison task (VPC).

Six-, 9-, 12- and 18-month-olds (n=96) were familiarised with a single image and tested for recognition after a 1-min delay in either the Same room or a Different room. Infants of all ages exhibited recognition memory when the test occurred in the same context as learning. Age-related changes were observed when the test occurred in a different context: 12- and 18-month-olds exhibited recognition memory while 6- and 9-month-olds did not. An additional group of 9-month-olds (n=12) demonstrated that the null preference observed was not simply due to disruption from leaving the room between familiarisation and test.

The present findings are consistent with operant conditioning and deferred imitation research showing that the ability to express memory across a change of location emerges during the first year of life (e.g., Hartshorn et al., 1998; Hayne et al., 2000). Flexibility across locations develops prior to flexibility across a change in stimulus background in the VPC task. This contextual flexibility is observed between 12- and 18-months (Robinson & Pascalis, 2001). A range of contextual details are thus encoded into memory during infancy but may be afforded different levels of importance, or may be integrated differently with the target stimulus, at different ages.

### Relational Memory during Infancy: Evidence From Eye Tracking

**Jenny Richmond**, Charles Nelson
*Children's Hospital Boston, Harvard Medical School, Boston, USA*

Across the first two years of life, infants become increasingly able to retrieve memories under conditions in which the cues and/or context have changed. Some researchers have attributed age-related changes in memory flexibility to the prolonged maturation of hippocampal circuitry (Jones and Herbert, 2006). Evidence from animal studies has shown that the hippocampus forms memories that are composed of networks of related items; relational networks can be used to make inferences about memories that are only indirectly connected, allowing for flexible expression (Eichenbaum, 2002). It is possible that in the absence of mature hippocampal circuitry infants fail to encode memories relationally, thus precluding flexible retrieval.

Here we use a relational memory eye-tracking task that has been shown to depend on the hippocampus in adults (Hannula, Ryan, Tranel, & Cohen, 2007) to test this hypothesis. In this paradigm, nine-month-old infants (N=42) learned about the relation between arbitrarily paired scenes and faces. During study trials, infants were presented with faces that were superimposed on scenic backgrounds. During probe trials, infants were shown three faces that were superimposed on a familiar scene. Although all test faces were equally familiar, only one had been presented with the probe scene earlier. Probes occurred after a lag of 0 (the scene/face match occurred in the immediately previous trial) or a lag of 2 (the scene/face match occurred two trials previously). Visual behavior was recorded continuously using a TOBII eye-tracking system.

Infants exhibited preferential looking at the face that matched the probe scene during the first 1000 ms of the test, however, the time course of this effect varied as a function of delay. These results highlight the utility of eye-tracking methods in assessing the nature of infant memory representations and suggest that by 9-months of age the hippocampus is sufficiently mature to support relational memory.

### Infants' Prior Experience Influences Representational Flexibility

**Julien Gross**, Harlene Hayne
*University of Otago, Dunedin, New Zealand*

Studies have shown that experiences provided by an adult during a learning session facilitate the flexibility of memory retrieval by infants. In contrast, less is known about the effect of prior experience that infants bring to the experimental setting. During the course of their daily lives, infants undoubtedly accumulate experiences that could contribute to individual differences in memory performance. One potential source of individual differences in experience might be independent locomotion. As infants begin to crawl, they are faced with the challenge of transferring information acquired in one context to similar problems encountered in another. In light of this challenge, Rovee-Collier (1996) has hypothesized that infants' ability to retrieve their memories in novel situations may be enhanced as they learn to crawl. We tested this hypothesis by examining whether individual differences in crawling and walking increased the flexibility of memory retrieval.

Parents of 140 6-month-old infants were provided with a checklist which they used to record their infant's motor skill development. When infants were 9- and 12-months old, we assessed their memory using deferred imitation. For infants in the demonstration condition, an experimenter performed a target action(s) with a novel stimulus. The action(s) was demonstrated three times in succession. Infants' ability to reproduce the target action(s) was assessed after a 24-hour delay. Infants in the control condition were not shown the target action(s) prior to the test. Independent groups of infants were tested with either the same stimulus or a different stimulus.

Infants who were crawling by 9-months or walking by 12-months exhibited more flexible memory retrieval than did infants who were not crawling or not walking. These data confirm that that independent locomotion enhances the flexibility of infant memory retrieval. We are continuing to explore the relation between motor development and memory development with this cohort as they get older.

## *Vowels and Consonants in Early Words: Difference or no Difference?* *(Regular Symposium, Perceptual Development)*

**Chairs:** *Thierry Nazzi & Nivedita Mani*

**Discussant:** *Christopher Fennell*

**Nivedita Mani**[1] Suzanne Van Der Feest[2] **Thierry Nazzi**[3] Christopher Fennell[4]

*1. University of Oxford, Oxford, UK; 2. University of Pennsylvania, Philadelphia, USA; 3. Laboratoire Cognition et Développement, CNRS, Paris, France; 4. University of Ottawa, Ottawa, Canada*

Research investigating the nature of infants' lexical representations argues that early words are phonologically well-specified: infants look longer at the image of an object when its label is correctly pronounced than when the label is mispronounced by 14 months of age for consonants (Swingley & Aslin, 2000; 2002; Ballem & Plunkett, 2005, and around 15-to-18 months for vowels (Mani & Plunkett, 2007). However, 20-month-olds overall fail to learn two words that differ by a single vowel, while successfully learning two words differing in a consonant, suggesting that more weight is given to consonants over vowels in lexical acquisition (Nazzi, 2005).

The planned symposium consists of three talks and a discussion. The first talk (Mani & Plunkett) suggests a symmetry in English-learning infants' sensitivity to vowel and consonant mispronunciations of familiar words at 12-months: vowels and consonants appear to constrain lexical recognition in a similar manner. The second talk (Van der Feest & Swingley) reports cross-linguistic differences between Dutch and English 21-month-olds' interpretation of vowel duration variation in familiar words: Dutch, but not English listeners are sensitive to vowel length distinctions. The final talk (Nazzi, Havy, Floccia & Butler) reports differences in use of vocalic and consonantal information in learning new words, both for French-learning 16-month-olds and for French- and English-learning 30-month-olds.

The symposium investigates the role of different factors (such as infants' familiarity with the stimuli or the phonological changes being tested) in assessments of the phonological specificity of early lexical representations. The symposium addresses this issue using different tasks (Inter-modal Preferential Looking, Word-learning forced choice tasks), different languages (Dutch, French and English) and different kinds of stimuli (familiar and novel words) in an attempt to fully explore the phonological specificity of early lexical representations. Results will be discussed by Chris Fennell.

### 12-Month-Olds Are Sensitive to Vowel and Consonant Mispronunciations of Familiar Words

**Nivedita Mani**, Kim Plunkett

*University of Oxford, Oxford, UK*

**Introduction:** English infants look longer at a target object when its label has been correctly pronounced compared to when the label is mispronounced by either a single vowel or a single consonant at 15-, 18- and 24-months of age: infants pay attention to vowels and consonants in familiar words (Mani & Plunkett, 2007). Is this sensitivity to mispronunciations acquired only towards the middle of the second year of life, or do infants fully encode the vowels and consonants in words early on? In order to investigate this possibility, we tested 12-month-olds' sensitivity to mispronunciations of the word-medial vowels and word-initial consonants of monosyllabic, familiar words. We compare infants' sensitivity to vowel and consonant mispronunciations to test the hypothesis that consonants play a greater role compared to vowels in lexical representation.

**Method:** Infants were presented with images of two familiar objects on a screen for five seconds. One of the objects was labelled with a correct pronunciation or a word-medial vowel mispronunciation (Experiment 1) or word-initial consonant mispronunciation (Experiment 2).

**Results:** Infants look longer at the target image following correct pronunciations compared to vowel mispronunciations ($p < .005$). Similarly, infants look longer at the target image following correct pronunciations compared to consonant mispronunciations ($p = .017$).

**Conclusions:** The results suggest a symmetry in infants' sensitivity to vowel and consonant mispronunciations as early as 12-months of age. There are no differences in the roles of vowels and consonants in lexical access of familiar words. The differences between the current data and Nazzi's proposal that vowels may be less influential than consonants in lexical recognition (Nazzi, 2005) are explored. We suggest that the differences between the tasks used to assess language development may provide an explanation for the differences in the results.

### A Crosslinguistic Study of Vowel Duration in 21-Month-Olds' Early Lexical Representations

**Suzanne Van Der Feest**, Daniel Swingley

*University of Pennsylvania, Philadelphia, USA*

**Background:** We examined Dutch and English learners' interpretation of vowel duration variation in familiar words. Acoustic distributions are similar in the two languages' infant-directed speech. However, children must discover different functions of duration from these distributions: signaling vowel identity (more in Dutch than English; Dutch man["man"] ≠ maan ["moon"]), or voiced coda consonants (only English, compare leaf, leave). Dietrich, Swingley & Werker (2007) showed that only Dutch (not English) toddlers considered 2 nasal-final novel words different if their vowel duration varied (tam ≠ taam). We asked two questions: have Dutch toddlers learned an abstract phonological feature? Do English learners attend to duration when relevant in English, in words with stop-consonant codas?

**Method:** Following Swingley & Aslin (2000), 21-month-old English and Dutch learners heard familiar words correctly pronounced (CP) or mispronounced (MP) while viewing the named target and a distracter. Mispronunciations involved digitally lengthening short vowels (intrinsically short Dutch vowels; English vowels before unvoiced stops) or shortening long vowels.

**Results:** Although English vowel duration cues coda voicing, English-learning children showed unimpaired recognition of manipulated words, suggesting underweighting (or no discovery yet) of the duration cue to coda voicing (English learners do react to complete voicing substitutions in codas (Swingley, 2005)). Only the Dutch showed effects of durational mispronunciations. Furthermore, the Dutch showed an asymmetry: shortening, not lengthening, mispronunciations were detected (ANOVA condition (CP, MP-long, MP-short) $F=7.2$, $p<0.01$; CP vs MP-short $t=5.2$, $p<0.01$; CP vs MP-long ns). Dutch children differ from adults, who accept neither lengthened short vowels nor shortened long vowels.

**Conclusion:** The Dutch vowel-shortening effect held for vowels [o:,I:] where tense/lax opposition isn't cued by duration, suggesting that toddlers apply a phonological generalization transcending the phonetics of individual sounds. We discuss how both the crossling-

uistic difference and the Dutch asymmetry might be accounted for by phonological underspecification (Lahiri & Reetz, 2002).

### Consonantal and Vocalic Specificity in Early Word Learning: Comparative French/English Data

**Thierry Nazzi**[1] Mélanie Havy[1] Caroline Floccia[2] Joseph Butler[2]

*1. LPP, CNRS-Université Paris Descartes, Paris, France; 2. University of Plymouth, Plymouth, UK*

Our research explores the use of phonetic information during lexical acquisition, given research showing that 13-month-olds cannot simultaneously learn two phonetically similar words (consonant contrast) while 20-month-olds can (Stager & Werker, 1997; Werker et al., 2002). In previous studies (Nazzi, 2005; Nazzi & New, 2007), we used a name-based categorization paradigm to explore the acoustic detail that 20-month-olds use when simultaneously learning new words. Infants' succeeded for minimal consonantal contrasts, but failed for minimal vocalic contrasts. Success on vocalic contrasts was however found at 30 months. These results support the proposal that consonants play a more central role than vowels in specifying lexical identity (Nespor et al., 2003). We present new evidence on this issue.

First, we used a simplified "plain" word-learning task to test 24 French-learning 16-month-olds on 8 pairs of words that all minimally contrasted on their initial consonants, by either a place (/tize/-/kize/) or a voice (/pivã/-/bivã/) contrast. Infants performed above the 50% chance level for both voice (63%, p = .015), and place (67%, p = .002). An ongoing experiment is evaluating vocalic contrasts, involving either place (/döla/-/dola/) or aperture (/tugi/-/togi/) contrasts. Preliminary results for 12 French-learning 16-month-olds suggest performance at chance level (57% correct).

Second, we explored how French- and English-learning 30-month-olds react when placed in a situation in which they have to choose between a consonant- versus a vowel-based mispronunciation (target: /pize/, to choose between /tize/ and /pyze/). According to Nespor et al. (2003) and our previous data, infants in this situation should choose to group together the objects whose names share the same consonants. This is confirmed by data from 16 infants in each population, which show a bias to choose the object sharing the same consonants in both French (60.2%, p = .007) and English (56.5%, p = .046).

---

## *Fear Development in Early Childhood: Methodological Considerations and Factors that Explain Stability and Growth*

*(Regular Symposium, Emotional Development)*

**Chair***: Maria Gartstein*

**Discussant***: Samuel Putnam*

**Maria Gartstein**[1] David Bridgett[1] Kristin Buss[2] Elizabeth Kiel[3] Carmen González[4] Jose Carranza[4] Ester Ato[4] **Samuel Putnam**[5]

*1. Washington State University, Pullman, USA; 2. The Pennsylvania State University, University Park, USA; 3. University of Missouri-Columbia, Columbia, USA; 4. University of Murcia, Murcia, Spain; 5. Bowdoin College, Brunswick, USA*

Although fear, or behavioral inhibition, has been examined in a variety of contexts, methodological and developmental questions remain, especially for the period of early childhood. The purpose of this international symposium is to address a number of these remaining questions, specifically those related to the convergence of parent-report and laboratory measures of fear, stability and moderators of stability for childhood fear, and questions regarding developmental trajectories and predictors of developmental change in fear. The laboratories represented in this symposium were selected because they represent a diverse sample of researchers examining questions related to child fearfulness at different points in development, examining important methodological and developmental issues in a complimentary manner. In the first presentation, results from a latent growth examination of fear development in two samples of infants (one assessed through parent- report and the other one evaluated via laboratory observations) are presented. Findings highlight developmental similarities and differences between maternal report and laboratory indices of fear in the first year of life as well as the role of maternal depression and fear in the developmental trajectories of fear in these samples.

Second, findings from a longitudinal investigation of temperament conducted in Spain, are presented, demonstrating relative stability in fear from infancy to early childhood, as well as evidence for some convergence of parent-report and laboratory measures of fear. The final presentation examines moderators of fear and shyness stability in early childhood. Observed shyness and boldness at 24-months were associated with parallel observed indices at 5 years of age. General patterns of change across age in maternal-report of Surgency, Negative Affect, Fear, and Shyness were examined. Stability was observed when children were high in shyness at 24-months during the low-fear episodes, with these children being more anxious at 5 years, compared to children high in shyness during the high-fear episodes.

### Developmental Trajectories of Fear in the First Year of Life: A Latent Growth Examination

David Bridgett, **Maria Gartstein**, Erin Iddins, Christopher Robertson, Kristin Ramsay, Danielle Wald, Anna Rittmueller, Lindsey Yake, Haley Kendall, Jessica VanVleet

*Washington State University, Pullman, USA*

The purpose of the current investigation is to examine the developmental trajectories of infant fear, utilizing latent growth modeling (LGM), during the first year of life. In the current studies two maternal characteristics, depression and fear were examined as potential predictors of change in child fearfulness. In study 1, 154 mothers of 4 month old infants from Northwest region of the U.S. completed measures of maternal depression (BDI) and fear (Subscale of the Adult Temperament Questionnaire) as well as the IBQ-R. These mothers also completed the IBQ-R when their infants were 6 (n = 115), 8 (n = 99), and 10 (n = 87) months of age. Initial findings indicated that maternal depression accounted for significant variance in change across time, but not initial levels of infant fear (Figure 1; ÷2 (df = 10) = 11.25, p = .33; CFI = 1.00; RMSEA = .028; AIC = -8.75). Higher maternal depression was associated with increasing infant fear from 4 to 10 months of age.

In study 2, an independent sample of 123 mothers from Eastern Washington and Northern Idaho completed measures of maternal depression (PSI Depression Subscale) and fear (ATQ) when their infants were 4 months of age. Caregivers and infants were assessed at 8 (n = 78), 10 (n = 62), and 12 (n = 56) months of age on standardized laboratory measures of infant fear (e.g., intensity of facial fear, distress vocalizations, bodily fear), summed to create a fear composite score. Consistent with Study 1 findings, initial results indicate that maternal depression accounted for significant variance in change in fear from 8 to 12 months of age, with higher depression scores leading to increases in fear across time (Figure 2; ÷2 (df = 4) = 5.34, p = .25; CFI = 1.00; RMSEA = .05; AIC = -2.64).

### Factors Accounting for the Stability of Shyness and Boldness from 24 months to Kindergarten

**Kristin Buss**[1] Elizabeth Kiel[2]

*1. The Pennsylvania State University, University Park, USA; 2. University of Missouri-Columbia, Columbia, USA*

Estimates of the stability of fearful/shy temperament and boldness/surgency are consistent, yet typically modest (Rothbart et al., 2000; Pfeifer et al., 2002). It is important to determine the factors that account for the stability of temperament, especially those that may contribute to risk for maladaptation (Sroufe & Rutter, 1984).

The current study examined the stability of shyness and boldness in a sample of 105 children from 24-months to kindergarten. Several factors, including context effects and gender, were examined to determine potential mechanisms for stability and change. Children visited the laboratory at 24 months and were observed in 7 episodes designed to be fear-eliciting. Temperament was also assessed via questionnaires at 2, 3, 4, and 5 years of age. At age 5, the kindergarten year, children were observed in 7, fear-eliciting episodes (data collection ongoing). For each episode, we scored the intensity of fear, shyness, and withdrawal (i.e., shyness) and the intensity of boldness, exuberance, and approach (i.e., boldness).

We found that observed shyness at 24-months was associated with observed shyness at 5 years ($r = .36$, $p < .05$), and likewise for boldness ($r = .30$, $p < .05$). General patterns of change across age in maternal-report of Surgency, Negative Affect, Fear, and Shyness were examined in multilevel growth models. Initial models indicate an increase in Surgency ($b = .26$, $t = 5.54$, $p < .001$); a decrease in Negative Affect ($b = -.15$, $t = -3.51$, $p < .01$); and no significant change for either Fear ($b = .09$, $t = 1.17$, $p = .24$) or Shyness ($b = .21$, $t = 1.40$, $p = .16$). However, we found stability when children were high in shyness at 24-months during the low-fear episodes. These children were more anxious at 5 years compared to children who were high in shyness during the high-fear episodes. Additional moderators of stability will be discussed.

### Studying Children's Social Fear from12 to 48 Months through Laboratory and Questionnaires: Continuity and Convergence of Measures

Carmen González, Jose Carranza, Ester Ato

*University of Murcia, Murcia, Spain*

The aim of this work was to study the continuity/change of social fear and to examine convergence between parent-report and laboratory observations. The sample consisted of 60 infants (29 girls, 31 boys). The Toddler Behavior Assessment Questionnaire (TBAQ; Goldsmith, 1987) was completed at 12, 18, and 24 months, yielding the Social Fearfulness scale. At 48 months, the Children's Behavior Questionnaire (CBQ; Rothbart, Ahadi, Hershey, & Fisher, 2001) was administered, providing Fear and Shyness scales.

The Strange Situation (Ainsworth & Witting, 1989) was administered at 12 months, with the stranger encounter episode analysed for fearful distress, including: (a) Intensity of fear expression, and (b) Intensity of vocal distress, combined in an average composite. The Laboratory Assessment Battery (LAB-TAB, Goldsmith & Rothbart, 1991; Goldsmith & Reilly, 1994) was administered when children were 18, 24, and 48 months, and the "Stranger approach" task coded according to the same scheme.

In a regression analysis laboratory-based social fear at 12 months predicted parallel scores at 24 months ($F = 3.95$; $p < .05$). Social fear at 18 months predicted social fear at 24 months ($F = 4.70$; $p < .05$), and at 48 months ($F = 12.64$; $p < .001$). TBAQ Social fear at 12 months predicted TBAQ Social fearfulness at 18 months ($F = 15.23$; $p < .001$) and 24 months ($F = 4.89$; $p < .05$). TBAQ Social fearfulness at 24 months predicted both CBQ Fear ($F = 6.64$; $p < .01$) and Shyness ($F = 6.52$; $p < .05$).

Significant correlations between laboratory and questionnaire indices were observed at 12 months ($r = .36$, $p < .05$); marginally significant results emerged at 24 months ($r = .30$, $p = .06$).

---

## *Manual Action Selection during Infancy*

*(Regular Symposium, Motor and Sensorimotor)*

**Chair:** *Daniela Corbetta*

**Discussant:** *Neil Berthier*

**Daniela Corbetta**[1] **Jeffrey Lockman**[2] Jessica Sommerville[3] **Neil Berthier**[4]

*1. The University of Tennessee, Dept. of Psychology, Knoxville, USA; 2. Tulane University, Dept. of Psychology, New Orleans, USA; 3. University of Washington, Dept of Psychology, Seattle, USA; 4. University of Massachusetts, Dept. of Psychology, Amherst, USA*

Infants typically begin to reach for objects around 3-4 months old. Then, within a few months, they develop the ability to manipulate objects, explore them, and use them as tools to achieve a wide variety of goals. How do infants learn to select the appropriate actions to interact effectively with their surrounding? And how early do they begin to show such action selection capabilities?

This symposium brings together four experts (3 presenters and 1 discussant) in the areas of reaching and tool use in infancy. Each expert will address the questions of this symposium from different approaches. Each approach will highlight the many facets and processes that are involved in the early selection of actions. The first presentation will illustrate how the selection of actions in 6-to-10 month old infants applies to the context of surface and tool exploration. It will show that from the earlier age, infants clearly select different actions patterns to explore different surfaces and use tools distinctively to achieve different goals. The second presentation will highlight the role of prior experience on 10- and 12-month-old infants' selection of tools. Again, evidence indicates that within the first year, infants can already benefit from prior tool manipulation to make appropriate tool selection within specific task contexts. Finally, the third presentation will focus on young infants motor patterns in reaching and more specifically on their ability to break preferred motor tendencies to select the successful movement solution to obtain a toy. Together, these talks will highlight the idea that action selection emerges and develops in the first year of life from the combination of a number of factors involving exploration, prior experience, motor flexibility, and environmental/tasks constraints.

### Selectivity of Manual Action during Exploration of Objects and Surfaces

Jeffrey Lockman

*Tulane University, Dept. of Psychology, New Orleans, USA*

Selectivity is a hallmark of adaptive action. Although individuals are capable of performing a multitude of actions at any one time, they typically select actions based on the relation between their own physical characteristics and their immediate surroundings (Gibson & Pick, 2000). Here, we consider the origins of this ability with reference to manual action. We ask how do infants begin to explore objects and

surfaces selectively and how such selectivity can support problem solving and tool use.

In this context, we present work on infant exploration of objects and surfaces. We discuss our studies in which infants (6, 8 and 10 month-olds, N=20 per group) are presented objects and surfaces which vary in material composition (e.g, rigid/flexible objects; rigid/flexible/discontinuous/liquid substrates). Results indicate that across age, infants explore objects, surfaces and their combination selectively, employing actions that exploit the unique physical properties of the objects and surfaces before them. In some instances, selectivity increased with age.

In a subsequent work with new infants (N=60) distributed similarly across age, we repeated the above study but attached cylindrical handles to the same objects. The goal was to determine whether infants also evidence similar selectivity of action when using handled objects. Importantly, results indicated that at all age levels, infants selectively related the handle-held objects to the surfaces. For instance, when holding the object's handle, infants displayed significantly more banging of the hard object on the rigid surface, but little banging when presented other object-surface combinations.

Collectively, these results suggest that by the second half year, infants combine objects and surfaces selectively, even when the object is held by its handle. We conclude by discussing how such selectivity can support early attempts at problem solving and tool use that require objects to be related to surfaces in particular ways.

### Tool Use in the 1st Year of Life: Infants Select Appropriate Tool Use Actions Based on Tool and Goal Object Properties

Jessica Sommerville, **Erika Feldman**

*University of Washington, Dept. of Psychology, Seattle, USA*

Successful tool use involves the selection and implementation of appropriate actions based on tool and goal object properties. We investigated the development of this ability across two studies. In Study 1, 10-month-old infants (n = 32) were trained to use a plastic cane to retrieve out-of-reach toys and then allowed to select between two novel tools: a rigid tool that could be used to retrieve an out-of-reach toy and a floppy tool that could not. Infants' tool selections were compared to baseline trials in which no goal object was present. Infants selected the rigid cane at a rate above that predicted by their choices on the baseline trials ($t(31) = 5.55$, $p<0.001$), and varied their actions on the tools as a function of tool properties, adopting instrumental approaches when acting on the rigid cane and playful approaches when acting on the floppy cane (Fisher's exact test, $p< .001$).

Study 2 demonstrated that 12-month-old infants (n = 20) also use goal object properties to select tool use actions. After infants were familiarized with a light (70 g.) and a heavy (470 g.) plastic block, they were given the opportunity to retrieve the heavy or light block (on alternate trials) when it sat out of reach supported by a cloth. Infants were more likely to use instrumental strategies (e.g., pull the cloth) to obtain the block on light than heavy block trials (Fisher's exact test, $p< .001$). Infants' actions on the cloth also varied as a function of block weight: infants produced more bimanual actions on the cloth when the block was heavy than when it was light ($p < .05$). Taken together, these findings suggest that the ability to select actions to match relevant features of tool use events emerges within the first year of life.

### Selecting Appropriate Movements to Reach Along the Sides of an Obstacle

**Daniela Corbetta**, **Joshua Williams**, Benji Craddock

*The University of Tennessee, Dept. of Psychology, Knoxville, USA*

Learning to select proper movement patterns to act on objects effectively is a process that begins early in infancy with the development of reaching. Previous research has shown that selecting actions that tailor object properties appears around 8 months. Before 8, infants tend to display more stereotypical movements patterns. One such response is the tendency of young infants to reach for all objects with two arms. Here, we ask whether such stereotypical response would subsist when the task limits access to the toy to one arm.

We tested thirty 6, 7, and 8 month olds with a "board task". In this task, infants were reaching for small objects presented at midline on a board. During 5 baseline trials, the board was oriented such that both hands had direct toy access. Then, the board was rotated 90 degrees such that an opaque panel separated the right and left hemispaces of the child and the toy was presented against one side of the panel at the child's midline. In this condition, both arms could still be moved forward, but only one hand could have access to the toy.

Results show that even the youngest infants who had the strongest two-handed tendencies were able to break this preferred motor pattern to select the arm matching the object side and activate that arm only to reach. This finding was maintained in 7 and 8 month olds. Thus, it appears that even infants with less experience at reaching and with seemingly rigid movement patterns, can modify their motor response to meet the task demands. This means that before 8 months, infants are capable of identifying the pertinent parameters of the task and have the motor flexibility to map their motor response to the particular characteristics and constraints of the task.

---

## *Social-Cognitive Development in Infancy: The New Look*

*(Invited Symposium, Social Development)*

**Chair:** *Carol Dweck*

### Internal Working Models of Attachment in Infancy: New Methods, New Evidence

Susan Johnson

*Stanford University, Stanford, USA*

Nearly half a century ago, John Bowlby proposed that the instinctual behavioural system that underpins an infant's attachment to its mother is accompanied by "internal working models" of the social world-models based on the infant's own experience with her caregiver (Bowlby, 1958, 1969/1982). These mental models were thought to mediate, in part, the ability of an infant to use her caregiver as a buffer against the stresses of life, as well as the later development of important self-regulatory and social skills.

The current studies report the first evidence for infants' "internal working models" of attachment that use measures independent of the attachment behaviours themselves. We used a standard visual habituation technique to assess infants' expectations of a caregiver's and an infant's behaviour during abstractly depicted separation and reunion events. Infants' attachment status was then assessed in the Strange Situation. Securely and insecurely attached infants differed in their expectations of how both the caregiver and the infant would behave toward the other during the events. For example, the securely

attached infants looked significantly longer when the depicted parent ignored the infant's cry during separation by moving farther away from, rather than returning to the child. Conversely, the insecurely attached infants looked longer if the mother returned, as though the securely attached infants, but not the insecurely attached infants were surprised to see a parent act unresponsively. These results are clear evidence that infants' interpretations of the social world are influenced by their own histories with their caregivers, as predicted by Bowlby. They also show the potential power of bringing methods from the fields of infant cognition and perception to bear on important issues in social development.

### Roots of Social Cognition: Self-Other Mapping and the 'Like Me' Hypothesis

Meltzoff Meltzoff

*Institute for Learning & Brain Sciences, University of Washington, Seattle, USA*

Some of the most exciting interdisciplinary work in infancy concerns the foundations of social cognition - humans' ability to understand and communicate with other people. Imitation and gaze following are two important aspects of infant social cognition. Infants imitate readily, however they are not automatic imitators and display flexibility in choosing when, what, and whom to imitate. Emotions play a role in regulating whether infants imitate as well. At a more theoretical level, I will discuss the mechanisms underlying infants' ability to imitate and the function it plays in social development. In imitating, infants recognize that other people are 'like me' in their actions (behavioural imitation) - they can act like the other and the other can act like them. This identity between self and other is the bedrock of social cognition. Based in part on this foundation, children later develop the idea that others are 'like me' in their internal mental states (theory of mind). Thus imitation is a measure of social cognition and also provides a mechanism of change in social-cognitive development. This is because imitation is a case of coordinating 1$^{st}$ and 3$^{rd}$ person viewpoints. The infant sees an act 'from the outside' (as performed by another) but is able to translate that into a 1st-person act. The bidirectional mapping between self and other embodied in imitation plays a crucial role in the development of other aspects of social cognition.

### Cooperation and Communication in the Second Year of Life

Michael Tomasello

*Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany*

Although primates have evolved complex cognitive skills and strategies for competing with others in their social group, only humans have developed complex cognitive skills and motivations for collaborating with one another in joint endeavours. This cooperative dimension of human cognition emerges most clearly around the first birthday as children begin to collaborate and communicate with joint intentions and joint attention. This collaboration is also grounded in social motivations for helping and sharing with others that are unique to humans. In using the skills of shared intentionality that underlie these cooperative interactions, 1-year-olds come to create perspectival cognitive representations.

## *How Experience Works on Development Through Genetic and Epigenetic Mechanisms* *(Workshop, Biological Processes)*

**Chair:** *Rachel Keen*

**Rachel Keen**

*Department of Psychology, University of Virginia, Charlottesville, USA*

Epigenetics, 'the study of (heritable) changes in genome function that occur without a change in DNA sequence' is an emerging field that is radically changing our understanding of environment-gene interactions, and that thus has profound implications for developmental psychology. In this workshop we present three stimulating speakers who have agreed to give you a primer on this important, emerging field. From its theoretical foundations in developmental psychology and evolutionary theory, through modern developments in genetics, and including the new science of epigenetics, this workshop will introduce you to recent advances in the biological sciences that allow us to - no, that demand that we - look at nature-nurture interactions in entirely new ways.

### Do We Need to Rethink Our Theories of Development in Light of Epigenetics?

Robert Lickliter

*Florida International University, Miami, USA*

An increasing appreciation of the dynamic, contingent, and complex nature of development revealed by work in cellular and developmental biology, neuroscience, and developmental psychology has led a growing number of biologists and psychologists to challenge the traditional notion of genes as the primary determinant of developmental outcome. In particular, recent evidence indicating the key role of epigenetic processes in the generation of physical and behavioural phenotypic traits and characters has called into question several ideas and principles that have been used to explain the processes of development and heredity over the last century. These include the notions that there are instructions for building organisms that reside in their genes (*predetermined epigenesis*), that genes are the exclusive vehicle by which these instructions are reliably transmitted from one generation to the next (*heredity as gene transmission*), and that there can be no meaningful feedback from the environment or the experience of the organism to the genes (*genetic encapsulation*). I will discuss how our growing knowledge of the remarkable intricacies of gene-environment interactions argues against these long-standing notions. I will also explore how this new knowledge provides developmentalists with an outline of a new conceptual framework for forging a deeper understanding of the roles of early experience in life-span development, the varied sources of phenotypic plasticity, and the ways and means by which transgenerational stability and variability is achieved. I argue that the shift away from genocentric thinking currently taking place across the life sciences (exemplified by the content of this workshop) requires us to re-examine our theories regarding the relations between development, heredity, and evolution.

### Gene by Environment Interactions on Behaviour: A Primer

Marla Sokolowski

*Department of Biology, University of Toronto, Mississauga, Canada*

The talk begins with a modern view of nature-nurture which translates into a discussion of gene by environment interactions and reac-

tion norms. Experimental designs necessary to partition variation in behaviour into genetic and plastic components are discussed. This is addressed using single gene, quantitative genetic and genomic analyses. The nature of a DNA, RNA and protein and how it can generate biological complexity in different environments is discussed. Data from the literature showing the interdependence of genes and the environment is briefly reviewed including studies addressing genetic polymorphisms and gene expression. The importance of the social environment during development and adulthood is also discussed from the perspective of how genes, the environment and development interact. Of particular interest is how the social environment during development and adulthood changes an organism's gene expression and how certain genotypes exhibit vulnerability and/or resilience to early adversity.

### Maternal Care: The Epigenome and Phenotypic Differences in Behaviour: A Workshop On the Role of Epigenetic Processes in Early Life

Moshe Szyf

*Department of Pharmacology and Therapeutics, McGill University, Montréal, Canada*

We will discus how the genome is programmed by the epigenome and the fundamental processes of chromatin and DNA methylation. Epigenetic patterns are sculpted during development to shape the diversity of gene expression programs in the different cell types of the organism. The epigenome of the developing fetus is especially sensitive to maternal nutrition, and exposure to environmental toxins as well as psychological stress. We propose that not only chemicals but also exposure of the young pup to social behaviour, such as maternal care, could affect the epigenome. Since epigenetic programming defines the state of expression of genes, epigenetic differences could have the same consequences as genetic polymorphisms. We will propose here a mechanism linking maternal behaviour and epigenetic programming and we will discuss the prospect that similar epigenetic variations generated during early life play a role in generating inter individual differences in human behaviour and we will present data from different human cohorts. We will discuss the possibility that exposures to different environmental toxins, which affect the epigenetic machinery might alter long-established epigenetic programs in the brain.

These studies are funded by the National Cancer Institute of Canada and the Canadian Institute of Health Research

---

## *Neuro-Computational Approaches To Early Lexical Acquisition* *(Regular Symposium, Communication and Language)*

**Chair:** *Julien Mayor*

**Discussant:** *Jeff Elman*

**Julien Mayor**[1] Ping Li[2] Gert Westermann[3] Denis Mareschal[4] Kim Plunkett[1] **Jeff Elman**[5]

*1. University of Oxford, Oxford, UK; 2. University of Richmond, Richmond, USA; 3. Oxford Brookes University, Oxford, UK; 4. Birbeck College, London, UK; 5. University of California, San Diego, La Jolla, USA*

A wealth of empirical data documenting the conditions that facilitate infant word learning has accumulated over the past two decades. Theoretical accounts are also wide ranging from socio-pragmatic accounts, to cognitive approaches and specifically linguistic accounts. However, there have been very few attempts to identify the types of neural mechanisms that underlie infant word learning. This symposium will provide a neuro-computational perspective on three issues that are of central importance to any account of word learning: First, we examine the type of neural mechanisms that are capable of explaining how infants apply newly learnt words to novel objects and show how quite simple assumptions can explain the taxonomic constraint (Mayor and Plunkett). A second contribution uses a similar type of network architecture to show how infants might learn two labels for the same object - an important characteristic of bilingual lexical development and for building lexical hierarchies (Li). The third contribution shows a different type of network architecture can be used to model the subtle interactions between words and category formation even before infants begin to utter their first words (Westermann and Mareschal). All of these models show how high level linguistic and cognitive properties of word learning can be explained in terms of lower level neural interactions. Finally, our discussant (Elman) will provide a link between these development models and his general approach to lexical representation in which words are to be considered as stimuli that operate on (mental) states.

### A Neuro-Computational Account of Taxonomic Responding

**Julien Mayor**, Kim Plunkett

*University of Oxford, Oxford, UK*

We start with the assumption that word learning begins with understanding the relationship between a word and the object it stands for. Furthermore, in order to capture the mechanisms of early lexical development, it is necessary to take into consideration the role of pre-lexical categorisation of objects and sounds. Recent research emphasises the role of perceptual sophistication (such as of word segmentation or visual cortical structuration) as a pre-requisite for learning novel word-object associations.

We propose a connectionist model of early lexical development built up of two Self-Organising Maps, respectively achieving object and acoustic token categorisation. After map structures emerge, we build associative connections based on the co-occurence of objects and labels, capturing the joint attentional activities between infants and caregivers. We show that even based on a single word-object pairing, the system successfully generalises labels to novel objects of like kind. We argue that this generalisation capacity of the model captures a learning constraint known as the taxonomic assumption; an emergent property of the underlying neural architecture.

Moreover we show that a prerequisite for good word-object generalisation in our model is to provide the system with well-structured maps. Once the perceptual system can achieve coherent object and sound categorisation, word-object associations are learnt fast and generalise well. This finding is consistent with a series of studies suggesting that speech perception and cognitive development in infancy predicts language development in the second year of life. The model captures the claim made that auditory perception bootstraps word learning.

In summary, we show from a modelling perspective how taxonomic responding can be built on pre-existing categorisation abilities. This neuro-computational account of taxonomic responding confirms the importance of pre-lexical categorisation abilities as predictors of successful lexical development.

### Dynamic Self-Organization and Lexical Acquisition

**Ping Li**

*University of Richmond, Richmond, USA*

How do young children develop structured mental representations for the vast number of words in any given language? How do bilinguals deal with the even more daunting task of organizing two lexicons? Our research attempts to provide insights into the understanding of these questions from computational and neurocognitive perspectives. In particular I will present DevLex, a computational

model of the development of lexicon (Li et al., 2004, 2007). Of particular relevance to the issue of dynamic self-organization is the model's ability to demonstrate how early learning impacts later development, that is, how early learning leads to dedicated cognitive and neural structures that affect the shape and outcome of later development (positively or adversely). In the case of monolingual acquisition, rapid vocabulary growth observed in early childhood (the so-called "vocabulary spurt") is predated and prepared by the system's building of a structural representation that sets up the basic organization of the lexicon. In the case of bilingual acquisition, the structural consolidation of the first-language lexicon adversely impacts the representation and retrieval of the second-language lexicon, resulting parasitic L2 structure due to reduced plasticity in the organization and restructuring process (Hernandez & Li, 2007). These findings point to the developmental dynamics in which mechanisms of learning interact with the timing and history of learning to determine developmental trajectories.

**References:**

Li, P., Farkas, I., & MacWhinney (2004). Early lexical acquisition in a self-organizing neural network. Neural Networks, 17, 1345-1362.

Li, P., Zhao, X., & MacWhinney, B. (2007). Dynamic self-organization and early lexical development in children. Cognitive Science, 31.581-612.

Hernandez, A., & Li, P. (2007). Age of acquisition: Its neural and computational mechanisms. Psychological Bulletin, 133, 638-650.

### Modeling the Transition from Perceptual to Conceptual Categorization

**Gert Westermann**[1] Denis Mareschal[2]

*1. Oxford Brookes University, Oxford, UK; 2. Birkbeck College, London, UK*

**Background and Aims:** Before the onset of first words, young infants form categories on the basis of the perceptual properties of objects. At around 10 months of age infants begin to be able to associate visually presented objects with auditory object labels. However, the precise mechanisms by which these associations are formed and how they affect previously established category structures remain unknown. Here we present a neural network model to explore these questions. The model, which is based on the idea that early categorization is based on the unfolding integration of 'hippocampal' and 'cortical' memory systems has previously (ICIS 2006) been shown to account for a range of early categorization behaviors. We enhance this model with a mechanism for associating objects with labels to investigate the effect of labels on the representation of perceptual categories, and the extension of labels to unlabeled objects.

**Methods:** The model consisted of two linked 3-layer auto-encoder networks which learned to reproduce an input on their output side. Object labels were introduced by requiring the network to generate a label on presentation of an object. A set of objects was described in terms of basic feature values. Objects were labeled at different levels (global and basic). The hidden layer activation patterns in the subsystems were analyzed to investigate the development of representations in each memory system.

**Key Results:** Labels acted to warp the internal representations of the model in a way that formed a compromise between perceptual and conceptual similarity structures. When only some members of a category were labeled, labels were extended to other members of the same category ('taxonomic constraint'), but also to perceptually similar members of other categories ('overextension'). Labeling those overextended objects with their correct names gradually enhanced the representational space to reflect better the conceptual structure of the overall category space.

**Conclusions:** The proposed model is a powerful tool for investigating the transition from pre-linguistic categorization to labeled categories.

---

## *Joint Attention: Adaptation or Acquired Skill?* *(Regular Symposium, Communication and Language)*

**Chair:** *David Leavens*

**discussant:** *Jeremy Carpendale*

**David Leavens**[1] Kim Bard[2] Timothy Racine[3] Vasudevi Reddy[2]

*1. University of Sussex, Falmer, UK; 2. University of Portsmouth, Portsmouth, UK; 3. Simon Fraser University, Vancouver, Canada*

It is widely claimed that the onset of pointing by human infants signifies a human species-unique capacity for the discrimination and representation of others' perspectives and intentions; a nascent theory of mind. According to this view, these representations of others' perspectives and intentions come to mediate infants' communicative behaviour by the beginning of the second year of life. Pointing, especially pointing to inform others, or to share attention with others, is commonly construed as an index of these dawning representational capacities. One line of argument that has been used to support this argument is the widespread claim that apes-humans' nearest living relatives-do not point to inform, or share attention with their social partners.

The speakers believe that this claim is premature, ignores a considerable history of empirical reports, and suffers from epistemological assumptions that are not well-supported by logic or evidence. Bard has studied cognitive development in infant chimpanzees, Leavens has studied gestural communication in apes and human children, and Racine has studied socio-cognitive development in human infants. Bard and Barta will present data showing that chimpanzee infants spontaneously display joint attention with their caregivers and that their competencies vary as a function of differences in early rearing histories. Leavens and his colleagues will summarize more than a dozen studies of joint attention in more than 120 chimpanzees, review 90 years of observations of ape pointing, and present videotaped examples of "declarative" communication by apes. Racine and Susswein will critique contemporary, disembodied theories of human joint attention, arguing that cognition cannot be logically isolated in individual brains, that cognition is distributed between organisms and their social and physical environments. Together, these three talks will refute some of the more egregious misconceptions about alleged human uniqueness and the epistemological bases for understanding human communicative development. Discussant: Vasu Reddy.

### How Does Joint Attention Develop in Young Chimpanzees?

**Kim Bard**[1] Judit Barta[2]

*1. Centre for the Study of Emotion, Portsmouth, UK; 2. University of Portsmouth, Portsmouth, UK*

**Background and Aims:** Joint attentional performance depends on a developmental background of engagement with adults, engagement with objects, and particular socialization practices concerning the role of caregivers in engaging with the environment. Although many have investigated joint attention in chimpanzees, few have studied the emotional, attentional, and cognitive processes that underpin joint attention, and fewer have studied these as they develop in infant chimpanzees. The primary aim of this study was to assess the roles of early socialization (Standard institutional versus Responsive Care) and of age (8, 9 and 10 months) in the development of joint attention in nursery-reared chimpanzees. Our hypothesis was that RC would enhance joint attention (JA) performance, potentially through enhancing motivation.

**Method:** Sixteen chimpanzees were raised from birth in a Responsive Care (RC) nursery, which nurtured chimpanzees' social-emotional communication, and 16 were raised in a Standard Care (ST) nursery. All were tested with the Bayley Scales of Infant Development (Bayley, 1969) monthly from 3 months of age.

**Results:** We found that the RC group had higher cognitive scores (MDI), and significantly better performance on four categories of performance compared with ST chimpanzees: Object manipulation ($p<0.001$), social ($p<0.001$), object-object combinations ($p<0.05$), and joint attention ($p<0.01$). Age differences were found in object manipulation ($p<0.05$), object-object combinations ($p<.05$), but were not found in JA. Chimpanzee 9-month-olds that passed more JA items had higher MDI, more positive affect, higher activity scores, and were better at meeting the demands of the task (all correlations, $p<.05$).

**Conclusions:** The present study has important implications: Socialization had a major impact on emotional responsiveness, especially toward objects; 8-to-10 month chimpanzees spontaneously display joint attention, however, in the socialization climate of these biomedical nursery settings, chimpanzees did not show age-related improvements in JA.

### Ape Performatives: "Declaratives" and Other Imperative Acts

**David Leavens**[1] William Hopkins[2] Jared Taglialatela[2] Jamie Russell[2]

*1. Department of Psychology, Falmer, UK; 2. Yerkes National Primate Research Center, Atlanta, USA*

It is well-established that children in Western cultures begin to point, typically, by the end of the first year. Developmental psychologists distinguish "proto-imperative" pointing (pointing to request delivery of objects) from "proto-declarative" pointing (pointing to share attention to distant entities or events). These terms were introduced by Bates and her colleagues (1975); they proposed a class of non-verbal "performatives," hypothesizing that they served as functional precursors to, or templates for, later speech acts. In their analysis, proto-imperatives were precursors to spoken demands, and proto-declaratives were non-verbal precursors to spoken comments. Importantly, the only substantive difference between them was in the apparent objectives: proto-imperative pointing served to obtain objects, and proto-declaratives were deployed to obtain social engagement from the caregiver, which took the form of "laughter, comment, smiles and eye contact" (Bates et al., 1975, p. 216). Thus, pointing was an instrumental, goal-directed act, irrespective of the specific nature of the positive consequences that maintained the behaviour.

Until recently, it was widely believed that apes could not point, and this was taken as evidence that pointing derived from our species-specific adaptations for speech. However, it has become clear that apes commonly point and display other referential behaviours. Many now argue that apes do not (a) point amongst themselves or (b) point "declaratively." These claims are myths and ignore scientific evidence to the contrary. In this paper we will review historical accounts of pointing by apes over the last century and summarize several hundred pointing episodes, including apparent "declarative" pointing, from our laboratory. The significance of these experimental findings is that ape pointing is consistent with the theoretical formulations of Bates and her colleagues, but calls into question contemporary claims to the effect that "declarative" communication is uniquely human, or indexes uniquely human cognitive capacities.

### Joint Attention as a Distributed Cognitive Process

**Timothy Racine**, Noah Susswein

*Simon Fraser University, Burnaby, Canada*

In light of certain limitations with identifying cognition with representation, theorists in a variety of domains have recently begun to speak of 'distributed cognition.' Some researchers that specifically address the role that social shaping and other forms of learning may play in early social cognition (e.g., Johnson, 2001; Leavens, Hopkins and Bard, in press; Susswein & Racine, in press; Racine & Carpendale, 2007) have applied this approach to the development of joint attention. However, expressing understandable scepticism, Harnad (2005, p. 501) claims that since "the processes that generate thinking and know-how are 'distributed' within the heads of thinkers, but not across thinkers' heads…there is no such thing as distributed cognition." But this conflates the processes that generate cognition with cognition itself. It is an empirical question whether the *processes that generate* cognition are distributed; the extent to or manner in which cognition itself is distributed is, however, a conceptual issue. To paraphrase Wittgenstein, the slinking posture of the cat stalking its prey is the best picture of an intention, but the slinking is not per se an intention; the intention and picture of it are logically distinct. Wittgenstein also famously stated that "An 'inner process' stands in need of outward criteria." But this is not to say that inner processes *are* outward criteria. There is a logical relationship between individual behaviour and many aspects of cognition such that behaviours can be usefully, with certain caveats, characterized as directly observable cognitive events. Further, the social practices and contexts that partially define certain cognitive activities can be usefully seen as constituting said cognitive activity. In this paper we conclude that conceiving of certain aspects of cognition as distributed can, when properly articulated, avoid some of the logical difficulties faced by standard mental representational views of joint attention.

## *Understanding Other's Actions in Infancy: Goals and Their Meaning* *(Regular Symposium, Social Development)*

**Chair:** *Gustaf Gredebäck*

**Discussant:** *Amanda Woodward*

**Gustaf Gredebäck**[1] Sabine Hunnius[2] Vincent Reid[3] Claes von Hofsten[4]

*1. University of Oslo, Oslo, Norway; 2. Nijmegen Institute for Cognition and Information Radboud University, Nijmegen, The Netherlands; 3. Durham University, Durham, UK; 4. Uppsala University, Uppsala, Sweden*

Infants develop the ability to perceive the goal of others' actions during their first year of life (Falk-Ytter, Gredebäck, & von Hofsten, 2006; Reid, Csibra, Belsky, & Johnson, 2007; Woodward, 1998). Most studies to date have manipulated properties of the actor or the degree to which observed actions are completed or not. This symposium presents three papers that investigate infant's action understanding by manipulating a different action component - namely the terminal part of actions. Each paper presents infants with frequently occurring and rational manual actions (spoon to mouth / phone to ear) and compare this to infrequent and irrational actions (spoon to back of hand / eyeglasses over mouth). Hunnius and Bekkering present infants with a series of objects being used in rational or irrational manners whereas Gredebäck and Melinder present infants with correctly and incorrectly executed feeding actions. Both studies rely on eye tracking technology and both demonstrate that infants predict the rational goal of an action, even when presented with multiple repetitions of irrational action terminations. Reid measures infants' EEG in response to similar events and finds differences in the N400 component, which is related to the violation of semantic sequences for the unanticipated action outcome. Together these studies demonstrate that infants during their first year of life have acquired a complex and detailed understanding of different actions and the context in which they occur.

### The Development of Functional Object Knowledge in Young Infants: a Study on Infants' Goal Anticipations

**Sabine Hunnius**, Harold Bekkering

*Radboud University, Nijmegen, The Netherlands*

Many actions in daily life involve objects (e.g., drinking from a cup, combing hair). Over the course of our lives we acquire conceptual knowledge about objects that is essential to the successful planning and performing of goal-directed actions. It is largely unknown to date how knowledge concerning the functional use of objects develops in early childhood. Between 12 and 24 months of age infants start to imitate object use they observe in adults in their symbolic play. Studies on tool use in infancy have suggested that only during the second year of life infants begin to use tools correctly (e.g., a spoon, a hammer; McCarthy et al., 2001). However, infants' functional object knowledge might start to emerge long before they are able to perform the appropriate actions.

This study examines infants' object knowledge through their anticipation of action goals during action observation. Proactive visual fixations of action goals can reveal infants' understanding of actions (Falck-Ytter et al., 2006) and infants' knowledge about objects. Infants (6, 8, 12, 14, and 16 months) and adults watched short movies of a person using several everyday objects. Participants were presented with objects being brought either to the correct goal (cup to mouth, phone to ear etc.) or to incorrect goal locations (cup to ear, brush to mouth etc.). Preliminary analyses demonstrate that infants and adults showed frequent anticipatory fixations of correct action goals. Older infants and adults exhibited more correct anticipations than younger infants, and there were differences in anticipation frequency between different objects for all age groups. When watching incorrect object use, adults began to show anticipatory looks to the incorrect goal location after a number of trials, whereas infants showed less "flexibility", which is consistent with results from tool use studies with older infants (Barrett et al., 2007).

### Goal Prediction during Observation of Rational and Irrational Social Events

**Gustaf Gredebäck**, Annika Melinder

*University of Oslo, Oslo, Norway*

Six and twelve month old infants were presented with a normal feeding event or with an irrational and infrequent feeding action. Both of these actions occurred in the context of a normal social interaction. More specifically, infants observed movies of two adult actors having a conversation and eating banana. At the end of each movie one of the actors directed a spoon filled with banana towards the other; either placing the food in the recipient's month (rational & frequent feeding) or on the back of the recipient's hand (irrational & infrequent feeding). Infant's eye movements were recorded as they observed these events. Twelve-month-olds predicted the goal of the normal feeding event - looking at the mouth before the spoon arrived. The ability to predict this event correlated with infants experience with being feed. When presented with the irrational and infrequent social event infants also looked at the recipient before the spoon arrived, however, they seldom predicted the current action goal. Instead they consistently fixated the mouth despite being presented with 18 repetitions, all demonstrating the irrational and infrequent action terminating on the models hand. Six-month-olds did not reliably predict either of these actions. This study demonstrates that infants understanding of social events is closely linked to their life time experience with similar events and that infant by the end of their first year assume that actions are rational and functionally related to the goals specified in the current context.

### Neural Correlates of Violation of Expectation for Goals in Adulthood and Infancy

Vincent Reid

*Durham University, Durham, UK*

Multiple facets of actions have been proposed to be processed differently by infants, from action means to terminal goal. The series of studies presented here investigate infant processing of terminal components of goal directed action. Three photographs of key components of simple actions were presented to infants. The first displayed the action context. The second image depicted the initiation of the action. The final frame showed the completion of the action, either as an expected conclusion to the action or as a violation of that expectation. Event-related potentials were recorded in adults and in infants of 9 and 7 months in response to the presentation of the final photograph. Results indicate in adults and 9 month olds a distinct neural response, the N400, which is related to the violation of semantic sequences for the unanticipated action outcome. No such component was found in infants of 7 months. We present evidence from behavioural work with 5 month old infants which suggests that the difference between 9 and 7 month old infants is a consequence of task demands. These data

show that the processing of goal direction is incrementally refined throughout the latter half of the first postnatal year.

---

## *A Cross-Linguistic Look at Infant Speech Segmentation*

*(Regular Symposium, Communication and Language)*

**Chair:** *Jessica Hay*

**Jessica Hay**

*University of Wisconsin-Madison, Madison, USA*

A fundamental goal in language acquisition is to determine how infants are able to find words in a continuous and acoustically complex speech stream. A significant body of research suggests that infants can use both language-specific cues (e.g., native-language prosody and phonotactics), as well as language-general statistical information (e.g., transitional probability), to segment speech streams into candidate words. Although these studies have provided insight into the mechanisms underlying infant language learning, many early reports on these abilities involved very controlled stimuli (e.g., artificial languages without or with restricted prosodic markers) and limited their study to English-learning infants.

This symposium will bring together researchers from labs in different countries to discuss infant speech segmentation. The talks will focus primarily on the various cues infants use to segment speech across languages, and provide insight into how infants from various linguistic environments might segment natural speech. Polka and colleagues will suggest that French and English-learning infants' segmentation abilities are tied to native-language rhythmic structure and dialect. Pelucchi, Hay, & Saffran will demonstrate that English-learning infants can use transitional probability as a cue to word boundaries even in infant-directed speech from an unfamiliar language-in this case, Italian. Johnson will show that despite the prevalence of diminutives in Dutch, infants are unsuccessful in segmenting root forms embedded in these morphologically complex words.

These international experts will demonstrate the importance of accounting for linguistic experience when developing theories of infant speech segmentation. As discussant, Dan Swingley will provide novel insight into the segmentation problem by applying his expertise in modeling infant segmentation to help illustrate cross-linguistic similarities and differences. This symposium will provide members the opportunity to become familiar with some of the most current research and issues in cross-linguistic infant speech segmentation.

### English Infants Learn Italian: a Statistical Word Segmentation Study

**Bruna Pelucchi**[1,2] Jessica Hay[2] Jenny Saffran[2]

*1. University of Ferrara, Ferrara, Italy; 2. University of Wisconsin - Madison, Madison, USA*

**Background and Aims:** Previous research has shown that infants are equipped with powerful statistical learning mechanisms that they can use during word segmentation tasks (e.g., Saffran et al., 1996; Aslin et al., 1998). Evidence comes from artificial language studies, where 'words' are defined solely by their transitional probabilities (TP). Artificial languages lack the auditory complexity and acoustic information found in natural languages. To what extent do these studies scale up to real-world language acquisition? To address this question, we tested whether infants use TP for segmenting a naturally-produced foreign-language.

**Methods:** English-learning 8-month-old infants were exposed to 2 minutes of infant-directed Italian. In addition to over 100 words with variable length, the narrative contained 2 disyllabic words with high internal TP (*melo* & *fuga*) and 2 words with low TP (*casa* & *bici*). Both word types were presented with equal frequency, and were equated acoustically. Using a headturn procedure, infants in Experiment 1 were tested on high TP words vs. novel words (*tema* & *pane*). In Experiment 2 infants were tested on high TP vs. low TP words. Half of the infants were randomly assigned to counterbalanced versions of the language.

**Results:** In both experiments infants showed a familiarity preference, listening longer to words with high TP that to novel (Exp. 1, $p<.01$) or low TP words (Exp. 2, $p<.01$).

**Conclusion:** These results demonstrate that infants are able to use transition probability even in the presence of complex linguistic input, such as an unknown language. Disyllabic words in both Italian and English tend to have a trochaic stress pattern, which may have aided infants' segmentation. However, given that all test words conformed to the same stress pattern, TP remains the most informative cue to differentiate the various word types. Results support the hypothesis that infants use TP during real-world language learning.

### Speech Segmentation in French-Learning Infants: Language-Specific and Dialect-Specific Patterns

**Linda Polka**[1] Jennifer Proulx[1] Karima Mersad[2] Galina Iakimova[2] Megha Sundara[3] Thierry Nazzi[2]

*1. McGill University, Montreal, Canada; 2. CNRS - Université Paris Descartes, Paris, France; 3. Institute for Learning and Brain Sciences, Seattle, USA*

Speech segmentation skills develop in infancy and are influenced by the prosodic structure of the infant's native language. Studies using the HPP task show that English infants appear to favor a stress-based procedure (Jusczyk et al., 1999) whereas French infants favor syllable-based procedure (Nazzi et al., 2006). Cross-linguistic studies suggest that infants make use of prosodic cues specific to the rhythmic class of their native language but are not narrowly tuned to the prosodic patterns of their mother tongue dialect. Specifically, Canadian French-learning infants failed to segment bi-syllabic words in a rhythmically different non-native language (Canadian English) but succeeded when tested using either Canadian French or European French stimuli (Polka & Sundara, 2003). In this talk, we will present new findings that address the language-specific and dialect-specific nature of word segmentation in French-learning infants.

First, we will report findings from a more direct assessment of cross-language segmentation. We tested Canadian French and Canadian English 8-month-olds using a task designed to assess segmentation in two languages (CFrench and CEnglish) in the same infant within a single test session. Prior studies include only between group comparisons. The findings confirm that infant word segmentation skills are not readily adapted to a rhythmically-different non-native language.

Second, we will describe recent studies that may challenge the notion that word segmentation is not dialect specific. Differences emerge when Parisian French and Canadian French infants are tested using the same European French stimuli and also the same Canadian French stimuli. These findings, together with acoustic analyses, suggest that word segmentation is influenced by experience with a specific dialect and interactive style. Prosodic cues, determined by linguistic and extra-linguistic factors, appear to play an important role in the development of word segmentation strategies.

### Dutch Infants' Segmentation of Diminutive Word Forms: an Exploration of Morpheme Stripping and Lexical Embedding

**Elizabeth Johnson**

*University of Toronto, Toronto, Canada*

**Background and Aims:** Past research has shown that infants fail to recognize words embedded in longer words, e.g. English-learning 11-month-olds do not recognize the word *king* as familiar after listening to passages containing the word *kingdom* (Jusczyk, Houston, & Newsome, 1999). We explore whether this is also true of morphoogically comlpex word forms. Dutch provides an excellent test case since up to 30% of child-directed Dutch nouns are produced in the diminutive (Gillis, 1997). Diminutive forms use morphological variation to indicate smallness or affection., e.g. in English *Tim* becomes *Timmy* or *dog* becomes *doggie*. Similarly, in Dutch, the name *Els* becomes *Elsje* or *hond* 'dog' becomes *hondje*. We predict that Dutch-learners may strip off the highly frequent suffix *-je*, to recognize embedded root words (Aslin, Saffran, Newport, 1998; Christophe et al., 1997).

**Methods:** Fifty-six 11-month-old Dutch-learners were familiarized to passages containing two nonsense words. Half were familiarized with non-diminutives (*kag* and *hies* or *det* and *zeut*), half were familiarized with diminutives (*kagje* and *hiesje* or *detje* and *zeutje*). Following familiarization, infants were tested for their recognition of the familiarized word-forms using the Headturn Preference Procedure. All infants were tested on the same 4 words: *kag*, *hies*, *det* and *zeut*. We predicted that if Dutch-learners extract root words from diminutives, then all infants regardless of familiarization condition should recognize the familiar root words.

**Results:** Surprisingly, we found that only those infants familiarized with non-diminutives showed evidence of recognizing the words (p=.005). Infants familiarized with diminutives looked equally to both familiar and unfamiliar words (p=.38).

**Conclusion:** Our results indicate that Dutch-learners do not strip off the suffix *-je* to recognize the root form of a morphologically complex diminutive form. We are currently further testing this under more realistic conditions where both familiarization and test stimuli are embedded in fluent passages.

---

## *Methods and Measures Used in Assessing Infant Language Development* *(Regular Symposium, Theory, Methods and History)*

**Chair:** *Nivedita Mani*

**Discussant:** *Kathy Hirsh-Pasek*

**Anne Fernald**[1] **Nivedita Mani**[2] **Leslie Cohen**[3] **Kathy Hirsh-Pasek**[4]

*1. Stanford University, Stanford, USA; 2. University of Oxford, Oxford, UK; 3. University of Texas at Austin, Austin, USA; 4. Temple University, Ambler, USA*

The Inter-modal Preferential Looking Technique (ref) and the Switch design (ref) are two of the most common paradigms used in assessing infant language development. Despite their frequency of use, there remain a number of concerns regarding our understanding of the appropriate conditions for use and the interpretation of the measures of infant behaviour associated with both these paradigms. The proposed symposium addresses some of these issues using experimental research and theoretical debate.

The first two papers analyse the differences between the most commonly used measures in research assessing infant lexical development. The first paper (Fernald) emphasises the dynamic and continuous nature of time-course measures in contrast to the more categorical measures usually associated with infant preference. Fernald argues that real-time measures have particular advantages when studying developmental change in sentence processing, where the focus is on increasing efficiency, not just on outcome.

The second paper (Mani & Plunkett) highlights the differences between the cognitive processes underlying response latency and looking time measures. Mani & Plunkett analyse divergences in the patterns of results obtained using these different measures to explore the cognitive underpinning of these measures.

The final paper (Cohen) presents a description of the "Switch Design" in an attempt to outline the appropriate conditions for use of this paradigm in assessing infant development. Cohen compares use of the Switch and IPL paradigms and questions whether both these paradigms might be tapping into associative, rather than referential relationships between cross-modal stimuli, in the infants' mind.

Hirsh-Pasek, one of the early pioneers of the inter-modal preferential looking technique, will provide an over-arching discussion of the papers.

### Differences Between Latency and Looking Time Measures in Infant Studies

**Nivedita Mani**, Kim Plunkett

*University of Oxford, Oxford, UK*

Most research on infant language development report their analyses using either a response latency measure or a looking time measure as their dependent variables. The latency measure computes the time taken by infants to switch from a distracter to a target image following labelling of the target image. The looking time measures compute the proportion of time infants spend looking at a target image over the total amount of time spent looking at both target and distracter images.

We present data from two experiments where the direction of latency and looking time measures are divergent, despite both types of measures yielding significant results. The first experiment is a standard mispronunciation study (Mani & Plunkett, 2007) where infants were presented with images of two familiar objects followed by either a correct pronunciation or an onset consonant mispronunciation of the label of one of the images. Infants spent a greater proportion of time looking at the target image when the label was correctly pronounced than when it was mispronounced (p=.025), suggesting impaired recognition of the association between the mispronounced label and the target image. Conversely, infants latencies to switch to the target image were faster following mispronunciations than correct pronunciations (p=.04).

The second experiment finds that infants' latencies are shorter, i.e., infants are faster to recognise an image (cat) when it is primed by a phonologically related image (cup) compared to an unrelated image (door) (p=.039). Conversely, infants spend less time looking at the target when it is preceded by a related image than an unrelated image (p=.02).

These experiments suggest that latency and looking time measures tap into very different cognitive processes, and that the divergence in the pattern of results found in these experiments provide us with a clue to understanding the cognitive underpinning of these measures.

### Looking-While-Listening: Using Real-Time Measures of Speech Processing to Monitor Comprehension By Very Young Language Learners

**Anne Fernald**, Virginia Marchman, Ana Luz Portillo
*Stanford University, Stanford, USA*

The "looking-while-listening" methodology uses real-time measures of the time course of young children's gaze patterns in response to speech. This procedure is low in task demands and does not require automated eye-tracking technology, similar to "preferential looking" procedures. However, this paradigm differs critically from preferential-looking procedures in the methods used for data reduction and analysis, yielding high-resolution measures of speech processing from moment to moment, rather than relying on summary measures of looking preference. Because children's gaze patterns are time-locked to the speech signal and coded frame-by-frame, response latencies can be coded with millisecond-level precision on multiple trials over multiple items. The meticulous procedures required in the collection, reduction, and analysis of such detailed data are demanding but well worth the effort, revealing a dynamic and nuanced picture of young children's developing skill in finding meaning in spoken language.

### Pros and Cons of the "Switch Design" in Lexical Acquisition and other Infant Learning Tasks

**Leslie Cohen**
*University of Texas at Austin, Austin, USA*

In this presentation I will describe the essentials of the "Switch Design" and will mention how it has been used effectively in a variety of infant perception, cognition, and language acquisition tasks. These tasks include studies of infant face perception, object perception, categorization, music perception, and word learning. I will note instances when the label "Switch Design" has been applied inappropriately, and what assumptions and procedures are required for a proper "Switch Design" study.

When the Switch Design is used in a lexical acquisition task, the basic notion is that if infants respond to a switched word-object pair as novel, the investigator can assume the infants have formed an association between the word and the object. However, if infants respond to the switched word-object pair as familiar, no definitive conclusions can be drawn. Additional control studies are required to determine how the infants are processing those words and objects. Some examples of these control studies will be mentioned. Finally I will indicate the difference between assumptions of association and assumptions of reference. Admittedly, the "Switch Design" can only get at association, which may be a necessary condition, but certainly is not a sufficient condition for assuming referential intent. I will note the wide disagreement among investigators about assumptions of sufficient conditions and I will also raise the important question of whether other infant paradigms, such as IPL, also may only be getting at association rather than reference.

## *The Traumatized Brain*

*(Invited Symposium, Psychopathology and Developmental Delay)*
**Chair:** *Ronald Barr*

### Abusive Head Trauma in Infants: A Unique Injury in A Vulnerable Population

Lori Frasier

This presentation will focus on the unique aspects of abusive head trauma in infants, also called Shaken Baby Syndrome. The speaker will discuss the specific vulnerabilities of infants and how this injury differs from non-inflicted injury in this population. Also discussed will be what is known about predictors of neurological impairment at the time of injury, as well as the long term consequences to development in infancy and childhood. Current literature as well as case studies will be used to illustrate these concepts.

### Factors Influencing Neocortical Development in the Normal and Injured Brain

Bryan Kolb
*University of Lethbridge, Lethbridge, Canada*

Both pre- and postnatal developmental events have profound effects on brain and behavioural development and these effects vary exquisitely with the precise age, sex, and type of experience. The brain-altering events include both pre- and postnatal injury as well as sensory and motor, hormonal, and pharmacological events. The outcomes of traumatic events such as perinatal brain injury can be modified by both pre- and postnatal experiences. For example, prenatal tactile stimulation alters the development of the normal brain and enhances the functional outcome from postnatal cerebral injury. Although the mechanisms by which the prenatal experience alters the normal and injured brain is poorly understood, it is clear that the same experience differentially effects the normal and injured brain. One explanation for such differential effects is a difference in gene expression and there are marked differences in global methylation patterns in the effect of early experiences on the normal and injured brains. Another explanation is that behaviour (such as play) is altered and this, in turn, alters brain development. Factors that facilitate brain and behavioural growth in normal and traumatized brains include tactile stimulation of the pregnant mom or of the infant rats, complex housing of the juvenile and adolescent animals, vitamin and mineral supplements, or the pre- or postnatal administration of growth factors. Detrimental experiences include prenatal stress, prenatal exposure to psychoactive drugs including both psychomotor stimulants as well as prescription drugs, and restricted access to play partners. Knowledge of factors influencing brain development in laboratory animals can be translated both to the treatment of the traumatized human infant brain as well as in the prenatal treatment of children at risk.

### Abnormal Brain Development in Newborns with Congenital Heart Disease: Insights From MRI

Steven Miller
*University of British Columbia, Vancouver, Canada*

Congenital heart disease (CHD) one of the most common birth defects diagnosed in Canada, affecting 1 in 100 newborns each year. Most forms of CHD have become amenable to excellent anatomic sur-

gical repair and affected infants usually grow into healthy children. Recently, it has been reported that this improved survival of newborns with CHD is associated with a range of neurodevelopmental (e.g., motor, cognitive, social) delays or deficits that pose significant burdens on the child, family and society. These impairments are frequently attributed to acquired brain injury secondary to CHD.

Brain abnormalities in critically-ill newborns with CHD are now *safely* and reliably detected with serial magnetic resonance imaging (MRI). Advanced MRI techniques, such as MR spectroscopic imaging (MRSI) and diffusion tensor imaging (DTI), now provide an unprecedented window into neonatal brain development *in vivo*. MRSI measures regional brain biochemistry, including N-acetylaspartate (NAA) and lactate, which are useful in assessing metabolic changes with brain development and injury. DTI characterizes the three-dimensional spatial distribution of water diffusion in each voxel of the MR image, providing a sensitive measure of regional brain microstructural development. Our studies and those of others show a surprising predominance of white matter injury (WMI) in up to one half of infants with CHD, with injuries identified before and after neonatal surgery. WMI is an unexpected pattern of brain injury in term newborns with CHD because WMI reflects a selective vulnerability of developmentally regulated cell populations that are not expected in the brain at term. We now recognize that term newborns with congenital heart disease have widespread brain abnormalities before they undergo cardiac surgery. The imaging findings in such newborns are similar to those in premature newborns and may reflect abnormal brain development *in utero*.

Advanced brain imaging techniques are allowing a better understanding of the important inter-play between brain development and brain injury in the high-risk newborn.

Funding: March of Dimes Foundation, American Heart Association, Larry L Hillblom Foundation, CIHR, MSFHR, NIH.

---

## *Natural Born Pedagogy?: The Role of Mind-Reading in Cultural Knowledge Transmission* *(Regular Symposium, Cognitive Development)*

**Chair***s: Deborah Kelemen & Brenda Phillips*

**Discussant:** *Michael Tomasello*

**Brenda Phillips**[1] **Deborah Kelemen**[1] Rebecca Seston[1] Krista Casler[2] Krisztina Kupán[3,4] Jozsef Topal[3,4] György Gergely[3] Victoria Southgate[5] Coralie Chevallier[6] Gergely Csibra[5] Michael Tomasello[7]

*1. Boston University, Boston, USA; 2. Franklin & Marshall College, Lancaster, USA; 3. Hungarian Academy of Sciences, Budapest, Hungary; 4. Eötvös University, Budapest, Hungary; 5. Birbeck, University of London, London, UK; 6. Universite de Lyon, Lyon, France; 7. Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany*

Decades of research have shown that humans rapidly learn from others' explicit child-directed behavioral demonstrations, but why? One well-accepted view argues that learning is facilitated because infants' sensitivity to the behavioral cues that typically accompany a demonstration (e.g. eye contact, pointing) yield a basis for inferring the intended goal of the demonstrator (Tomasello et al., 2005). Another recent view similarly emphasizes infants' sensitivity to such behavioral cues but instead argues that their effectiveness derives not from facilitating intention-reading but by functioning as innate sign stimuli of a conspecific's desire to pedagogically communicate new, relevant, cultural information (Csibra & Gergely, 2006). The three presentations in this symposium explore these competing views regarding the psychological underpinnings of cultural knowledge transmission. Our first presenters review evidence supporting "intuitive pedagogy", also presenting new comparative findings indicating that infants and domesticated dogs only learn cognitively opaque means-end actions after a pedagogical demonstration and that the A-not-B error only occurs for infants and dogs (but not wolves) when object-transfer takes place in an ostensive-communicative context. Our second presenters provide evidence that infants decide which aspect of a demonstrated act (style or outcome) to imitate based on assessments of the informational novelty of each component. Hence, faithful imitation is influenced by the perceived relevance of an action rather than the transparency of the goal. In sympathy with an intention-reading view, our third presenters demonstrate, however, that toddlers find it difficult to fast-map the specific functions of novel tools based solely on witnessing others' ostensive child-directed tool use demonstrations. Furthermore, children readily and enduringly learn the functions of novel tools after eavesdropping on others' intentional tool use behavior in the absence of child-directed ostensive cues. Our discussant will adjudicate the debate, also bringing to bear his own social cognition research with children and non-human primates.

### Young Children Can Categorize Novel Tools By Eavesdropping on Others' Intentional Acts

**Brenda Phillips**[1] Deborah Kelemen[1] Rebecca Seston[1] Krista Casler[2]

*1. Boston University, Boston, USA; 2. Franklin & Marshall College, Lancaster, USA*

Prior work reveals that when presented with two physically dissimilar but equally affordant tools, 2.5-year-olds need only one demonstration of a model using one tool to achieve a goal (e.g., inserting to operate a light box) to fast map this activity as its exclusive and enduring function; they selectively returned to the demonstrated tool for that task and avoided use of it for anything else (e.g., cracker crushing) (Casler & Kelemen, 2005). How does this fast-mapping occur? One view is that children are learning from the intention of the model's goal-directed action (Meltzoff, 1988; Tomasello, 1999). Another view is that children fast-learn from the ostensive-communicative pedagogical signals of the model (Csibra & Gergely, 2005).

We present two studies exploring these interpretations. In one study, 2.5-year-olds saw the same child-directed demonstration as Casler and Kelemen (2005) but in contrast to the original method, children had no hands-on opportunity to reproduce the model's intentional actions at the time of demonstration. Toddlers were unable to fast-map a specific function to a tool on observation of a child-directed pedagogical display aloneâ¤"a finding weakening the claim that children are innately sensitive to conspecifics'ostensive-communicative signals to relevance. In a second study, 3.5-year-olds readily and enduringly learned the function of a novel tool after eavesdropping on someone using it in the absence of child-directed ostensive cues. In this study, children surreptitiously observed from a "hidden"room as an agent performed various actions including preferentially using one of two equally affordant tools for a task. Based on this intentional but non-pedagogical display, children selectively returned to the model's preferred tool for the task and avoided using it for alternative purposes. The implications of these results for the development and transmission of artifact knowledge will be discussed.

### Sensitivity to Communicative Intent Tells Young Children What to Imitate

**Victoria Southgate**[1] Coralie Chevallier[2] Gergely Csibra[1]

*1. Birbeck, University of London, London, UK; 2. Universite de Lyon, Lyon, France*

How do children decide which elements of any given demonstration they should imitate? One suggestion is that infants imitate what they perceive to be the goal of the demonstrator (Carpenter & Tomasello, 2005). An alternative prediction stems from the proposal that infants conceive ostensive demonstration as communication (Csibra & Gergely, 2006). Selective imitation of a demonstrator's actions may reflect the infants' attempt to extract the relevant communicative intent from the experimenter's demonstration, and imitate what they perceive the demonstrator is intending to communicate to them.

Two groups of 18-month-old infants were shown a toy animal either hopping or sliding (action style) into a toy house (action outcome), but the communicative relevance of the action style differed depending on the condition. For infants in the equal relevance group, all the information was new and so equally relevant. However, for infants in the unequal relevance group, the action outcome was already communicated to the infant prior to the main demonstration, rendering the action style more relevant. Infants in the unequal relevance group imitated the action style significantly more than infants in the equal relevance group, suggesting that the relevance manipulation modulated their interpretation of the action demonstration. Furthermore, infants in the unequal relevance group often imitated the action style at the expense of the action outcome, a behaviour never observed in the equal relevance group. These results indicate that, like adults (Sperber & Wilson, 1986), human infants expect communication to contain relevant content and imitate action elements that, relative to their current knowledge state or to the common ground with the demonstrator, is identified as most relevant.

### The Functional Role of Ostensive Communicative and Referential Cues in Social Learning: a Comparative Perspective

**Krisztina Kupán**[1,2] Jozsef Topal[1,2] György Gergely[1]

*1. Hungarian Academy of Sciences, Budapest, Hungary; 2. Eötvös University, Budapest, Hungary*

Young infants show special sensitivity to ostensive-communicative and referential cues (OCRs) (such as eye-contact, motherese, gaze-shift or pointing, Tomasello et al., 2005; Csibra & Gergely, 2006). According to 'natural pedagogy' theory (Gergely & Csibra, 2006) OCRs trigger a specialized social-communicative learning system selected to ensure efficient cultural learning. In this view early joint referential interactions involving OCRs serve a primarily epistemic function manifesting new, relevant, and kind-generalizable information for infants to fast-learn. Supporting evidence demonstrates that action-observation in OCR vs. non-communicative contexts leads to differential learning effects (selective imitation, Brugger et al., 2007; Király et al., 2004, social referencing, Egyed et al., 2007), differential object-encoding (Yoon et al., submitted). Here new evidence is presented from other domains to further demonstrate the interpretation-modulating role of OCRs.

Unlike most non-human species (including primates), dogs do show sensitivity to OCRs (Hare et al., 2002; Miklosi et al., 2003). To compare the functional nature of ostensive-referential communication we presented human infants vs. dogs (and human-raised wolves) similar actions in OCR vs. non-communicative contexts. Study 1 (binary object-search choice task) showed that only in the OCR-context did both infants and dogs re-enact a cognitively opaque action (manipulating an empty container-E to release a ball from a visibly baited Container-B), while in the non-communicative demonstration-context both groups chose Container-B. In dogs, however, the OCR context-effect disappeared when during testing the demonstrator was absent, while infants generalized their imitative response to the demonstrator-absent situation, too. Study 2 (AnotB object-search task) demonstrates both in 10-month-olds and dogs that the AnotB search error only appears in a social-communicative (OCR-cued) action-demonstration context. In contrast, human-raised wolves - who don't develop sensitivity to OCRs, Miklosi et al., 2003) - exhibit no AnorB error in either action-observation contexts. We discuss the implications of these results that seriously challenge standard explanations of the classical AnotB error phenomenon.

---

## *Rule Learning in Infants with Non-Linguistic Stimuli*

*(Regular Symposium, Cognitive Development)*

**Chair:** *Yael Gertner*

**Discussant: Gary Marcus**

**Yael Gertner**[1] **Renee Baillargeon**[1] Cynthia Fisher[1] Scott Johnson[2] Erik Thiessen[3] Colin Dawson[4] Louann Gerken[4] Gary Marcus[5]

*1. University of Illinois Urbana Champaign, Champaign, USA; 2. UCLA, Los Angeles, USA; 3. Carnegie Mellon University, Pittsburgh, USA; 4. University of Arizona, Tucson, USA; 5. New York University, New York, USA*

To learn the rules of their language, infants must possess powerful learning mechanisms, one of which may be a mechanism for extracting algebraic rules (Marcus et. al., 1999). What is the nature of this rule-learning mechanism? Is it specific to language or can it be used in other domains? Recent evidence suggests that infants can learn rules involving non-linguistic stimuli under limited conditions (Marcus et al., 2007; Saffran et al., 2007). For example, Marcus et al. (2007) found that 7.5-month-olds detect rules when presented with sequences of non-linguistic auditory stimuli if they first hear a rule involving linguistic stimuli.

The research in this symposium brings to light three additional conditions under which infants learn rules with non-linguistic materials. This research comes from three different laboratories and involves three different kinds of stimuli. The first paper finds that 7-month-olds detect rules when presented with sequences of three-dimensional objects that differ in their physical properties (e.g., containers, tubes, or covers) but not in their pattern and color. The second paper reports that infants detect rules when presented with paired stimuli from two different modalities-tones and shapes-but not with stimuli from either modality alone. Finally, the third paper finds that, although 7.5-month-olds cannot detect rules when presented with musical chords, 4-month-olds can, suggesting that infants' rule-learning mechanism is influenced by experience within a domain.

The present research suggests that infants succeed in detecting rules with non-linguistic stimuli under diverse circumstances, yet not unconditionally. One possible explanation for these various findings is that rule learning requires the formation and comparison of robust sequence representations, and that such representations are achieved through different processes with different stimuli. Our discussant Gary Marcus will discuss this and related issues, and more generally will speculate about what the present results tell us about infants' rule-learning mechanism.

### Tube, Container, Container: Rule Learning in 7-Month-Old Infants

**Yael Gertner**[1] Renee Baillargeon[1] Gary Marcus[2] Cynthia Fisher[1] Scott Johnson[3]

*1. University of Illinois Urbana, Champaign, USA; 2. New York University, New York, USA; 3. UCLA, Los Angeles, USA*

Are the mechanisms that underlie rule learning in infants specific to language? In a series of experiments, we tested 7-month-old infants' ability to extract rules from non-linguistic materials. Because even young infants attend to the distribution of open and closed surfaces in objects, we used sequentially presented objects infants would readily categorize as tubes, containers, covers, or blocks.

In Experiment 1, infants received three familiarization trials (F1, F2, F3), each showing an ABB pattern (F1: block, tube, tube; F2: container, block, block; F3: block, cover, cover). Next, infants received a test trial showing either the same ABB pattern (tube, container, container), or an ABA pattern (container, tube, container). Stimuli were controlled to ensure that infants could not form a non-abstract rule based on extraneous features. In Experiment 2, infants were familiarized with an AAB pattern and tested on an AAB or an ABA pattern. In Experiment 3, infants were familiarized with AAB or ABB and tested on both patterns.

In all three experiments, infants showed a reliable familiarity preference, looking longer at the test item that matched the pattern shown during familiarization. Infants were thus able to extract the ABB and AAB patterns and recognized new sequences that instantiated those patterns. Control results supported this interpretation.

In a final experiment, infants familiarized with an ABA pattern were not able to discriminate it at test from an ABB sequence. This failure might reflect memory demands: because the objects were shown sequentially, and each object was rotated a few times before being placed upright on the apparatus floor, adjacent similarities might have been easier for infants to detect than non-adjacent ones.

Together, our results demonstrate that 7-month-olds can extract rules that involve object categories they readily use. As such, our results challenge the view that rule learning is specific to language.

### Redundant Cross-Modal Relations Facilitate Visual Rule Learning

Erik Thiessen

*Carnegie Mellon University, Pittsburgh, USA*

Infants learn generalizable rules from exposure to speech. Upon hearing ABA sequences like "ga ti ga" and "lee ma lee," infants identify the underlying rule that the first and third element are identical (Marcus et al, 1999). Subsequently, they discriminate ABA sequences with entirely novel elements from novel ABB sequences. However, infants have difficulty identifying ABA or ABB patterns in non-linguistic stimuli, such as looming shapes or musical tones (e.g., Marcus, Fernandes, & Johnson, 2007).

To better understand infants' difficulty in identifying rules in non-linguistic stimuli, we presented infants with sequentially looming shapes paired with synchronized tones. Infants fail to identify rules from either kind of stimuli in isolation. But after habituation to ABA (or ABB) sequences of shapes where each shape is paired with a unique tone, infants discriminate between test sequences (composed solely of novel looming shapes) that follow, and sequences that violate, the rule to which they were habituated.

One reason why pairing shapes and tones may help is that the tones provide a redundant cue to the rule. Another possibility is that the tones increase the variability of the ABA (or ABB) patterns in the input. There are twice as many items that exemplify the rule - the shape sequences, and the tone sequences. In Experiment 2, we simplified the input, such that all 9 of the shape sequences were paired with the same sequence of three notes: C-F-C in the ABA condition, and C-F-F in the ABB condition.

Even when the input is simplified in such a manner, infants identify the underlying rule. These results suggest that redundant cues, even in the absence of increased variability, facilitate learning. If so, infants may be more successful in identifying rules from speech than from non-linguistic input because infants detect and process more redundant information in speech.

### Domain-Dependent Refinement of Attention to Relations

Colin Dawson, Louann Gerken

*University of Arizona, Tucson, USA*

One of the biggest challenges for learners is to separate relevant from irrelevant sources of information in the environment. Biology undoubtedly plays an important part in constraining learning mechanisms, whether by means of the architecture of perceptual systems themselves or through innate cognitive biases. However, the role of prior experience in refining learning mechanisms may be larger than was once thought. A series of experiments with infants suggests that, as they gain experience with different input domains, they learn to emphasize sources of information that have proved reliable in the past, and de-emphasize sources that have been noisy or unreliable. Critically, a source that is reliable in one domain may not be reliable in another. Infants' differential performance between domains reflects this discrepancy.

4-month-olds and 7.5-month-olds were familiarized with sequences of musical chords adhering either to an AAB or an ABA pattern. When tested on novel chord sequences adhering to the two patterns, the 4-month-olds, but not the 7.5-month-olds, listened longer to phrases with the novel pattern. In another experiment, 7.5-month-olds were familiarized with melodies, in several keys, that either all ended on a I chord or all ended on a V chord. When tested on melodies in novel keys, the infants listened longer to those melodies that adhered to the opposite pattern. Taken together with previous findings that 7.5-month-olds learn AAB/ABA generalizations over strings of syllables, these results suggest that, as infants gain experience with music, they learn to ignore position-sensitive repetitions of single chords, instead attending to the tonal structure of the music. A survey of children's songs confirms that nearly all phrases end on either a I or a V chord, but the occurrence of repeated notes in three-note windows at phrases' ends is not significantly more frequent than would be expected by chance.

---

## *Representations in Action: How Looking and Reaching Guide the Formation of Item and Category Representations*

*(Regular Symposium, Attention, Memory and Learning)*

**Chairs:** *Donna Fisher-Thompson & Gregor Schoener*

**Discussant:** *Denis Mareschal*

**Gregor Schöner**[1] **Donna Fisher-Thompson**[2] Joshua Goldberg[3] Sammy Perone[4] Rick Gilmore[5]

*1. Institut für Neuroinformatik, Ruhr-Universität Bochum, Bochum, Germany; 2. Niagara University, Niagara University, USA; 3. Indiana University, Bloomington,*

*USA; 4. University of Iowa, Iowa City, USA; 5. Pennsylvania State University, University Park, USA*

The central question this symposium addresses is how the dynamics of action influence the nature of representations infants form. Participants provide evidence that the formation of item and category representations in infancy are guided by the dynamics of looking, an active process through which infants control their own stimulation. Similarly, motoric representations are driven by the active generation of motor behavior.

The first talk presents a theoretical model of how looking behavior and perceptual processes are coupled, and how this coupling leads to the formation of memory traces in paired-comparison tasks. An analysis of the model's behavior and critical empirical findings focusing on the micro-structure of fixations and gaze shifts supports the particular form of perceptual-motor integration captured by the model and the processes purported to underlie visual habituation.

The second talk presents evidence that a similar process of habituation underlies reaching performance. In particular, the authors present evidence that the amount of movement infants generate with a sound-producing lever decreases over trials. When the lever is reoriented--changing the required movement but leaving the visual layout essentially unchanged--infants dishabituate.

Recent experimental data suggests that the learning context makes a strong contribution to the breadth of categories infants learn. In the third talk, the authors present a dynamic neural network that learns the visual details of object by looking at them, revealing how patterns of looking constrain the formation of object categories. In particular, looking among multidimensional stimuli in different task contexts leads to the formation of different category structures, showing that categories emerge from the dynamics of looking and the processes that relate looking to remembering.

The discussant provides a unique perspective on this fresh look at the processes of building representations, bringing a focus on infant attention to bear on the nature of representations in action.

### Stickiness or Space: Evidence from a Dynamic Field Model of Infant Looking and Habituation

**Joshua Goldberg**[1] Donna Fisher-Thompson[2]

*1. Indiana University, Bloomington, Indianapolis, USA; 2. Niagara University, Niagara University, USA*

Looking times and visual preferences are a prime source of scientific knowledge about cognition in infancy. In order to learn, infants must stabilize their perceptual world by fixating, but their looking behaviors must also remain flexible so they avoid getting "stuck" and missing out on other relevant parts of the world. It is with these issues in mind that we present a new model of infant looking behaviors and habituation.

Our model includes a neural activation field for motor control of gaze, modeled dynamically in continuous time, that controls the duration of each fixation and generates plans for gaze shifts. These looking behaviors are generated with no memory for locations of prior looks or locations of stimuli. A separate perceptual activation field processes only the object currently in the focus of attention. Excitatory and inhibitory memory traces within the perceptual field strengthen or weaken responses to particular stimuli, which in turn affect fixation length via feedback to the motor planning field. Habituation and looking preferences are accounted for by varying the stickiness of fixation; the model is not more likely to shift attention to a novel stimulus.

To corroborate simulation results from the model, we present experimental data from infant preferential looking and habituation experiments showing that infants do not shift preferentially or more quickly to novel stimuli. For example, when 3-month-old infants were tested in our lab using a fixed-trial preferential looking task, 26% of looks directed toward familiar stimuli resulted in a gaze shift, a percentage nearly identical to the 24% found for looks directed toward novel stimuli. Realistic patterns of habituation and fixation emerge from the model that account for real-time looking behaviors found in the lab. We conclude that infants control their own exposure to stimuli in real time by controlling patterns of fixation and looking away.

### Task Specific Categorization in An Autonomous Dynamic System

**Sammy Perone**[1] John Spencer[2] Lisa Oakes[3]

*1. University of Iowa, North Liberty, USA; 2. University of Iowa, Iowa City, USA; 3. University of California at Davis, Davis, USA*

Looking measures have provided fundamental insights into the nature of categorization in infancy, revealing that age as well as the stimulus and task context contributes to whether infants learn narrow, exclusive categories or broad, inclusive categories. However, links between looking and categorization processes remain poorly specified. To achieve a common framework for thinking about looking and learning, we propose a dynamic field theory that specifies how learning and memory processes are organized in infant categorization tasks and over development.

Our proposal is centered on the selectivity hypothesis, which states that by looking at exemplars, the dimensions along which categories can be recognized and differentiated emerge due to strong, accumulated activation within local regions of particular continuous feature dimensions. Critically, we show that selectively can emerge via the dynamics of looking by using a dynamic neural network that learns the visual details of objects by looking at them. As the network looks among category exemplars, it perceives and forms a memory for the metric details of the feature dimensions present. When the model forms a robust ÒworkingÓ memory of a target item, the system is released from fixation and is free to look among the remaining targets.

Selectively emerges within this framework under particular task and stimulus conditions. When infants are presented with pairs of category exemplars, for instance, they often learn exclusive categories, but when infants are presented with exemplars in succession, they often learn inclusive categories. Simulations show that selectivity emerges quickly in the paired context as the network samples multiple feature values from multiple dimensions on each trial. In addition, infants often learn more exclusive categories as they become older. This arises in the model by increasing the strength of neural interactions, which allows older infants to more effectively hone in on the dimensions that differentiate categories.

### The Dynamics of Infant Motor Habituation

**Gregor Schöner**[1] Jing (connie) Feng[2]

*1. Institut für Neuroinformatik, Ruhr-Universität Bochum, Bochum, Germany; 2. Indiana University, Bloomington, USA*

Infant visual habituation plays a critical role in how infants explore their environments and control visual cognition. But is habituation a property only of sensory processes or may habituation be induced by motor behavior alone? What form of control would such motor habituation provide? To establish habituation and dishabituation of

motor behavior we investigated whether infants show a decrease in activity when they repeat the same movement and whether they resume activity when the movement is changed.

We presented twenty-six 15-month-old infants with a visually unattractive box with a single sliding lever, that generated music when moved. The box could be presented in two orientations which afforded either horizontal or vertical lever movement. Infants were given 15-second fixed-interval trials to play with the box, which was presented in one orientation during the habituation phase, in the other orientation during the test phase. An infant-controlled procedure was used to determine when infants reached habituation criterion. The test phase consisted of two trials. Lever movement was recorded on a computer which also controlled the playing of music while the lever moved. In addition, infants' eye movement and lever action were recorded on video-tape.

Infants showed clear patterns of habituation, the total duration of lever movement on the last 3 habitation trials being reduced by 54% from that on the first 3 habituation trials. 77% of the infants reached the habituation criterion. When movement direction changed infants showed significant dishabituation (4.2 ± 4.1 sec, one sample t-test $t(51) = 7.466$, $p < .001$).

The results demonstrate that infants can habituate to repeating a simple movement and then dishabituate when the movement direction is changed. Thus, habituation may be a process for controlling behavioral activation more generally, not only when exploring the visual environment.

---

## *Using the Still-Face to Assess Bio-behavioral Indicators of Emotion Dysregulation in High and Low Risk Mother/Infant Dyads* *(Regular Symposium, Emotional Development)*

**Chair:** *Jennifer Ablow*

**Discussant:** *Cynthia Stifter*

**Jennifer Ablow**[1] **Elisabeth Conradt**[1] **Nanmathi Manian**[2] Marc Bornstein[2] O. Maurice Haynes[2] **Ginger Moore**[3] Ashley Hill[4] Cathi Propper[4] Susan Calkins[5] W. Roger Mills-Koonce[4] Martha Cox[4] Cynthia Stifter[3]

*1. University of Oregon, Eugene, USA; 2. National Institutes of Child Health and Human Development (NICHD), Bethesda, USA; 3. The Pennsylvania State University, University Park, USA; 4. University of North Carolina at Chapel Hill, Chapel Hill, USA; 5. University of North Carolina- Greensboro, Greensboro, USA*

The Still-Face Paradigm (SFP) has become a standard laboratory procedure for assaying the quality of an infant-caregiver relationship by evaluating the infant's distress in response to their parent's emotional neutrality and/or unavailability. The prototypic infant response is distress given their parent's atypical behavior. More recently, the SFP has been used to examine the process by which infant's distress can be regulated during the SFP's reunion phase - either by the infant herself or through interaction with the caregiver. The regulation of emotion is a critical developmental objective in a child's early life, as it lays the foundation for long-term health. During the past decade we have seen more research targeting the biological and behavioral underpinnings of emotion regulation as it develops within the context of the parent-infant relationship. During and following moments of distress, parents must manage their own arousal to aid in infant regulation by appropriately reading infant signals and responding in a sensitive manner. However, early programming models suggest that chronic perturbations in mother-infant dynamics are particularly problematic and may serve to organize regulatory systems that predispose infants to future disorder.

The aims of this symposium are to examine mother and infant behavioral and physiological emotion regulation processes during SFP. Central to each of the three papers in this symposium are issues of mother-infant autonomic attunement/synchrony, maternal sensitivity, and emotion regulation in both partners during the reunion phase of the SFP. In addition, two of the papers study regulation during the SFP in samples of risk: mothers with depression and mothers in poverty at risk for parenting problems. Our discussant, a leading expert in developmental psychophysiology and early emotion development, will consider how these papers inform our understanding of how relational psychophysiology supports or hinders the development of infant emotion regulation under varying conditions of risk.

### Infant Regulation in the Still-Face Situation at 5 months: Concurrent Predictors and Longitudinal Outcomes

Nanmathi Manian, Marc Bornstein, O. Maurice Haynes

*National Institutes of Child Health and Human Development (NICHD), Bethesda, USA*

The infant's ability to disengage from distressing stimulation is a key component of self-regulation. We use a modified still-face (SF) procedure to examine the transition from social interaction to gaze aversion in infants of Depressed and Well mothers. We also examine concurrent predictors (maternal sensitivity and infant temperament) and longitudinal outcomes (child behavior problems) of this transition.

Groups of 26 Depressed and 30 Well mothers were selected based on a psychiatric interview and observed in face-to-face interaction in the laboratory when their infants were 5 months. Infant behaviors were coded in 1-s time intervals into mutually exclusive codes. Dyads were videorecorded in their homes for 1 hr and coded for maternal sensitivity. Maternal reports of infant temperament were administered at 5 months and behavior problems at 15 months.

To examine infant transitioning from social interaction to gaze aversion during SF at 5 months, we used Event Sequential Analysis (Bakeman & Quera, 1996) to generate conditional probabilities (odds ratios). As expected, infants of Well mothers, but not Depressed mothers, were able to transition from social engagement to gaze aversion. In addition, mothers who were observed to be more sensitive, and infants who were temperamentally less negative, were better regulated and could disengage from a distressing stimulus at 5 months.

A significant interaction emerged between depression and the transitional probabilities in predicting child internalizing behavior problems at 15 months. For infants whose mothers were previously depressed, greater ability to transition to gaze aversion during SF at 5 months was associated with lower ratings on internalizing problems at 15 months.

We conclude that gaze aversion during SF procedure reveals important individual differences in infant self regulation. The ability to modulate arousal by averting gaze from an unresponsive mother indicates concurrent and future regulatory ability in infants, especially in infants of depressed mothers.

### Mother-Infant Vagal Regulation in the Still-Face Paradigm is Moderated by Maternal Sensitivity

**Ginger Moore**[1] Ashley Hill[2] Cathi Propper[2] Susan Calkins[3] W. Roger Mills-Koonce[2] Martha Cox[2]

*1. The Pennsylvania State University, University Park, USA; 2. University of North Carolina at Chapel Hill, Chapel Hill, USA; 3. University of North Carolina-Greensboro, Greensboro, USA*

Little research has examined parents' physiological responses interacting with infants, although the ability of parents to support infants' regulation may be a function of effectiveness in regulating their own arousal. Especially when infants are distressed, parents who manage their own reactions effectively are likely to sensitively attend and respond to needs of their infants. The overall goal of the current study was to examine maternal sensitivity as a moderator of mothers' and infants' physiological regulation during parent-infant interaction.

Mothers (N = 152) and their 6-month-old male and female infants from a diverse community sample (equal numbers of African and European American families from lower- and higher-income groups) were observed in the Still-Face Paradigm (SFP). Mothers' and infants' affective states were coded at 1-s intervals and vagal tone (RSA) was measured. Mothers and infants showed opposite patterns of RSA regulation. Mothers' RSA increased during disengagement and decreased during re-engagement, reflecting demands to structure and support the interaction. Infants' RSA decreased during disengagement, reflecting the need to support self-regulatory behaviors, and increased during re-engagement. Infants of highly sensitive mothers showed an unexpected decrease in RSA during re-engagement ($t(260) = -2.70$, $p < .01$) and their mothers showed a greater decrease than other mothers ($t(260) = -2.50$, $p < .05$). Their similar physiological responses may have been related to behavioral synchrony. In support of this, higher levels of synchrony between mothers' and infants' behavioral states predicted lower infants' RSA (beta = -.18, $p < .05$) and lower mothers' RSA (beta = -.17, $p < .05$ ) in the re-engagement episode, controlling for baseline RSA.

Findings extend our understanding of the impact that parenting may have on emerging physiological regulation during early infancy.

### Bio-Behavioral Markers of Emotion Dysregulation in At-Risk Mother-Infant Dyads

Elisabeth Conradt, Jennifer Ablow, Jeffrey Measelle

*University of Oregon, Eugene, USA*

Few studies have examined how infant-caregiver interactions affect infant recovery, both physiologically and behaviorally, following a social stressor such as the Still-Face Paradigm (SFP). Some studies have found that mothers who are more responsive have infants who show more effective physiological regulation during the reunion episode of the SFP. To our knowledge, this research has been conducted largely with low-risk families. Currently, little is known about the autonomic processes of at-risk mother-infant dyads. The present study examined the relation between maternal and infant physiology during the SFP using a sample living below the poverty line and at risk for abusive parenting. Maternal sensitivity during the reunion episode of the SFP was observed as a possible moderator.

Continuous measures of heart rate (HR) and respiratory sinus arrhythmia (RSA) were collected for 95, 5-month-old infants and their mothers during the SFP. Maternal behavior during the reunion episode was coded using the Murray Global Rating Scales of Maternal Sensitivity.

Preliminary analyses of our RSA data using classification tree analysis suggested three groupings. One group comprising mothers with high levels of RSA (low arousal) during the still face and reunion portions, had infants who displayed low RSA (high arousal) throughout the SFP. These women were rated as less sensitive during reunion. Another group suggests women with low RSA in both phases whereas their infants exhibited low RSA during the still face portion, and high RSA during reunion. These mothers were high in sensitivity. A third group of women exhibited low RSA in both phases whereas their infants exhibited high RSA during the still face and low RSA during reunion. Behaviorally, these mothers were rated as low in sensitivity and high in intrusiveness. Our data will be discussed in terms of the role of maternal sensitivity in supporting mother-infant autonomic recovery from social stress.

---

## *Intentional Understanding in Infancy: a Debate*

**Moderator:** *Philippe Rochat*

**Participants:** *Gergely Gyorgy & Chris Moore*

### Understanding Persons As Intentional Agents

Chris Moore

*Dalhousie University, Halifax, Canada*

As adults, we understand that intentionality is a property of individual persons and that the category of persons includes self as well as others. When and how do infants develop this kind of understanding? I argue that such an individualistic concept of person entails a form of self-other equivalence whereby both self and other are understood to be embodied agents with subjective experiences, and that this understanding develops during the second year of life. Younger infants can detect the object-directed activity of others and can organize their own intentional activity in relation to that of others. However, this entails only an understanding of how intentional actions may be shared or co-ordinated with others and not yet an individualistic conceptual understanding of persons. I suggest cognitive and symbolic reasons why the development of a conceptual understanding of persons as intentional agents must wait until the end of infancy.

### Infants' 'Rich' Understanding of Intentional Agency: Representing Communicative and Referential Intentions during the Second Year

Gergely Gyorgy

*Institute for Psychological Research Hungarian Academy of Sciences, Budapest, Hungary*

Different lines of recent research converge on the view that by one year of age infants can interpret object-directed actions of others in terms of person-specific intentions or dispositional attitudes that they infer and attribute to the actor. However, it has been unclear (and strongly debated) whether and when infants become able to infer and represent a variety of other types of intentions (such as communicative and referential intentions) expressed by ostensively cued referential action manifestations during early triadic communicative interactions. I'll summarize a series of new studies that tested the hypothesized interpretation modulating role of ostensive and referential cues on infants' intentional representations of different types of actions that they observed either in a non-communicative 'incidental observation' situation or in a social-communicative ostensive cueing

context. Our results (with14- and 18-month-olds) provide converging evidence from different task domains (imitative learning of novel means, understanding others' referential emotion expressions, and interpreting object-hiding actions in a binary search (AnotB) task) that a) (as predicted by natural pedagogy theory, Csibra & Gergely, 2006; Gergely & Csibra, 2005, 2006) infants show special sensitivity to ostensive communicative cues interpreting them as manifestations of the other's overt communicative intention that is specifically addressed to the infant, b) they attribute different intentional contents to the (same) action when it is performed in a non-communicative context than when it is manifested in an ostensive-referential communicative context. Based on such data I'll argue that during their second year infants already possess a 'rich' and differentiated concept of intentional agency and can represent others' actions in terms of different types of communicative and referential intentional contents.

---

## *The Emergence of Phonological Contrast from Lexical and Perceptual Processes* *(Regular Symposium, Communication and Language)*

**Chair:** *Bob McMurray*

**Discussant:** *Katharine Graf Estes*

**Bob McMurray**[1] Gwyneth Rost[1] Christopher Fennell[2] Erik Thiessen[3] **Katharine Graf Estes**[4]

*1. University of Iowa, Iowa City, USA; 2. University of Ottawa, Ottawa, Canada; 3. Carnegie Mellon University, Pittsburgh, USA; 4. University of California, Davis, Davis, USA*

Phonological contrasts are perceptual distinctions that are defined by their ability to distinguish words in the lexicon. Thus, contrast emerges from perceptual processes and lexical structure. Both sides of this equation, however, develop at their own rate and via separate (though interdependent) mechanisms. One result of this is that during infancy, phonological contrasts are unstable because of the incomplete development of perceptual abilities and the small number of known words.

Research has examined word learning during this time, and demonstrated that 14-18 month-olds have difficulty learning phonologically similar words (e.g. Stager & Werker, 1997), suggesting that phonological contrast is not developed to a point that supports learning. To date, explanations for this have focused on the source of failure, examining top-down factors like competition (e.g. Swingley & Aslin, 2007) or task-demands (Stager & Werker, 1997).

However, this does not address how functionally useful contrast emerges in this context. This symposium examines the development of perceptual and lexical processes that contribute to contrast in word learning. Gwyneth Rost and Bob McMurray's talk examines acoustic/phonetic variability as a support for contrast, suggesting that variability is crucial in the development of the perceptual side of the equation. Christopher Fennell's talk builds from the finding that a carrier phrase augments learning and asks if coarticulatory cues in the sentence are responsible. It suggests that they are insufficient-top down factors may be responsible. Erik Thiessen's talk examines lexical structure and suggests that acquiring a third similar word can provide the necessary lexical support for learning similar words. Katharine Graf Estes, whose work examines the interface of perception and word learning will serve as discussant.

These studies reveal how phonological contrast emerges from the interplay of lexical and perceptual factors during late infancy, and provide the first clues as to how infants learn similar sounding words.

### Phonetic Variability and Early Word Learning

Gwyneth Rost, Bob McMurray

*University of Iowa, Iowa City, USA*

During early word learning infants fail to learn similar words (bih/dih) despite their ability to discriminate between phonemes. Explanations center on top-down factors: task demands (Stager & Werker, 1997) or competition between lexical items (Swingley & Aslin, 2004). However, no one has examined bottom-up factors. We hypothesize that 14 month-olds' phonetic categories are not developed robustly enough to support word learning, and that providing phonetic variability in the training sequence might bootstrap these categories. This was tested in a series of experiments using the switch task (Werker et al., 1998).

Experiment 1 replicated Werker et al. (1998), using a single exemplar of the words /buk/ (buke) and /puk/ (pook). As expected, sixteen 14 month-olds failed to learn these minimal pairs (p=.84). Experiment 2 tested the role of variability using multiple-exemplar habituation (54 exemplars across 18 speakers). Infants learned the words (p=.01). Thus, phonetic variability may augment early phonetic categories to support learning minimal pairs.

It is unclear whether variation in phonetic cues (voice-onset time: VOT) or non-phonetic ones (speaker, pitch) supported learning. Experiment 3 examined phonetic cues, using a buk/puk continuum that varied in VOT alone (-40 to 100 ms). During habituation, words were presented in a bimodal frequency distribution (Maye, Werker, & Gerken, 2002) to provide appropriate variability. Infants failed to learn (p=.98). A follow-up experiment simultaneously manipulated three cues to voicing and found no effect (p=.43). Thus, variation in contrastive cues alone was insufficient. A final experiment examined variation in non-contrastive cues. Early results suggest infants can learn under this condition.

Infants learn lexical neighbors given a variable set of exemplars. Since variation adds task demands (speaker normalization) without altering top-down factors, phonological development must also contribute to this task. The fact that VOT variation is not sufficient suggests a role for non-criterial acoustic variation in phonological development.

### Does Coarticulatory Information Aid Use of Phonetic Detail at 14 Months?

Christopher Fennell

*University of Ottawa, Ottawa, Canada*

Fennell and Waxman (in prep; Fennell, 2006) demonstrated that presenting novel words in the context of naming phrases (e.g., "Look at the din!") aided 14-month-old infants in noticing phonetic changes in the target word (e.g., "Look at the bin!"). This effect is not seen when isolated words are used (e.g., change from "Din!" to "Bin!"; Stager & Werker, 1997). They hypothesized that naming phrases allowed infants to cement the link between object and label, reducing the demands placed on the infant. However, infants may have used extra perceptual information present in the naming phrase task that was absent the isolated word task: coarticulatory effects between the determiner and the onset of the target word. Coarticulation effects occur as we move from one articulatory gesture to another, and listeners are perceptually sensitive to these effects on individual sounds (e.g, Martin & Bunnell, 1982). The current study tests if the addition of coarticulatory cues to a word learning task allows infants to use more phonetic detail than when those cues are absent (i.e., isolated words). Replicating the previous studies that showed infants' failure to notice consonant chan-

ges in isolated words, the only change in experimental design was the addition of a nonce syllable ending in a schwa prior to the target word, thus adding coarticulatory information. Infants of 14 months were habituated to one novel object-label combination: a nonsense object paired with the auditory label "ge bin". They were then tested on a small change in the label: the object paired with "ge din". Word order was counterbalanced. Infants did not look longer to the object when the label changed than to a trial where no change occurred. This indicates that the addition of coarticulatory information does not aid novice word learners in using target phonetic detail in this task.

### Evidence That the Variability in Lexical Frames Affects Children's Use of Phonemic Contrasts

Erik Thiessen

*Carnegie Mellon University, Pittsburgh, USA*

In word-learning tasks, 14-month-olds fail to use phonemic differences they can hear (Stager & Werker, 1997). While children can hear the difference between "daw" and "taw," they treat them as interchangeable labels. By 18 months, children are more likely to use phonemic distinctions in a word-learning task. One possible explanation for this is that older children have larger vocabularies that consist of very few minimal-pair words (Charles-Luce & Luce, 1990). Vocabulary growth may help children use phonemic contrasts by exposing them to phonemes in distinct contexts.

To test this hypothesis, we replicated Stager and Werker's (1997) results. In two extra conditions, children learned a label for the daw-object, as well as labels for two other objects. In the Similar Contexts condition, the additional objects were labeled "tawgoo" and "dawgoo." In the Distinct Contexts condition, the additional objects were labeled "tawgoo" and "dawbow," providing examples of "daw" and "taw" in distinct contexts. In the Distinct Contexts condition, but not the Similar Contexts condition, infants dishabituated when the daw-object was paired with "taw."

Additionally, we assessed whether children in the Distinct Contexts condition learned about syllables (like "daw" and "taw") or phonemes (/d/ and /t/). The effects of learning appear most powerful in contexts very similar to the exposure. Infants exposed to "dawbow" and "tawgoo" use the difference between "daw" and "taw," but treat "yad" and "yat" or "dee" and "tee" interchangeably.

If the distribution of phonemes in the lexicon affects children's use of phonemic contrasts, children should begin to use phonemes that occur frequently earlier than rare contrasts. A second experiment assessed this prediction with 18-month-olds. According to the MacArthur CDI, /d/-/t/ initial words are about three times more common than /s/-/z/ words. While 18-month-olds successfully use the /d/-/t/ contrast, they fail to use the /s/-/z/ distinction.

---

## *Does She Know or Doesn't She? Reasoning About Others' Knowledge States* *(Regular Symposium, Cognitive Development)*

**Chairs:** *Yuyan Luo & Kristine Onishi*

**Discussant: Lou Moses**

**Yuyan Luo**[1] **Kristine Onishi**[2] Susan Birch[3] **Lou Moses**[4]

*1. University of Missouri, Columbia, USA; 2. McGill University, Montreal, Canada; 3. University of British Columbia, Vancouver, Canada; 4. University of Oregon, Eugene, USA*

To make sense of others' behavior, we must understand that their knowledge may differ from our own. Different perspectives may lead to the unavailability of some information to one of the parties and differential information may lead to different levels of certainty. For example, Mom's keys may be visible to me but hidden from you behind the cereal box; I might be more certain than you about the location of her keys.

Does an infant understand that others' knowledge may be incomplete and may differ from her own? Would an infant expect others' actions (pointing, labeling) to be based on their knowledge, not on her own? Does an infant realize that two others may have knowledge that differs which would then be reflected in their behaviors? Thus, might infants prefer to learn from the person who appears more certain than one who appears less so?

Luo and Beck demonstrate that 16-month-old infants use an agent's line-of-sight to determine which part of an object is visible to the agent which then influences her pointing behavior. Allard and Onishi show that 14-month-old infants also use an agent's line-of-sight to determine which of two objects is visible to the agent which then affects her labeling behavior. Birch finds that 30-month-old infants preferentially learn a novel behavior from an agent exhibiting (through intonation and facial expression) cues of certainty rather than uncertainty. Moses will discuss these convergent findings, drawing upon his perspective on children's understanding of mental states including intentions and perceptions.

Thus, infants seem to understand that people's knowledge states can differ from their own and from each other and these knowledge states guide actions. In addition, they understand that when it comes to learning from others, it may be more useful to pay attention to the person with better information.

### Can You See What I See? Perspective-Taking in a Violation-Of-Expectation Task at 16 Months

**Yuyan Luo**[1] Whitney Beck[2]

*1. University of Missouri, Dept. of Psychological Sciences, Columbia, USA; 2. University of Missouri, Columbia, USA*

Twelve-month-olds realize that when an agent cannot see an object, her incomplete perception still guides her object-directed actions. What if the agent had incomplete perception because she could only see one part of the object?

In the present research, 16-month-olds were assigned to a congruent, an incongruent, or an ignorance condition. During familiarization, the infants were shown an agent who preferred red over other colors. During orientation, two screens (congruent condition: one red and the other green on both front and back; incongruent condition: one had a green-front but a red-back, and the other had a red-front but a green-back; ignorance condition: only the front of the screens was

red or green) were introduced while the agent was absent. The infants could see both sides of the screens during orientation. During test, the agent, who could only see the back of the screens, pointed to the red- (red-front event) or green-front screen (green-front event).

The infants in the congruent condition looked reliably longer at the green- than at the red-front event, suggesting that they expected the agent to point to the red screen since it was her preferred color and were surprised when she failed to do so. The infants in the incongruent condition looked reliably longer at the red- than at the green-front event, suggesting that they expected her to point to the green-front screen that had a red-back visible to her and were surprised that the agent pointed at the red-front screen instead. The infants in the ignorance condition looked equally at the red- and green-front events, suggesting that they had no expectation as to which screen the agent should point at because neither screen was colored on the back.

Together, the present results further showed that infants consider others' perceptions to interpret their behavior, even when these perceptions are incomplete.

### What You Say is (Not Quite) What You See: Perspective Taking in 14-Month-Old Infants

Andréanne Allard, **Kristine Onishi**

*McGill University, Montreal, Canada*

Our perceptions influence our behaviour. If we are unable to see an object, we are unlikely to reach for it and we are unlikely to label it. By 13 months of age, infants take into account what others can see when making predictions about their reaching behaviour (e.g., Luo & Baillargeon, in press). Do infants also use this information when making predictions about the linguistic behaviour of others?

14-month-old infants were shown objects with labels that were familiar to them (dog, keys). The objects were shown one at a time while the actor labeled them. Next, during test, the actor labeled one of the objects (e.g., dog) while one object was in plain view and the other was in a box with one open side. The open side faced the infant, so the infant could see both objects and the actor could see only one of them. For half the infants the actor labeled the object they could both see while for the others she labeled the object only visible to the infants. Infants looked longer when the actor labeled the object visible only to the infants, suggesting that they expected her linguistic behaviour to depend on her visual perspective.

When the actor demonstrated that she knew what was in the box and that she wanted to label that object (even if it was not in her view when she was actually doing the labeling), infants showed the reverse pattern (looking longer when the actor labeled the object visible to both of them). Along with results from a control condition, this pattern of findings suggests that by 14 months of age infants understand that the visual perspective of others may differ from their own and that this perspective may influence not only reaching actions but also linguistic behaviour.

### Early Appreciation of Nonverbal Cues to Epistemic States

**Birch Susan**

*University of British Columbia, Vancouver, Canada*

Much research on the development of social perspective-taking has focused on infants' and children's ability to infer others' epistemic states (e.g., beliefs, knowledge, ignorance, and levels of confidence or uncertainty). Previous research has shown children's ability to capitalize on a variety of cues that can be used to infer another's epistemic state, such as whether that person has had perceptual access (see Robinson, 2000 for a review), how accurate the person has been in the past (e.g., Koenig & Harris, 2006), and a person's verbal statements of confidence or ignorance (e.g., Sabbagh & Baldwin, 2001). Yet very little research has addressed children's use of others' nonverbal and paralinguistic cues of confidence and uncertainty, and how vigilance of these cues influences early learning. Nonverbal cues may serve as some of the earliest toeholds from which to infer the unobservable world of others' minds. We presented 2-year-olds (M = 30 months) with videos in which 2 females interacted with novel objects; one portrayed nonverbal and paralinguistic cues of knowledge and confidence (e.g., facial expressions of satisfaction, confident vocal tone); whereas the other portrayed nonverbal and paralinguistic cues of ignorance or uncertainty (e.g., puzzled facial expressions, vocal hesitancy). The children then observed a final video of one of the same two females intentionally using her forehead to turn on a tabletop light (either the confident model or the unconfident model). Children who witnessed the confident model were more likely than those who witnessed the unconfident model to imitate her head action, ($z = 2.97$, $p < .05$). Follow-up studies are exploring these sensitivities in younger infants. These results support and extend recent findings suggesting an early appreciation that others are fallible and that the contents of others' minds can differ.

---

## *Infants Learn Statistics, So Now What? What Infants Can Do with their Sensitivity to Probabilistic Information*

*(Regular Symposium, Attention, Memory and Learning)*

**Chair:** *Natasha Kirkham*

**Discussant:** *David Sobel*

**Natasha Kirkham**[1] **Dave Sobel**[2]

*1. Centre for Brain and Cognitive Development, Birkbeck College, University of London, London, UK; 2. Brown University, Providence, USA*

Understanding one's environment depends on being able to extract consistency and order from one's surroundings while simultaneously ignoring the noise. Research over the past 10 years, concerned with infants' sensitivity to probabilities, has revealed an early-developing and robust capacity to perceive probabilistic patterns under many conditions (e.g., Aslin, Saffran, & Newport, 1998; Gomez & Gerken, 1999; Saffran, Aslin, & Newport, 1996), and across different modalities (e.g., Kirkham, Slemmer, & Johnson, 2002; 2007; Fiser & Aslin, 2003). This sensitivity suggests a powerful learning mechanism, which could support the acquisition of higher cognitive processes.

This symposium is designed to address the usefulness of this aptitude in probabilistic learning across a variety of cognitive skills. The purpose of the proposed talks is to bring together researchers from different areas of cognitive development, and with different theoretical backgrounds, who are interested in how infants might use their sensitivity to statistically-defined event patterns to gain practical knowledge about the world.

David Rakison (CMU) will present work from the arena of category perception, specifically focusing on the animacy/inanimacy distinction, Natasha Kirkham (CBCD, Birkbeck College, U of London) will speak about the role visual statistical learning plays in supporting event prediction, and Fei Xu (UBC; with Tamar Kushnir, Michigan) will discuss how statistical learning can help infants and young children infer an

agent's preferences. David Sobel (Brown) will discuss these data, adding ideas from his work on causality.

### The Past is the Best Predictor of the Future: Infants' Use of Patterns to Predict Upcoming Events

**Natasha Kirkham**[1] Hanna Muenke[2] Michael Ramscar[2]

*1. Centre for Brain and Cognitive Development, Birkbeck College, University of London, London, UK; 2. Stanford University, Stanford, USA*

Statistical learning is a particularly compelling early-developing learning mechanism put forward in recent years to account for how infants and children build complex representations and acquire sophisticated knowledge. It has become evident that infants and young children have access to a powerful domain-general learning device: In laboratory experiments they can quickly learn statistically defined (or probabilistic) patterns in both auditory and visual domains (Fiser & Aslin, 2003; Kirkham et al., 2002; 2007; Saffran et al., 1996). Young children, as well, are quickly capable of understanding probabilistic information. This learning device, coupled with a rich and accessible environment provides the building blocks for mature knowledge, allowing infants to successfully monitor and understand their surroundings. In this paper I will present evidence from a series of eye tracking and habituation experiments showing that infants (from 5 to 11 months of age) can use this learning mechanism to make predictions about future events (Kirkham et al., 2007; Sobel & Kirkham, 2006). In addition, I will present data suggesting that infants and children use different strategies (e.g., maximizing versus probability matching) in order to make these predictions. I will discuss the results of this work in terms of a developmental theory of multiple cue integration, which suggests that richer, more numerous cues, and cross-modal stimuli support infants' ability to learn visual sequences and events.

### Infant Deduction: How Babies Go From a to B, and Then to C

**David Rakison**

*CMU, Pittsburgh, USA*

Previous research has shown that infants extract regularities about the static and dynamic features of objects in the world and that the ensuing representations are the beginnings of what is called the animate/inanimate distinction. For example, infants around 14 to 18 months of age associate specific object features (e.g., legs) with specific dynamic motions (e.g., walking) (Rakison, 2004, 2005a,b). It has been hypothesized that infants generalize from these associations (e.g., things with legs walk) to other featural regularities that are not causally related to the initial pairing (e.g., things with eyes walk) (Rakison, 2005a). This form of generalization involves deduction, or more specifically hypothetical syllogism, but such deductive abilities have not yet been demonstrated in infants. In this paper, I will present a number of experiments with the habituation paradigm that examined 8- to 26-month-olds' ability to perform such deductive reasoning for static and dynamic features and objects. The results of the experiments reveal that infants are capable of such deduction for static features and objects within the first year of life but that they are unable to make similar inferences for dynamic features and objects until the end of the 2nd year. The data will be discussed with regard to the development of concepts for animates and inanimates and the nature of early learning mechanisms.

### Toddlers' Social Learning From Statistical Evidence

**Tamar Kushnir**[1] Jennifer LaBounty[1] Fei Xu[2] Henry Wellman[1]

*1. University of Michigan, Ann Arbor, USA; 2. University of British Columbia, Vancouver, Canada*

Do the statistical properties of the environment shape young children's inferences about social phenomena? Infants have been shown to be sensitive to random sampling; they expect samples to be representative of (have the same characteristics of) their underlying populations. In this study, we investigate whether intentionally generating a non-representative sample leads toddlers to infer that the actor was expressing a preference.

Study 1 set up our general method and established that toddlers keep track of others' experiences. Eighteen-month-olds played with two objects, one in the presence of an adult experimenter and another in her absence. The adult later made an ambiguous request for an object, keeping her gaze neutral with respect to both objects. The toddlers responded by giving the adult the object that was novel to her, though both were familiar to the child.

Study 2 used this method to examine whether sampling characteristics might influence toddlers' responses. Eighteen to 24-month olds were shown a box containing multiple small toys. In one group, 15% of the toys were of type A, and 85% were of type B. In the other group, 100% of the toys were of type A. In both groups, an adult experimenter removed 5 toys of type A from the box and played with them. Later, the adult made the same ambiguous request as in Study 1. In the 15% group, toddlers treated the adult's systematic choice of A items as revealing her preference and so gave her toy A. In the 100% group, like in study 1, toddlers treated this as a request for a novel toy, and gave her toy B. The toddlers' responses revealed their sensitivity to the relationship between the sample and the population of objects. This demonstrates that children's developing social understanding can be influenced by statistical properties of evidence.

---

## *Smiling and Laughter in Infants in Comparative and Developmental Perspective*

*(Regular Symposium, Emotional Development)*

**Chair:** *Kim Bard*

**Discussant***: Harriet Oster*

**Kim Bard**[1] Masako Tomonaga[2] **Kiyobumi Kawakami**[3] **Marina Davila Ross**[1] Kirsty Ross[1] **Harriet Oster**[4]

*1. Centre for the Study of Emotion, University of Portsmouth, Portsmouth, UK; 2. Primate Research Institute of Kyoto University, Inuyama, Japan; 3. University of the Sacred Heart, Tokyo, Japan; 4. School of Continuing and Professional Studies, New York University, New York, USA*

Increased interest in expressions of positive emotion is based on (a) developmental research establishing early links between feelings and facial expressions (e.g., Messinger, 2002); (b) theoretically-driven research indicating positive emotions have distinct evolutionary functions (e.g., of Broadening and Building, Fredrickson, 2003); and (c) comparative research establishing similarities across closely related primate species, in facial movements (e.g., Vick et al., 2007), emotions (e.g., de Waal, 2003), and in some developmental processes (e.g., neonatal imitation: Bard, 2007). In this symposium, we bring together developmental and comparative researchers who study smiling and laughter, i.e., facial and vocal expressions of joy, to enhance our

understanding of the phylogeny and ontogeny of positive emotion. Kawakami investigated the developmental course of spontaneous smiling and laughter, finding unilateral smiles predominate in newborns but bilateral smiles become more frequent by 2 months, reflecting increasing cerebral control. Spontaneous laughs were less frequent than smiles, but had a longer duration, supporting their conclusion that smiles and laughs may be distinct expressions from very early in life. Davila Ross investigated the comparative basis for rapid facial mimicry, finding that juvenile orangutans, but not infants, more often than not mimic a playface (open mouth expression of joy) during play. This suggests that rapid facial mimicry may have a long evolutionary history. Ross, Bard, & Thorsteinsson investigated expressions of joy in 1-year-old infants of two cultures and two captive chimpanzee groups, finding differences in the contexts of joy, and in play partners. Coding of facial movements (with ChimpFACS and with BabyFACS) will elaborate the variations in the form of expressions of joy across species and across cultures. Harriet Oster will lead the discussion by elaborating on the coding of smiling and laughter with BabyFACS, and on the cross-cultural similiarities and differences in expressions of positive emotion.

### Development of Smiles and Laughter in Young Infants

**Kiyobumi Kawakami**[1] Kiyoko Takai-Kawakami[2] Fumito Kawakami[3] Masaki Tomonaga[4]

*1. University of the Sacred Heart, Shibuya-ku, Japan; 2. Japan Women's University, 2-8-1,Mejirodai,Bunkyo-ku, Japan; 3. Tokyo Institute of Technology, 2-12-1,Ookayama,Meguro-ku, Japan; 4. Kyoto University, Kanrin,Inuyama, Japan*

**Background and Aims:** We have intensively studied spontaneous smiles and spontaneous laughs (smiles accompanied by vocal sounds: Kawakami et al., 2006, 2007).

**Method:** Ten newborn infants were observed cross-sectionally, and seven infants were observed longitudinally. Videotaped observations were coded for spontaneous smiles (lip corner raised, during sleep or drowy periods, lasting for 1s or more, with no obvious cause), and spontaeous laughs (spontaneous smiles with vocal sounds).

**Results:** We found that 1) unilateral spontaneous smiles were more common than bilateral smiles in neonates, but by the 2nd month bilateral smiles were more common, 2) spontaneous smiles were observed to occur even in the 6th month, 3) spontaneous laughs were observed from the first month, 4) the durations of spontaneous laughs were longer than those of spontaneous smiles and 5) almost all spontaneous laughs were bilateral.

**Conclusion:** Our common knowledge on spontaneous smiles should be changed. At 2 months, infants show socially elicited smiles. Spontaneous smiles and social smiles coexist during infant periods. We should recognize that spontaneous smiles even in the 6th month (mothers reported to us that they observed them after the 12th month). Our common knowledge on laughter should be changed, too. We have believed that infants begin to laugh from the 4th month. But babies show laughter from the 1st month. "Spontaneous smile" and "Spontaneous laugh" might be different behaviors from the beginning.

### Rapid Open-Mouth Face Mimicry in Orangutan Social Play

**Marina Davila Ross**[1] Susanne Menzler[2] Elke Zimmermann[3]

*1. Psychology Department/University of Portsmouth, Portsmouth, UK; 2. Institute of Biometry/University of Veterinary Medicine Hannover, Hannover, Germany; 3. Institute of Zoology/University of Veterinary Medicine Hannover, Hannover, Germany*

**Background and Aims:** Rapid facial mimicry, which occurs when a facial expression of one individual evokes within one second the same facial expression in another individual, was so far described as unique to man. It was demonstrated to undergo involuntary mechanisms and lack cognitive feedback. In humans, rapid facial mimicry is closely linked to emotional conveyance. To study whether rapid facial mimicry occurs in nonhumans, we assessed its presence for open-mouth faces in orangutans during dyadic play. Open-mouth faces of nonhuman primates during play might be homologous to human facial laughter.

**Method:** In this study, the rapid facial response of one playmate to the facial expression of the other playmate was evaluated for 25 orangutans of two age groups: infants and juveniles/subadults. Specifically, it was assessed if infant and juvenile/subadult orangutans show more congruent responses than noncongruent responses to the facial displays of their playmates.

**Results:** Data clearly demonstrated significantly more congruent responses than noncongruent responses in juvenile/subadult orangutans. Such difference was not found in infants. Furthermore, they showed that congruent responses occurred with a probability of 53%.

**Conclusion:** The results of this study imply that rapid facial mimicry, which might be linked to emotional conveyance, is present in juvenile/subadult orangutans but not in infant orangutans. Furthermore, since not all open-mouth faces evoked congruent responses in orangutans of this study, there must be nonfacial factors superimposed to its occurrence.

### The Form and Context of Smiles in Infancy Across Cultures and Primate Species

**Kirsty Ross**, Kim Bard, Kate Thorsteinsson

*University of Portsmouth, Portsmouth, UK*

Smiles emerge in early infancy and are universally recognized as expressions of joy. In chimpanzees, an emotionally similar expression is the playface, which also emerges in early infancy. Maternal responsiveness to the smiles of very young infants varies. Less is known about smiles later in infancy, either across cultures or across species. This study explores the form and context of smiles in one-year-old infants from two cultures: a traditional agricultural community in Cameroon (n=10) and middle-class urban Britain (n=10), and in one-year-old chimpanzee infants from Chester Zoo (n=4) and PRI, Kyoto University (n=3).

Infants were videotaped in their home environments. Playful activities were microanalyzed for the presence and contexts of smiles or playfaces. Muscular movements in facial expressions were analysed using the Baby Facial Action Coding System (BabyFACS: Oster & Rosentein, 1996) and the new Chimpanzee Facial Action Coding System (ChimpFACS: Vick, Waller, Parr, Smith Pasqualini, & Bard, 2006).

**Results:** Differences were found in the activities eliciting the highest rate of smiles and playfaces: communicative and rhythmic social play for Cameroonian infants, joint object engagement for British infants, and mild rough and tumble play for chimpanzee infants. The role of

playmates in eliciting smiles also varied, with mothers being the dominant influence for British infants, peers for chimpanzee infants, and various adult and child playmates being important for Cameroonian infants. In the chimpanzees, peak smiling expressions with each partner included relaxed or extended jaw drops (AU26 or AU27, respectively), but not always other action units (sometimes lip corners were raised, AU12; sometimes upper lip was raised, AU10; and sometimes lower lip was depressed, AU16).

**Conclusion:** Smiles seems to be socialized at an early age to support activities and interactions valued by the social group. Expressions of joy, contexts, and play partners vary across human cultures and across closely related primates.

---

## *Atypical Face Processing in Infants at Risk for Autism Spectrum Disorders (ASD)* *(Regular Symposium, Perceptual Development)*

**Chair:** *Karen Dobkins*

**Discussant:** *Daphne Maurer*

**Karen Dobkins**[1] Charles Nelson[2] Kasia Chawarska[3] **Daphne Maurer**[4]

*1. University of California San Diego, La Jolla, USA; 2. Harvard University, Boston, USA; 3. Yale University School of Medicine, Child Study Center, New Haven, USA; 4. McMaster University, Hamilton, Canada*

Recent epidemiological data suggest that the prevalence of autism spectrum disorders (ASD) is 1 per 166 children. While the hallmarks of ASD are differences in social, communicative, and emotional behaviors, many recent studies have shown that individuals with ASD also exhibit atypical processing of faces, a highly socially-relevant visual cue. This symposium explores development of face processing atypicalities in studies of young infants who are at genetic risk of developing ASD because they have an older sibling diagnosed with the disorder. The study of these "high-risk" infants relative to a "low-risk" comparison group (i.e., infants from families without ASD history) may provide insights into the development of ASD, as well as markers that can be used for early detection.

Three studies provide converging evidence that ASD is associated with atypical face processing in the first year of life. First, Karen Dobkins presents event-related potential (ERP) data from 10-month-olds, showing that compared to low-risk control infants, who show faster neural responses to faces than objects, high-risk infants show faster responses to objects than faces. And, psychophysical data at 6 months suggests that these atypical face/object responses may originate in the Magnocellular visual pathway. Second, Charles Nelson presents ERPs charting out the development of familiarity effects, showing that neural responses to familiar vs. unfamiliar faces change between 3 and 12 months, findings that lay the groundwork for comparisons between low- and high-risk infants. Third, Kasia Chawarska presents face scanning data showing that while low-risk infants' attention to the eyes of a face is roughly constant between 1 and 4 years, high-risk infants who develop ASD show declining attention to eyes, and increasing attention to non-key features (hair, ears, cheeks). Finally, our discussant, Daphne Maurer, provides commentary and insight into the mechanisms that may underlie deviations in the trajectory of face processing development.

### Atypical Face Processing in Infants at Risk for Autism Spectrum Disorders (ASD): Origins in Low-Level Visual Processing?

**Karen Dobkins**, Leslie Carver, Joseph McCleery, Natacha Akshoomoff

*University of California San Diego, La Jolla, USA*

Many previous studies have documented atypicalities in face processing in individuals with autism spectrum disorders (ASD). Because ASD is not diagnosed reliably before 24 months, to explore development of these face processing atypicalities, we investigated face processing and low-level visual processing (using event-related potentials, ERPs and psychophysics) in young infants who are at genetic risk of developing ASD because they have an older sibling diagnosed with the disorder. By studying visual processing in these "high-risk" infants, as it compares to that in "low-risk" control infants (i.e., typically developing infants from families without history of ASD), we capitalize on the notion that traits of ASD are often present in relatives of individuals with ASD (i.e., the "broader autism phenotype"). Differences observed between high- and low-risk infants might provide markers of ASD early in infancy.

In our face processing studies, we recorded ERP and psychophysical responses to pictures of faces vs. non-face objects (toys, strollers). ERP results shows that for the P400 brainwave, low-risk infants exhibit significantly faster responses to faces than objects (by ~38 msec), whereas high-risk infants exhibit the opposite effect; faster responses to objects than to faces (by ~18 msec). Psychophysical face data show a similar pattern. In low-level psychophysical studies, we measured sensitivity of the Magnocellular (M) and Parvocellular (P) visual pathways in 6-month-olds. Results show significant differences between high- and low-risk infants only in M pathway processing. Based on known projections from the M pathway to face processing areas during development, we propose a potential causal link between the observed face and low-level visual processing atypicalities. In sum, these findings reveal atypicalities in higher-level face vs. object processing, as well as low-level M vs. P pathway processing, in high-risk infants in the first year of life, which may be risk factors in the development of ASD.

### Electrophysiological Assessment of the Processing of Familiar and Unfamiliar Stimuli in Infants at Risk for Autism Spectrum Disorders or Language Impairment

**Charles Nelson**[1] **Karen Dobkins**[2] Helen Tager-Flusberg[1] Vanessa Vogel-Farley[1]

*1. Harvard University, Boston, USA; 2. University of California, San Diego, La Jolla, USA*

The benefits of early intervention for children with neurodevelopmental disorders are widely recognized. Unfortunately, the median age for diagnosing a child with autism spectrum disorder (ASD) is between 3 and 4 years, thus limiting opportunities for very early intervention. One important research goal is to lower the age at which the earliest signs of ASD can be reliably identified. Earlier identification would maximize opportunities for intervention at optimal developmental stages. Some progress has already been made in identifying manifestations of autism at around 12 months of age. Zwaigenbaum and colleagues found that by 12 months, high-risk infants who later met diagnosis for ASD scored on at least 7 behavioral markers on the Autism Observation Scale for Infants (AOSI). Yirmiya and colleagues found that by 14 months, high-risk siblings had significantly lower language scores on the Bayley scales.

In the current project we employ high-density event-related potentials (ERPs) and eye tracking to examine risk for ASD among infants at high risk for autism. Infants are being studied at 3, 6, and 12 months; the task involves discrimination of mother vs. stranger face. We have tested 22 children to date. Because of small sample sizes, we have collapsed over group. Preliminary inspection of the data suggests that at 3 months, infants are showing a larger Positive Slow Wave (PSW) to mother vs. stranger face, and a larger P400 to stranger vs. mother. At 6 months we observe that the NC and PSW are larger to mother vs. stranger, whereas the N290 is larger to stranger vs. mother. Finally, at 9 months the NC and N290 are larger to mother vs. stranger, whereas the P400 is larger to stranger vs. mother. This project will lay the groundwork to identify early neurobehavioral risk markers for ASD and language impairment.

### Spatial Distribution of Attention during Face Scanning: Typical Developmental Trajectories and Autism Specific Deviations

**Kasia Chawarska**[1] Frederick Shic[2] Ami Klin[1] Frederick Volkmar[1]

*1. Yale University School of Medicine, Child Study Center, New Haven, USA; 2. Yale University Department of Computer Science, New Haven, USA*

Recent studies document deficits in face recognition in 2- to 3-year-olds with autism spectrum disorders (ASD). It has been hypothesized that disruption in the encoding of facial identity is associated with an abnormal distribution of attention to key features of faces. However, the typical developmental trajectory of face scanning in the first years of life and the extent of the deviations from the typical trajectory in ASD are unknown. This study focuses on the spatial distribution of visual attention in response to static images of faces in typically developing (TD) children vs. high-risk children who developed ASD, in four cross-sectional samples: 6 to 12 months, 12 to 24 months, 24 to 36, and 36 to 48 months. Patterns of scanning were recorded using eye-tracking.

Preliminary results suggest that, in the first year, TD infants focus predominantly on the eye area. In the second year, however, their attention to the mouth region increases and time spent looking at non-key areas of the face decreases (e.g. hair, ears, and cheeks). In children who developed ASD, the proportion of time spent focusing on the eyes decreases from the first to the fourth year of life. Simultaneously the proportion of time dedicated to non-key facial features increases. Unlike TD children, there were no age-dependent changes in attention to the mouth. In children who developed ASD, the observed age-related decrease in attention to the eye region might reflect the cumulative effects of an atypical pattern of social experiences. And, in the second year of life, the lack of an age-related increase of attention to the mouth area in these children may be linked to abnormalities in language development.

## Oral Presentations, March 28, 2008

### Which Physiological Measures Should Be Used in Emotion Regulation Research? *(Round Table)*

**Tracy Dennis**[1] Kristin Buss[2]

*1. Hunter College, The City University of New York, New York, USA; 2. The Pennsylvania State University, State College, USA*

There is growing interest in the use of physiological measures related to child emotion regulation. Indeed, the NIH has highlighted the need for research examining the biological underpinnings of emotion and emotion regulation. Many researchers, however, are unclear about which measures are most appropriate for their research questions. This proposed Breakfast Roundtable Discussion has four goals: highlighting important issues and challenges related to physiological measurement of emotion regulation; generating guidelines for matching physiological measures with unique aspects of emotion regulation; articulating the research benefits of these measures; and creating a forum for sharing experiences and challenges. Several physiological measures may be particularly appropriate for assessing distinct temporal stages of emotion regulation. For example, neurophysiological measures such as EEG and event-related brain potentials can measure affective reactivity and cognitive processes occurring within a few milliseconds. Functional magnetic resonance imaging has a relatively slower temporal resolution (in seconds) but has superior anatomical specificity that can compellingly portray the interplay between emotion and cognition. Cardiovascular response measures such as heart rate, respiratory sinus arrhythmia, and pre-ejection period may or may not index regulatory capacity; in addition to their high temporal resolution, these measures can be tracked while children are ambulatory, thus increasing ecological validity of the measurement context. More slowly emerging neuroendocrine measures such as hypothalamic-pituitary- adrenocortical axis (HPA) responsiveness and salivary alpha amylase provide meaningful measures of stress reactivity over a period of minutes or hours and may vary among children showing distinct difficulties with emotion regulation. In this proposed Breakfast Roundtable Discussion, the authors will lead the discussion on these topics. T. Dennis will lead the discussion on the use of neurophysiological and neuroimaging techniques and their integration with behavioral assessment and K. Buss will lead the discussion on the use of cardiac indices and neuroendocrine measures.

### Communicating Research Through Regulations *(Round Table)*

**Judith Colbert**

*Consultant, Guelph, Canada*

Governments around the world implement the social policies that shape early environments using four instruments (illustrated here in relation to breast feeding): direct operation (establish a breast-feeding clinic), funding (support community-based organizations that promote breast feeding), regulation (develop licensing requirements for the safe storage of expressed breast milk in child care settings), and consultation (provide pamphlets about breast feeding). This presentation focuses on the third instrument, regulation.

As a writer and consultant my primary task is to incorporate research findings into documents such as reports, training materials, and child care licensing regulations. When developing regulations, governments ask, "What are the risks?" and "How can risks be managed." For answers,

they look to researchers, stakeholders and the public. Researchers are especially important because new regulations must be approved by legislators. Such approval often depends on facts verifying that regulations are necessary and appropriate. Later, when regulations are in place, licensors encourage compliance by disseminating information, including evidence from research, to providers and parents, and ultimately, the community at large. "Back to sleep" regulations, now in many jurisdictions, illustrate the positive results of successful relationships between researchers and regulators.

Too often, however, there appear to be few links between researchers and regulators: researchers and regulators use different language, researchers often have unrealistic views of regulation, researchers seem unaware of potential value of data collected by regulators, and regulators are unaware of research activity and findings.

Major questions for discussion include "How do licensing agencies and researchers learn about each other?" "How can links be strengthened?" "Are there examples of effective relationships?" "What current research findings should be communicated to regulators?" "What research projects would benefit from access to licensing data?" These questions are especially urgent in relation to programs for infants where risks are high and outcomes long-term.

## *From Statistical Regularities to Conceptual Inference*

*(Invited Symposium, Cognitive Development)*

**Chair:** *Elizabeh Spelke*

### At the Origin of Rationality: How Intuitions of Probabilities Shape Predictions About the Future

Luca Bonatti

*Cognitive Neuroscience Sector, Trieste, Italy*

Rational agents should integrate probabilities in their predictions about uncertain future events. However, whether humans can do this, and if so, how this ability originates, are controversial issues. I will presenting evidence suggesting that 12 month olds have rational expectations about the future based on estimations of event possibilities, without the need of sampling past experiences. I will also show that such natural expectations influence preschoolers' reaction times (RTs), while frequencies modify motor responses, but not overt judgments, only after four years of age. I will argue that at the onset of human decision processes, the mind contains an intuition of elementary probability that cannot be reduced to the encountered frequency of events nor to elementary heuristics.

### Going Beyond the Evidence: Children's Ability To Draw Rich Inferences From Sparse Data

Laura Schulz

*Department of Brain and Cognitive Sciences, MIT, Cambridge, USA*

I will discuss recent work suggesting that young children can use minimal evidence (e.g., about perceptually unique objects) to infer the existence of more abstract causal laws -- laws about classes of objects and causal relationships among the classes. Moreover, such newly inferred abstract laws are robust to anomalous evidence. When children observe data that appears to be inconsistent with the abstract laws they (correctly) posit the existence of unobserved entities rather than revise the causal laws. This suggests that children's ability to learn robust, abstract principles does not depend on extensive prior experience but can occur rapidly, on-line, and in tandem with inferences about specific causal relations.

### Are We Rational Learners? Insights From Human Infants

Fei Xu

*University of British Columbia, Vancouver, Canada*

One hallmark of human learning is that we can use the statistical information in the input to make meaningful inferences based on small amounts of data. Computational cognitive scientists have argued in recent years that contrary to past research on human reasoning, adults may be rational statistical learners employing general principles of Bayesian statistics. What are the developmental origins of these statistical inference abilities? I will present evidence that by 8-12 months of age, human infants are able to generalize from small samples to larger populations, integrate constraints into their computations, and estimate the probabilities of events. I will also present evidence from preschoolers suggesting that these basic computational abilities are employed in various domains of cognitive development such as learning words, making inductions, and inferring preferences.

## *Infants' Use of Shared Experience in Communication*

*(Regular Symposium, Communication and Language)*

**Chair:** *Kristin Liebal*

**Discussant:** *Michael Tomasello*

**Patricia Ganea**[1] Megan Saylor[2] **Henrike Moll**[3] **Kristin Liebal**[4] **Michael Tomasello**[4]

*1. Boston University, Boston, USA; 2. Vanderbilt University, Vanderbilt, USA; 3. Institute for Learning and Brain Sciences, University of Washington, Seattle, USA; 4. Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany*

The ability to rely on shared experience or common ground when communicating is an essential pragmatic skill (e.g., Clark & Marshall, 1981; Clark, 1996), unique to human communication. Very little is known about the development of this ability in infancy. Do 1-year-old infants interpret others' communication from an egocentric perspective or do they rely on shared experience? Is this ability already present in nonverbal communication? This symposium brings together new research to present growing evidence for infants' early pragmatic competence.

The first speaker presents a series of studies showing that 15- and 18-month-old infants use past shared linguistic experience to interpret others' ambiguous requests and that 18-month-olds can do so even after a delay. The second speaker provides empirical evidence that 14-month-olds interpret an adult's communicative act neither from an egocentric perspective nor from the perspective of the adult alone-but rather from a perspective that is grounded in their previously shared experiences. The third speaker presents a series of studies revealing that 14- and 18-month-old infants use shared experience to comprehend as well as to produce nonverbal communicative acts such as pointing gestures. This indicates that the ability to use shared experience is present even before infants become competent with language, and that it reflects a more general pragmatic skill underlying communication.

Taken together, this research demonstrates that 1-year-old infants have developed a surprisingly sophisticated pragmatic competence,

which is manifested even in preverbal communication. The discussant comments on this research topic, puts the importance of this form of shared intentionality into a broader context, both phylogenetically and ontogenetically, and discusses its relation to the development of language and theory-of-mind abilities.

### Infants' Use of Shared Language during Ambiguous Communication

**Patricia Ganea**[1] Megan Saylor[2]

*1. Boston University, Boston, USA; 2. Vanderbilt University, Nashville, USA*

Increasingly, research on children's language development has acknowledged the importance of the social context in which children learn about the world. As the other talks in this symposium reveal, infants demonstrate impressive ability to use information about a person's past physical behavior, especially when communicating about things that are not directly observable. In this talk I will present data on infants' ability to use information from a person's past speech to make inferences about her intended referent. The ability to use verbal information from a shared conversation is an essential pragmatic skill (e.g., Clark & Marshall, 1981) which enables us to participate effectively in dialogue. Very little is known about the emergence of this ability.

In a series of studies, an experimenter mentioned an absent object (e.g., telephone) several times while looking around for it. After the experimenter searched for the object, she opened a door to another room where she found 2 objects (e.g., telephone and duck) and asked the child, "Can you give it to me?" In this task, the infant had to (1) understand the initial reference to the absent object, then, at the time of the request, (2) recall the experimenter's previous reference to the object, and (3) infer that the object that she wanted was the one that she had previously talked about. Both 15- and 18-month-olds used the speaker's previous reference to the absent object to interpret the request. The 18-month-olds did so even when the request was made after a delay. When the request was made by a person who did not participate in the conversation, the infants did not use the prior verbal information. The evidence presented provides information about the early emergence of pragmatic competence and it reveals a basic appreciation of the shared nature of conversation.

### 14-Month-Olds Know what Others Know only in Joint Attention

Henrike Moll

*Institute for Learning and Brain Sciences, University of Washington, Seattle, USA*

In order to communicate effectively with others, children have to come to understand what other people do and do not know from past experience. In two studies, we investigated if and how 14-month-old infants know what others know from past perceptual experience. In the first study, infants were presented with an adult who excitedly requested an object from them while looking in the direction of three objects. The adult got excited about one of the three objects because she had not experienced it before and so it was new for her. In this study, infants who had previously shared the known objects together with the adult selected the object that was new for the adult significantly, $p < .05$. In contrast, infants who had not shared the known objects with the adult selected the object that was new for the adult at chance level, $p > .99$. Similar results were obtained in a second study. In contrast to the previous study, the adult in this study knew all three objects when making the ambiguous request. But she had had a special experience with one of the objects, and the question was if 14-month-olds would interpret the adult's excitement as referring to this 'special object'. Again, infants who had shared the adult's experiences with the objects were able to disambiguate her request, $p < .01$, but infants who had only watched the adult experience the objects individually were not, $p > .60$.

Taken together, these results indicate that 14-month-old infants know what others know only when they share the others' experiences in joint attention. We will discuss why joint attentional frames and the sharing of experiences within these frames is crucial for an understanding of other people's mental states.

### The Role of Shared Experience in Infants' Nonverbal Communication

**Kristin Liebal**

*Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany*

Several theoretical models emphasize the role of shared experience or common ground in human communication (e.g., Clark, 1996): interlocutors anchor their communication, both production and comprehension, within the common ground they have previously shared. Here I show that even pre- or just-linguistic infants already use shared experience in both comprehension and production of nonverbal communication. In a first study, 18-month-olds shared two different games with two different adults. Later, when one adult pointed at a novel object, they appropriately put the object into the game they had previously shared with the pointer (Fisher's exact test, $p<.02$). Fourteen-month-olds used shared experience only in a simpler task: after having shared a clean-up game with an adult, infants cleaned a novel object up when the adult pointed at it. In contrast, these same infants did not do this when a second adult pointed without having shared the clean-up game with them (McNemar, $p<.04$).

Eighteen-month-olds also produce pointing gestures based on the experiences they have shared with others. In a third study, infants shared two different games with two experimenters (duck game, teddy game). Afterwards, they went to the test room with either experimenter 1 (E1) or experimenter 2 (E2) where they faced two pictures: one that represented the activity they had shared with E1 (e.g., duck), the other represented the activity they had shared with E2 (e.g., teddy). Results indicated that infants communicated for the experimenter based on the experience they had previously shared with her (Fisher's exact test, $p<.02$).

Together, this research shows that infants are competent with pragmatic aspects of communication even before they are fully competent with language: they rely on the common ground they have shared with their interlocutors in both comprehension and production of communicative acts. This skill might pave the way for similar developments in linguistic communication.

## *How Infants Acquire Grammatical Categories: the Role of Distributional, Prosodic and Phonotactic Information in the Acquisition of Noun and Verb Categories*

*(Regular Symposium, Communication and Language)*

**Chairs:** *Melanie Soderstrom* **&** *Erin Conwell*

**Discussant:** *James Morgan*

**Melanie Soderstrom**[1] **Erin Conwell**[1] Toben Mintz[2] Barbara Hohle[3] Susan Ott[3] Rushen Shi[4] Andréane Melançon[4] Annick Moisan[4] **James Morgan**[1]

*1. Brown University, Providence, USA; 2. University of Southern California, Los Angeles, USA; 3. University of Potsdam, Potsdam, Germany; 4. University du Quebec a Montreal, Montreal, Canada*

Acquiring grammatical categories is fundamental to the acquisition of grammar. Using a variety of methodologies and covering a breadth of languages, this symposium examines infants' use of distributional, prosodic and phonotactic properties of language to acquire the categories of noun and verb. The research indicates that learners can use information available in speech to categorize words.

Toby Mintz finds that simple distributional properties of language support grammatical category learning. His behavioral work with both infants and adults shows that the words framing a target word are used for categorization. He also extends the model from English to other languages, and suggests ways that infants might label these categories.

Barbara Höhle and Susan Ott show that German-learning 16-month-olds are sensitive to the phonotactic differences between nouns and verbs in that language and that they use this information when processing fluent speech. To our knowledge, this is the first study examining the role of phonotactics in grammatical category development. Because phonotactic information does not require a deep understanding of syntax or semantics, it may be particularly useful in early bootstrapping of categories.

Rushen Shi and colleagues present acoustical analyses of mothers speaking Quebec French to infants before and after the onset of vocabulary acquisition. Prosodic characteristics differentiate nouns and verbs at both ages, but effects are stronger for the older group. They are testing the effects of these prosodic differences on infants' discrimination of novel "nouns" and "verbs" preceded by appropriate function word cues. Again, these cues may be valuable to learners at the onset of categorization, as they are readily available in speech.

James Morgan serves as discussant. Recent work from his lab examines English-learning infants' ability to differentiate nouns and verbs, using both distributional and prosodic cues. His research program emphasizes the use of multiple cues during language learning.

### Distributional Analysis as a Method for Categorizing Words in Infancy

Toben Mintz

*University of Southern California, Los Angeles, USA*

Grammatical categories such as noun, verb, and adjective, are the building blocks of linguistic structure. Understanding how infants and young children learn the categories of words in their language is crucial for any theory of language acquisition. Even if the knowledge of the existence of lexical categories is innate-i.e., that there are nouns, verbs-learners still must learn the assignments of words to categories. This problem can be divided into two components: 1) identifying which words belong together in a category, 2) assigning a syntactic label (e.g., noun) to the category. One theory about (1) proposes that learners attend to lexical co-occurrence patterns, noting the environments in which words occur, and categorizing words together that occur in similar environments. For example, noting that 'cat' and 'dog' both can occur after 'the' and 'a', or before 'runs', etc., would cause a learner to categorize them together. I will discuss a particular sequential pattern called a frequent frame, and show that it provides robust, cross-linguistically available cues to categories, and requires minimal computational resources. Further, I will review behavioral research with adults and infants suggesting that human learners use this pattern to categorize words.

Relating to (2), I will discuss preliminary work suggesting that learners could identify which distributionally defined categories are nouns and which are verbs based on the imageability of the category members. Gillette et al. (1999) had college students rate the imageability-the extent to which a word arouses mental images-of a set of words on a 7 point scale. I will discuss a computational model that uses these imageability ratings to determine which distributionally defined categories are nouns, and which are verbs. In a preliminary analysis of 6 child-directed corpora, the average imageability scores were higher for distributional categories containing nouns than for those containing verbs.

### Phonological Cues to the Syntactic Categorization of Words: Evidence from German-Learning 16-Month-Olds

Barbara Höhle, Susan Ott

*University of Potsdam, Potsdam, Germany*

Previous research has shown that several phonological cues correlate with the syntactic categories of nouns and verbs in English (Kelly, 1996). Whether infants are aware of these correlations and use them to syntactically categorize new nouns and verbs has not yet been addressed. Our study examined phonotactic structure as one possible phonological cue to word category. In German, monosyllabic words with a short lax vowel followed by two consonants (e.g. /fɛlt) could either be a noun or a verb with the same probability. In contrast, the same form with a long tense vowel has a very high probability of being a verb rather than a noun. Given infant's sensitivity to phonotactics (e.g. Friederici & Wessels, 1994) we tested whether German learners use these regularities to assign a syntactic category to novel nouns and verbs. Using the Headturn Preference Procedure, 16-month-olds were presented with sentences containing a novel word of the crucial phonotactic structure in either a noun or a verb context:

noun context: Der /te:ft/ /tɛft/ wohnt im Dorf (The te:ft/tɛft is living in a village)

verb context: Der Tiger /te:ft/ /tɛft/ im Zoo. (The tiger te:fts/tɛfts in the zoo)

We expected a difference in listening time for the two sentence types in the noun condition but not in the verb condition. The results confirmed this: in the noun context, the children listened longer to the sentences containing a novel word with a tense rather than a lax vowel. In the verb contexts no difference occured.

These results indicate that German 16-month-olds have gained some knowledge about the correlation of the phonotactic structure and the syntactic use of words. They provide the first evidence that in addition to distributional information (Höhle et al., 2004; Mintz, 2002), features of the word form assist infants to syntactically categorize content words.

### Perceptual Cues and Syntactic Categorization of Nouns and Verbs

Rushen Shi, Andréane Melançon, Annick Moisan
*Université du Québec à Montréal, Montreal, Canada*

Our research considered the basis for infants' syntactic categorization of nouns and verbs. Study 1 investigated whether input speech contains acoustic cues supporting the distinction of the two categories. Sentences in French were constructed with disyllabic non-words used as nouns and verbs. We balanced utterance positions, sentence length, content-function-word alternation, and prosodic phrasal grouping, thus isolating the factor of syntactic category while keeping constant other factors that influence prosodic realisations of words. Furthermore, using the same targets as nouns and verbs in different sentences enabled us to consider how syntactically ambiguous words are categorized.

French-speaking mothers read the sentences to their four- and 11-month-old infants (before versus at the onset of vocabulary learning). Acoustic analyses revealed that in speech to both ages, vowel duration for nouns was overall longer than for verbs (p=.071). All targets showed a longer duration for the second vowel (p=.000), but the difference in nouns was greater than in matched verbs (Duration-Category interaction p=.022). F0 patterns did not differ for nouns and verbs in speech to four-month-olds, both exhibiting low-high. However, in speech to 11-month-olds, this low-high pattern was more extreme for nouns; verbs showed equal pitch for the two syllables. This Pitch-Category-Age interaction was significant (p=.009). Thus, nouns and verbs are acoustically marked, with cues stronger when infants start learning words and their categories.

Study 2 inquired what cue(s) infants use in the categorization of nouns and verbs: acoustical, distributional, or their correlation. French-learning 14-month-olds were familiarized with non-words preceded by determiners (noun use) or by pronouns (verb use). All infants were tested with the non-words preceded by novel determiners versus by novel pronouns. The acoustic patterns of non-words were kept equal across categories, to test distributional contribution. Preliminary results showed no evidence of categorization. We are conducting experiments involving correlated distributional and acoustical cues.

---

## *How Infants Use Color in Understanding the Physical World*

*(Regular Symposium, Cognitive Development)*

**Chair***: Anna Franklin*

**Discussant***: Marc Bornstein*

**Anna Franklin**[1] **Zsuzsa Kaldy**[2] Teresa Wilcox[3] Marc Bornstein[4]

*1. University of Surrey, Guildford, UK; 2. University of Massachusetts Boston, Boston, USA; 3. Texas A&M University, Texas, USA; 4. National Institute of Child Health and Human Development, Bethesda, USA*

Since the 1970's, there has been much research on infant color vision, for example, research investigating changes in color discrimination across early infancy and the biases that infants have to certain colors. However, the dimension of color has received relatively little attention in studies of infant cognition. This is surprising, considering that color is a pervasive feature of our visual environment. The three papers that will be presented in this symposium have a common focus on the dimension of color, and each paper investigates how it applies to a different aspect of infant cognition. The first paper, by Wilcox and Woods, outlines research on the role of color in object segregation, individuation, and identification tasks and contrasts it with the use of other features. The second paper, by Kaldy, Blaser and Crug, discusses the difficulty of comparing the influence of different perceptual dimensions in infant cognition, and illustrates a technique that equates the perceptual salience of dimensions across age groups, using color as a case study. The third paper, by Franklin, Clifford, Holmes, Drivonikou, and Davies, considers the processes that underlie infant categorization, by investigating the neural markers and lateralization of categorization of color in infancy. Marc Bornstein - one of the pioneers of research on infant color perception and cognition - will be the symposium discussant. His paper will discuss the research presented and frame this within the wider context. The final section of the symposium will be reserved for a discussion of the broader impact of the findings of the symposium on an understanding of infant cognition in general.

### Infants' Use of Color in Object Processing

**Teresa Wilcox**[1] Rebecca Woods[2]

*1. Texas A&M University, Texas, USA; 2. Steven F. Austin State University, Austin, USA*

Over the last several years, research has revealed that infants are more likely to draw on form (shape, size) than color information within the context of object segregation, individuation, and identification tasks. One explanation that has been offered for this pattern of results, and for which there is empirical support, is that form features are more intimately linked to objects and are more reliable predictors of an objects' identity than color information. At the same time, infants' capacity to attend to color differences is not an all-or-none function. For example, infants' sensitivity to color information can be increased by select experiences. In addition, color differences are more salient when combined with luminance differences. This talk integrates a body of research that has identified conditions under which infants succeed and fail to attend to color information in object processing tasks. On the basis of these findings, conclusions are drawn about the mechanisms by which infants learn that color is important to tracking the identify of objects, how color gets integrated into infants' object representations, and the importance of color to interpreting physical events more generally. Finally, this work will be considered within a broader perspective that takes into account other factors, such as object kind, that can influence color processing. As a whole, systematic investigation of color processing within the context of object identity tasks has provided insight into perceptual and cognitive processes that support learning in infancy.

### What is the "Same Amount of Change" For Infants at Different Ages?

Zsuzsa Kaldy, Erik Blaser, Aaron Crug
*University of Massachusetts, Boston, USA*

**Background and Aims:** Research in the past two decades has shown that infants' knowledge about their physical world is surprisingly rich. In the first part of the talk, we will focus on the kinds of featural changes that infants can detect and use in object identification. This line of research led us to raise the simple, yet largely neglected, "problem of salience": when comparing feature changes between perceptual dimensions or age groups, these changes need to be equally salient to allow for legitimate comparisons. In the second part of the talk, we will discuss a novel paradigm that allows one to control this factor, and we will apply it in order to calibrate color stimuli between two different age groups.

**Method:** In each trial, a yellowish baseline object was paired with another object that differed in color (this comparison object was randomly chosen from a set of 5 objects with increasing red saturation, relative to the baseline). Direction of infants' gaze (left/right) was coded. Data from 6-month-olds (n=9) and 9-month-olds (n=8) yielded reliable, monotonically increasing psychometric functions of preference versus feature 'intensity' (redness). From this function, we chose the color value that had yielded 66% preference. This color value was pitted against the baseline in a subsequent working memory experiment.

**Results and Conclusions:** Younger infants needed a substantially larger physical change along the color dimension to reach the same preference level that older infants did. In other words, when infancy researchers use the same object sets across age groups, they might not be presenting infants with the same magnitude of change in the psychological sense. In terms of working memory, data collection is still in progress, but our preliminary results suggest that infants in both age groups could succeed with color, when salience is properly controlled.

### Neural Markers and Lateralization of Infant Categorization: the Domain of Color

**Anna Franklin**[1] Alexandrea Clifford[1] Amanda Holmes[2] Gilda Drivonikou[1] Ian Davies[1]

*1. University of Surrey, Guildford, UK; 2. Roehampton University, London, UK*

**Background and Aims:** Although infants' ability to categorise information is well documented, the processes that underlie infant categorization are not fully understood. One example of infants' ability to categorise is infants' categorization of color. Although color is a physical continuum, infants at just 4-months are able to parse the continuum into discrete categories (e.g., Bornstein, Kessen & Weiskopf, 1976; Franklin & Davies, 2004). Here, we present two experiments that investigate the way in which the infant brain categorises color. Experiment 1 investigates the neural markers and Experiment 2 investigates the lateralization of the effect.

**Methods:** Experiment 1 measured Event-Related Potentials (ERPs) in 7-month old infants on a visual oddball task. A standard stimulus was presented repeatedly (e.g., Green1), interspersed with less frequent presentations of two deviant stimuli - either from the same category (e.g., Green2) or from a different category to the standard (e.g., Blue1). Experiment 2 used a target detection task (Franklin, Pilling & Davies, 2005), where a coloured target was shown on a coloured background, with target-background pairs either from the same or different categories. Targets were lateralized to the left or right visual field, and using an eye-tracker, the time that elapsed before infants initiated an eye-movement to the target was recorded.

**Results and Conclusions:** In Experiment 1 category effects in infant ERP components were found, with a significantly greater Nc and NSW for different- than same-category deviant stimuli. In Experiment 2, less time elapsed before infants initiated an eye-movement to the target when targets were shown on different- than same-category backgrounds, although only for targets presented to the left-visual field-right hemisphere. These results suggest that both attentional processes and novelty detection underlie infant color categorization, and that infant color categorization is lateralised to the right hemisphere.

## *Memory and Attention in Infancy: Exploring Pathways to Language and Cognition*

*(Regular Symposium, Attention, Memory and Learning)*

**Chair:** *Anna Franklin*

**Discussant:** *Marc Bornstein*

**Mikael Heimann**[1] Tomas Tjus[2] Karin Strid[2] Rechele Brooks[3] Andrew N Meltzoff[3] Lars Smith[4] **Jane Herbert**[5]

*1. Linköping University, Linköping, Sweden; 2. Göteborg University, Gothenburg, Sweden; 3. University of Washington, Seattle, USA; 4. The National Network for Infant Mental Health, Oslo, Norway; 5. University of Sheffield, Sheffield, UK*

Memory and attention represents two fundamental processes in human development. They function as important vehicles for both communicative (language) and cognitive development. Attentional processes such as joint attention has been identified as an early marker for language development and new findings on early memory indicates a similarly important function for recall memory (i.e. deferred imitation). However, attentional processes can be defined differently (i.e. joint attention, joint engagement and gaze following) and the predictive value of early recall memory has not been well studied.

This symposium aims at discussing new findings on early attentional processes and early memory processes. The first talk (Brooks & Meltzoff) will present observations showing that gaze following observed before 12 months predicts vocabulary growth one year later, findings that will be discussed in terms of the social foundations of language. In the second talk (Strid, Tjus & Heimann) early observations on deferred imitation and, to some degree, joint attention will be linked to communication skills at 14 months and cognitive function at 50 months. The fact that deferred imitation was the single strongest predictor of gestural communication suggests an important function for early recall memory. Finally, the third talk included in the symposium (Smith) will have a methodological focus. More specifically, it will be demonstrated that differential methods for observing joint attention yield differential results for the relationship between joint attention and later language development.

A major goal for the individual presentations as well as for the discussant (Jane Herbert) will be to invite the audience to discuss the findings and conclusions presented. We wish to view and explore these new findings from many different perspectives in order to achieve a better understanding of the implications, in order to form new hypotheses for future studies and in order to continue our theory building.

### The Relation of Joint Attention and Early Language Skills: Differential Methods Yield Differential Results

**Lars Smith**

*National Network for Infant mental Health, Norway, Oslo, Norway*

**Background and Aims:** The context of assessment is an important measurement issue in joint attention research. Joint attention (JA) may be assessed in an infant-caregiver interaction paradigm, or alternatively in an infant-tester paradigm. Little is known about the relations of data derived from these contrasting methods.

**Methods:** This issue was investigated in a study of 23 typically developing infants. Capacity to initiate and respond to JA was assessed at 14 1/2 months using the ESCS (Mundy et al. 1996). A parent-child free-play interaction, also at 14 1/2 months, was coded for episodes of joint engagement (JE) (Carpenter et al., 1998). Vocabulary and

language were assessed at 24 months with the MacArthur, the Reynell and the Kaufman Expressive Vocabulary. An index of language-related performance (ILRP) was derived from the Bayley, omitting items overlapping with cognitive items.

**Results:** On the ESCS the infants initiated JA 31.6 times on the average, whereas they responded to JA bids 8.6 times. In the play situation the participants were jointly engaged 26.6 % of the time on the average. The three predictor variables were moderately and positively related. The lagged correlations evidenced a differential pattern. Whereas the ESCS variable IJA predicted later language comprehension, the ESCS variable RJA was related to the ILRP. The duration of JE was significantly related to all but one of the outcome measures. A Hierarchical Linear Regression analyses lent support to only one model. RJA made a significant contribution to the index of LRP.

**Conclusion:** Contrasting assessment methods yielded differential results. Especially, RJA bore a stronger relation to the ILRP than did IJA or JE. The theoretical implications of these data will be discussed.

### Social Routes to Language: Growth Curve Modeling of Vocabulary Growth Based on Preverbal Gaze Following and Pointing

**Rechele Brooks**, Andrew N Meltzoff

*University of Washington, Seattle, USA*

**Background and Aims:** It has been argued that gaze following gives infants a boost in word learning, because they can use it to identify a speaker's referent (Baldwin, 1995; Bruner, 1983; Tomasello, 1995). Once gaze following emerges, infants can look where another is looking, which could assist their word learning. In past work, 10- to 11-month-old, but not 9-month-old, infants distinguish when someone is looking (i.e., has open eyes) as opposed to when someone is simply turning her head (e.g., with closed eyes) (Brooks & Meltzoff, 2005). Thus, infants notice eye gaze in time to support early word learning. In this talk, we use growth curves to test whether social-cognitive abilities (gaze following and pointing) at 10-11 months affect lexical development through 24 months.

**Methods:** In a longitudinal study, 10- and 11-month-old infants (N = 32) observed an adult turn toward one of two targets without any vocal, emotional, or gestural cues. In each of 4 trials, infants' gaze following was scored for a correct look (adult's target) or an incorrect look (opposite target). Each infant received an average duration of correct looking score. During the same lab session, infants received a pointing score for whether or not they pointed at any distal objects. Productive vocabulary was measured via the MacArthur-Bates Communicative Developmental Inventories at 10-11, 14, 18, and 24 months.

**Results and Conclusion:** With growth curve analyses, we found that infants' gaze following and pointing predicted the rate of change in productive vocabulary. Both average duration of correct looking and pointing (*ps* < .001) predicted accelerated vocabulary growth through 24 months, even with control for maternal education. The results will be discussed in terms of the social foundations of language, in which gaze following helps infants connect a speaker's gaze to a focal object.

### From Deferred Imitation to Language and Cognition: Observations from a Longitudinal Swedish Study

**Karin Strid**[1], Tomas Tjus[1], Mikael Heimann[2]

*1. Göteborg University, Gothenburg, Sweden 2. Linköping University, Sweden*

**Background and Aims:** Several studies have shown that recall memory, observed with the deferred imitation (DI) paradigm, is a robust phenomenon well before the child's first birthday. The aim of the present study was to investigate possible links between deferred imitation and other early emerging abilities such as social communication, recognition memory, early language and later cognitive competence.

**Methods:** Thirty Swedish children were observed at 6, 9, 14 and 50 months. Memory (DI and novelty preference) was assessed at 6 and 9 months, social communication (turn taking and joint attention) (Early Social Communication Scales), language and communication (MacArthur CDI) at 14 months, and cognition at 4 years (McCarthy).

**Results:** (1) A regression model including memory measures and turn taking abilities as predictors and gestural communication (14 months) as an outcome variable explained 41 % of the variance in gestural communication (adj. $R^2 = .41$, $p < .01$). DI was the singel strongest predictor in this model. (2) The long-term effect of deferred imitation and social communication skills (e.g. joint attention) was investigated longitudinally by dividing the children into groups according to their performance in infancy. Four groups were created this way: High on both DI and social communication (SC), Low on both variables, and the two cross-pairings. The results showed that a subgroup of children performing Low on both DI and SC differed significantly from the collapsed result for the other three groups ($p < .01$).

**Conclusions:** Deferred imitation observed in infancy is related to both early language and later cognitive competence. It is beneficial to look at both cognitive and social abilities in infancy in order to better understand how early memory and communication skills develop and how they are related to later development.

---

## *Biophilia and Biophobia: Babies' Responses to Living Things*

*(Regular Symposium, Perceptual Development)*

**Chair:** *Megan Pickard*

**Discussant:** *Susan Johnson*

**Megan Pickard**[1] **Vanessa LoBue**[1] Judy DeLoache[1] Ross Flom[2] Dan Hyde[3] Heather Whipple[4] Karen Wynn[5] **Susan Johnson**[6]

*1. University of Virginia, Charlottesville, USA; 2. Brigham Young University, Provo, USA; 3. Harvard University, Cambridge, USA; 4. University of Minnesota, Minneapolis, USA; 5. Yale University, New Haven, USA; 6. Stanford University, Palo Alto, USA*

In the biophilia hypothesis, E.O. Wilson proposed that humans have an evolved attunement to living things-the myriad animals and plants with which early humans co-existed. Biophilia manifests itself most commonly in the positive feelings that people have for animals, as evidenced in America by the extremely high level of pet ownership and the fact that zoos are the most frequently visited public institutions. Wilson's concept also embraces some negative reactions commonly experienced to certain types of animals that posed threats to survival throughout human evolution (e.g., biophobia).

Biophilia has been influential in many fields but has received little attention by developmental psychologists. If humans do have an

evolved affinity for living things, it should be apparent early in life. Accordingly, the papers in this symposium report some of the first research on infants' and young children's reactions to a variety of animate stimuli.

First, LoBue, Pickard, and DeLoache will present direct evidence of biophilia and biophobia in infants, demonstrating that infants show a high level of positive interest in animals in general, but are also prepared to associate fear with snakes. Second, Flom will discuss infants' response to aggressive animal displays, reporting that they match threatening sounds with threatening animal faces (e.g., snarling dogs). Third, Wynn will show that infants employ distinct strategies in interacting with other people, particularly those who may pose a threat. As discussant, Susan Johnson will bring to bear her expertise in children's conceptual knowledge of animals, objects, and people.

Taken together, the results of the research to be reported in this symposium are consistent with the main concept of biophilia-that humans have evolved adaptive strategies for interacting with both beneficial and threatening aspects of the biological world.

### Lions and Tigers, Great! Snakes, Oh My! Babies' Responses to Different Kinds of Animals

Vanessa LoBue, **Megan Pickard**, Judy DeLoache
*University of Virginia, Charlottesville, USA*

Humans and animals evolved in a dynamic environment, serving as predator, prey, and companion to one another. Accordingly, the biophilia hypothesis purports that humans possess an evolved affinity for living things, particularly animals.

Young infants know a good deal about animals, discriminating them from inanimate objects on the basis of perceptual features and expectations about their behaviors. However, we know very little about babies' reactions to animals. In this talk, we present evidence of infants' attunement to animals in general (i.e., biophilia), in addition to babies' specific responses to threat-relevant animals (e.g., biophobia).

First, we observed 18- to 36-month-olds' behaviors in a room containing a variety of appealing toys and two live animals - a hamster and a fish. Every single child who entered the room spontaneously noticed and interacted with both animals. In a second study, we showed 4- to 12-month-olds pairs of moving animals and inanimate objects. The babies expressed a strong interest in the animals, looking more than twice as long at the animate than the inanimate stimuli.

In a second series of studies, we found that infants detect snakes extremely quickly and associate fear with them. Seven- to 9-month-olds watched pairs of moving animals on a screen, one snake and one non-snake. During each pair, they heard a happy or fearful voice. Infants looked longer at the snake when hearing a fearful voice than a happy voice. In a second set of studies, we found that infants, children, and adults all detect the presence of snakes more quickly than other animals.

Overall, these studies provide evidence for biophilia and biophobia in babies; babies express a marked attunement to animals in general and quite specific responses to snakes.

f studies, we found that infants, children, and adults all detect the presence of snakes more quickly than other animals.

Overall, these studies provide evidence for biophilia and biophobia in babies; babies express a marked attunement to animals in general and quite specific responses to snakes.

### Infants' Intermodal Perception of Canine (*Canis familairis*) Faces and Vocalizations

**Ross Flom**[1] Dan Hyde[2] Heather Whipple[3]
*1. Brigham Young University, Provo, USA; 2. Harvard University, Cambridge, USA; 3. University of Minnesota, Minneapolis, USA*

It is well established that human infants are able to detect intersensory relationships for a variety of stimuli, including intensity, tempo, affect, and the relationship between various lip movements and speech sounds. Recently it has been shown that 4- and 6-month-old infants, but not 8- and 10-month-old infants, can match a rhesus macaque's threat or coo call with the appropriate macaque facial expression using the temporal synchrony of the mouth opening and the onset of the call. The purpose of the current experiment was to examine whether human infants can match aggressive and non-aggressive canine vocalizations (i.e. barks) with the appropriate facial expression (aggressive or non-aggressive) while controlling temporal synchrony.

Thirty-two infants at 6-, 12-, 18-, and 24-months of age simultaneously viewed a static aggressive and non-aggressive image of the same canine and heard either an aggressive or non-aggressive bark. Infants' preferential looking to the congruent and incongruent event was assessed.

Results indicate that 6-month-olds perceived the intermodal correspondence among aggressive and non-aggressive barks and the appropriate canine expression ($t(31) = 5.8$, $p < .01$). In contrast, 12-, 18-, and, 24-month-olds preferential looking did not exceed chance ($t(31) = .186$, $p > .10$; $t(31) = 1.30$, $p > .10$; $t(31) = .64$, $p > .10$, respectively). At no age did infants show a preference for either the aggressive or non-aggressive image when presented silently (all p's >.1).

The results of this study are the first to demonstrate that human infants can perform cross-species intersensory matching for affect. The results will be discussed in terms of what information infants are using in making the intersensory match, the effects of experience with canines, perceptual narrowing, as well as the development of stranger wariness.

### Babies' Responses to Potentially Threatening People

Karen Wynn
*Yale University, New Haven, USA*

Humans must be able to evaluate the actions and intentions of the people around them, and to make accurate decisions about who is friend and who may be foe, who is an appropriate social partner and who is not. We must also determine, for each individual we encounter, what interactive styles and strategies to adopt. Indeed, not only humans but all social animals benefit from the capacities to identify conspecifics, distinguish individuals that may help them from those that may harm them, and adopt appropriate interaction strategies.

In this talk I will present evidence from two distinct research programs, that even within the first 3 to 6 months of life these capacities are already vigorously operative in human infants. First, I will describe research showing that infants identify certain categories of adult humans as potentially threatening individuals, and will describe two adaptive strategies that infants employ in their own face-to-face interactions with these individuals. Second, I will describe evidence showing that infants take into account an individual's actions towards others in evaluating that individual as appealing or aversive. Across a range of distinct positive and negative social scenarios, infants prefer an individual who helps another to one who hinders another, prefer a

helping individual to a neutral individual, and prefer a neutral individual to a hindering individual.

These findings constitute the first evidence that preverbal infants assess individuals on the basis of their behavior towards others. The early developmental emergence of this capacity supports the view that social evaluation is a biological adaptation.

---

## *Autism in Infants and Toddlers: Asian Perspectives*

*(Invited Symposium, Psychopathology and Developmental Delay)*

**Chair:** *Yoichi Sakakihara*

**Yoichi Sakakihara**

*Ochanomizu University, Tokyo, Japan*

Autism, once regarded as a rare disorder among children, is currently considered to be one of the most common neuropsychiatric disorders. Because of its high incidence and profound social as well as cognitive deficits, much attention has been paid to the early detection of and intervention for autism. In this invited symposium, research on the early recognition and detection of autism will be presented by four specialists in autism research in Asian regions.

### Early Detection of Autism Spectrum Disorder (ASD) in Japan: From 18 Months to 36 Months

Yoko Kamio

*Department of Child and Adolescent Mental Health, National Institute of Mental Health, Tokyo, Japan*

In Japan, autism accompanied with speech delay can be detected relatively well at the regular 18-month health check-up. However, the identification of milder forms of autism among toddlers, such as high-functioning autism spectrum disorder (ASD), remains challenging, since early preverbal behavioural markers have not yet been specified.

Our ultimate aim is to establish a prospective database of behavioural and corresponding cognitive/neural developmental characteristics of children with ASD from one year of age, and to improve skills and techniques for early detection of children with ASD who have various needs. Early detection of toddlers on a broader autism spectrum based on such scientific evidence would enable us to conduct earlier intervention, which may prevent secondary emotional and behavioural difficulties and reduce family stress.

In our community-based longitudinal study, a population aged 18 months (n=1400) was screened using the Japanese version of the M-CHAT with a two-stage procedure. High-risk children suspected of ASD were followed up and evaluated at ages 2- and 3-years using the Childhood Autism Rating Scale Tokyo-Version, DSM-Ö§-TR, and IQ/DQ tests.

In general, the M-CHAT screening can successfully differentiate children with ASD from non-ASD children with a few modifications of threshold criteria at 18 months of age in Japan. The checklist items, which could effectively differentiate ASD toddlers from the others at 18 months, include different social variables across domains: social interest, imitation, joint attention, social reference and symbolic functions. On the other hand, those parents having children with suspected ASD unexpectedly reported that their children were capable of showing eye contact, smiling back, and responding to being called. This kind of incongruence between the outcomes of the parental report and of the actual behavioural observation of the ASD high-risk children can be interpreted as being influenced by the child-rearing culture of and/or the personalities of the parents.

An in-depth examination on the cognitive level could specify qualitative differences from typical social behaviours, such as gaze behaviour and imitation. We have also found heterogeneity of early brain development in contrast with the current dominant hypothesis of early brain overgrowth.

Together with the current research findings, domain-general impairments related to social development found in toddlers with ASD seem to be stable between age one and age two, but brain overgrowth before age one has not been found in this study.

Sponsors: RISTEX (Research Institute of Science and Technology for Society) and the Koseirodosho (Ministry of Health, Labour and Welfare, Japan) grants to Y. Kamio.

### Early Development of Children with Pervasive Developmental Disorders

Sadaaki Shirataki

*Graduate School of Clinical Psychology, Mukogawa Women's University, Ikebiraki-Cho, Japan*

In our previous work, we comprehensively studied the early development of children with autism. In this study, we took a prospective approach and did a longitudinal follow-up of those early infants, starting with their 1:6 yr health check-ups in a Public Health Center. We know already what kind of early behaviours are useful as markers with which we can select at-risk infants who may become diagnosed with autism when they reach 2:6 years. In Japan, we have a very good system of check-up of all infant health and developmental benchmarks starting from as early as 4-months, and continuing at 7-months, 1:6 yrs, and thereafter. Furthermore, the rate of infants who are brought to the Public Health Center to have a check-up is as high as 96% of all infants in almost every region throughout Japan.

Recently, however, a group of children has emerged showing three cardinal symptoms of autism with a very modest degree of severity, which is called a High Functioning Pervasive Developmental Disorder (HFPDD). Therefore, our next task is to determine those early developmental phenomena typical of HFPDD to be able to achieve early detection of these at-risk infants and make a diagnosis of future HFPDD. We compared early developmental benchmarks using early behaviour check lists newly devised by us, for children with autism and those with HFPDD. We found some remarkable differences between them. Among many phenomena or milestones, the establishment of an attachment relationship between infant and mother was possible before 2:6 years old in the great majority of the infants with HFPDD, but, it was only possible in around ten percent of the infants with autism. These results will be discussed in relation to the early development of children with PDD.

### Checklist for Autism in Toddlers (CHAT-23) and a Pilot Study on Early Intervention for Autism in Chinese Children

Virginia Wong

*Department of Paediatrics & Adolescent Medicine, The University of Hong Kong, Hong Kong, China*

The Checklist for Autism in Toddlers (CHAT) and the Modified Checklist for Autism in Toddlers (M-CHAT) are screening tools recommended at 18-24 months for autistic children. CHAT-23 has been translated into Chinese, and combines M-CHAT (23 questions) with graded scores and

section B (observation) of CHAT. We performed a cross-sectional study with 212 children in two groups (mental age =18-24 months): Group 1 (N=87), Autistic Disorder / Pervasive Developmental Disorder; group 2 (N =125), Non-autistic. The checklist included self-administered questionnaires with 23 questions (part A) and direct observations of 5 items (part B). We found that 7 key questions concerning areas of joint attention, pretend play, social relatedness and social referencing were identified as discriminative for autism. For part A, failing any 2 out of 7 key questions gave a sensitivity of 0.931 and specificity of 0.768. Failing any 6 out of all 23-questions produced a sensitivity of 0.839 and specificity of 0.848. For part B, failing any 2 out of 4 items produced a sensitivity of 0.736, specificity of 0.912, and positive predictive value of 0.853.

We performed a Randomized Controlled study to evaluate the efficacy of an early intervention program for toddlers with autism. Using a self devised "Autism-1-2-3" approach, 17 toddlers with autism, aged 17-36 months, were trained with targeted (1) eye contact, (2) gestures, and (3) vocalisations/words in their communication and social interaction. Intervention consisted of 10 sessions over 2 weeks. The children were randomized into the Intervention (n=9) and Control (n=8) groups. Results using ADOS showed that intervention was effective in improving language and communication (p=.007) and reciprocal social interaction (p=.011), including vocalization (p=.005), pointing (p=.020), requesting (p=.010), and quality in initiating interaction (p=.015). Symbolic play was also improved (p=.003). Parents perceived significant improvement in language (p=.010) and social interaction (p=.007) using RLRS; their own stress level was reduced on PSI/SF (p=.004). We have demonstrated with evidence that the "Autism-1-2-3" approach improved communication and social interaction for toddlers with autism.

### Toward Constructing Converging Assessments for Early Diagnosis of Young ASD Children

Nianli Zhou

*East China Normal University, Shanghai, China*

**Purpose:** Because of the lack of clear neurobiological markers, ASDs are necessarily defined by screening instruments. SCQ, DBC-P,M-CHAT and STAT are used widely for diagnosis of infants and toddlers with ASDs. Based on these tools, we tried to construct a comprehensive assessment.

**Method:** The comprehensive assessment was formatted as questionnaires, observation tools, collections of children's works, and psychological measurements. For 12- to 36-month-old children, questionnaires and psychological measurements are used. According to the criteria of DSM-IV, ICD-10 and CARS, we developed a new questionnaire which focuses on ASDs characteristics: repetitive and restricted behaviour and interests, eye contact and gesture, social skills and communication, etc., for a total of 10 categories. Psychological measures assessed motor skills, social interaction, initiative and responsive attention, and receptive and expressive language. For 24-36mon children, we added observation and collection of creative works. Observational tools included a coding sheet for "pretend play", free play, drawings of persons, and sand play. Analysis of children's pretend behaviours, imagination, and language level were included with these data.

**Results:** Preliminary assessments were done for 10 children of 19-36mon who had been reported to have autism-like behaviour, and quantitative data was collected. The questionnaire was evaluated with 1 to 5 five ranks. High scores were much more indicative of ASDs behaviours. Psychological measurements were grouped into 7 age ranks, in 3 month increments. Each item was given 1 score, all scores were calculated, and then, according to the child's calendar age, the score was converted into a developmental quotient. At the same time, the criteria of drawing persons, sand play, and the analysis of the child's work were integrated with the score. The range of correlation coefficients for 5 correlated items is 0.66-0.78.

**Discussion:** The reliability and validity of the comprehensive assessment can not be confirmed yet, because of the small sample size. Further study is necessary to confirm the validity of our assessment.

---

## *Infants' Use of Communicative Cues to Interpret Others' Actions* *(Regular Symposium, Cognitive Development)*

**Chair***: Elena Hoicka*

**Discussant***: Alan Leslie*

**Elena Hoicka**[1] **Su-hua Wang**[1] Kyong-sun Jin[2] Alia Martin[3,4] **Alan Leslie**[5]

*1. University of California, Santa Cruz, USA; 2. Yonsei University, Seoul, Korea; 3. McGill University, Montreal, Canada; 4. New York University, New York, USA; 5. Rutgers University, New Brunswick, USA*

Communicative cues such as words, intonations, and emotional vocalizations constitute useful information for interpreting others' actions. There already exists evidence that infants draw upon emotional information to detect the goal of an action (e.g., Phillips, Wellman, & Spelke, 2002) and that they can detect different kinds of communicative cues (e.g., Vouloumanos & Werker, 2007). However, less is known about whether infants use different communicative cues to identify goals in different contexts. Here we gather new findings that address this issue from multiple perspectives.

Research by Martin, Vouloumanos, and Onishi shows that 12-month-olds recognize that in the absence of shared observations, words can be used to convey one's goal to others (e.g., to specify one's desired object), whereas emotional vocalizations alone cannot. Furthermore, Jin and Song report that 14-month-olds attend to a spoken word that accompanies a goal-directed action, and that upon hearing a different word infants expect a change to the goal. Finally, research by Hoicka and Wang indicates that 15-month-olds attend to intonation patterns embedded in speech to infer the nature of subsequent actions (e.g., whether an actor is being funny or sweet) and that infants this age distinguish between humorous and sweet intonations (even though both convey positive emotions) and expect the speaker to behave accordingly.

Together this research sheds new light on infants' use of communicative cues for predicting others' behavior in a variety of situations. First, these studies provide converging evidence that infants interpret actions by using communicative cues, including words and intonation patterns. Second, these studies reveal that by the end of their second year, infants already possess a complex understanding about social communication: they recognize that particular cues can convey some but not other kinds of goals, and they are capable of matching specific cues to specific goals.

### Fifteen-Month-Old Infants Match Humorous Cues to Humorous Actions

**Elena Hoicka**, Su-hua Wang
*University of California, Santa Cruz, USA*

Past research shows that parents scaffold humor for infants through social interactions (e.g., Reddy, 2001; Schieffelin, 1986). For example, when parents read humorous texts to their toddlers, they increase the pitch, speak louder and slower, and use a rising linear contour, as opposed to reading neutral and sweet texts (Hoicka & Gattis, 2006). The goal of the present study is to investigate whether toddlers use these humorous cues embedded in speech to infer a humorous situation and expect the speaker to act accordingly.

Sixteen 15-month-olds (nine boys) participated. The infants saw two test events. In each event, an experimenter spoke a sentence followed by an action. The cue in the sentence was either humorous (laughter and a humorous intonation pattern) or sweet ("Awwww" and a sweet intonation pattern). The action was either humorous (e.g., putting a shoe on a doll's hand) or sweet (e.g., putting a shoe on a doll's foot). The cue and action were consistent in one event (matching event) and inconsistent in the other event (mismatching event).

The results indicated that the infants looked significantly longer at the mismatching than at the matching event, $t(15) = 2.33$, $p = .034$. Fourteen of the 16 infants responded in this pattern, $X2(1, N = 16) = 9.00$, $p = .003$. There were no effects of gender, trial order, or cue. An additional condition examines whether infants take into account the identities of the speaker and the actor (i.e., whether it has to be the same person).

The present findings suggest that 15-month-old infants expect humorous action to follow humorous but not sweet speech, and expect sweet action to follow sweet but not humorous speech. They also suggest that infants this age differentiate humorous and sweet cues even though they both convey positive emotions.

### Infants' Use of Words in Reasoning About Others' Goals: Evidence From 12- and 14-Month-Old Infants

Kyong-sun Jin, Hyun-joo Song
*Yonsei University, Seoul, Korea*

Like adults, infants perceive the goal-directedness of others' actions (e.g., Woodward, 1998). By 12 months, infants are sensitive to emotional information in reasoning about others' goals (e.g., Phillips et al., 2002). By 16 months, they can interpret a change in others' words as signaling a changed goal (Song et al., 2005). The current research examined whether infants younger than 16 months can expect an actor to change her goal when she changes her word.

In the present research, 12- and 14-month-olds were familiarized with the following event: an actor's hand rested on an apparatus floor, centered between two toys; the actor uttered a word ("Modi") three times, reached for and grasped one of the toys. Following familiarization, the locations of the two toys were reversed. During the test event, the actor said a different word ("Papu") three times; then she grasped the new toy, now in the position formerly occupied by the old toy (new-toy event) or the old toy, now in the position formerly occupied by the new toy (old-toy event). Since the experiment was conducted with Korean-speaking infants, nouns without determiners were used.

According to preliminary data, 12-month-olds looked about equally whether they watched the new- or old-toy event. These results suggest that when hearing a different word, 12-month-olds detect the change in the actor's word but have no specific expectation as to which object she will reach for. In contrast, 14-month-olds appeared to possess a clear expectation that the change in the actor's word would signal a change in her goal: those who watched the old-toy event looked reliably longer than those who watched the new-toy event.

Thus, at least by 14 months, infants can interpret different words as signaling different goals. We discuss the implications of infants' emerging appreciation of language for action comprehension.

### 12-Month-Olds Expect that Speech can be Used to Communicate a Goal

**Alia Martin**[1,2] Athena Vouloumanos[1,2] Kristine Onishi[1]
*1. McGill University, Montreal, Canada; 2. New York University, New York, USA*

Speech is a special signal even in the first years of life: Infants prefer speech over other sounds, expect speech to be people- rather than object-directed, and use speech to inform their expectations about objects, categories, and people (Fulkerson & Waxman, 2006; Legerstee et al., 2000; Vouloumanos & Werker, 2007; Xu, Cote, & Baker, 2005). The goal of this study was to discover whether infants also understand that speech has a communicative function -- that a person can communicate information about a goal using speech, but not an emotional vocalization.

In a paradigm based on Woodward (1998), 12-month-olds were familiarized with a scene in which Actor1 reached for one of two objects in front of her (the target) after looking at both objects. After familiarization, Actor1 was absent and Actor2 appeared and interacted briefly with both objects. In test, both actors were present but only Actor2 could physically reach the objects. After looking at both objects, Actor1 uttered one of two vocalizations, and then was given one of the objects by Actor2. When Actor1 uttered a nonsense word ("koba"), infants looked significantly longer when Actor2 gave her the non-target than the target object; they expected Actor1's speech to result in Actor2 handing over the target. In contrast, when Actor1 uttered a positive emotional expression ("oooh!"), infants showed the reverse pattern. In an additional condition, when Actor2 was present throughout the familiarization trials, infants again expected Actor2 to hand over the target, looking longer when Actor2 handed over the non-target.

These results suggest that 12-month-olds understand that speech can be used to communicate specific information, in this case about a goal, that other vocalizations cannot. By the end of their first year, infants understand at least one of the functions of speech -- its ability to communicate specific information.

---

## *Social Cognition For Communication: Infants' and Toddlers' Production and Comprehension of Displaced and Iconic Reference* *(Regular Symposium, Communication and Language)*

**Chair:** *Ulf Liszkowski*

**Discussant:** *Chris Moore*

**Ulf Liszkowski**[1] Megan Saylor[2] Tanya Behne[3]
*1. Max-Planck-Institute for Evolutionary Anthropology, Leipzig, Germany; 2. Vanderbilt University, Nashville, USA; 3. University of Manchester, Manchester, UK*

Recent research suggests that human communication rests on sophisticated social-cognitive and communicative abilities already before being fully linguistic. This symposium brings together new

experimental findings using action-based measures which elucidate the complexities underlying young toddlers' and infants' prelinguistic communication, while also highlighting differences to non-linguistic apes. The symposium showcases infant communication about imagined absent entities, and discusses its underlying social-cognitive abilities.

The first speaker focuses on factors in the developing comprehension of words referring to absent things. Reducing spatio-temporal proximity and memory load of the absent referent revealed early competence in 12- to 15-month-olds. Familiarity with the absent referent influenced verbal reference comprehension between 15-31 months. The speaker argues for a domain-general link between infants' developing comprehension of verbal absent reference and their representational capacities.

The second speaker presents new evidence for comprehension of non-verbal referential intent. Twelve-months-olds in a hiding game understood points to a cloth as actually referring to an occluded referent underneath. This ability (absent in apes) correlated with infants' own pointing to occluded things. Older children also comprehended adults' iconic reference to specific actions, and creatively referred with iconic gestures to actions for an adult. The speaker argues for a prelinguistic bi-directional understanding of reference and discusses developing iconic reference.

The third speaker presents evidence for a new phenomenon: Infants refer to absent entities before language. In two different contexts 12-month-olds made reference either declaratively to share or imperatively to request currently absent entities by pointing to their previous or commonly known but empty locations. In a similar request situation, chimpanzees pointed only to occluded - but not to locations of absent - referents. The speaker concludes that displaced reference rests on social-cognitive and motivational abilities that are ontogenetically already prior to language.

The discussion focuses on different theoretical accounts of social-cognitive development and communication in infancy.

### What's Near and Dear: the Role of Proximity in Absent Reference Comprehension

**Megan Saylor**[1] Patricia Ganea[2] Mark Somanader[1]

*1. Vanderbilt University, Nashville, USA; 2. Boston University, Boston, USA*

Absent reference understanding is a core achievement of early development that enables conversations to move beyond the concrete present to matters abstract and hypothetical. Such understanding supports the technological and cultural innovation typical of our species, because it enables transmission of knowledge across space and time. Nevertheless, questions remain about its origins. One question is whether the emergence of absent reference is best explained by domain-specific or domain-general skills. The role of domain-general skills has been suggested by three recent studies that showcase links between absent reference comprehension and infants' representational capacity.

In one study, a researcher talked to 12- to 31-month-olds about present and absent items that varied in their familiarity: highly familiar items (i.e., caregivers who had not accompanied infants), familiar items with a known name, and novel items with a newly learned label. Communicative behaviors (searching, looking or gesturing at referent location) were used as measures of absent reference comprehension. As object familiarity decreased only older infants demonstrated robust comprehension: thus, 31-month-olds responded to all three types of references, 23-month-olds responded only to references to highly familiar and familiar items, and 15-month-olds responded only to references to highly familiar caregivers. However, two separate studies suggest that younger infants' difficulty with absent referents is related to the proximity of the referents to the conversational context. When the distance was reduced by showing infants reminders of mentioned absent things or by talking about absent people that were just outside of a room, 12- and 15-month-olds also demonstrated robust comprehension of absent reference.

These findings suggest that domain general representational capacities may support infants' absent reference understanding. Identifying the skills involved in the emergence of absent reference comprehension has the potential to inform research on the origins of language within the human species and comparative studies of language.

### Prelinguistic Infants Communicate About Absent Entities; Apes Don't

**Ulf Liszkowski**

*Max-Planck-Institute for Evolutionary Anthropology, Leipzig, Germany*

One characteristic feature unique to human language is the ability to refer to things beyond the immediate 'here and now'. This talk overturns this established view and shows for the first time that infants make reference to absent entities already before language.

First, we found that 12-month-olds pointed at the location of a ceased event. If E had seen and liked it before, infants pointed to share her interest more than when she had not liked it, and when she emoted uninterestedly infants pointed to inform her more when she had not seen it than when she had, thus revealing a context-sensitive prelinguistic capacity to refer to absent events.

In a new study we presented 12-month-olds with a request scenario in which they saw adults repeatedly place and retrieve desirable toys and boring tissues each from a specific location. When it was infants' turn to request, the toy location was empty (absent group) or the toy was put inside the location and so present but occluded (occluded group). The majority of infants pointed to the location of the absent toy, requesting an absent entity by pointing to its commonly known but otherwise arbitrary empty location. Performance was not different to the occluded group.

In another new study, nonlinguistic apes who also point - albeit only with the motive to request and not like infants to share interest or help by informing - were confronted with the same request scenario. Apes only pointed to the occluded entity but not to the location of the absent entity, thus revealing limits in their referential communication, and differences to infant pointing beyond the previously shown motivational differences.

Results demonstrate that communication about absent entities depends on social-cognitive abilities and shared context that run deeper than language and are ontogenetically - but likely not phylogenetically - prior to language.

## *Mutual Exclusivity in Word Learning: Mechanism and Development* *(Regular Symposium, Communication and Language)*

**Chair:** *Emily Mather*

**Discussant:** *William Merriman*

**Emily Mather**[1] Justin Halberda[2] Susanne Grassmann[3] **William Merriman**[4]

*1. University of Oxford, Oxford, UK; 2. The John Hopkins University, Baltimore, USA; 3. Max-Planck-Institute for Evolutionary Anthropology, Leipzig, Germany; 4. Kent State University, Kent, USA*

A major constraint on young children's word learning is the bias to map novel labels onto name-unknown objects, rather than name-known objects. This behaviour is often referred to as mutual exclusivity (Markman, 1989; c.f. Mervis & Bertrand, 1994). While there is much evidence for such a bias, there is dispute over the underlying mechanism. Little is also known about the development of the bias, the impact of processing demands, and the 'cue validity' of the bias relative to other word learning cues. This symposium will present data from different age groups and experimental paradigms to illuminate the cognitive processes underpinning mutual exclusivity and factors influencing the use of the strategy.

*Justin Halberda* uses converging methodologies with children aged 17 months to four years to provide evidence of a fundamental shift in the mechanism supporting the bias to map novel labels to novel objects. Specifically, behavioural changes occurring at 2.5 years of age suggest a shift from an associative mechanism to the use of a domain-general, deductive process. The remaining talks explore factors affecting the bias in infants aged less than 2.5 years. *Mather and Plunkett* present data on infants' looking behaviour at 19.5 and 22.5 months to reveal how the processing demands of the input influence the unfolding of mutually exclusive responding, and how this may change with age. *Grassmann and Tomasello* use object selection studies with two-year-olds to investigate the robustness of mutual exclusivity against conflicting information; their data suggest that salient pragmatic cues can override mutual exclusivity.

Discussion will be lead by *William Merriman* , a prominent investigator of mutual exclusivity (e.g. Merriman & Bowman, 1989; Merriman & Schuster, 1991), who will facilitate a thought-provoking debate on what can be understood about mutual exclusivity from this symposium.

### Developmental Change in the Computations That Support the Mapping of Novel Labels to Novel Objects

**Justin Halberda**

*The John Hopkins University, Baltimore, USA*

Aims and **Method:** Cognitive strategies grounded in both symbolic and associative computations may help guide word-learning. I present evidence from eye-tracking and pointing behavior that children 2.5 years and older rely on the symbolic, deductive strategy Disjunctive Syllogism (Process-of-elimination) to determine the referent of a novel label, while children younger than 2.5 years use the associative strategy Map-Novelty-to-Novelty to succeed in these same contexts. Children ranging from 17 months to 4 years, saw paired images of known and novel objects and were asked to find the referent of both known and novel labels. On critical trials, one familiar (e.g. ball) and one novel object were presented and children were asked to, "point at the [e.g. dax]".

**Results and Conclusions:** All children successfully increased their looking to and pointed at a novel object upon hearing a novel label. However, details of children's eye movements and their reaction times to point suggest that the computations supporting successful word learning undergo developmental change at approximately 2.5 years of age. Older children showed a systematic double-check of the familiar object distractor (e.g. ball) before returning gaze and pointing to the novel object. This pattern is consistent with reasoning via Disjunctive Syllogism (i.e. the word "dax" either refers to the ball or the novel object; it can not refer to the ball because that is called "ball"; therefore it refers to the novel object). Younger children showed a pattern consistent with Map-Novelty-to-Novelty as they maintained fixation on a novel object after hearing a novel label. Further data from experiments with 2.5-year-olds reveals that Disjunctive Syllogism is a domain-general inference strategy available to children of this age. In tasks involving social inference, logical negation, and object search 2.5-year-olds also succeed and show the hallmarks of Disjunctive Syllogism in both looking and pointing behavior.

### The Impact of General Processing Factors on Mutually Exclusive Responding

**Emily Mather**, Kim Plunkett

*University of Oxford, Oxford, UK*

**Background and Aims:** Unlike word-learning situations where there are explicit attentional cues, such as pointing or eye gaze, mutual exclusivity is a more implicit cue to the referent of a label. In situations requiring mutual exclusivity, infants may be particularly sensitive to other attentional cues such as stimulus familiarity or novelty (Hunter & Ames, 1983). Thus, a critical factor in mutual exclusivity may be the amount of exposure to potential referents. Therefore, we manipulate stimulus exposure in a mutual exclusivity task and measure baseline attention to novelty.

**Method:** 19.5- and 22.5-month-olds were given 24 6s trials in a preferential looking task. Trials presented a familiar and novel object, and either a familiar label, a novel label, or a control phrase ("Look at that!"). Trials were split into pre- and post-naming phases. Each trial was presented twice at a fixed interval of six trials.

**Results:** For original trial presentations, infants displayed a significant naming effect on familiar label trials, but no systematic preferences on novel label and control trials. For repeat trial presentations, 22.5-month-olds displayed significant preferences for the familiar image on familiar label trials and for the novel image on novel label trials. Interestingly, these effects occurred *prior* to naming; furthermore, there were no effects on control trials. While 19.5-month-olds had a trend towards this pattern, they did not have significant preferences on novel label trials.

**Conclusions:** Initially, older infants' attention did not differ between novel label and control trials; when novel label trials were repeated, mutual exclusivity occurred. Because the effect occurred prior to naming on repeat trials, the *memory* of the novel label on the original trial eventually triggered attention to the novel object. Thus, with increasing exposure to potential referents, a mutual exclusivity response may gradually emerge, overriding baseline attention to familiarity and novelty.

### Lexical Conventions vs. Pragmatics in 2-Year-Old's Interpretation of Novel and Familiar Words

**Susanne Grassmann**, Michael Tomasello

*Max-Planck-Institute for Evolutionary Anthropology, Leipzig, Germany*

**Background and Aims:** In a new twist of research, two recent word learning studies pitted pragmatic cues against lexical principles: Markman et al. (2003) showed that 15-to 20-month-olds rejected a familiar object as the referent of a novel word even though it was the only object present when the novel label was uttered. Jaswal and Hansen (2006) showed that 3- to 4-year olds disregarded a speaker's gaze direction or pointing if it conflicts with mutual exclusivity. In our studies we examined in more detail which factors determine whether children rely on pragmatic or lexical information in reference solution.

**Method and Results:** In Study 1 we investigated 24-month-olds' reference solution when mutual exclusivity was in conflict with pointing. Children were presented with one familiar and one novel object in an object choice task. The experimenter pointed to the familiar object (e.g., a car) and simultaneously used a novel word (e.g., "give me the modi"). We varied the realization of the pointing gesture: index finger only (Condition 1) vs. whole forearm + gaze alternation (Condition 2). We found that only the latter overrides mutual exclusivity: 98% of the 2-year-olds followed the natural pointing gesture and disregarded mutual exclusivity.

In a follow-up study we are examining whether 24-month-olds still rely on the pointing gesture when the lexical cue is stronger. Therefore, we used familiar words as lexical cues and pitted them against pointing. Again, children saw two objects: One is the referent of the lexical cue, the other one is the referent of the pointing gesture. Preliminary results indicate that children preferably follow the lexical cue (approx. 60%). Thus, whether children rely on lexical conventions which are in conflict with pragmatics depends on whether the referent of a word can be identified directly (familiar labels) or only indirectly by exclusion (novel labels).

---

## *The Scope and Origins of Children's Assumption of Conventionality* *(Regular Symposium, Social Development)*

**Chairs:** *Gil Diesendruck & Susan Birch*

**Discussant:** *Deborah Kelemen*

**Gil Diesendruck**[1] **Susan Birch**[2] Hannes Rakoczy[3] **Deborah Kelemen**[4]

*1. Bar-Ilan University, Ramat-Gan, Israel; 2. University of British Columbia, Vancouver, Canada; 3. Max-Planck-Institute for Evolutionary Anthropology, Leipzig, Germany; 4. Boston University, Boston, USA*

In order to become effective communicators, children need to assume that there are certain conventional words used to express given meanings. This helps children efficiently express their ideas, and interpret others'. A number of recent studies suggest that from early on children hold an assumption of conventionality regarding words. Given that other forms of cultural knowledge are also symbolic and arbitrary, yet shared by members of the culture, an assumption of conventionality regarding other cultural forms might be crucial for becoming well-adapted members of a culture. The present symposium will examine the scope of young children's assumption of conventionality, and some of the potential cues children use to determine whether or not a cultural form is conventional. The first presentation will discuss how infants and young children are sensitive to various non-verbal cues about the reliability of cultural agents, and how this sensitivity affects their willingness to learn cultural information - namely words and object uses - from such agents. The second presentation demonstrates how 2- to 4-year-olds not only prefer to learn from agents who are knowledgeable about the conventions of a culture, but indeed treat certain types of cultural information - in this case, games - as normative. In other words, children believe that there are appropriate ways to perform certain cultural activities, and expect others to follow such conventions. The third presentation assesses the extent to which the intentionality and stability of people's actions - here, the uses of artifacts and communicative gestures - may lead 2- to 3-year-olds to assume the action is indicating a convention. The discussant will address how the studies provide converging evidence about the central role an assumption of conventionality plays in young children's acquisition of culture, and about how this assumption might emerge from children's understanding of others' minds.

**Individual Presentations:**

1 "Young children's credibility vigilance when learning social conventions" ; Authors: Susan Birch, Sophie Vauthier, Nazanin Akmal, & Kristen Frampton.
2 "'Who knows how it's done?' Young children differentially learn norms and rules from reliable and adult models"; Authors: Hannes Rakoczy, Felix Warneken, & Michael Tomasello.
3 "Behavioral cues to conventionality: The role of intention and stability"; Authors: Gil Diesendruck, Shifra Wolgelernter, & Lori Markson.
4 Discussant: Deborah Kelemen

### Young Children's Credibility Vigilance When Learning Social Conventions

**Susan Birch**[1] Sophie Vauthier[1] Nazanin Akmal[1] Kristen Frampton[2]

*1. University of British Columbia, Vancouver, Canada; 2. University of Toronto, Toronto, Canada*

Children acquire a wealth of information from others. This 'social transmission' is not usually the only route to knowledge acquisition; one can learn through direct observation, logical reasoning, trial and error, etc. However, learning social conventions (i.e., practices that are socially-sanctioned and often arbitrary) provides a unique situation in which children must rely on others rather than attempting to learn through logical reasoning or trial and error. With this dependence on others comes another challenge: humans are fallible (e.g., they make mistakes, offer information even when they are uncertain, etc.), so how do children decide what and who to believe? Through a series of studies with infants and children (18 months-4 years), I will demonstrate how early 'credibility vigilance' (i.e., attention to, and appreciate of, various cues to whether information is credible) aids conventional learning. In one study, for example, children witnessed a puppet either correctly (Condition 1) or incorrectly (Condition 2) label common objects (e.g., ball) and then provide labels for novel objects. After a delay, a second puppet demonstrated that she was knowledgeable about the labels for common objects and offered alternative labels for the novel objects. Participants in Condition 2 were more likely to favor the labels offered by the second speaker than those in Condition 1. Another dataset shows that infants prefer to learn about social conventions from those who exhibit nonverbal cues of knowledge and confidence over those who exhibit nonverbal cues of uncertainty. Moreover, when only given the choice to learn from someone who was either confident or not (rather than choosing between 2 sources) infants were less likely to imitate the actions of an unconfident model,

$z = 2.97$, $p < .05$. Discussion will focus on the process of learning social conventions as well as children's understanding of social conventions.

### "Who Knows How It's Done?" - Young Children Differentially Learn Norms and Rules From Reliable and Adult Models

**Hannes Rakoczy**, Felix Warneken, Michael Tomasello

*Max-Planck-Institute for Evolutionary Anthropology, Leipzig, Germany*

Children from around 3-4 engage in differential social learning from others depending on relevant model characteristics. They selectively learn new words from confident over uncertain models (e.g., Sabbagh & Baldwin, 2001), from reliable over unreliable models (e.g., Koenig and Harris, 2005), and from adults over children (Jaswal & Neely, 2006).

However, from this line of research it remains unclear whether children find one model just smarter and thus copy her, or whether they see the action demonstrated by the competent model as the normatively correct way to act.

A different line of research suggests that young children from around 2-3 do engage in cultural learning of the latter form (Rakoczy et al., in press): Not only do they imitatively learn how to play simple rule and pretence games from single adult models, but they learn them as rule-governed activities with normative structure, as indicated in their normative responses (protest, critique) to third party mistakes.

Combining these two lines of research, in several studies young children's differential social learning of rule-governed activities from different models was investigated. First, 3-and 4-year-olds selectively learned to play novel games from adult over child models, and took the adult way to play it as the normatively correct one: when a third party entered and played like the child model, children criticized significantly more than when the third party played the adult way. Second, 4-year-olds in another set of studies showed an analogous pattern when confronted with a reliable and an unreliable character, selectively imitating and normatively following the former.

This suggests that young children do not just see one model as smarter than another one, but see her as more competent in transmitting cultural knowledge about how things are (normatively) to be done. The findings are discussed in the broader context of social cognition and cultural learning.

### Behavioral Cues to Conventionality: the Role of Intention and Stability

**Gil Diesendruck**[1] Shifra Wolgelernter[1] Lori Markson[2]

*1. Bar-Ilan University, Ramat-Gan, Israel; 2. University of California - Berkeley, Berkeley, USA*

Children seem to assume that there are conventional ways to refer to objects. The present project assesses whether children hold such an assumption about two additional cultural forms: the functions of artifacts and communicative gestures. Here we investigate what causes children to assume conventionality with a particular focus on the intentionality and stability of these cultural forms.

In Study 1, an experimenter showed 2- and 3-year-old children novel artifacts, and performed novel functions with them. The manner in which the experimenter performed the functions was either intentional or accidental, and either stable (repeating it three times) or variable (performing it slightly differently each time). After exposure to one such demonstration, children were asked a series of questions to test whether they interpreted the demonstrated function as conventional (e.g., "What would other people do with this object?"). The findings revealed that stability, but primarily intentionality, influenced children's understanding of the function as conventional, and that this understanding increases with age.

Study 2 used a similar procedure to assess 2- and 3-year-old children's understanding of communicative gestures. An experimenter exposed children to a novel gesture in either an intentional and stable manner or an accidental and variable manner. Again children were asked a series of questions to assess their interpretation of the gestures. The findings revealed that children in the intentional and stable condition were more likely to interpret the gestures as conventional.

Finally, Study 3 assessed whether children expect others to learn about functions of objects from actors who use objects intentionally as opposed to accidentally. Results from this study reveal that children hold this expectation.

These studies begin to uncover the cues in people's behaviors that lead children to assume conventionality, and how this assumption characterizes children's learning of various forms of cultural knowledge.

---

## *Progress in Understanding Infant Crying and Sleeping Problems, Their Distinguishing Features, and Outcomes*

*(Fishbowl Symposium, High Risk and Pediatric Issues)*

**Chair:** *Ian St James-Roberts*

**Ian St James-Roberts**[1] Thomas Anders[2] Harriet Hiscock[3] Dieter Wolke[4] Ronald Barr[5] Marc Bornstein[6] Beth Goodlin-Jones[2] Mechthild Papousek[7]

*1. Thomas Coram Research Unit, Institute of Education, University of London, London, UK; 2. Department of Psychiatry & Behavioral Sciences, UCDavis M.I.N.D. Institute, Sacramento, USA; 3. Centre for Community Child Health, Royal Children's Hospital and Department of Paediatrics University of Melbourne, Melbourne, Australia; 4. Department of Psychology & Health Sciences Research Institute, University of Warwick, Warwick, UK; 5. Centre for Community Child Health Research, UBC Faculty of Medicine, Vancouver, Canada; 6. Child & Family Research, NIH/NIHCD, Bethesda, USA; 7. Instiute for Social Pediatrics, University of Munich, Munich, Germany*

Infants who cry a lot or wake their parents at night are common concerns for parents and costly problems for health services. In America, 23% of parents reported their babies' crying to be a problem, and 74 % discussing their 4-9 month-olds' night waking and fussing with their pediatrician. Other Western countries have comparable figures. In the United Kingdom, the time professionals spend discussing these problems with parents during early infancy costs the National Health Service £65 million ($130 million) per year. More rarely, but tragically, infant crying can elicit shaking and other forms of parental abuse, sometimes leading to infant brain damage or death. These findings highlight the need to understand the development of infant crying and sleeping behavior and to distinguish the factors which lead to poor outcomes.

Researchers have often considered infant crying and sleeping problems to be highly interrelated. However, recent studies indicate the existence of at least three different infant groups: infants who cry a lot in the daytime and evening in the first 12 weeks, infants who wake and signal parents at night after 12 weeks of age, and infants who have multiple, crying sleeping and other problems after 12 weeks. The third, smaller, group appears to be at much greater risk of serious long-term disturbances.

Most researchers study infant crying or sleeping behavior, so that this symposium's goal of inviting researchers to discuss these in relation to

each other is believed to be innovative as well as timely. To this end, the symposium will bring together leading researchers from America, Australia and England. As well as summarizing progress in their own field, the speakers will be asked to address a common set of questions designed to stimulate discussion by the invited expert panel of the similarities and differences in the phenomena involved.

### Contributions of Parenting to Infant Crying and Sleeping Problems

**Ian St James-Roberts**

*Thomas Coram Research Unit, Institute of Education, University of London, London, UK*

Substantial progress in understanding infant crying and sleeping problems has occurred in recent years. First, a conceptualization which recognises parental vulnerabilities and the context of Western culture is needed. Babies who cry a lot or wake their parents at night are challenging in societies which promote dual employment and Western family structures and lifestyles. Second, most infants who display these behaviours are not unwell, but a small minority have organic disturbances. Third, developmental processes are important. Infant crying, bouts of un-soothable crying, and parental concern about crying, peak at around 5-6 weeks of age. Most infants cry 50% less by 12 weeks and lack subsequent problems. About 3% of infants continue to cry a lot and have multiple problems at older ages. Most infants wake at night in the early weeks, but two thirds stop waking their parents during the night by 12 weeks of age. Failure to achieve this predicts chronic night waking.

Perhaps because such rapid changes in both realms of behaviour occur in the first three months of age, several researchers (including the author) have argued that they reflect common etiological processes. In contrast, recent findings have indicated that they have separate causes.

This presentation will bring together new and existing evidence from the author's and others' comparative studies, randomised controlled trials and epidemiological research to argue that problematic infant crying and sleeping behaviours present at different ages and times of day, often occur in different infants, and respond to different environmental influences. I will propose that parenting acts as an external environmental regulator in early infancy and as a source of cues for learning after six weeks of age. The implications of this explanatory framework for future, integrative, research and for parents and health service professionals will be outlined for discussion by the symposium panel.

### Behavioral Insomnias of Infancy

**Thomas Anders**, Beth Goodlin-Jones

*Dept. Psychiatry & Behavioral Sciences, UC Davis M.I.N.D Institute, Sacramento, USA*

This fishbowl presentation will review the definitions, origins and treatments of sleep onset and night waking behavioral insomnias in infants, and propose quantitative research diagnostic criteria designed to further study these common disorders. The developmental trajectory of self-soothing and signaling night time behaviors will be reviewed as they emerge on the pathway from parent-infant regulation to self regulation. A theoretical transactional-developmental model will be offered in an attempt to explain the "dyadic" relationship origin of both well regulated and dysregulated sleep. Time permitting, video clips of infant/toddler sleep onset and night awakening disorders will be shown. Discussion will focus on signaled awakenings without parental response, with parental response, and self-soothing awakenings without and with parental responses. Treatment approaches will emphasize culturally sensitive, family specific practices of sleep hygiene, strategies for learning to fall asleep and the problems associated with separation around bedtime.

### Interventions For Infant Sleep and Cry Problems: Effective Strategies and Predictors of Non-Response

**Harriet Hiscock**[1,2,3] Jordana Bayer[1,2,3] Anna Price[1,2] Melissa Wake[1,2,3] Frank Oberklaid[1,2,3]

*1. Centre for Community Child Health, Royal Children's Hospital, Melbourne, Australia; 2. Murdoch Children's Research Institute, Melbourne, Australia; 3. Department of Pediatrics, University of Melbourne, Melbourne, Australia*

**Background:** Between 20% and 30% of Australian parents report problems with infant sleep and crying in the first 8 months. Intervention approaches have largely focused on behavioural strategies including educating parents about normal sleep and crying patterns, phasing out sleep associations, and encouraging infants to self-settle. Despite this, some infants develop persistent sleep and crying problems. A public health approach to these issues could include primary prevention (offered to all families), secondary prevention (targeted to those with established problems) and tertiary management for children who do not respond.

Drawing on data from two programs - one primary prevention and one secondary prevention - we aim to identify effective strategies to prevent infant sleep ad crying problems and predictors of persistent problems.

**Methods:** Baby Business (pilot, n= 70 families) is a two-session, parenting group program, designed to prevent infant sleep/crying problems. Delivered at infant age 3-6 weeks and 8-10 weeks by well child nurses, it incorporates information on normal sleep and cry patterns, common sleep associations, medical causes of crying, and settling strategies. The Infant Sleep Study (randomised controlled trial, n=324) is a targeted program for infants aged 8-months whose parents report an infant sleep problem. Delivered by well child nurses, it incorporates behavioural interventions including graduated extinction and adult fading.

**Results:** Outcomes including parent report of sleep and crying problems, infant behaviour (Barr diary), parent mental health, and usefulness of program strategies will be presented. Potential child (eg gender, allergy status) and family (eg maternal depression) factors that predict persistent sleep and cry problems will be discussed.

**Conclusions:** A population approach to early infant sleep and crying problems could include a coordinated framework of primary, secondary and tertiary management. Screening for children at risk of long-term problems could occur after primary and secondary programs, provided suitable risk factors can be identified.

### Developmental Consequences of Regulation Problems in Infancy and ADHD

**Dieter Wolke**, Muthanna Samara, Renate Meyer

*University of Warwick, Department of Psychology and Health Science Research Institute, Warwick Medical School, Warwick, UK*

This presentation will be looking at the longterm consequences for infants who have multiple crying, sleeping or feeding problems after 12 weeks of age. The core symptoms of regulatory problems are excessive crying, sleep and feeding problems, that are often co-morbid and

persist beyond the period of colic crying (i.e. beyond 3 months of age). The major difficulty is one of under-regulation of behavioural states, i.e. inability to stop crying, difficulties to fall asleep or return to sleep or difficulties to control food intake. Attention- and Hyperactivity Disorder (ADHD) is also characterised by problems of under-regulation of attention and/or motor activity levels.

We propose that despite changes in behaviour phenotype over age, the core difficulty of regulation of infants may be seen as ADHD in older children. Three published studies from the UK, Sweden and Germany showed significant association between early regulatory problems ADHD type problems, IQ or scholastic achievement in early to middle childhood. We will be presenting new findings from two further large scale studies, the Bavarian Longitudinal Study (Germany) and the ALSPAC study comprising 1500 and 8000 infants and a birth or pregnancy cohort study, respectively. The analyses to date indicate that early regulatory problems are related to ADHD and conduct problems at 6 to 8 year of age in both studies. The ALSPAC study found that ADHD is already predicted by excessive crying in the first months of life pointing to a neuro-developmental explanation. In contrast, comorbid ADHD and conduct disorder appear to be related to later regulatory problems pointing to an interaction between toddler behaviour and parenting difficulties. The implications for further research and possible early prevention of ADHD are discussed.

## *Memory Enhancers: Chunking, Feeding and Sleep*

*(Invited Symposium, Attention, Memory and Learning)*

**Chair:** *Michael Lewis*

**Michael Lewis[1] Lisa Feigenson[2] Ronald Barr[3] Rebecca Gomez[4]**

*1. UMDNJ-Robert Wood Johnson Medical School, New Brunswick, USA; 2. Johns Hopkins University, Baltimore, USA; 3. Centre for Community Child Health Research, Child and Family Research Center, , ; 4. The University of Arizona, Tucson, USA*

### The Feeding Effect On Infant Memory For Spoken Words

Ronald Barr

*Centre for Community Child Health Research, Child and Family Research Center, Vancouver, Canada*

For a number of years, memory enhancement by glucose has been demonstrated in a wide range of ages, clinical populations, tasks and functions, but with some tasks being preferentially affected, including declarative memory. In infants, glucose metabolism is less stable, and may be affected by the stress of the birth process and weight loss after birth. We endeavoured to determine whether variations in patterns of typical feeding of infants at and following birth might be associated with fluctuations in memory, as this could play a role in early infant learning.

In a series of studies, we used information processing paradigms with head turning toward sound that included Familiarization (orientation-habituation), Delay, Recovery, and Novelty phases in an infant-controlled procedure. These studies showed that (1) 2-4 day old infants have enhanced memory over a 100 second pause for unfamiliar word sounds ('tinder' or 'beagle') following a 2 gm/kg glucose feed than a water feed; or (2) following a typical breast or formula feeding compared to water; (3) 2 week old infants show enhanced memory following a typical feed over a range of pauses from 100 to 500 seconds, the 'memory gain' amounting to more than 2 minutes; (4) feeding enhancement for unfamiliar words is about as strong as "Familiarity" (i.e. familiar words spoken by a familiar speaker ['baby' by mother]), but does not further enhance memory for "Familiarity" in 2-4 day olds; and (5) short (hourly) interfeed intervals compared to long (3 hourly) intervals preferentially enhance memory for an unfamiliar word in 10 day olds before and after feeding. By comparison, there is little feeding effect on attention (number of trials to achieve 'orientation') or rate of learning (trials to 'habituation').

These findings imply that there is a robust feeding effect on delayed recall memory for spoken words in the earliest days of life. Memory for spoken words is not a stable cognitive function, but fluctuates with nutrient state.

### Conceptual Knowledge Increases Infants' Memory Capacity

Lisa Feigenson

*Johns Hopkins University, Baltimore, USA*

Working memory capacity is highly constrained in adults and infants, with both groups able to remember only about 3 separate items at once. One reason adults are rarely conscious of this constraint is that we can increase memory using stored conceptual knowledge. A well-known example of this is chunking. For example, the letter string PBSBBCCNN is much easier to recall after recognizing the three television acronyms PBS, BBC, and CNN that comprise it. In this example, adults use previously acquired concepts to parse an undivided array into smaller units that are more efficiently stored in memory. Such memory reorganization is widely used by adults, but its origins remain a mystery. Five-year old children can increase memory via chunking if provided explicit instruction, raising the possibility that this process is a cultural construction acquired through explicit teaching. In contrast to this hypothesis, recent work from my lab demonstrates spontaneous chunking by young infants. We show that untrained 14-month old infants increase their memory capacity using stored conceptual knowledge. Infants failed to remember 4 items when presented with object arrays that could not easily be parsed into smaller chunks. In contrast, infants succeeded when presented with arrays that could be parsed based on perceptual, conceptual, or linguistic similarity. This demonstrates that without instruction or conscious effort, a fundamental memory computation is available starting in infancy, years before the development of explicit meta-memorial strategies.

### Sleep and Memory Consolidation in Infant Learning

Rebecca Gomez, Almut Hupbach, Richard Bootzin, Lynn Nadel

*The University of Arizona, Tucson, USA*

Working memory capacity is highly constrained in adults and infants, with both groups able to remember only about 3 separate items at once. One reason adults are rarely conscious of this constraint is that we can increase memory using stored conceptual knowledge. A well-known example of this is chunking. For example, the letter string PBSBBCCNN is much easier to recall after recognizing the three television acronyms PBS, BBC, and CNN that comprise it. In this example, adults use previously acquired concepts to parse an undivided array into smaller units that are more efficiently stored in memory. Such memory reorganization is widely used by adults, but its origins remain a mystery. Five-year old children can increase memory via chunking if provided explicit instruction, raising the possibility that this process is a cultural construction acquired through explicit teaching. In contrast to this hypothesis, recent work from my lab demonstrates spontan-

eous chunking by young infants. We show that untrained 14-month old infants increase their memory capacity using stored conceptual knowledge. Infants failed to remember 4 items when presented with object arrays that could not easily be parsed into smaller chunks. In contrast, infants succeeded when presented with arrays that could be parsed based on perceptual, conceptual, or linguistic similarity. This demonstrates that without instruction or conscious effort, a fundamental memory computation is available starting in infancy, years before the development of explicit meta-memorial strategies.

---

## *Continuity and Change in Early Language Development*

*(Invited Symposium, Communication and Language)*

**Chair:** *Sandra Waxman*

### Continuity in Processing Skill: Early Fluency in Understanding Facilitates Language Learning

Anne Fernald, Virginia Marchman

*Stanford University, Stanford, USA*

Although research on the continuity of information-processing abilities from infancy to later childhood has focused primarily on visual processing, there is growing interest in how infants' skill in interpreting auditory stimuli relates to later developmental outcomes. Several studies have linked speech processing skills in the first year to later vocabulary development (Benasich & Tallal, 2002; Tsao, Liu, & Kuhl, 2004; Newman, et al., 2006), assessing individual differences in perception of speech sounds not yet meaningful to preverbal infants. In a longitudinal study from 12 to 25 months, Fernald, Perfors and Marchman (2006) used an online procedure that requires infants to listen for meaning in spoken language, finding robust relations between real-time measures of comprehension and linguistic development. Those children who were faster to interpret familiar words in fluent speech also had more accelerated vocabulary growth across the second year. When children who were tested as infants were then later assessed on standardized tests of language and cognition, speed of word recognition and vocabulary size at 25 months accounted for substantial variance in linguistic and cognitive skills at 8 years. Why is early efficiency in speech processing so strongly predictive of long term outcomes? One explanation is that infants who are faster to encode the auditory signal in relation to the visual scene have more robust lexical representations that can be reliably accessed during language production. Greater speed in word recognition during early language learning may also facilitate children's success in inducing meanings of novel words from linguistic and non-linguistic context, and also in tracking morphosyntactic regularities critical for lexical and grammatical growth. In recent experiments we show that infants who are faster in interpreting familiar words in continuous speech are also more successful in learning novel words downstream, suggesting that early fluency in understanding has cascading consequences for language learning.

### Learning the Hard Words: The Information-Growth Hypothesis

Lila Gleitman

*University of Pennsylvania, Philadelphia,*

A contrasting idea is that these adult/infant differences are better characterized as informational than as conceptual. Perhaps, to (loosely) paraphrase Plato, the problem of novice word learners is that they must recover what they previously knew *by the use of the senses* (Phaedo, c.a. BCE412): As learning begins, all mapping is solely between heard words (qua phonological segments) and the real-world settings in which these occur. If so, it's understandable why words that refer to nonobservables (e.g., *think*) or that don't refer at all (e.g., *probably*) make trouble. Infants display considerable skill at mind reading such that they strikingly often extract a relevant interpretation - get the gist - when they hear people talking to them. Nevertheless such unlearned conceptual and linguistic foundations may not sufficiently constrain the mapping task. To solve the mapping problem for the lexicon, a sophisticated computational learning theory needs to be, and is, constructed by the novice. In particular, learners come to rely significantly on distributional features of language itself to glean the meanings of the more abstract words. Some evidence favouring this information-growth hypothesis is that late-learning novices (cf Snedeker, Geren & Martin, in press) and simulated adult learners (Gillette, Gleitman, Gleitman & Lederer, 1999) show learning properties similar to infants when linguistic-distributional information is unavailable or inaccessible.

### Early Acquisition of Nouns and Verbs: The Role of Universal Conceptual Constraints, Word Learning Biases and Syntactic Cues

Imai Mutsumi

*Keio University, Tokyo, Japan*

For young children to infer the meaning of a new word, they must be able to identify what form class the word belongs to, and understand how that form class maps onto semantics. Some researchers have stated that syntactic cues indicating the word's form class plays a crucial role here (e.g., Bloom, 1994; Gleitman, 1990; Quine, 1969). One extreme view is that it is only by first noting the difference in the form across different words (e.g., Fep vs. a fep; a dax vs. some dax) that children become aware of the semantics underlying different form classes (e.g., Quine, 1969). A critical test for this view is whether children learning a language that does not syntactically mark contrasting word classes experience substantial difficulty in acquiring them.

Japanese provides one test case, in that it does not syntactically distinguish proper nouns and common nouns, nor does it distinguish count nouns and mass nouns. Another example is the distinction between nouns and verbs. Chinese provides another type of test case; while in some languages (Japanese, German, etc.) nouns and verbs are clearly distinguished in the word form by inflectional or derivational morphology, in other languages, such as Chinese, the distinction is less clearly marked, and the word's form class can only be identified by the global argument structure.

I will present data from a series of three studies examining (1) how Japanese children map a novel noun to a proper noun or a common object noun; (2) how Japanese children map a novel noun to an individuated object or non-individuated substance, and what they understand about the extension principles underlying object names and substance names; (3) how Japanese, English and Chinese children map a novel noun or a verb onto an action event and generalize its meaning.

The overall pattern of results indicates that conceptual factors universally play a primary role as constraints in early lexical acquisition. Syntactic cues, when available, interact with the conceptual nature of the target word class as well as word learning biases children universally possess. For the noun lexicon, children possess basic conceptual categories (individuals, categories of individuated things, categories of

non-individuated things) and certain expectations about how a novel noun should map to its referent. With this knowledge, they are able to identify a word's form class even without aid from syntactic cues at the very beginning stages of word learning. In the realm of verbs, however, categories of actions in the abstract sense (actions segregated from objects) may be acquired through the experience of word learning, and syntactic cues

play a heavier role than for nouns.

---

## *Conceptual Primitives For Processing Events and Learning Relational Terms* *(Regular Symposium, Communication and Language)*

**Chairs:** *Shannon Pruden & Tilbe Goksun*

**Discussant:***Susan Hespos*

**Shannon Pruden**[1] **Tilbe Goksun**[2] Marianella Casasola[3] Laura Lakusta[4] **Susan Hespos**[5]

*1. University of Chicago, Chicago, USA; 2. Temple University, Philadelphia, USA; 3. Cornell University, Ithaca, USA; 4. Harvard University, Cambridge, USA; 5. Northwestern University, Evanston, USA*

Relational terms (i.e., verbs, prepositions, and adverbs) are the cornerstone of language development, bringing together two disparate fields, infants' event processing and linguistic theory. To learn relational terms, children must first dissect the fluid events around them. Only then can they map aspects of these events (e.g., path-manner, containment-support, source-goal, and figure-ground) to words. Thus, abstracting those conceptual primitives lexicalized in relational terms is a major developmental milestone for infants learning any language. This symposium pulls together the very first studies that bridge the gap between research on infants' event processing and the acquisition of relational terms.

Three papers explore infants' abstraction of conceptual primitives and their developmental trajectories, and the role that these conceptual primitives play in learning relational terms. The first paper by Goksun and colleagues builds on what we know about infants' conceptualization of path and manner by exploring infants' discrimination of two other primitives: figure and ground. In the second paper, Lakusta explores the hypothesis that event representations reflect linguistic structure by asking whether pre-linguistic infants can form broad categories of source and goal events. Casasola, in the third paper, discusses what we know about infants' categorization of containment and support relations and argues that not all spatial relations are created equal, with the support relation developing later and influenced by linguistic input. Finally, our discussant, Susan Hespos, will talk about the implications of these findings in terms of abstraction of events and relational terms and how path-manner, figure-ground, containment-support, and source-goal form the foundations for learning language.

Taken together, the research presented in this symposium shows that pre-linguistic infants bring to the task of learning language the ability to abstract, discriminate, and categorize those elements that are lexicalized in relational terms.

### Processing Events and Relational Terms:Figures are More Prominent than Grounds

**Tilbe Goksun**[1] Kathy Hirsh-Pasek[1] Sarah Roseberry[1] Roberta Golinkoff[2]

*1. Temple University, Philadelphia, USA; 2. University of Delaware, Newark, USA*

To learn relational terms like verbs (e.g. running) and prepositions (e.g., on), children must parse events into units like paths, manners and goals. This research expands the literature by asking whether infants isolate two components of event structure central to word learning: figure (moving entity) ground (the stationary setting) (Talmy, 2000). Some languages like Japanese include the ground in the meaning of the verb. To learn any of the world's languages, children must be able to distinguish between grounds and figures in dynamic events. Using televised displays of different people traversing various grounds (e.g., railroad, road, grass), we ask: 1) Do infants discriminate figures and grounds in nonlinguistic dynamic events, 2) Is there primacy for figure or ground in processing these events?

Using the Preferential Looking Paradigm (PLP), twenty-three 7- to 9-month-old (M= 7.89) and eighteen 10- to 12-month-olds (M= 10.97) were tested in either a figure discrimination or a ground discrimination experiment. Infants were familiarized with a scene in which one figure (e.g., woman) traversed across one ground (e.g., railroad). In figure discrimination, they compared an old event (e.g., woman crossing railroad) with a new event changing only in the figure (e.g., man crossing railroad). In ground discrimination, infants saw the same old event paired with a new event that changed only the ground (e.g., woman crossing street). The dependent variable was looking time where increased looking time to the novel event suggested processing of figures or grounds.

**Preliminary Results:** 7- to 9-month-olds displayed no preference to novel events in either condition.10- to 12-month-olds looked significantly longer at the novel figure (M= 63%, $p < .05$), but not at the novel ground.

Paralleling findings in the literature these data suggest 12-month-olds attend differentially to some aspects of events over others. Implications for event processing and language learning are discussed.

### Infants' Categorization of Sources and Goals in Motion Events

**Laura Lakusta**

*Harvard University, Cambridge, USA*

Talking about an event requires accurately representing its components (e.g., figure, motion, path, and reference object) and mapping them into language. How do infants accomplish this task? One possibility is that infants' event representations are articulated in a way that reflects linguistic structure. The current study explores this hypothesis by testing how infants represent sources and goals (the duck moved off the box into the bowl) across motion events.

In language, the notions 'source' and 'goal' refer to starting points and end points in events that crosscut conceptual domains (e.g., animate and inanimate motion, transfer; Gruber, 1965; Jackendoff, 1983). Furthermore, by the age of 2.5 years, children have a single broad category of source that encompasses starting points across different event types (Clark & Carpenter, 1994). Do infants have broad categories of source and goal, ones that can be mapped directly into language?

Fourteen- (N=32) and 18-month-old (N=31) infants were familiarized to motion events including a goal path (e.g., duck moved to a tree/onto a box) or a source path (e.g., duck moved from a tree/off of a box). During test, infants viewed motion events including a novel goal path (e.g., duck moved into a box) or a novel source path (e.g., duck moved out of a box). In an additional condition, infants only viewed the test events, in order to obtain a measure of infants' baseline preference for goal or source. The results suggest that infants formed a broad goal category; infants familiarized with goal path events overcame a baseline preference for goal, and showed a different looking pattern than those infants who were familiarized with source

path events. Preliminary data suggest that infants also formed a broad source category. These findings suggest that the nature of prelinguistic representations of goal and source may reflect the structure of language.

### How Infants Learn to Form Spatial Categories: Does One Size Fit All?

**Marianella Casasola**

*Cornell University, Ithaca, USA*

From the earliest stages of acquiring spatial terms, young children's spatial words reflect the semantic pattern specific to their language (Choi & Bowerman, 1991; Choi, McDonough, Mandler, and Bowerman, 1999). The early emergence of language specificity in children's spatial terms has raised questions about the relative contribution of infant spatial concepts versus spatial language in the development of particular spatial concepts. Does experience with spatial language contribute to the development of the underlying spatial concepts or does language instead merely select among infants' existing spatial concepts? In an effort to address this question, several experimental studies of infants' categorization of containment and support will be presented. The results outline different developmental trajectories for these two relations. While infants of 6 months can form an abstract categorical representation of containment, infants of 18 months still struggle to form a spatial category of support. The role of spatial language in the development of these relations also differs. Cross-linguistic comparisons of Korean- and English-learning infants demonstrate that prelinguistic infants do not require experience with spatial language in order to form a spatial category of containment whereas infants best learn to form a support spatial category when provided with a spatial word. The results suggest that the relation between spatial cognition and spatial language may not be the same for all spatial relations. While infants do not require experience with language to form an abstract categorical representation of containment, experience with language can facilitate infants' categorization of support. That is, the development of infants' spatial categories may not be characterized by 'one size fits all'. Rather, the degree to which infants' nonlinguistic abilities versus spatial language contributes to the development of infants' spatial categories may vary with the spatial relation in question.

---

## *Emotion and the Development of the Ecological Self*

*(Regular Symposium, Emotional Development)*

**Chair:** *Carl Frankel*

**Discussant:** J*oseph Campos*

**Carl Frankel**[1] **Joseph Campos**[2]

*1. Vanderbilt Kennedy Center, Nashville, USA; 2. University of California, Berkeley, Berkeley, USA*

Emotions come about as a result of the import of environmental events for the self. Long before the organization of the abstract conceptual self described by James (1890), infants organize an ecological self--a sensorimotor phenomenon directly perceived in the relation of the infant to the environment (Neisser, 1988). The infant's ecological self progressively differentiates and becomes better organized with changes in the infant's abilities to engage in commerce with the world. The development of emotion and of the ecological self should be and, we find, are inextricably intertwined during infancy.

Visual proprioception, the perception of self-movement in response to optic flow, is an observable instance of the development of the ecological self. So also is perception of how to grasp effectively, as is the anticipatory perception of possible falls and how to prevent them. This symposium presents findings showing how these instances of the ecological self and emotions co-develop in infancy.

- As infants start to reach and grasp, they encounters the possibility of having exploration frustrated, due to their own lack of adequate grasping skills.
- As infants start to locomote, they encounter a need to maintain postural stability and conversely to prevent falls. Infants concommitantly change their emotional response to optic flow and to drop-offs.
- When self-produced locomotion is induced in endogenously prelocomotor infants using a powered-mobility device, their emotions change during the act of controlling the PMD, exhibiting smiles of agency; and, after three weeks of training, infants experience cardiac acceleration on a Visual Cliff.

These findings indicate that infants' emotions develop in concert with new motoric acquisitions that in turn, as Neisser argued, are constitutive of infants' ecological self.

### Predictive Grasp and the Development of Targeted Anger in Infancy

David Witherington

*University of New Mexico, Albuquerque, USA*

Between 4 and 7 months of age, infants undergo a significant transition in the development of anger. At 7 months, infants target their anger to people in a way not evident at 4 months. In this talk, I examine a potential account for how this transition occurs. By this account, targeted anger involves a change in the intentionality of infant anger such that the anger of the 7-month-old exhibits a distinct object-directedness, in contrast to that of the 4-month-old. This transition, I argue, may relate to changes taking place between 4 and 7 months in infants' anticipation of resistance to their reaching and grasping activity, specifically manifest in the emergence of predictive hand shaping when reaching for objects of different orientations. Such predictive hand shaping can be framed in terms of the development of the ecological self, as it involves a new appreciation for and accommodation to the specific kinds of resistance objects afford action. I will present data that speak to the potential utility of this explanatory account.

### Co-Acquisition of Postural Stability and the Fear of Falling

**Carl Frankel**[1] Joseph Campos[2] Brian Meyer[2] David Anderson[3]

*1. Vanderbilt Kennedy Center, Nashville, USA; 2. University of California, Berkeley, Berkeley, USA; 3. San Francisco State University, San Francisco, USA*

This talk presents findings that show an important role, in the acquisition of wariness of heights, of the many ordinary 6 to 12 inch falls that infants incur, as they acquire the postural stability needed to operate on a progressively narrower base of support. Interestingly, experienced "short" falls do not make infants afraid of short falls generally. Infants typically incur many butt-plants in learning to pull-to-stand, then invite many more when letting go of all support, to learn to free stand. Yet "short" falls do play a role in the acquisition of wariness of heights! In two studies of 37 week old infants, we found that locomotor experience that involves some opportunity to fall correlates with the infant's emotional responses in contexts of maintaining

postural stability and preventing falls. One study (n=39) contrasted a group of prelocomotor and belly crawling infants with a group having experience of form(s) of locomotion that incur a risk of falling. Infants with "can-fall" locomotor experience were more likely to display an emotion in the moving room than those with none. In the second study (n=37), all infants were locomotor, and we examined the relationships among locomotor experience, behavior on the visual cliff, and display of emotion in the moving room. As infants had more "can-fall" experience locomoting, they were less likely to venture onto the deep side of a three foot visual cliff. In addition, infants who did not venture onto the deep side were more likely to display emotion in the moving room. We take this to indicate that, from ordinary encounters with gravitational acceleration, infants calibrate and extrapolate the emotional sting that they risk, from large drops and from unexpected threats to postural stability.

### Control Over a Powered-Mobility Device Affects the Ecological Self and also Positive and Negative Emotions

**Ichiro Uchiyama**[1] Mika Ueno[1] David Anderson[2] Joseph Campos[3]

*1. Doshisha University, Kyoto, Japan; 2. San Francisco State University, San Francisco, USA; 3. University of California, Berkeley, Berkeley, USA*

This talk presents findings showing that when endogenously prelocomotor infants acquire the skill of controlling a powered-mobility device, they exhibit a step-function increase in the expression of smiling. In addition, self-produced locomotion causes both an increased wariness of heights and increased sensitization to information from the environment that indicates a threat to postural stability. Endogenously prelocomotor infants (n=22, age=31 weeks) were randomly assigned to one of two conditions. Both groups visited the lab five days per week for three weeks. Infants in the control group played with the mother, while infants in the experimental treatment group were seated for 10 minutes per lab visit in a powered mobility device (PMD), a motorized go-cart that infants learn to activate to roll forward by pulling on a joystick. In the PMD, infants experience many important concomitants of self-produced locomotion, including optic flow, translation through distances in space, changing distances between the self and other objects, and the accelerations and decelerations of starting and stopping. Infants also experience that these covary with their own actions. As such, midway through training, most infants exhibited broad, sustained smiles and concurrently increased joystick-pulling rates. In addition, infants in the experimental condition displayed greater postural compensation in the moving room at post-test than at pre-test, and greater postural compensation at post-test than the control group at both pre-test and post-test. And, when placed on the deep side of a three foot visual cliff, infants in the experimental condition evidenced greater cardiac acceleration than control group infants. Thus, control over locomotion affects joy of mastery, wariness of heights, and postural compensation in response to visual proprioception.

## *The Development of Early Prosocial Behaviors*

*(Regular Symposium, Social Development)*

**Chair:** *Felix Warneken*

**Discussant:** *Tracy Spinrad*

**Felix Warneken**[1] **Amrisha Vaish**[1] Margarita Svetlova[2] **Tracy Spinrad**[3] Kristina Olson[4]

*1. Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany; 2. University of Pittsburgh, Pittsburgh, USA; 3. Arizona State University, Tempe, USA; 4. Harvard University, Cambridge, USA*

Prosocial behaviors emerge early in ontogeny and rely on cognitive, emotional, and motivational mechanisms. In order to gain new insights into these mechanisms and their interrelation, the symposium brings together researchers working on different aspects of prosociality. Specifically, the symposium will not only highlight various prosocial behaviors (e.g., comforting, sharing, helping) but also delve into their underlying psychological mechanisms.

Vaish and colleagues present developmental and comparative research on basic forms of prosocial behavior, focusing on the cognitive abilities and motivations that lead to helping and sharing. Specifically, they show that the possibly primate-general ability to read others' goals enables both infants and chimpanzees to help others instrumentally. Moreover, 18-month-olds sympathize with and subsequently behave prosocially toward others through a social-cognitive evaluation of the other's situation, even in the absence of distress cues.

Svetlova and colleagues add an important developmental dimension to the study of prosocial behavior by tracking children's helping and sharing behavior throughout the second year. They show that at 12 months, infants detect others' negative affect but only by 18 months do they act prosocially in response to this affect. However, in the absence of situational or distress cues, even 2-year-olds require explicit communicative cues about the other's desire for an object in order to initiate acts of sharing.

Olson and Spelke will then present work showing further development and sophistication in children's sharing, as seen in the ability of 3-year-olds to use social relationships in order to make judgments about whom to allocate more or fewer resources to. In particular, they show that 3-year-olds can use evolutionarily beneficial strategies such as kinship and direct and indirect reciprocity as guiding principles for sharing.

Our discussant, Tracy Spinrad, will integrate and comment on these presentations and relate these new findings to the broader field of prosocial development.

### Social-Cognitive Contributors to Prosocial Behavior

**Amrisha Vaish**, Felix Warneken, Michael Tomasello, Malinda Carpenter

*Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany*

Prosocial behaviors such as helping and comforting appear early in ontogeny. Prior work has focused on emotional processes involved in these behaviors (e.g., emotional contagion and empathy). However, cognitive processes that help children assess the other's situation likely also play a critical role, but have been studied less. We therefore examined two different social-cognitive processes underlying prosocial behaviors.

First, we investigated children's instrumental helping based on an understanding of others' goals. Children were tested in situations which required the ability to identify the goal another person was

trying to achieve and an altruistic motivation. These studies established that during the second year, children's emerging understanding of goals enables them to intervene in a variety of situations. New data suggest that such helping is driven by an intrinsic motivation: 20-month-olds who had previously been rewarded for helping were less likely to help subsequently as compared to children who had not been rewarded (p=.006), indicating that rewards can undermine children's altruistic tendencies.

Second, we examined children's sharing based on a cognitive assessment of the other's emotional state. Previous research on sympathy involved presenting children with distressed persons. We asked whether young children can sympathize in the absence of emotional cues. We showed 18- and 24-month-olds an adult either harming another adult by, e.g., destroying her possessions (Harm) or doing something similar that did not harm her (Neutral). The hurt experimenter expressed no emotions in either condition. Nevertheless, in Harm, more children showed sympathy toward the victim, p=.016, children showed more subsequent prosocial behavior toward the victim, p=.047, and children's degree of sympathy correlated with their prosocial behavior, r(22)=.39, p=.032. Young children thus sympathize with a sufferer cognitively.

These studies suggest that young children act prosocially not only in response to overt emotional cues but also through a social-cognitive evaluation of situational factors.

### Prosocial Behavior in Toddlers: Developments in Empathic Responsiveness and Sharing

**Margarita Svetlova**, Sara Nichols, Celia Brownell
*University of Pittsburgh, Pittsburgh, USA*

To be able to respond prosocially, one has to understand what another person needs, feels, or wants. One of the early indices of this understanding is empathic response to another's distress, which develops over the second year of life. Desire understanding also develops during this period, providing the necessary prerequisite for such prosocial responses as helping and sharing. In this presentation we examine how early prosocial behavior varies as a function of the cues available to the child regarding the partner's feelings or desires.

In one study, we presented 12-, 18- and 24-month-old children with a "baby" (realistic looking doll) producing either happy or distressed vocalizations. Twelve-month-olds stopped playing and attended more often to the distressed baby than to the happy baby, whereas 18- and 24-month olds exhibited a larger range of prosocial responses to the crying baby, including greater empathic concern at 24 months. Thus, by 12 months of age children discriminate peers' positive and negative affect based on vocal cues alone, but prosocial behavior in response to vocal distress emerges later, by 18 months.

In a second study, we presented 18- and 24-month-old children with a sharing task in which the potential recipient was either silent about her desires or made them explicit. Adapted from work on altruism in chimpanzees, the task ensured that all children had the same opportunity and incentive to share. Children chose between two alternatives: 1) to give food both to themselves and a familiar adult, or 2) to give food to themselves alone. Both younger and older children chose randomly when the recipient was silent. However, when the recipient made her desires explicit 24-month-olds shared whereas 18-month-olds did not. Thus, for very young children prosocial behavior in response to another's desire depends on explicit communicative cues, and emerges by 24 months.

### The Foundations of Cooperation in Young Children

**Kristina Olson**, Elizabeth Spelke
*Harvard University, Cambridge, USA*

Previous research has investigated the development of young children's prosocial tendencies, demonstrating that prosocial behavior begins in the first year of life with considerable increases in sharing behavior in the second year of life. In parallel, evolutionary theorists have hypothesized the importance of specific rules that may have promoted cooperation across evolution, but have primarily tested for these principles using computational modeling and experiments on human adults. In the current research we ask whether kin preference, direct reciprocity, and indirect reciprocity are present in young children.

In all of our studies we presented children (age 3.5 years) with a protagonist (doll) that they are directed to help throughout the study. Children were introduced to other dolls, described in relation to the protagonist (e.g., the protagonists' sisters) and were asked to distribute resources (e.g., stickers) to these other dolls.

In our study of kin preference, children directed the protagonist to share more with kin than strangers, t(17)=2.34, p=.032, and more with friends than strangers, t(15)=3.09, p =.007, but made no distinction between close non-kin (friends) and kin, p=ns. In studies of reciprocity, children directed the protagonist to give more resources to the dolls that had previously given to the protagonist compared to those who had given to another doll, t(20)=2.27, p=.035, consistent with an understanding of direct reciprocity. Consistent with an understanding of indirect reciprocity, children also shared more resources with the dolls who had shared with another doll compared to those that had not shared at all, t(28)=2.39, p=.024. These findings suggest that young children can apply evolutionarily beneficial strategies by age 3.5 years, even in situations in which they are not the direct beneficiaries of the rewards.

---

## *What's in a Touch* *(Regular Symposium, Biological Processes)*

**Chair:** *Ruth Grunau*

**Discussant:** *William Fifer*

**Ruth Grunau**[1,2] Catharine Rankin[3,4] **C. Johnston**[5]

*1. Child and Family Research Institute, University of British Columbia, Vancouver, Canada; 2. Dept. of Pediatrics, University of British Columbia, Vancouver, Canada; 3. Brain Research Centre, University of British Columbia, Vancouver, Canada; 4. Psychology Dept., University of British Columbia, Vancouver, Canada; 5. McGill University School of Nursing, Montreal, Canada*

Touch is the earliest developing sensory system. The importance of touch in developing regulation of stress, promoting cognitive and social development, as well as early infant attachment, is well established in mammals, including humans. A basic feature of all nervous systems is that during development, activity dependent processes sculpt the patterns and strengths of connections between brain cells. Critical periods for human brain development occur before and after birth, rendering the immature brain susceptible to effects of early stress. Adverse early experience can lead to altered hormonal, autonomic and behavioural stress regulation. Conversely, developmentally appropriate touch may buffer effects of early stress. Basic research on touch in a simple animal model (the microscopic worm C. elegans) to investigate the ways that early experience affects the developing nervous system and alters behaviour, neural connections and growth

in adult animals, has led to increased knowledge of the importance of mechanoreceptor systems in understanding developmental mechanisms (C. Rankin). It is well established that early stress has long term effects on hypothalamic-pituitary-adrenal (HPA) axis activity. Human infants born extremely preterm (≤28 weeks gestation) are exposed to prolonged pain-related stress during neonatal intensive medical care, that is associated with critical and persistent changes in the developmental trajectory of basal stress hormone (cortisol) levels (RE Grunau). Importantly, "skin-to-skin" between preterm neonates and their mothers appears to ameliorate stress in the NICU, which may in turn contribute to improved developmental outcomes for this fragile population (CC Johnston). Through considering these multiple lines of evidence, we will extend our understanding of the mechanisms of effects of adverse and beneficial touch during development, with the hope of developing ways to prevent or ameliorate adverse effects of early stress.

### Pain-related Stress in Infants Born Preterm

**Ruth Grunau**

*Child and Family Research Institute and Pediatrics Dept., University of British Columbia, Vancouver, Canada*

Early environmental stress can permanently reprogram hormonal, autonomic and behavioural systems.

Developmentally unexpected tactile stimulation, related to handling and repetitive skin-breaking procedures, are intrinsic to hospitalization in the neonatal intensive care unit (NICU). Human infants born preterm at extremely low gestational age (ELGA ≤28 weeks gestation) are physiologically fragile, display low threshold to touch, and are outside the protective intrauterine environment, at a time of particular vulnerability of the rapidly developing brain. Evidence that cumulative neonatal procedural pain, during this period of physiological immaturity, induces shifts in behavioural and hypothalamic-pituitary-adrenal (cortisol) regulation to a range of stressors across infancy and early childhood will be presented. Chronic pain and stress in ELGA infants appear to 're-set' arousal and self-regulation systems. Specifically, we find that down-regulation of neonatal cortisol levels is evident while infants are exposed to ongoing stress in the NICU, continuing to 3 months corrected age (CA; i.e. adjusted for prematurity), with a switch to persistent up-regulation of basal cortisol levels at 8 and 18 mo CA, suggesting long term programming. Prolonged high endogenous glucocorticoid exposure in toddlers born extremely preterm may be one mechanism contributing to long-term difficulties with attention, executive function, memory, learning and behaviour in this population. Parenting factors such as maternal stress and interaction behaviour appear to moderate long-term effects of neonatal stress.

### The Fundamentals of Early Experience - a Kiss May Just Be a Kiss, and a Sigh, Just a Sigh: But a Touch Could Change Your Life

**Catharine Rankin**

*Brain Research Centre and Psychology Dept. University of British Columbia, Vancouver, Canada*

There are a number of scenarios by which children are deprived of sufficient levels of stimulation, or receive inappropriate stimulation, during development. These include premature birth, or growing up in institutional facilities (i.e. orphanages in developing countries), which provide basic care, but little stimulation. Often children from these situations do poorly in later life and have low IQ, because stimulation is an important component of normal nervous system development. A basic feature of all nervous systems is that during development activity dependent processes sculpt the final patterns and strengths of connections between brain cells. As a result of altered early experience changes in brain connections, behaviour and general growth and health have been reported in mammals, including humans. We are using a simple model system, the microscopic worm C. elegans, to investigate the ways that early experience affects the developing C. elegans and alters behaviour, neural connections and growth in adult animals. Through this research we will extend our understanding of the mechanisms of the critical periods during development and with the hope of developing ways to reverse the effects of early deprivation in other systems.

### The Effects of Skin-to-Skin Contact on Pain Response in Preterm Neonates

**C. Johnston**

*McGill University School of Nursing, Montreal, Canada*

Skin-to-skin contact, commonly referred to as Kangaroo Care after its resemblance to marsupial behaviour, was originally implemented in the neonatal population to provide continuous warmth to neonates born preterm for whom traditional incubators were inaccessible. Serendipitous observations of increased duration of periods of quiet sleep lead researchers to examine its use in situations of high stress, specifically acute painful procedures. Results from several studies will support the hypothesis that it is touch that is the 'active ingredient' in reducing the stress response to a painful event. Full term neonates, moderately preterm neonates 32-36 weeks gestational age and very preterm neonates 28-32 weeks all show remarkable decrease in pain expression when in kangaroo care. Augmenting kangaroo care with rocking, maternal voice, and sucking opportunity had no effect. Underlying mechanisms considered are endogenous opiate release and/or oxytocin release. Further research currently underway is examining the effect of natural mother providing kangaroo care versus others.

---

## *Issues in Early Identification of Autism in Diverse High-Risk Infant Cohorts*

*(Regular Symposium, Psychopathology and Developmental Delay)*

**Chair:** *Judith Gardner*

**Discussant:** *Lonnie Zwaigenbaum*

**Judith Gardner**[1] Bernard Karmel[1] Ira Cohen[2] Peter Mundy[3] **Lonnie Zwaigenbaum**[4]

*1. Department of Infant Development, New York State Institute for Basic Research in Developmental Disabilities, Staten Island, USA; 2. Behavioral Assessment & Research Laboratory, Department of Psychology, New York State Institute for Basic Research in Developmental Disabilities, Staten Island, USA; 3. University of California at Davis School of Education and M.I.N.D Institute, Davis, USA; 4. University of Alberta & Glenrose Rehabilitation Hospital, Edmonton, Canada*

Complex neurodevelopmental processes underlie autism spectrum disorder (ASD). Defining these processes is fundamental to identifying precursors in infancy; but doing so raises issues, especially because of the developmental nature of ASD in which atypical behaviors emerge after one year of age or later. Some issues include: (1) early identification of precursor behaviors since specific early intervention is more effective the milder the condition and/or the earlier begun; (2) detection and verification of atypical development, both for understanding biological/neural substrates and relations to neurobehavioral

organization, and for identifying infants most at risk; and (3) differentiation of identified infants from others at risk for developmental disabilities but not autism in order to optimize intervention strategies. This symposium provides new information addressing these issues. Presenters bring a broad array of knowledge and experience about relevant developmental processes in high-risk infants and children, with applications to identifying and diagnosing autism. Two populations of infants appear higher-risk; those with obstetric/neonatal complications (2-4-fold increase) and siblings of affected children (10-fold increase). Karmel evaluated neonatal indicators and infant behavior in a subset (~ 2%) of NICU children suspected of ASD, incidentally recruited at birth for longitudinal study concentrating on arousal regulation, attention and motor development. He describes differences in demographic, CNS injury, and behavior between these children and other high-risk infants. Cohen evaluated about 1/3 of these suspect children, all diagnosed on the spectrum. He presents comparisons between their demographic and early behavior with later performance on the PDDBI, and in relation to other non-NICU diagnosed children. Mundy has studied joint attention and social communication with different populations of infants. He reports findings of joint attention and neurodevelopment of brain mechanisms mediating social executive functions in ASD and other risk conditions. Zwaigenbaum will discuss and integrate the issues with respect to reported findings in light of his experience with baby siblings of affected children and early diagnostic behaviors.

### Contrasts of Medical and Behavioral Data from NICU Infants Suspect and Non-Suspect for Autism Spectrum Disorder (ASD)

**Bernard Karmel**[1] Judith Gardner[1] Lauren Swensen[1] Elizabeth Lennon[1] Eric London[2]

*1. Department of Infant Development, New York State Institute for Basic Research in Developmental Disabilities, Staten Island, USA; 2. New York State Institute for Basic Research in Developmental Disabilities, Staten Island, USA*

Infants with obstetric/neonatal complications appear to be at high-risk for ASD. Our longitudinal studies evaluate the development of regulatory mechanisms from birth in infants assigned to the NICU. Consistent with previous reports, retrospective evaluation of records indicated approximately 2% of our population (n = 42 of > 2100) were suspect or diagnosed with ASD. Suspect and non-suspect infants were compared on demographic and medical indicators as well as a wide range of behaviors from birth to 3 years to characterize effects potentially useful in early diagnose of ASD. As expected, the suspect ASD group was predominantly male (81% vs. 54%). Moreover, their mothers were more educated (14.9 vs. 13.8 years). Suspect ASD infants were born at lower gestational age (GA) and birth weight (BW), controlled for gender and maternal education. Suspect and non-suspect infants did not differ on intrauterine growth, degree of early asphyxia, or severity of CNS involvement, controlled for GA or BW. Suspect ASD infants showed a pattern of behavioral deficits starting in the newborn period. They had a higher incidence of visual asymmetries and a lower incidence of head control problems at 1 month. They also showed poorer modulation of visual attention across feeding and stimulus conditions at 1 and 4 months, indicating potential deficits in development of regulatory systems. Controlling for maternal education and CNS injury, assessments indicated lower scores on Bayley-II PDI and MDI starting at 7 and 10 months respectively, and on Griffiths Mental Development Scales between 2 and 3 years. These data suggest that, as early as newborns, infants suspected or diagnosed with ASD may form a distinct sub-population within NICU-assigned babies, with visual and arousal regulation deficits even when compared to other high-risk infants who also may experience regulatory deficits, but in different ways. Such differences may be indicative of precursors to ASD expression seen at older ages.

### Associations between Early Measures of Medical Complications and Neurobehavioral Integrity with later Dimensional Measures of Autism Traits in NICU Infants

**Ira Cohen**, Tina Rovito-Gomez

*Behavioral Assessment & Research Laboratory, Department of Psychology, New York State Institute for Basic Research in Developmental Disabilities, Staten Island, USA*

Autism is a complex disorder of development and represents a subclass of Pervasive Developmental Disorder (PDD). It is crucial to identify early biological and behavioral risk factors for PDD, as well as for its severity, since there is evidence that early intervention is effective in improving long-term outcome, especially among more mildly affected cases. Researchers have attempted to identify early signs by studying "baby sibs" - infant siblings of children with autism (10-fold increased risk for developing PDD). Another group at risk is infants with obstetrical/neonatal complications (3-4 fold risk). The Behavioral Assessment and Research group at IBR has diagnosed with PDD approximately 1/3 of the 2% suspect cases who had been studied intensively by the Infant Development group. Assessments included the Autism Diagnostic Observation Schedule-G (ADOS-G), Vineland Adaptive Behavior Scales, and parent and teacher ratings based on the PDD Behavior Inventory (PDDBI), an age-standardized dimensional measure of PDD traits. Data will be presented on the behavioral characteristics of this subgroup of PDD, how they compare with typically referred cases, and the relations between early physical and neurobehavioral measures with later dimensional measures of PDD traits and adaptive skills. Preliminary data suggest moderate to strong associations between birth measures (e.g., head circumference, Apgar scores) and neurobehavioral assessments performed before 12 months of age with later PDDBI domain scores: SENSORY (sensory seeking-type behaviors); Social Discrepancy Composite (a measure of social competence); AUTISM Composite (a measure of autism severity); REPRIT Composite (a measure of classic autism traits); and AWP Composite (a measure of autistic and non-specific behavioral traits). NICU infants are at high risk for PDD, in addition to other developmental disabilities. These data indicate that early physical and neurobehavioral measures suggest associations to later PDD traits. The patterns thus far, although specific to these NICU infants, appear to fall between those for CNS-injured and cocaine-exposed infants.

### New Perspectives on Joint Attention in Children with Autism and Their Siblings

Peter Mundy

*University of California at Davis School of Education and M.I.N.D Institute, Davis, USA*

Joint attention deficits are a cardinal symptom of autism, and a marker of risk among infant siblings of children with autism. Several new observations have recently deepened our understanding of the significance of joint attention disturbance in autism spectrum disorders. Social cognitive theory suggests that the onset of joint attention occurs between 9 and 12 months of age. However, theory and research from an information processing perspective suggests that the attention systems involved in joint attention reflect posterior and anterior corti-

cal systems that have their onset by 3 months of age and perhaps as early as the neonatal period. New research also emphasizes that joint attention reflects processes associated with human learning, as well as social cognitive development. These two aspects of joint attention, learning processes and social cognition, are ultimately synergistic. Understanding this synergism is vital to recognizing the significance of joint attention disturbance in early human development and autism. Joint attention may also reflect as much about awareness of self-intended behavior (e.g., attention) as it does about awareness of the intentional behavior of other people. Self-intended behavior involves choices based on value and predictions of reward. Thus, value, reward, or motivation may play a central role in the development of "self-intended attention" and joint attention. An appreciation of this may be critical to understanding the genesis of joint attention deficits in autism. Finally, joint attention is but one component of a dynamic system of social development. Interactions with other developmental milestones may be critical to its typical and atypical development. To illustrate this, data on a regression in typical joint attention will be discussed. This occurs in conjunction with the onset of walking, when the symptoms of autism often become more prominent, and may involve a vulnerable period in the motivation for social engagement.

## Oral Presentations, March 29, 2008

### Teaching Developmental Science: Integrating Scholarship and Pedagogy *(Round Table)*

Wendy Ostroff[1] **Megan McIlreavy**[2] **Jamie Cooper**[3]

*1. Sonoma State University, Rohnert Park, USA; 2. University of Georgia, Athens, USA; 3. George Mason University, Fairfax, USA*

Most of us, in addition to running labs and training researchers, spend a lot of time in the classroom, trying to integrate our research in Developmental Science into a broader context and to make cutting edge theories and data accessible to students of various levels. Rather than seeing these activities as separate (even as stealing time away from one another) we need to approach the teaching of our discipline with the same rigor that we approach our programs of research. This roundtable discussion initiates a conversation about how we teach in the field of Developmental Science and how we can better integrate that with our scholarly lives (i.e., make our teaching public, available for comment and review by peers, and work that can be built upon and contribute to the field). It will be a forum to share resources, ideas, insights and pedagogical tools in the inherently interdisciplinary fields of Developmental Science and Infancy Studies.

### Understanding Coparenting Alliances in Nuclear, Fragile, and Extended Kinship Family Systems: Taking Stock of Best Practices and Unresolved Issues in Conceptualization and Assessment *(Round Table)*

**James McHale**[1] **Mark Feinberg**[2] **France Frascarolo**[3] **Deborah Jones**[4] **Kristin Lindahl**[5] **Neena Malik**[6] **Sarah Mangelsdorf**[7]

*1. USF St. Petersburg, St. Petersburg, USA; 2. Pennsylvania State University, University Park, USA; 3. Centre D'Etude de la Famille, Lausanne, Switzerland; 4. Univerisity of North Carolina at Chapel Hill, Chapel Hill, USA; 5. University of Miami, Miami, USA; 6. Universiity of Miami Miller School of Medicine, Miami, USA; 7. University of Illinois, Urbana, USA*

Since the very first reports of coparenting during infancy were disseminated at ICIS 15 years ago, over two dozen laboratory studies have linked early coparenting dynamics and adjustment to infant and toddler adaptation. Field studies of fragile families have also identified coparenting as a central socialization dynamic for families of infants and young children, but have proceeded largely without tested, agreed-upon tools for validly assessing coparenting adaptation. Field efforts have also been hampered by an absence of consensually agreed-upon coparenting conceptualizations and measures appropriate for extended kinship systems. This roundtable gathers together leading international experts in coparenting theory and assessment who bring substantial experience working with diverse family systems. Panelists include leading experts in coparenting risk, prevention, and intervention; observational assessment of mother-father-infant triads; coparenting adaptations in single-parent families; and cultural influences on coparenting arrangements and dynamics in African American, Hispanic, and multi-cultural families. Aims of the roundtable are to outline major conceptual similarities and differences in the coparenting adaptations and dynamics of nuclear, fragile, and extended kinship families raising infants and toddlers; to articulate current best practices for assessing coparenting risk and adaptation; and to pinpoint as-yet unresolved gaps that would allow for sensitive conceptualization and assessment of coparenting in fragile and extended kinship systems. Segment One of the session will be given

to commentary on the relevance of central coparenting dimensions - solidarity, antagonism, and detachment - in nuclear, fragile, and extended kinship families, and to conceptualization and assessment considerations not adequately addressed by this rubric. Segment Two will address best practice assessment paradigms and tools, gaps, and needs in incisive assessment. Audience commentary will be solicited after both segments, toward charting directions for future collaborative research on coparenting of infants and toddlers.

---

## *Beyond Where?: Using Neuroimaging to Examine How Infants Learn About and Represent the World*

*(Invited Symposium, Cognitive Development)*

**Chair:** *Charles Nelson*

### Measuring Gamma-Band EEG Oscillations as a Tool to Study Infant Cognition

Gergely Csibra

*Birkbeck, University of London, London, UK*

One can measure the functional brain activation of babies for several purposes. First, variations of neural activation measured in controlled situations may reveal how the infant brain works, and when these results are compared across development or with those of adults, they allow insights into early development of the cerebral cortex and perhaps other structures. Second, correlating neural activations with behavioural performance across individuals can generate hypotheses about the neural mechanisms that underlie overt behaviour, and may lead to a better understanding of individual differences or developmental disorders. Finally, functional brain activations in infants can be used to test, support, or falsify theories of infant cognitive development¬-as long as such activations could be plausibly identified as neural 'signatures' of certain kinds of representations or computations.

In this talk, I will illustrate this third, most modest, usage of neuroscientific approach to infant cognition by examples of measurement of high-frequency (20-60 Hz) electroencephalographic oscillations. These gamma-band oscillations have been shown to correlate with the haemodynamic activations recorded by functional magnetic resonance imaging (fMRI) and near-infrared spectroscopy (NIRS). We found such gamma-band responses when infants observe an object going into occlusion, and showed that such activations are absent when the object disappears without being occluded. Using this finding, we tested whether infants process faces the same way as they do with inanimate objects. In another set of studies, we found frontal gamma-band oscillations in response to direct gaze, and then demonstrated the same activation in response to another stimulus indicating communication. Such findings support the hypothesis that infants perceive direct gaze as a communicative cue.

### Beyond Where? Neuroimaging and the Discovery of How the Infants Learn How to Represent the World

Jacques Mehler

*International School for Advanced Studies, Trieste, Italy*

After using behavioural methods to characterize cognitive development, we recently added neuroimaging procedures. On the one hand, neuroimaging has made it possible to link brain mechanisms to cognitive processing while on the other it allows us to characterize both the cognitive abilities of neonates and those of three month olds. The introduction of non-invasive imaging helps to corroborate or to reject the conjectures derived from behavioural methods.

Using near infrared spectroscopy we have shown that at birth natural language activates the temporal areas in the LH whereas time reversal of the same utterances does not result in an activation of the LH. These results are compatible with those obtained with three-month olds who were studied using fMRI and with previous behavioural results.

In a further near infrared spectroscopy study we have shown show that newborns tend to extract a simple syllable repetition at the edge of tri-syllabic items, i.e., ABB, where A and B are syllables selected amongst many different syllables (allowing us to construct many different items). In a second experiment we presented non-adjacent repeating syllables like in the AXA structure (where A and X represent different sets of syllables) and infants' brains failed to react differently to this structure as compared to an ABC one.

To conclude we argue that students of language acquisition should accept that there is more to the human mind than the ability to project rules and compute distributional regularities. I will argue that one ought to add a set of ad-hoc tools that arise as a consequence of the way in which the vertebrate's sensorium processes sequential stimuli

### Using Neuroimaging to Study the Development of Domain-Specific Mechanisms.

Rebecca Saxe

*Department of Brain and Cognitive Sciences, MIT, Cambridge, USA*

Classically, cognitive developmental psychology has investigated the structure of the mind by studying the behavioural task performance of infants and children. Functional neuroimaging offers an alternative dependent measure to study the components of cognitive processes, and therefore to address the same fundamental questions. For example: To what extent is the mind organized into dedicated, domain-specific mechanisms for specific classes of representations? If there are domain-specific mechanisms in the adult mind, do these mechanisms mature early in infancy, or does selectivity emerge slowly over development? Finally, if specialization of function develops gradually, what aspects of biology or experience control this development?

In this talk, I will describe neuroimaging studies that investigate these questions, focusing on one domain: Theory of Mind, or the ability to think about thoughts. Functional neuroimaging studies of adults have revealed a group of brain regions reliably recruited when participants read about a character's thoughts: bilateral temporo-parietal junction (TPJ), posterior cingulate, and medial prefrontal cortex. The RTPJ, in particular, is a good candidate for a domain-specific mechanism: its response is high for stimuli that require thinking about thoughts, but low for closely matched logical and social controls.

Recent studies directly address the development of specialization in the RTPJ. First, a study of school-aged children found that although the general contours of the brain network for Theory of Mind are in place by age 6, extreme specificity for belief information in the RTPJ does not emerge until age 9. Second, a study of congenitally- and late-blind adults found that the structure and selectivity of the Theory of Mind network does not depend on visual social experience. I will discuss these results in light of recent studies of Theory of Mind in infancy.

## *Prenatal Exposure to Women's Mood Dysregulation: What is the Signal Affecting the Fetus and Child?*

*(Regular Symposium, Emotional Development)*

**Chair:** *Catherine Monk*

**Discussant:** *Tim Oberlander*

**Catherine Monk**[1] Sherryl Goodman[2] Patricia Brennan[2] Tim Oberlander[3]

*1. Columbia University/New York State Psychiatric Institute, New York, USA; 2. Emory University, Department of Psychology, Atlanta, USA; 3. University of British Columbia, Department of Pediatrics, Vancouver, Canada*

**Background and Aims:** Development begins before birth. According to accumulating evidence, women's experiences and experience-based alterations in their physiology influence the child's future psychobiology. However, it is unclear what specifically in women's lives is transmitted to the fetus and affects the child's development. Some studies indicate prenatal anxiety and depression have long term consequences for the child, but is it the exposure to the mental illness *per se*, or to life stress associated with these disorders, that affects offspring outcome? Animal data indicate that cortisol may be the pathway by which maternal psychology 'gets under the skin' to influence fetal development, yet the few human studies evaluating this hypothesis show equivocal results. Moreover, little is known about the timing and chronicity of exposure to women's distressed moods as these factors impact the child. Finally, what about the influence of psychopharmacology? Does a mood improvement during pregnancy also reach the developing child? This symposium addresses these questions. We aim to consider what *is* the signal underlying the associations between women's prenatal functioning and early child - and fetal - functioning.

**Participants:** Each panelist will discuss research on prenatal programming focusing on different characteristics of maternal functioning and offspring development and ages. Monk will examine women's antenatal psychiatric status and stress-related physiology in relation to fetal heart rate; Goodman will consider the timing and chronicity of women's antenatal depression, stress, and anxiety as associated with newborns' neurobehavior; Brennan will look at women's antenatal mood and stress, as well as medication use in relation to 6-month old infants' stress-induced cortisol and heart rate reactivity. Oberlander will discuss the implications of selective serotonin reuptake inhibitors (SSRIs) taken by depressed mothers during pregnancy on infant development, as well as the neonatal impact of combined exposure to maternal depressed mood and SSRIs.

### Fetal Heart Rate Reactivity is Associated with Women's Psychiatric Status and Cortisol

**Catherine Monk**[1,2] William Fifer[1] Lynn Evans[1] Lauren Kaplan[1]

*1. Columbia University, New York, USA; 2. New York State Psychiatric Institute, New York, USA*

**Background/Aims:** Women's antenatal psychiatric illness predicts characteristics of child psychobiology. These antenatal effects rarely are identified during pregnancy. We hypothesized that fetal heart rate (HR) during women's exposure to laboratory challenge would be associated with women's diagnostic status and stress-elicited cortisol activity.

**Method:** In the 2nd trimester, 123 women underwent a psychiatric interview (SCID). In the 36th-38th gestational week, they completed a questionnaire rating pregnancy-specific stress (PES), and continuous ECG, blood pressure, respiration, and fetal HR were measured during a 5 minute baseline period followed by a five minute stressor, the Stroop color-word matching task. Three salivary cortisol samples were taken 30 minutes apart: at the start of the session (baseline), after practicing the Stroop task (anticipation), at the end of the study (completion).

**Results:** The diagnostic groups were: depression, including comorbity with an anxiety disorder (n=28); anxiety disorder only (n=21); controls (n=74). During the challenge task, women's cardiorespiratory activity increased and there were no group differences. Cortisol reactivity (anticipation - baseline) differed by group ($F(2, 99) = 3.45$, $p < .05$); depressed women, who had higher levels during baseline, had a bigger decrease ($p < .05$). Concurrent with women's cardiorespiratory reactivity to stress, fetal HR increased in the depressed group compared to controls ($F(2, 125) = 4.42$, $p < .01$; Post-hoc $p < .05$). In a regression model of fetal HR change controlling for demographic variables, ($R2 = .41$, $p < .001$), cortisol change during anticipation was a significant predictor, along with diagnosis, concurrent acute changes in women's respiration and maternal HR, and PES.

**Discussion:** These results suggest that in the context of stress-based acute changes in women's cardiorespiratory activity, which may function as stimuli to the fetus, antenatal psychiatric status and cortisol activity both contribute to the resulting group differences in fetal HR reactivity. Pregnancy related stress also is a factor.

### Women's Antenatal Depression and Newborn Neurobehavioral and Neuroendocrine Functioning: Tests of Moderators and Mediators Over Mid- to Late-Pregnancy

**Sherryl Goodman**[1] Sarah Brand[2] Matthew Rouse[2]

*1. Emory University, Department of Psychology, Altanta, USA; 2. Emory University, Atlanta, USA*

**Background/Aims:** Women's depression during pregnancy is associated with newborns' poorer neurobehavioral and neuroendocrine functioning. We propose to present data on theory-driven moderators (antenatal stress, anxiety) and mediators (antenatal cortisol levels) that help explain those associations.

**Method:** Participants were pregnant women (n=81) all of whom had a past major depressive episode. Depression, anxiety, stress, and cortisol were measured each month through mid- to late pregnancy. We thus improved on the typical reliance on one or two data collections, often only late in pregnancy. Within one week postpartum, the newborns were administered the Neonatal Behavioral Assessment Scale (NBAS) and their salivary cortisol was collected at baseline and in response to the NBAS administration.

**Results:** Over half (51%) of the women experienced antenatal depression. Newborns of these women, compared to those whose mothers had no antenatal depression, scored less optimally on State of Organization [$F(1,72) = 7.73$, $p < .01$] and Autonomic Stability [$F(1,72) = 4.75$, $p < .05$]. More severe and more variable antenatal depression predicted higher newborn cortisol at baseline ($r = .36$ and $.48$, respectively) and post stress ($r = .37$ and $.44$). Regarding moderation, women's antenatal anxiety, stress, and depression levels were highly intercorrelated (r's from .58 to .79); neither stress nor anxiety moderated depression as a predictor of newborn NBAS scores ($r2$ change $= .01$). Regarding mediation, women's antenatal cortisol was significantly related to newborn cortisol ($r=.43$), which in turn was related to several NBAS subscales.

**Discussion:** The results suggest that it is antenatal depression and not moderation with anxiety or stress that is associated with newborn

functioning. We found limited support for mediation: women's pregnancy cortisol was significantly related to infant cortisol levels at birth and infants' cortisol levels were related to some subscales of the NBAS.

### Prenatal Maternal Stress and Depression and Infant Outcomes

**Patricia Brennan**, Elaine Walker, Jeffrey Newport, Zachary Stowe

*Emory University, Atlanta, USA*

**Background/Aims:** Prenatal maternal depressive symptoms have previously been associated with elevated cortisol and heart rate levels during infancy. In this study we explored the relationships between maternal prenatal stress and depressive symptoms and umbilical cord cortisol, as well as infant neurological functioning, cortisol and heart rate responses to stressors at 6 months of age.

**Method:** A total of 84 women (79 with a history of Axis I disorders) were recruited through the Emory Women's Mental Health Program. These women completed prospective measures of depressive symptoms and stress during pregnancy, their newborn infant's cortisol was measured in umbilical cord blood, and their 6 month old infant's heart rate and/or cortisol responses to stress were measured in the context of an arm restraint and noise burst stressor task in the laboratory.

**Results:** Maternal mean stress and depressive symptom scores during pregnancy were highly correlated (r=.79). All analyses controlled for maternal psychotropic medication use (n=65), age, and bipolar disorder (n=11). Umbilical cord cortisol was unrelated to maternal depression scores in pregnancy (t=-1.54, p=.13) but it was negatively associated with maternal prenatal reports of perceived stress (t=-2.08, p=.04). Infant neurological functioning and RSA change during the arm restraint stressor task were unrelated to maternal prenatal reports of stress and depression, but were both positively associated with umbilical cord cortisol (RSA:t=2.23, p=.03; Neurological screen: t=2.36, p=.02). Cortisol reactivity to the lab stressor tasks was unassociated with predictors in the current study.

**Discussion:** These results suggest that (in the context of a high risk sample with the majority of women on medication) maternal stress during pregnancy may be negatively related to 6-month infant outcomes through its effect on fetal/infant cortisol levels at birth. In this particular sample higher umbilical blood cortisol levels were associated with better neurological functioning and stress regulation at 6 months of age.

---

## *The Emerging Self* *(Regular Symposium, Social Development)*

**Chair:** *Michael Lewis*

**Michael Lewis**[1] Betty Repacholi[2] Andrew Meltzoff[2] Philippe Rochat[3] Claudia Passos-Ferreira[4] Dennis Carmody[1]

*1. UMDNJ - Robert Wood Johnson Medical School, New Brunswick, USA; 2. University of Washington, Seattle, USA; 3. Emory University, Atlanta, USA; 4. State University of Rio de Janeiro, Rio de Janeiro, Brazil*

This symposium has as its focus the emerging self. There is evidence that while some aspects of the self exist early, it is not until the second half of the second year that a representational self emerges. The three papers in this symposium examine the relation between the emergent self and the idea of possession (it is mine), the imitation of others, and brain maturation, which may support this development. The integration of the study of possessions, imitation and brain maturation from three of the most active laboratories provides a forum for the study of the emergent self and has implications for social and emotional development.

Betty Repacholi and Andrew Meltzoff will present their work on infant imitation, while Philippe Rochat and Claudia Passos-Ferreira will discuss their studies of infant ownership. Dennis Carmody and Michael Lewis will present their work on brain maturation in infancy as it relates to the emergence of self representation. Michael Lewis will serve as discussant.

### Infants Use Attentional Cues to Determine Whether Emotional Information Is Relevant to the Self

**Betty Repacholi**, Andrew Meltzoff

*University of Washington, Seattle, USA*

**Background and Aims:** By 18 months, infants can use indirect emotional information (i.e., emotional communications directed toward a third party) to regulate their behavior (Repacholi & Meltzoff, 2007). It would be maladaptive, however, if infants responded to every emotional display that they saw or overheard. Infants need to be able to determine when these emotional signals are relevant to the self and when they are not.

**Methods:** In Study 1, 18-month-olds watched an Experimenter demonstrate an action on an object. Another adult (the Emoter) subsequently entered the room and expressed Anger or Neutral affect toward the Experimenter in response to her actions. Infants were then given 20s to play with the object. The Emoter was silent and neutral during this 20s response period. She faced the infant, but her eyes were either directed toward a magazine (Anger-distracted) or the infant (Anger/attentive-to-infant and Neutral/ attentive-to-infant). Two further trials involving different objects followed this identical procedure. In Study 2, the Emoter looked toward the infant during the response period, but her eyes were either open (Anger/eyes-open and Neutral/eyes-open) or closed (Anger/eyes-closed).

**Results:** Each infant received an imitation score (0-3) based on the number of trials in which they imitated the Experimenter's action. In Study 1, infants in the Anger/attentive-to-infant condition imitated fewer actions (M=1.42) than did infants in the Neutral/attentive-to-infant (M=2.21) and Anger-distracted (M=2.29) conditions, ps<.05. In Study 2, infants in the Anger/eyes-open condition had lower imitation scores (M=1.33) relative to infants in the Neutral/eyes-open (M=2.33) and Anger/eyes-closed (M=2.10) conditions, ps<.05.

**Conclusions:** Infants registered whether they were the focus of the Emoter's gaze. Their imitation was regulated according to whether they themselves were being watched by a person who had previously become angry when the action was performed. Theories of self that support this understanding will be discussed.

### From Implicit to Explicit Ownership

**Philippe Rochat**[1] Claudia Passos-Ferreira[2]

*1. Emory University, Atlanta, USA; 2. State University of Rio de Janeiro, Rio de Janeiro, Brazil*

By the time children are reportedly recognizing themselves in mirrors (18-24 months), they begin to show signs of self-conscious emotions and concerns for others. They become explicit in their claim of possession and entitlement by using possessives such as "Mine!" (meaning "not yours!"). We present research and theoretical ideas on the origins

and the developmental emergence of such coalesced pattern of behaviors.

First, we review a few among many studies demonstrating that early on infants discriminate what is caused by their own actions, and what is not. This represents a first implicit (perception-action) level of ownership that is constitutive of a pre-conceptual "ecological" sense of self. Potential mechanisms underlying this primary sense of ownership (e.g., mirror system and multi-modal treatment capacity that are prescribed from birth) are necessary, but not sufficient for the development of the conceptual sense of self that emerges by the end of the second year. This development is rooted in triadic social exchanges involving self and others in relation to physical objects.

By 9 months, parallel to explicit joint engagement and re-engagement of others in triadic exchanges, infants begin to manifest an explicit sense of possession via claim of exclusivity, the weariness of stranger and sometime acute affective investments into "transitional" objects for comfort and self-regulation in the face of separation. From then on, children become explicit about what they own as well as their sense of entitlements in relation to others. They start to identify themselves in objects they own, objectifying the self in the process as well as discovering the social power of explicit ownership for the control of social affiliation, reputation, and the gain of recognition from others. We discuss this process that finds its roots in infancy and would deserve much more empirical scrutiny.

### Self Representation and Brain Development

Dennis Carmody, Michael Lewis

*UMDNJ - Robert Wood Johnson Medical School, New Brunswick, USA*

**Background and Aims:** While some aspects of self development occur during the first year of life, self representation does not emerge until the middle of the second year. Measures of self representation include visual self-recognition, pretense, and the use of personal pronouns. Specific brain region activation has been found to be associated with self representational behaviors in adults, specifically in regions near the temporo-parietal junction, as well as the medial frontal cortex (Kampe, Frith, & Frith, 2003). The present study was designed to explore specific brain regions associated with the emergence of self representation.

**Methods:** Two studies are reported in which self representation is related to brain maturation. The first study examined 15 infants and toddlers, who had no MR findings as a consequence of the MRI examinations. The second included 23 infants and toddlers who had MR findings. We looked at self representation in relation to regional brain maturation. Mirror recognition, personal pronoun usage, and pretend play were used to generate an aggregate self representation score (SRS).

**Results:** In Study 1, the maturation of the left temporo-parietal junction was associated with the self representation score. This was also true for the MR findings group in Study 2. Combining the two groups of children revealed an association between maturation of left temporo-parietal junction and self representation, $r (n=38) = .40$, $p < .02$.

**Conclusion:** The findings from this study indicate that the degree of brain maturation in a specific region, independent of age, is related to the emergence of children's self representation. The degree of maturation in the left temporo-parietal junction which is most related to self representational behavior. This is consistent with other findings which implicate the temporo-parietal junction in its role in self representational behavior.

## *Selective Imitation in Infancy*

*(Regular Symposium, Social Development)*

**Chair:** *David Buttelmann & Norbert Zmyj*

**Discussant:** *Merideth Gattis*

**David Buttelmann**[1] **Norbert Zmyj**[2] Emily Bushnell[3] **Merideth Gattis**[4]

*1. Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany; 2. Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany; 3. Whitman College, Walla Walla, USA; 4. Cardiff University, Cardiff, UK*

Infants' ability to socially learn from others has been investigated intensively. Yet, little is known about factors that influence infants' imitative behaviour. What components of the demonstration do they rely on when deciding whether to copy an observed behavior or not? This symposium is directly linked to that question by presenting research investigating different characteristics of the model and the demonstrated action that preverbal infants take into account when imitating observed behavior.

The first presenter will focus on the relevance of the model's age when demonstrating novel and familiar actions. The likelihood of preverbal infants imitating a novel action increases as the age of a model increases. The opposite seems to be true for familiar actions: when presented with actions already in their repertoire, infants prefer to imitate models of their age group. The second presenter will show that preverbal infants are sensitive to the model's competence when copying means to achieve a desired effect. Finally, the data presented by the third presenter shows that infants are sensitive to the causality of perceived actions. For example, after observing action sequences they only copy those actions which are perceived as being relevant for producing the desired effect.

In sum, the presentations of this symposium show that preverbal infants do not blindly copy actions of others. Infants' choices whether or not to imitate a perceived behavior are influenced by both the model's characteristics in terms of age and competence as well as the action characteristics, including familiarity versus novelty and the observed causality of an action sequence. This research depicts infants' ability to extract reliable information from others' behavior and their selectivity in imitation. The discussant will evaluate the present findings in light of previous research on context sensitive imitation in infancy.

### Imitation of Differently Aged Models in 14-Month-Old Infants

**Norbert Zmyj**[1] Moritz Daum[1] Wolfgang Prinz[1] Gisa Aschersleben[2]

*1. Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany; 2. Saarland University, Saarbrücken, Germany*

Many studies, which investigate imitation in infancy, used adults as models. Yet, it is unclear whether infants differentially imitate depending on the age of the demonstrating model. On the one hand, adults are cultural experts and they are able to outline new and relevant behaviour that is worth to be imitated (Csibra & Gergely, 2006). On the other hand, peers provide an increased similarity between model and infant which might facilitate imitation as argued by simulation based accounts of imitation (Meltzoff, 2005, Prinz, 2002). The aim of the present study was to investigate 14-month-olds' imitation of different actions (novel, familiar) performed by models of different age groups (peers, older children, adults). Therefore, we used a between-subject design in the following experiments. In Experiment 1, we used a task showing a novel action (head-on-box, Meltzoff, 1988) where the televised model turned on a lamp using the head. Each video

sequence was repeated five times. After the demonstration phase infants (n=72) could play with the lamp for 60 seconds. The likelihood of imitating a novel action increases as the age of a model increases (r=.35; p<.05). In Experiment 2, models of the same age categories as in Experiment 1 demonstrated four familiar gestures (e.g. clapping). A demonstration of a repeatedly performed gesture lasted for 25 seconds. It was scored whether infants performed the target action before, while or after being demonstrated on the monitor. Results indicated an increased imitation of the peer model compared to imitation of the older child and the adult model (F(2;33)=4.32; p<.05). In sum, our study suggests that infants flexibly adept their preference for a particular age group depending on the familiarity of the demonstrated action. The expertness by adult models encourages imitation of novel actions, whereas the similarity by infant models increases imitation of familiar actions.

### Does a Model's Observed Competence Influence Infants' Imitative Behaviour?

David Buttelmann, Malinda Carpenter

*Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany*

Recent research has shown that preschoolers' acquisition of novel words and proper names is influenced by a speaker's reliability (e.g., Birch & Bloom, 2002; Pasquini et al., 2007). In contrast to these verbal approaches, we investigated how a model's competence influences much younger children's copying of the model's actions or choices of objects.

We presented 14-month-old infants with two different sets of video sequences. In one set ("Preference"), they saw a model choosing a tool in order to perform a familiar action (e.g., eat pudding from a bowl). This choice was either competent (e.g., spoon) or incompetent (e.g., hairbrush). After having watched either the competent or the incompetent model, all infants saw the model choosing one of two novel objects in a preference context before they then were given a choice between the same two objects.

In the other set ("Imitation"), infants were shown a model interacting with a familiar object (e.g., soccer ball). For that, the model chose a specific body part to use the object with. Again, the model chose either competently (e.g., kicked with foot) or incompetently (e.g., "kicked" with nose). After having watched either the competent or the incompetent model, all infants saw the model operating two novel apparatuses (lamps operated by pushing) with an unusual body part (e.g., his head instead of his hand) before they then were given the apparatuses themselves.

Data collection is still in progress but preliminary results reveal that although the model's competence does not influence participants' preference for a novel object (F(1;23)=.00; p=.98), infants do tend to imitate the use of an unusual body part more often when the model is competent than incompetent (F(1;23)=3.26; p=.084). If these results hold, this will be the earliest demonstration of 'the competence effect' in infancy. If not, older age groups will be tested.

### "Only if it Works": Causal Knowledge Affects Infants' Selection of Actions to Imitate

Emily Bushnell, Jessica Yang

*Tufts University, Medford, USA*

Human infants are inveterate imitators; however, they do not imitate everything they see. Our symposium is aimed at identifying factors which influence infants' choices of whether to imitate observed behaviors. Other contributions will focus on characteristics of the person demonstrating the behaviors. We will focus on aspects of the observed actions themselves.

In one study, 15-month-olds were shown a pressing action with one toy and then a pulling action with a similar toy. One of these actions yielded an exciting effect, while the other had no consequence. Infants were then offered a third version of the toy which had both the pressing and the pulling handles. Most infants (12 of 15) chose the handle and performed the action which had previously led to an effect - their goal was to produce the effect, not just to copy the experimenter's behavior.

In another study, an experimenter showed infants two ways to open a box. Some infants saw a tool strategy first while others saw a hand strategy first. Virtually all infants imitated the first strategy after its demonstration. However, after the second demonstration showing the alternative strategy, most babies did NOT imitate the new strategy; instead, 28 of the 36 infants used the original strategy again. Infants were motivated to get the box open, and they chose a familiar means rather than imitating a new one.

In a third study, infants observed a sequence of two behaviors leading to an interesting effect. The first action was sometimes integral to the effect, while in other cases it was unrelated. Infants imitated the first action frequently when it was necessary; when it was not, they often imitated only the second action. Overall, our findings suggest that infants' assessment of an action as a means to a desired end strongly affects whether they imitate the action or not.

---

## *Social Perception: Lessons from the Development of Sensitivity to Biological Motion* *(Regular Symposium, Biological Processes)*

**Chair:** *Catherine Mondloch*

**Discussant:** *Nikolaus Troje*

**Catherine Mondloch**[1] Lucia Regolin[2] Francesca Simion[2] Daphne Maurer[3] **Nikolaus Troje**[4]

*1. Pychology Department, Brock University, St. Catharines, Canada; 2. University of Padova, Padova, Italy; 3. Department of Psychology, Neuroscience & Behaviour, McMaster University, Hamilton, Canada; 4. Queen's University, Kingston, Canada*

Innate sensitivity to characteristics of social stimuli, such as faces and biological motion, may facilitate learning about caregivers and other conspecifics. To date, most research has focused on early preferences for faces. Within two hours of birth newborns look preferentially towards three blobs arranged as facial features (e.g., Mondloch et al., 1999); likewise, visually inexperienced chicks preferentially approach the head and neck region of a hen (Johnson & Horn, 1988). These early preferences are not tuned to species-specific details of faces but serve two important functions: they facilitate rapid recognition of conspecifics (i.e., potential care-givers) and, at least in humans, allow for the later development of expert face processing (Le Grand et al., 2001). The present symposium will examine whether similar developmental

principles apply to biological motion. The first two speakers will present evidence that both dark-reared chicks (Regolin) and human newborns (Simion) demonstrate a preference for biological motion over other patterns of motion. Like face perception, this preference is not species-specific; newborns look preferentially towards walking hens and chicks show a preference for walking cats. The ability of both chicks and human newborns to detect biological motion is impaired when stimuli are inverted, indicating that perception of biological motion is constrained by core knowledge of gravity. Despite similar patterns of sensitivity to faces and biological motion in early development, the two systems are differentially affected by early visual deprivation. The third presentation (Maurer) will draw on studies of children treated for bilateral congenital cataract to show that, unlike most visual functions, sensitivity to biological motion develops normally in the absence of early visual experience. The discussant (Troje), who is well known for his extensive studies of adults' sensitivity to biological motion, will consider the implications of these findings for understanding social development and the origins of a "life detector".

### Naïve Newborn Chicks (*Gallus gallus*) Prefer Biological Motion Patterns

**Lucia Regolin**[1] Giorgio Vallortigara[2]

*1. University of Padova, Padova, Italy; 2. University of Trieste, Trieste, Italy*

Many animal species were shown to be able to discriminate biological motion displays. Such studies involved learning through conditioning procedures which are not viable with very young animals as a long preliminary training is required. We investigated discrimination of point-light animation sequences in newborn chicks employing an imprinting paradigm. Chicks pre-exposed to different point-light patterns were then capable to discriminate between displays depicting a walking hen and a rigid motion (Regolin et al, 2000), such discrimination relied on the temporally integrated motion sequence. Johansson (1973) had suggested that sensitivity to biological motion may be an innate feature of animals' visual system rather than one acquired through experience. Spontaneous preferences for biological vs non-biological motion were assessed in totally naïve, dark-hatched newborn chicks (hence in the total absence of any previous visual experience). Chicks underwent a simultaneous free-choice test between pairs of point-light displays representing a walking hen, a "scrambled" version of it, a rotating rigid object or a random dot motion. Results (Vallortigara et al., 2005) showed that the walking hen was not preferentially approached when compared to its scrambled version, although both patterns were preferred to the rigid or to the random dot motion. This suggests that chicks' preference was associated with a predisposition to attend to biological (semi-rigid) motion but not to the species-specific motion. Assumptions about direction of gravity maybe also predisposed in the vertebrate brain. Naïve chicks, when first exposed to the walking hen point-light sequence, responded by aligning their body along with the apparent direction of motion of an upright hen, but not of an upside-down hen (Vallortigara and Regolin, 2006). In humans, too, recognition of biological motion is impaired when the point-light animation is turned upside-down although this had been interpreted as evidence that past experience about direction of gravity influences biological motion perception.

### Newborns Prefer Biological Motion

Francesca Simion, Lucia Regolin, Hermann Bulf, Lara Bardi, Elisa DiGiorgio

*University of Padova, Padova, Italy*

Primitive neural pathways seem present in many vertebrates ensuring a bias to attend preferentially to conspecifics (Jonhson, 2006). Naïve chicks attend to patterns that correspond the head region of their caregivers (Morton & Johnson, 1991); similarly newborn humans preferentially orient toward faces (Valenza Simion, Macchi Cassia & Umiltà, 1996). A developmental perspective is critical to disentangle the unresolved issue of whether also the sensitivity to biological motion is an innate (rather than acquired through experience) capacity of the human system. Three experiments were run onto different groups of naïve newborns aged from 10 to 130 hours from birth. Newborns discriminated (Exp. 1) and selectively preferred (Exp. 2) biological motion (Johansson's displays) to random motion. Also, babies reacted in accordance to the existence of a predisposed assumption concerning direction of gravity in interpreting biological motion patterns (Exp. 3). To compare different species the stimuli we employed were the same point light animations already used with visually inexperienced chicks in previous research (where the biological motion stimulus depicted a walking hen, Vallortigara, Regolin & Marconato, 2005). Therefore, newborns' preference cannot be accounted for within a species-specific frame of reference. Our results support the idea of an evolutionary ancient neural mechanism for detection of biological motion that could be present in humans as well as in chicks before any visual experience. Such mechanism may act primarily to ensure a bias to attend toward or preferentially process sensory information about conspecifics, and may relate to the other, above mentioned, known mechanisms for the detection of animals' features. These results pave the way to a better understanding of the roots of the social brain and of the underlying mechanisms that drive the human system to process the social world (Spelke & Kinzler, 2007).

### Normal Sensitivity to Biological Motion Despite Early Visual Deprivation

**Daphne Maurer**, Alejo Freire, Terri Lewis

*Department of Psychology, Neuroscience & Behaviour, McMaster University, Hamilton, Canada*

Studies in humans, like those in monkeys, indicate that early visual input is necessary for normal visual development, even for aspects of vision that are very poor at birth and that have a protracted period of development. In humans, the long-term effects of early visual deprivation are evident from permanent visual deficits in individuals born with dense central cataracts in both eyes, despite treatment to remove the cataracts during infancy and many years of subsequent patterned visual input. Here we evaluated the importance of early visual input to the development of sensitivity to biological motion in 8 patients (aged 12-25 years) who had been deprived of patterned visual input until dense congenital cataracts were removed between 2 and 10 months of age. Their task was to discriminate point light biological motion displays depicting various human movements from scrambled versions of the same displays. On each trial, subjects indicated whether the person appeared in interval 1 or 2. To estimate thresholds, we added noise dots to the displays and used a staircase to estimate the maximum number of noise dots that could be tolerated at 71% discrimination accuracy. Surprisingly, patients' sensitivity to biological motion was entirely normal: every one of the eight patients had thresholds within the normal range of thresholds produced by

three age-matched controls. Yet, the same deprivation causes marked deficits in acuity, peripheral vision, the perception of global motion and global form, and face processing. We speculate that sensitivity to biological motion is spared because its neural network is stimulated by self body movement during the period of visual deprivation, perhaps via a homologue of the macaque mirror system.

## *Maternal Depression and Anxiety during Pregnancy: Effects on Fetal and Infant Behavior and Development*

*(Regular Symposium, Psychopathology and Developmental Delay)*

**Chair:** *Bárbara Figueiredo*

**Bárbara Figueiredo**[1] **Alexandra Pacheco**[1] **Raquel Costa**[1] Ana Conde[1] César Teixeira[1] Iva Tendais[1] Maria Rodrigues[2] Raúl Nogueira[2]

*1. Universidade do Minho, Braga, Portugal; 2. Maternidade de Júlio Dinis, Porto, Portugal*

**Background:** Empirical results show that not only mothers' postnatal but also prenatal anxiety and depression can negatively affect fetal and infant growth, behaviour and development. However, it is not clear which effects are due to the mothers' anxiety and/or depression, and the main contribution of mothers' mental health in the 1st, 2nd, or 3rd pregnancy trimester.

**Aims:** In this symposium, we intend to analyse the impact of women's mental health during pregnancy on fetal and neonatal growth, behaviour and development. Namely to study the effects of mothers' anxiety and depression symptoms during the 1st, 2nd and 3rd pregnancy trimester on (1) the fetal growth and activity during the 2nd trimester; as well as on (2) the "mother versus strange" preference and on (3) the neurobehavioral functioning in 2-day old infants.

**Procedures:** A sample of 100 fetus/infants recruited at the Júlio Dinis Maternity Hospital (MJD, Porto. Portugal) was followed from gestation to after childbirth. Repeated measures of anxiety (STAI-S/T, Spielberger et al., 1995) and depression (EPDS, Cox et al, 1987) were obtained at the 1st, 2nd and 3rd pregnancy trimesters, as well as at delivery on their mothers. Fetal behaviour was video-taped during the 2nd trimester ultrasound examination and biometry measurements were collected from clinical report. Infants' neurobehavioral functioning (NBAS, Brazelton & Nugent, 1995) and "mother versus strange" preference (Field et al., 1984) was assessed 2-day after birth.

**Results:** No significant differences were observed in the fetal growth and activity during the 2nd trimester according to mothers' anxiety and depression in the 1st and 2nd gestation trimesters. However, 2 days old infants of depressed women during the 3rd trimester of pregnancy look less both at the mother and at the stranger, and mothers' anxiety and depression during the 1st and 3rd pregnancy trimester predict worse neonatal behaviour and development.

**Conclusions:** Considering the risk for impaired fetal and neonatal behaviour and development mothers' mental health should be attended as soon as the 1st trimester of pregnancy.

### Maternal Depression and Anxiety during Pregnancy: Effects on Fetal Growth and Activity during the 2nd Gestation Trimester

**Bárbara Figueiredo**[1] Ana Conde[1] Iva Tendais[1] César Teixeira[1] Maria Do Céu Nogueira[2] Raúl Nogueira[2]

*1. Universidade do Minho, Braga, Portugal; 2. Maternidade de Júlio Dinis, Porto, Portugal*

**Aims:** To study fetal growth and activity during the 2nd gestation according to mothers' anxiety and depression during the 1st and 2nd trimester of pregnancy.

**Method:** The sample involved 64 fetus (32 female and 32 male), with an average gestational age of 21.02 weeks. Repeated measures of anxiety and depression were obtained in mothers in the 1st and 2nd pregnancy trimesters. Biometry data were collected from clinical report and fetal behaviour during the 2nd trimester ultrasound examination was videotaped for scoring; inter-observers agreement was good.

**Results:** After controlling for gestational age, significant differences were obtained: fetal growth was higher in fetus whose mothers were married [$F(1,45) = 2.54$; $p = .04$], living with the family of origin [$F(1,45) = 2.99$; $p = .02$] and employed [$F(1,45) = 6.82$; $p = .000$]. Significant differences in fetal heart rate were also found: fetal heart rate was lower in male fetus [$F(1,22) = 4.47$; $p = .05$] and in those whose mothers were living with the family of origin [$F(1,22) = 5.98$; $p = .02$] and had tobacco consumption [$F(1,22) = 6.12$; $p = .02$]. No significant differences in fetal growth and activity related to mothers' anxiety and depression symptoms at the 1st and 2nd pregnancy trimesters were observed.

**Conclusions:** Fetal behaviour and development is influenced by several prenatal factors related to the fetus and the mothers' socio demographics and drugs exposure, but not with the mothers' anxiety and depression. A differential impact of these factors in fetal growth and activity is suggested.

### Maternal Depression and Anxiety during Pregnancy: Effects on the Neonate "Mother versus Strange" Preference

**Alexandra Pacheco**, César Teixeira, Ana Conde, Bárbara Figueiredo

*Universidade do Minho, Braga, Portugal*

**Aims:** To study the impact of mothers' depression in the neonate habituation and preference for mother's versus a stranger's face/voice.

**Method:** Repeated measures of depression were obtained in mothers during the 1st, 2nd and 3rd pregnancy trimesters, as well as after delivery. Their newborns (N = 50) were evaluate on the first 2-days after childbirth in the habituation and preference for mother's versus stranger's face/voice paradigm. This procedure (Field et al., 1984) consists in a: 1) pre-test preference phase, 2) habituation phase, 3) post-test preference phase. The procedure was videotaped for scoring and inter-observers agreement was good.

**Results:** Infants of women depressed (EPDS>10) during the 3rd trimester of pregnancy 1) look less at their mothers both in the pre-test ($t = 2.097$, $p \leq .05$) and post-test preference ($t = 6.493$, $p \leq .05$) phases; 2) don't prefer their mothers to a stranger's face/voice ($t = 0.664$, $p = .517$); 3) and don't look more to the stranger in the post-test than in pre-test ($t = 1.670$, $p = .103$). Infant habituation and preference to mother's face/voice at 2 days old is different according to mother depression at 3rd pregnancy trimester but not according to mother depression during the 1st or 2nd pregnancy trimesters.

**Conclusion:** Newborn of mothers depressed during the 3rd trimester of pregnancy doesn't show any preference for their mother's face/

voice, and that may compromise mother-infant interaction as soon as after delivery.

### Maternal Depression and Anxiety during Pregnancy: Effects on the Neonate Neurobehavioral Organization

**Raquel Costa**, Alexandra Pacheco, César Teixeira, Ana Conde, Bárbara Figueiredo
*Universidade do Minho, Braga, Portugal*

**Objective:** To analyze whether maternal depressive and anxious symptoms during the 1st, 2nd and 3rd trimesters of gestation predict later neurobehavioral functioning in 2-day old infants.

**Procedure:** Repeated measures of anxiety and depression symptoms were obtained in mothers during the 1st, 2nd and 3rd trimesters of pregnancy and the neurobehavioral functioning of their 2-day old infants (N = 56) was later evaluated.

**Results:** Linear Regression Stepwise analyses on neonatal neurobehavioral organization with mother depressive and anxiety symptoms during the 1st and 3rd trimester of pregnancy entered as predictive variables suggested that depression in the 1st trimester predict neonatal range of state (explaining 7.7% of the variance), depression in the 1st and 3rd trimester predict neonatal withdrawal (explaining 22.7% of the variance) and depression and anxiety in the 1st trimester predict neonatal abnormal reflexes (explaining 41.4% of the variance)

**Conclusion:** Maternal depression in the 1st and 3rd trimester, and maternal anxiety in the 1st trimester predict a worse neonatal neurobehavioral development. Attending to maternal mental health as early as the 1st trimester of gestation is essential, considering the risk for future neurodevelopment difficulties that can be identified in 2-day old neonates.

---

## *New Approaches to Understanding and Treating Autism*

*(Invited Symposium, Psychopathology and Developmental Delay)*

**Chair:** *Lonnie Zwaigenbaum*

### Robot-Mediated Social Interaction For Autism Therapy

**Hideki Kozima**[1] Cocoro Nakagawa[1] Yuriko Yasuda[2]
*1. National Institute of Information and Communications Technology, Japan; 2. Omihachiman-City Daycare Center for Children with Special Needs, Japan*

This talk discusses how robot-mediated communication would contribute to psychological research and therapeutic practices for children with autism and related developmental disorders.

Autistic children, in general, have difficulties in exchanging and sharing intention and emotion through nonverbal information, and delay in language development, especially of pragmatic use of language. In spite of these difficulties in social interaction with people, autistic children are relatively good at interacting with objects. Though their interest and actions are often restricted to specific targets, autistic children are generally good at understanding and manipulating things as physical systems. This implies that information processing for objects (systemizing) and that for people (empathizing) are somewhat independent.

Robots can be seen either (or both) as physical systems or as human-like agents with mental states. So, robots could provide autistic children with opportunities to experience social interactions with agents through physical interactions with systems. Based on this idea, we developed a simple robot, Keepon. Keepon was designed to express only attention (by gaze and body orientation) and emotion (by simple body movements), so that autistic children could intuitively read its mental states and not be overwhelmed by the complicated facial expressions, body gestures, and speech of real humans.

For the past four years, we have been using Keepon as a mediator of social interaction at a daycare center for autistic children. Keepon is tele-controlled by an operator (researcher or therapist) who performs and observes the interaction with autistic children in their daily therapeutic environment. The longitudinal interactions showed that the minimally designed robot would be an useful tool for therapeutic interventions. Also, the video data taken from Keepon's subjective viewpoint (the onboard camera) have been utilized by the practitioners at the daycare center for sharing and exchanging understandings of each child.

### Developmental Trajectories in ASD from 12 to 36 Months

Catherine Lord
*University of Michigan, Ann Arbor, USA*

Autism is defined by difficulties in three areas: the quality of social reciprocity, communication, and restricted and repetitive behaviours, as well as onset prior to 36 months. However, the form of onset before 36 months has not yet been specifically determined. Research suggests that many children who at later ages will meet formal diagnostic criteria for autism will not necessarily show clear difficulties in all three areas at young ages. Our research and clinical work has asked whether autism can reliably be diagnosed in children as young as two years, is there a reason to distinguish autism from more broadly defined autism spectrum disorders at these young ages, and what are the trajectories of development associated with autistic spectrum disorders beginning under 3 years of age. The focus is on both positive (abnormal) behaviours and negative (the absence of abnormal) behaviours, which means that developmental level and contextual effects have to be taken into account. Research suggests that it is possible to diagnose autism reliably at age two. However, there is much more variability, particularly in children with less certain diagnoses, than there will be years later. The clinical and educational implications of these findings will be discussed.

### Resolution with Diagnosis Among Parents of Children with Autism Spectrum Disorders

Nurit Yirmiya
*The Hebrew University of Jerusalem, Jerusalem, Isreal*

Parents whose child receives a diagnosis of an Autism Spectrum Disorder (ASD) undergo a difficult process, one that requires changes in the expectations and hopes that they had for their child and for themselves as parents. Some parents are successful in revising their representations of the child and themselves in light of the child's diagnosis and are considered "resolved" with respect to the diagnosis, whereas others have difficulties in this process and are considered "unresolved" with respect to the diagnosis. The goal of this presentation is to enhance our understanding of resolution by examining the links between maternal and paternal resolution to both child and parental characteristics.

In two recent studies we concentrated on parental resolution among parents of children with ASD. In our first study we interviewed moth-

ers and fathers of children between the ages of 2-17 years with the Reaction to Diagnosis Interview (RDI; Pianta & Marvin, 1993) designed to assess resolution and examined whether resolution status was associated with the children's age, level of functioning, duration of time since receiving the diagnosis, and/or with parental characteristics including gender, IQ, indices of the Broad Autism Phenotype, and perceived impact on the family as well as perceived responsibility and involvement in childcare. Findings indicated that close to 50% of the parents were classified as resolved and that resolution status was not associated with the duration of time since receiving the diagnosis. Furthermore, resolution was associated only with perceived impact on the family and reported involvement in childcare, in that mothers who were resolved reported on less negative impact on the family and on less (over)involvement compared to unresolved mothers. In our second study we examined whether maternal resolution status among mothers of boys with ASD between the ages of 2.5-5.5 years was associated with maternal behaviour during mother-child interaction and the security of children's attachment to their mothers. Findings indicated that mothers who were classified as resolved had more optimal interactions with their children, and had children who were more likely to be securely attached compared to mothers who were classified as unresolved. The results of these studies suggest that even though children with ASD introduce profound challenges to the relationships they form with their caregivers, resolution is possible and appears to have important implications for parental and child well-being.

---

## *The Surprisingly Late Development of Goal-Directed Instrumental Action* *(Regular Symposium, Cognitive Development)*

**Chair:** *Ben Kenward*

**Discussant:** *Petra Hauf*

Stephan Verschoor[1] James Russell[2] **Ben Kenward**[3] **Petra Hauf**[4]

*1. University of Leiden, Leiden, The Netherlands; 2. University of Cambridge, Cambridge, UK; 3. Uppsala University, Uppsala, Sweden; 4. St. Francis Xavier University, Antigonish, Canada*

Much is known about the cognitive traits, such as memory and object permanence, which enable infants' actions. Considerably less is known about what actually motivates young children to act. Adults can perform intentional, goal-directed actions, which are motivated by a process integrating a desire for an outcome and an expectation that the action will result in that outcome. It has often been assumed that infants are also motivated to act by similar goal-directed processes. This has seemed reasonable, not least because we know that infants do encode associations between actions and their outcomes - evidence for this will be presented by Stephan Verschoor.

Only very recently, however, has data become available which directly addresses the issue of whether infants' instrumental actions are goal-directed. The method used is the experimental manipulation of the value of an action's outcome. This alters the performance frequency of goal-directed action because the tendency to perform such actions depends on the outcome value. This effect is observed in two-year-olds, but in younger children action performance is not related to the outcome value. Two independent and rather different studies each demonstrating this result will be presented by their authors: James Russell, and Ben Kenward.

Petra Hauf, who has recently reviewed the issue of infant intentionality, will discuss possible reasons for this surprising décolage between infants' ability to expect the outcome of their actions, and their ability to use this knowledge to motivate goal-directed action. Perhaps infants' action is motivated by stimulus-response habits acquired through reinforcement learning. Perhaps infant action-outcome associations do not take a causal form which can be used in goal-directed deliberation. Perhaps infants do have causal knowledge but have not yet developed goal-directed processes which can utilise it. Or perhaps we have simply not yet designed the experiments which will reveal truly goal-directed behaviour in infants.

Empirical Presentation 1: Stephan A. Verschoor, Action-effect learning and action control in infancy

Empirical Presentation 2: James Russell, The goal-directedness of young children's action assessed through devaluation experiments

Empirical Presentation 3: Ben Kenward, Is button pushing in young children goal-directedly motivated by the expected outcome?

### Action-Effect Learning and Action Control in Infancy

**Stephan Verschoor**, M. Weidema, S. Biro, B. Hommel

*University of Leiden, Leiden, The Netherlands*

To perform a goal-directed action, one needs to have some knowledge about the (possible) consequences of this action. According to the two-stage model of action control (Elsner & Hommel, 2001), voluntary action is anticipatory and, hence, must depend on associations between actions and their perceivable effects. In this model, action control is attributed to the automatic bi-directional association of movements and their sensory effects. Thus, it is assumed that perceiving a response effect primes the associated response, which should increase the likelihood of performing that response. Support for the two-stage model of action control was found in several adult studies (see Hommel, 2005). Although it is well established that very young infants can register, learn and remember movement-effect contingencies (e.g. Rovee-Rovee, 1969; Watson, 1972; Rochat, 1999), the bi-directional relation of these associations has not been studied directly. In the current study we used a modified version of the task used by Elsner & Hommel (2001) to study the acquisition and the use of action-effect associations in infants. Specifically, we tested if infants would execute more actions following an effect that had previously been associated with the action, compared to a non-associated effect. Results support the model: We found that 18-month-old infants but not 9 and 12 months olds executed significantly more actions following an associated effect than following a non-associated effect ($p<.01$). This finding implies that, at least in 18-month-olds, action-effect sequences are stored as bidirectional associations and that presenting an associated effect as a stimulus can automatically prime the associated action. However, we also believe that the paradigm used here may not have been sensitive enough to pick up the same effect in the younger age-groups. The factors that are likely to influence the storage and the retrieval of action-effect associations will be discussed.

### The Goal-Directedness of Young Children's Action Assessed Through Devaluation Experiments

James Russell

*University of Cambridge, Cambridge, UK*

In at least one domain, the instrumental learning abilities of children below the age of about 3 years lag behind those of the rat (Klossek, Russell, and Dickinson, 2007).

When rats learn to press a lever for food, do they really 'press for' the food or is it an S-R habit? If it is the former then the pressing will be modulated by a representation of (a) what is obtained through pressing and (b) the positive value of what is obtained. Adams and Dickinson (1981) showed that rats can engage in goal-directed action by devaluing the food reward gained by pressing. This caused them to press less frequently when tested in extinction. The Klossek et al study followed a similar logic. Children were trained to press pairs of visual icons on a touch-sensitive screen to view video clips of different kinds. When one of the clips was devalued by repeated presentation, children above 3 years of age were less likely to touch the icon associated with it, when tested in extinction.

I consider two kinds of account of this result. On the first view, different domains of cognitive ability develop at different rates and in relative isolation from one another. Because 'high level' instrumental learning does not have a significant role to play in the life of the young human, it has evolved to develop relatively late. On the second, the cognitive processes employed in passing the task do not parallel those employed by the rat, because the young human will succeed on this kind of task though a deliberative process.

I discuss how the latter account can be tested: (a) by presenting 3rd-person versions of the goal devaluation task, and (b) by examining parallels between goal-devaluation performance and performance on executive inhibition tasks. I present some preliminary data.

### Is Button Pushing in Young Children Goal-Directedly Motivated by the Expected Outcome?

**Ben Kenward**

*Uppsala University, Uppsala, Sweden*

A goal-directed action is motivated by a process integrating a desire for an outcome with an expectation that the action will result in that outcome. Goal-directed processes are not the only mechanisms allowing individuals to learn to react appropriately to circumstances. Individuals might learn to habitually respond to a particular stimulus configuration with a particular action, if that action is reinforced. In this case the tendency to perform the action is not related to the current value of the outcome because the behaviour is automatically elicited by its associated stimulus.

I present a study in which the value of an action's outcome was manipulated (Kenward, Folke, Holmberg & Gredebäck, in prep). 14-, 19- and 24-month-olds learnt that pressing a button allowed an object to be obtained from a box, and then took part in a play session which increased (revaluation group) or did not increase (control group) the value of the object. The revaluation was achieved by introducing the children to a play apparatus for which the box's object was necessary - for example a ball run for a ball. 24-month-olds in the revaluation group subsequently pressed the button more quickly and more often than the control group, but there was no effect of revaluation in the younger children, even though further tests for the 19-month olds indicated that the revaluation procedure was effective, and that an association between the box and the object it contained had been learnt.

These results suggest that 24-month-olds but not 19-month-olds were able to integrate knowledge of the action's outcome with the current value of that outcome in order to produce goal-directed behaviour. Because the younger children's tendency to push the button was not affected by the value of the outcome, a learnt habit seems a likely explanation for their button pushing.

## *The Origins of Social Cognition*

*(Regular Symposium, Cognitive Development)*

**Chair:** *Katherine Kinzler*

**Discussant:** *Emmanuel Dupoux*

**Katherine Kinzler**[1] J. Hamlin[2]

*1. Harvard University, Cambridge, USA; 2. Yale University, New Haven, USA*

The goal of this symposium is to explore the nature of and relationship among several core aspects of human social cognition. The first paper (presented by F. Warneken) will explore the possibility of a biological basis for human altruism, by providing evidence that both human infants and young chimpanzees engage in instrumental helping behavior, and interpret others' goal-oriented behavior in deciding when to help. The second paper (presented by J. Hamlin) will present data showing infants' early capacity to evaluate the social actions of others. In several studies, infants are shown displays of helpful and hindering behaviors, and demonstrate early social preferences for helpful compared to neutral individuals, as well as neutral compared to hindering individuals. Thus, from early on, infants evaluate both positive and negative actions, and these evaluations constrain their early social preferences among individuals. The third paper (presented by K. Kinzler) will presents evidence of infants'early attention to the language and accent with which others speak in guiding their early social interactions. Young children selectively prefer to take toys from, eat foods first eaten by, and demonstrate giving behaviors towards native speakers. Similar effects, however, are not obtained when infants are shown a contrast of own- vs. other-race individuals, suggesting the primacy of language in infants' evaluation of potential social partners. The discussant (E.Dupoux) will discuss these three papers in terms of a theoretical model illustrating how young children might use "proto-moral" systems that evaluate intentionality in others' actions, signals of distress viewed in agents, and potential ingroup and outgroup membership, to make social judgments concerning individuals and their actions.

### Children's Predisposition For Altruism

**Felix Warneken, Michael Tomasello**

*Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany*

One recent debate in the behavioral sciences concerns the origins of human altruism. Several researchers claim that altruistic behaviors are unique to humans, emanating from a human-specific psychology and cultural practices found exclusively in the human species. In particular, it is often assumed that human altruism is imposed by the social environment through the transmission and enforcement of prosocial norms. In contrast, we provide evidence for the hypothesis that humans have a biologically based predisposition to act altruistically independently of socialization. This is based upon two lines of research with chimpanzees and human infants.

First, recent experiments show that chimpanzees altruistically act towards humans (Warneken & Tomasello, 2006) and conspecifics (Warneken et al., 2007). This demonstrates that acts of altruism have a biological basis shared by humans and their evolutionary ancestors. Secondly, infants as young as 14 months of age perform acts of helping, indicating that humans have a predisposition for altruism prior to extensive socialization practices (Warneken & Tomasello, 2007). In addition, we will report new findings from an experimental study testing for the possibility that children are intrinsically motivated to help

others: 20-month-old children (N = 36) were assigned to one of three treatment conditions, differing in the the experimenter's response to children's helping (Reward; Praise; Neutral). In a subsequent test phase the experimenter always responded neutrally. Results showed that children who had previously received material rewards helped significantly less often than children from the Neutral or the Praise condition. This indicates that children's altruistic helping is driven by an intrinsic motivation, a tendency that can be undermined by external rewards.

These results will be integrated into a framework according to which humans and chimpanzees share a basic tendency for altruism, with humans having developed possibly species-unique mechanisms to sustain and facilitate this biological predisposition.

### Early Social Cognition

J. Hamlin, Karen Wynn, Paul Bloom
*Yale University, New Haven, USA*

To navigate the social world, one must be able to assess others from their behavior-to judge who is a reliable social partner and who is not. Our studies address the developmental origins of this capacity using 10-, 6-, and 3-month-old infants.

In Study 1, infants saw a character attempt unsuccessfully to climb a steep hill, who was alternately aided up the hill by a Helper, and pushed down by a Hinderer. As measured by both looking and reaching methods, infants preferred the Helper over the Hinderer (88% of 10-month-olds, 100% of 6-month-olds, and 75% of 3-month-olds; all p's < .05). A control condition ensured infants' responses reflect social, not perceptual, preferences: When the Climber was replaced with an inanimate ball pushed alternately up and downhill by two individuals, infants show no preference for the pusher-up over the pusher-down character.

A second experiment revealed that infants' preference for Helpers over Hinderers results from two distinct and separable effects: (1) an affinity for Helping individuals, and (2) an aversion to Hindering individuals. Interestingly, while 6- and 10-month-olds show both effects (all p's < .05), 3-month-olds show a reliable avoidance of Hinderers but not an independent preference for Helpers, a pattern consistent with the "negativity bias" found in studies of adult social cognition, in which negative information learned about an individual is more salient and more heavily influences judgments about the individual than positive information.

In sum, like adults, infants evaluate others based on their behavior. By 6 months of age, they are both attracted to individuals who have helped an independent third party, and avoidant of individuals who have hindered an independent third party. Our findings suggest that a distaste for anti-social others may exist developmentally prior to a preference for pro-social others.

### Infants and Children's Attention to Language Over Race in Guiding Social Preferences

**Katherine Kinzler**[1] Emmanuel Dupoux[2] Elizabeth Spelke[1]
*1. Harvard University, Cambridge, USA; 2. Laboratoire de Sciences Cognitives et Psycholinguistique, EHESS, Paris, France*

From birth, humans display a remarkable sensitivity to language and linguistic differences. Neonates prefer their native language to a foreign language, and even discriminate two foreign languages provided that they have sufficiently different rhythmic properties.

The present paper describes new research showing that (a) infants demonstrate social preferences for novel individuals who speak infants' native language with a native accent, and (b) early social preferences for native speakers surpass those based on race. In Experiment 1, 5-6 month-old infants demonstrated a visual preference for a person who previously spoke in their native language over a person who spoke either in a foreign language or in the native language with a foreign accent. In Experiment 2, 10-month-old infants preferred to accept one of two identical toys when offered by a native speaker rather than foreign speaker. This effect obtained even though language was never directly paired with the objects. In Experiment 3, 30-month-old children demonstrated giving behaviors selectively toward native-language speakers.

Though previous research shows that young infants display looking preferences towards own-race individuals, when 10- and 30-month-old infants were tested with the same measures of social exchange as described above, they did not use race to guide their early social behaviors. In contrast to the effects observed with language, infants accepted objects from, and gave objects to, both own and other-race individuals equally. Research with older children suggests that the predominance of social attention to language over race does not dissipate throughout development. Though 5-year-old children display robust race-based social preferences when two speakers were silent, their preference reversed with the other-race person spoke with a foreign accent. Thus, attention to linguistic differences among individuals, rather than racial distinctions, may play a primary role in the development of infants'and children's early social reasoning.

---

## *Mother-Infant Interactions: What Determines Parenting in Challenging Contexts?* *(Regular Symposium, Emotional Development)*

**Chair:** *Cynthia Smith & Esther Leerkes*

**Discussant:** *Susan Crockenberg*

**Esther Leerkes**[1] **Cynthia Smith**[2] Tracy Spinrad[3] **Susan Crockenberg**[4]
*1. University of North Carolina at Greensboro, Greensboro, USA; 2. Virginia Tech, Blacksburg, USA; 3. Arizona State University, Tempe, USA; 4. University of Vermont, Burlington, USA*

The parenting behaviors used in emotional situations with infants and young children can have a substantial and unique impact on their socioemotional development (Davidov & Grusec, 2007; McElwain & Booth LaForce, 2005), yet relatively little is known about the factors that predict how parents respond to their children in emotionally arousing contexts. Belsky (1984) proposed that contextual factors, parental resources, and child characteristics are important determinants of parenting behaviors, which in turn are associated with child outcomes. Since then, Crockenberg (1986; Crockenberg & Leerkes, 2003) has emphasized the importance of considering joint effects of child temperament and parent characteristics on individual and family functioning. The goal of this symposium is to consider the joint effect of infant temperament and maternal characteristics on mother and child behavior in emotionally challenging contexts. In the first paper, Spinrad, Eisenberg, and Iyer provide additional evidence supporting the view that maternal behavior in emotionally challenging contexts predicts toddler compliance and that the nature of this effect varies by toddler temperament. The second and third papers identify predictors of maternal behavior in emotion eliciting contexts. Smith and Goodwin discuss one potential determinant of parenting, maternal

personality, and how different personality dimensions and child temperament relate to maternal control of toddlers' behavior during a prohibition task. In the final paper, Leerkes examines the possibility that mothers' positive emotional and cognitive responses to infant crying predict maternal sensitivity to infant distress and buffer maternal sensitivity from the negative effect of infant temperamental reactivity. The results of each study underscore the importance of "goodness of fit" between parent and child characteristics. Susan Crockenberg will serve as the discussant and will integrate and critique these findings within the historical context of research linking infant temperament, maternal characteristics, and maternal behavior.

### Toddlers' Compliance and Noncompliance: Prediction from Maternal Behavior and Temperament across the Toddler Years

**Tracy Spinrad**[1] Nancy Eisenberg[1] Roopa Iyer[2]

*1. Arizona State University, Tempe, USA; 2. University of California at Berkley, Berkley, USA*

Toddlers' committed compliance is viewed as a marker of internalization, whereas defiance has been linked to later problem behaviors. We examined mothers' sensitivity, as well as toddlers' characteristics, as predictors of compliance and defiance longitudinally.

With regard to temperament, we focused on toddlers' effortful control, seen as a core dispositional characteristic contributing to regulated behavior and social competence (Spinrad et al., 2007). We also examined toddlers' anger proneness, a temperamental characteristics linked to increased problem behaviors (Eisenberg et al., 2001). Although the majority of studies assessing children's compliance have focused on parenting practices, we examined the interaction of temperament and maternal responsivity (Crockenberg, 1987). We predicted that committed compliance and low defiance would be more likely to occur when mothers were responsive, particularly for toddlers low in effortful control or high in anger proneness.

Participants were 256 toddlers (115 girls; mean age = 17.79 months) at T1 and 230 toddlers (102 girls; mean age = 29.8 months) at T2. Toddlers' committed compliance and defiance were observed in two contexts: (1) in response to parental requests, and (2) in response to parental prohibitions. Mothers' controlling behaviors were scored and used as a control variable, and mothers' sensitivity was observed. In addition, mothers and caregivers reported on toddlers' effortful control and frustration.

Preliminary results indicated that toddlers' defiance to prohibitions at T2 was predicted by the interaction of EC and maternal sensitivity, above and beyond the effects of maternal controlling behavior. Specifically, mothers' sensitivity was negatively related to defiance for toddlers' low in EC (slope = -.09, t = -2.90), but was unrelated for toddlers' who had moderate or high EC abilities. The processes by which parenting practices influence children's social functioning and the role of children's EC in these relations are discussed.

### Maternal Personality: Relations to Maternal Control with Toddlers

**Cynthia Smith**, Annabelle Goodwin

*Virginia Tech, Blacksburg, USA*

Toddlers are tasked with learning how to regulate their behaviors through the development of effortful control. Parenting behaviors that are not over-controlling have been associated with toddlers' ability to control their behaviors; however, not all parents display optimal levels of control. Parent personality has been identified as a potential key factor in understanding individual differences in parenting behaviors (Belsky & Barends, 2002). The current paper examined how the Big Five personality dimensions related to individual differences seen in maternal control tactics during a toddler prohibition task.

Mother-toddler dyads (72 boys, 68 girls; mean age = 32.10, SD = 1.63) were observed in a 3-minute prohibition task during which mothers were instructed not to let their children play with a set of attractive toys. The mean levels of maternal verbal control and physical control were coded. Mothers completed the Big Five Personality Measure, and scales for openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism were computed. Children's effortful control was computed from maternal report of attention shifting, attention focusing, and inhibitory control from the Early Child Behavior Questionnaire.

Preliminary analyses revealed that more agreeableness was associated with less verbal, $r = -.24$, $p < .01$, and physical control, $r = -.22$, $p < .01$. Additionally, more neuroticism was associated with more verbal control, $r = .18$, $p < .05$. Children's effortful control was associated with less maternal physical control, $r = -.32$, $p < .01$; however, similar findings between personality and parenting behaviors were found when effortful control was controlled for. To further our understanding of how personality relates to parenting, child temperament will be explored as a possible moderator of the relations between personality and parenting. Implications for the contributions of maternal personality to individual differences in parenting behaviors will be discussed.

### Predictors of Maternal Sensitivity to Infant Distress: A Social Information Processing Perspective

Esther Leerkes

*University of North Carolina at Greensboro, Greensboro, USA*

Responding sensitively to infant distress can be a daunting task for new mothers. Crying is aversive, signals that the infant needs something but determining what is often difficult, and as a society we judge mothers based on their ability to manage this distress. However, we know little about the process by which mothers determine when and how to respond to infant distress. This information is critical given considerable evidence that infants develop healthy relationships, behaviors, and skills in the context of early sensitive interactions with mothers.

The present study examined the extent to which mothers' positive emotional and cognitive responses to infant distress predict maternal sensitivity to infant distress as main effects and buffer maternal sensitivity from the negative effect of infant temperamental reactivity. Mothers (n = 101) were interviewed prenatally about their responses to videotapes of crying infants, were videotaped interacting with their own 6 month old infants in two emotionally arousing tasks, and participated in a video-recall interview about their thoughts and feelings during the emotionally arousing tasks. Measures of accurate identification of infant negative emotions, beliefs and goals about infant crying, emotion efficacy, and emotional reactions to crying were derived from the prenatal and postnatal interviews. Infant affect and maternal sensitivity to distress and to all infant cues were rated during the observational tasks.

Mothers' emotional and cognitive responses to infant distress predicted significant variation in sensitivity to distress and sensitivity to all infant cues during the arousing tasks. Prenatal and postnatal emotional reactions to and beliefs and goals about infant crying were the most consistent predictors both as main effects and in conjunc-

tion with infant temperamental reactivity as predicted. Results will be discussed from a social information processing perspective and implications for practice will be raised.

---

## *Assessment of Neonatal Movement Competence: Implications for Behavioral and Neurological Prediction*

*(Regular Symposium, Motor and Sensorimotor)*

**Chair:** *David Anderson*

**Discussant:** *Joseph Campos*

**David Anderson**[1,2] Marianne Barbu-Roth[3]

*1. Department of Kinesiology, San Francisco State University, San Francisco, USA; 2. Institute of Human Development, UC Berkeley, San Francisco, USA; 3. CNRS & Laboratoire Psychologie de la Perception, Université Paris 5, Paris, France*

A fundamental question in human development is whether the spontaneous and elicited behaviors of the newborn are direct precursors to the more elaborated and differentiated behaviors that are seen later in infancy. The answer to this question is vitally important to our understanding of how development takes place and to our ability to predict developmental outcomes based on behaviors that are seen during the fetal period, at birth, and during the first weeks of life. The aim of the symposium is to highlight some of the remarkable early movement competencies that have been discovered in various infant laboratories across the world and to examine some of the endogenous and exogenous factors that influence the assessment of these early competencies. We also aim to underscore how the aforementioned factors, in turn, influence our attempts to understand whether neurological and behavioral organization in the older infant emerges from specific rudimentary behaviors seen at birth (or earlier). The goal of the latter discussion is to emphasize that there is considerable controversy surrounding many claims that apparently precocious behaviors are the forerunners of later behaviors, with which they often share only superficial similarities. Careful analysis of the contextual factors that influence neonatal movement assessment can help to determine which claims are likely to be veridical and which are not.

The members of this symposium were chosen because they represent laboratories that are at the cutting edge of research on the assessment of neonatal movement behavior and its relation to later developmental outcomes. Moreover, the group of presenters is truly international and truly interdisciplinary, representing the fields of Kinesiology, Developmental Psychology, Pediatrics, and Neonatology. Aside from the theoretical insights this research can provide into the developmental process, the work also has important practical implications for the early diagnosis and remediation of impairments that may have long lasting consequences for a child's quality of life.

Discussant: Joseph J. Campos, University of California, Berkeley

### Attention and Motor Modulation in High-Risk Neonates

**Judith Gardner**[1,2] Bernard Karmel[1,2] Phyllis Kittler[1,2] Robert Freedland[1,2] Anthony Barone[2] Anantham Harin[2]

*1. New York State Institute for Basic Research in Developmental Disabilities, New York, USA; 2. Richmond University Medical Center, New York, USA*

**Background/Aims:** A unitary regulatory process integrating arousal, attention and motor action is hypothesized to underlie neonates' interactions with the environment. We show early CNS-related regulation problems yield important information about neonatal capacities and predict outcome. We report relations of three neonatal procedures to each other, to CNS injury, and to later outcome.

**Methods:** Newborns, tested in NICU and followed longitudinally, were classified as to severity of CNS injury. Procedures included arousal-modulated attention (AMA), stimulus modulation of motor activity (SMMA), and Rapid Neonatal Neurobehavioral Assessment (RNNA) of sensory and motor behaviors. AMA produced visual preference functions to lights flashing at 1, 3, and 8 Hz when arousal was modulated by feeding and stimulus conditions. SMMA produced a "quantity-of-movement" index (total-time-moving/total- observation-time) for each of three 2-min periods with a ceiling light/heat lamp turned on-off-on from videos of infants supine on an examination table. In light-off condition, ambient light decreased from 10.4 to 5.1 EV; infants' core temperature unchanged.

**Results:** In AMA, normal neonates are excellent modulators, preferring more stimulation when less aroused after feeding. CNS-injured infants are poor modulators, preferring less stimulation in all conditions. In SMMA, infants moved more in lamp-off condition. Amount of change across conditions was related to CNS injury but, opposite to AMA, CNS injury produced more modulation. SMMA related negatively to AMA at 1 and 4 months and to RNNA state control and jitteriness at 1 month. All measures predicted BSID MDI and PDI between 4 and 25 months to differing degrees.

**Conclusions:** These data demonstrate interdependency between motor activity and stimulation, which may be linked with arousal and attention. Importantly, early diagnosis of CNS pathology is related to attention/motor modulation underlying developing regulatory systems that have wide-range effects on later attention, motor, social, language, and cognitive functioning.

### Lateral Bias of Arm Movements in Neonates: the Effect of Head Position, Body Position, and Behavioral State

**Louise Rönnqvist**[1] Brian Hopkins[2]

*1. Department of Psychology, Umeå University, Umeå, Sweden; 2. Centre for Research in Human Development, Department of Psychology, Lancaster University, Lancaster, UK*

**Background and Aims:** Lateralization of movement patterns seems to appear early in human life, presumably before birth. However, knowledge of the relations between different movement patterns and different behavioral states and body positions of the neonate is scarce. Thus, we address that question in the present investigation.

**Methods:** Arm and head movements of twenty-five newborn infants were investigated at a mean age of 68 hours. The infants were placed in a custom-built, head-holder-platform that secured the trunk in a midline position but allowed the arms to move freely and the head to move from side-to-side through a range of 140°. Kinematic recordings of head and arm movements were made with the infant in a supine and a semi-upright position.

**Results:** The supine and semi-upright positions did not differentially influence lateral head preference. The number of head turns, maintenance and number of head midline crossings, and quantity of arm movements were strongly mediated by state. Both arms moved significantly more (in terms of number of angular velocity changes) when the head was in a right, compared to a left, position. Additionally, when the head was turned to the right, the right arm moved more and was positioned higher in the vertical plane than the left. This finding was more evident in the supine than the semi-upright position.

**Conclusion:** The present findings suggest that a preference for spontaneous, right arm activity is already present at birth and they support the idea of a normal lateralized gradient of neuronal differentiation and maturation from right to left. The association between head position and arm movements indicates that they likely stem from a common asymmetry that involves different pathways for the neck and arm muscles.

### Neonatal Stepping in Relation to Approaching and Receding Terrestrial Optic Flows

**Marianne Barbu-Roth**[1] David Anderson[2] Joëlle Provasi[3] Adeline Desprès[4] Ryan Streeter[5] Robert Schleihauf[5]

*1. CNRS and Laboratoire Psychologie de la Perception, Université Paris 5, Paris, France; 2. Department of Kinesiology, San Francisco, USA; 3. Laboratoire PsychoBiologie Développement, Paris, Paris, France; 4. Laboratoire Psychologie de la Perception, Université Paris 5, Paris, France; 5. Department of Kinesiology, San Francisco State University, San Francisco, USA*

**Background and Aims:** Recently, we have demonstrated that newborn stepping, the most primitive form of bipedal locomotion, can be modulated by optical flow, with 3-day-old infants producing significantly more air steps when exposed to a terrestrial optical flow specifying forward translation compared to an optical pattern specifying rotation or no self-displacement (Barbu-Roth et al., 2004, 2005, submitted). Here we investigate the specificity of visual-locomotor coupling by exposing neonates to terrestrial optic flows that move either toward or away from them.

**Methods:** Twenty four 3-day-old infants were held upright above a rigid, translucent surface onto which was projected a pattern of black and white dots that moved toward the infant (Toward), away from the infant (Away), or remained static (Static). The order of conditions was randomized and each condition lasted for one minute. Two video cameras, placed orthogonal to each other were used to capture the duration of crying and the number of air steps. The latter was determined both qualitatively by two independent coders and by custom Kinematic Analysis software.

**Results:** Planned comparisons revealed no significant differences between conditions in the overall amount of crying or in the number of steps taken while crying. However, more steps were taken in the Toward condition (12.2) than in the Static condition (7.7), $F(1, 23) = 4.71$, $p < .05$. The Static condition was not significantly different from the Away condition (10.3) and the Toward and Away conditions did not differ significantly. The kinematic data revealed interesting qualitative differences between the trajectory of the ankle in the Toward and Away conditions suggesting that a different gait pattern was elicited by an approaching and a receding optic flow.

**Conclusion:** These findings suggest a precocious capacity in the newborn to perceive and utilize visual information specifying different directions of self-locomotion. We believe that our data highlight the continuity between primitive stepping and independent walking as well as the importance of visual information for the control of neonatal movements.

## *Initial Steps in Acculturation: Perceptual Foundations*

*(Invited Symposium, Perceptual Development)*

**Chair:** *Daphne Maurer*

### Developmental Cerebral Lateralization and Early Speech Acquisition: Evidence From Neuro-Imaging Studies in Infants

**Emmanuel Dupoux**[1] Yasuyo Minagawa[2]

*1. Laboratoire de Sciences Cognitives et Psycholinguistique, EHESS, Paris, France; 2. Keio University, Tokyo, Japan*

The existence of dedicated networks for language in the left hemisphere of human adult brains has been well documented in several neuropsychological and neuroimaging studies. However, the neurocognitive development of this specialized system in infants is still poorly understood. This is mainly due to a lag in the development of infants' neuroimaging techniques usable in infants. Here, we review recent ground breaking studies using functional magnetic resonance, multi-channel event-related potential, and near-infrared spectroscopy (NIRS) which provide data on the cerebral bases and development of language in infants (e.g. Sato et al., 2004; Werker and Yeung, 2005; Dehaene-Lambertz et al., 2006; Minagawa-Kawai et al., 2007; In press). These studies enable us to compare activations in the developing brain with the cerebral organization of the mature language system (e.g. Friederici, 2002; Scott, 2005; Minagawa-Kawai et al., 2005). Focusing on functional hemispheric specialization in response to speech sounds, we argue that at least 2 factors, i.e. the acoustic and linguistic properties of speech sounds, influence hemispheric dominance, but that these impacts are different depending on the developmental stage. We propose that cerebral lateralization for language emerges out of the interaction between left-right biases in generic auditory processing, and a left-hemisphere bias for the extraction of sequential regularities. Specifically, at the initial stage, neural recruitment for speech processing is chiefly influenced by temporal and spectral properties of speech. As infants are exposed to language, the left hemisphere learning systems capture the newly learned sounds into circuits around the left-perisylvian areas. This model accounts for the reviewed developmental observations of a change from hemispheric dominance being driven by the low level properties of the stimuli to a hemispheric dominance being driven by function.

### Infants' Representation of Humans: Intermodal Processes

Olivier Pascalis

*University of Sheffield, Sheffield, UK*

The ability to recognize conspecifics is imperative for any species that lives in a social group. Adults have a multimodal representation of their conspecifics so recognition can be achieved on various cues such face, voice/language, or smell. Bonatti et al. (2002) suggested that infants had psychological assumptions to members of their species, meaning that they do have a representation of what is a human. Do infants have a modality specific or multi-modal representation of human? In term of face processing a preference toward human faces has been observed during the first week of life. There is a general consensus that we are 'becoming face experts' (Carey, 1992) and the immature face processing system present at birth develops with experience. The idea of a crude face representation during the first week of life is indeed well supported, however, recent

finding are suggesting the existence of a very rapid learning mechanisms for faces during the first week of life. I will review the evidence for such system and the impact it has on face representation. Neonates are however using cues from different modality to recognize individuals. Saï demonstrated that newborns only recognize their mother's face if a postnatal exposure to the mother's voice-face combination was available. Does it mean that infants have face-voice representation? We addressed this question studying the intermodal representation of race and language in 6 month olds. We found

that Caucasian infants correctly matched Caucasian faces to English language and Chinese faces to Chinese language. It demonstrates that 6-month-old infants have a cross-modal representation of both their own race and an unfamiliar race. The issue of inter-modal representation of humans during infancy will be discussed.

### Early Door Experience As Cultural Forerunner, Or Ways Mothers Use To Launch Predictable Cues in Their Infant's Environment

**Benoist Schaal**

*Centre Europeen des Sciences du Gout, Dijon, France*

From the earliest postnatal moments, when placed in favourable conditions, human infants have the capacity to express choices. They are thus able to extract information on which such choices are based. Most of this information is initially encoded within the maternal environment. Human olfactory propensities are first canalized in the womb, leading to infants that are "specialists" for processing certain door stimuli more readily than others. The fetal brain encodes indeed amniotic door stimuli and mediates attention when these odorants are re-encountered in the neonatal niche. The birth gap is crossed easier when such a set of sensory/cognitive competences are brought to it fostering then immediate engagement of investigation, recognition and decision for directed action. These inaugural capacities for perception are then completed and renewed through the developing infants' ability to encode and retain unprecedented information, and to use it according to the changing requirements of the environment and of the organism itself. Milk and breast cues are privileged means for such acquisition processes, both as media and reinforcers. We will present data on how infants respond to human milk door and how they learn doors associated with breastfeeding. Such breast-related door information prepares the infants' responsiveness to the next developmental steps leading to the independent intake of non-milk foods that are typical of the mother's culture. We will detail how such sensory continuities are based on modality-specific processes, but also highlight how amodal olfactory mechanisms may introduce predictability or generalization in the early door environment. Finally, we will address the extent to which early intermodal processes involving olfaction might govern the rapid expression of infants' adaptive responses in the maternal context. In sum, newborns are born with a draft version of the door culture they will later meet as infants, weanlings and children.

## *Methods in Developmental Cognitive Neuroscience: The State of the Art* *(Regular Symposium, Cognitive Development)*

**Chair:** *Scott Johnson*

**Discussant:** *Richard Aslin*

**Scott Johnson**[1] Dima Amso[2] Susan Hespos[3] Denis Mareschal[4] John Richards[5] **Richard Aslin**[6]

*1. UCLA, Los Angeles, USA; 2. Sackler Institute for Developmental Psychobiology, New York, USA; 3. Northwestern University, Evanston, USA; 4. Birkbeck College, University of London, London, UK; 5. University of South Carolina, Columbia, USA; 6. University of Rochester, Rochester, USA*

A complete description of cognitive, perceptual, motor, and social developmental processes must include knowledge about the development of neural systems. Obtaining information about neural function in adults is challenged by the complexity of neural activity and its inaccessibility to direct recording in humans. Obtaining information about neural function in infants and children is doubly challenging because our subject population is notoriously difficult to test. Nevertheless, important progress is being made in this area. This symposium will feature presentations by experts on four emerging technological advances in developmental cognitive neuroscience. Dima Amso will discuss functional magnetic resonance imaging (fMRI) and diffusion tensor imaging (DTI), methods that assess properties of cortical gray and white matter, respectively, and examine their maturation and consequences for cognitive development. Susan Hespos will discuss near-infrared spectroscopy (NIRS), a method that measures the hemodynamic response near the scalp, and present comparisons of infants and adults in tests of visual, auditory, and motor function. Denis Mareschal will discuss neuroconstructivism, a unifying theoretical framework comprising constructivism, neuroscience, and computational modeling, and consider its implications for developmental psychology. John Richards will discuss combining structural MRIs and high-density electroencephalographs (EEGs) to yield realistic cortical source models of cognitive function in infants, and describe the application of these models to questions of brain-behavior relations during early development. Finally, Richard Aslin, a leader in research on perceptual, cognitive, and cortical development, will serve as discussant. This group of talks is the first at a major developmental conference to represent these cutting edge methods in a single symposium, and as such truly represents the state of the art.

### Functional Magnetic Resonance Imaging & Diffusion Tensor Imaging: Applications and Promise For Developmental Research

Dima Amso

*Sackler Institute for Developmental Psychobiology, New York, USA*

Understanding the development of neural pathways underlying cognition, and the experiences that alter them, is imperative to cognitive development research. Magnetic resonance imaging (MRI), including its functional component (fMRI), and diffusion tensor imaging (DTI) are noninvasive research tools with broad potential to inform the field of developmental psychology. These techniques provide a unique opportunity to quantitatively assess biological and behavioral changes simultaneously and non-invasively. Structural MRI has been used to index biological maturation as measured by, for example, changes in cortical grey matter in the very early postnatal period in typically developing infants. DTI, in turn, provides important information about properties of white matter fibers or connectivity between brain regions. The functional component of MRI (fMRI) allows for repeated

in vivo measurement of brain activity, in response to external stimuli or experiences, by indexing changes in localized blood oxygen levels in the brain. The assumption that these localized increases in blood oxygenation reflect increases in neuronal activity has found empirical grounding in combined fMRI and electrophysiology studies of non-human primates. These neuroimaging techniques have already begun to provide important information about the interactions between brain maturation and environmental experience in cognitive development. This talk will discuss these powerful research tools, highlighting the importance of using a converging behavioral and neuroimaging methods approach. Where possible, examples will include developmental work that informs systems and processes in place as early as infancy.

### What is Optical Imaging and How Does it Work?

Susan Hespos
*Northwestern University, Evanston, USA*

Optical imaging is a method for measuring blood flow changes in the brain resulting from local activation. The technology, near infrared-spectroscopy (NIRS), is a good choice for research on surface cortical activity for several reasons. NIRS is portable, harmless, and non-invasive. Because the NIRS head-set is sewn inside a fleece cap that is placed on the baby's head, the infant is allowed to sit on their parent's lap and move with some freedom. Unlike fMRI instruments the NIRS instrument is silent, allowing presentation of auditory stimuli. The NIRS technique measures both oxyhemoglobin and deoxyhemoglobin with a high signal to noise ratio. Currently there are two limitations as a research tool: it is restricted to measurements near the cortical surface closest to the skull and so cannot reliably assess cerebral activity deep in the brain and it is not yet used widely with infants.

We will present findings from our experiments that measure changes in the hemodynamic response for visual, auditory, and motor areas on infants ranging from birth through 10 months. We have tested adult subjects in the same paradigms to allow for comparisons between infants and adults using NIRS and adults using NIRS and fMRI. In one study, we presented infants with native and non-native speech, and tonal sounds. We found more activation in the left hemisphere during native speech at all ages. A similar left hemisphere asymmetry was found in the young age group for non-native speech, but this effect dropped out by 6 months. The reaction for the tonal condition was significantly different from all other conditions.

In sum, the talk will demonstrate the feasibility of using the NIRS technology to test infants. In addition we will share our techniques for group analyses and how we keep our drop-out rate below 5%.

### Computational Models and Neuroconstructivism

Denis Mareschal
*Birkbeck College, Los Angeles, USA and University of London, London, UK*

In this talk I present the Neuroconstructivist Framework, a unifying framework for the study of development which brings together (1) constructivism (which views development as the progressive elaboration of increasingly complex structures), (2) cognitive neuroscience (which aims to understand the neural mechanisms underlying behaviour), and (3) computational modeling (which proposes formal and explicit specifications of information processing). The guiding principle of our approach is context dependence, within and (in contrast to Marr) between levels of organisation. We propose that three mechanisms guide the emergence of representations: competition, cooperation, and chronotopy, which themselves allow for two central processes: proactivity and progressive specialization. We suggest that the main outcome of development is partial representations, distributed across distinct functional circuits. This framework is derived by examining development at the level of: single neurons, brain systems, and whole organisms. We use the terms encellment, embrainment, and embodiment to describe the higher-level contextual influences that act at each of these levels of organisation. Computer and robotic models provide a concrete tool for investigating the processes and mechanisms involved in learning and development. This talk will discuss standard connectionist neural network models as well as multi-agent models, and robotic models that emphasize the need to take embodiment and brain-system interactions seriously.

### What's Inside a Baby's Head?

John Richards
*University of South Carolina, Columbia, USA*

Developmental psychologists studying infant cognitive development often use brain development as an explanation for cognitive development. Until recently it has been impossible to "look inside the baby's head" to determine brain developmental status. Neuroimaging techniques (MRI, PET) were limited to infants with medical indications, and a picture of the brain of the normally developing infant was not possible. Recently normally developing infants and children have had brain imaging with MRI. This includes early scattered reports of functional MRI (fMRI), the NIH MRI study of normal brain development, and my own use of 3T structural MRIs. These studies have resulted in very revealing findings about the nature of the infant brain and its relation to cognitive development.

The current presentation will describe an approach to studying the brain-cognitive relation in infant development with realistic cortical source models of EEG/ERP. High-density EEG is recorded while infants participate in cognitive psychophysiological tasks (e.g., recognition memory; spatial cueing; hidden objects). These infants also have a structural (anatomical) MRI. A realistic model of the spatial topography of the materials in the baby's head is constructed. Equivalent current dipole models of the event-related potentials taken in the psychophysiological tasks give the location of the brain activity during the task; presumably these are tied to the psychological processes involved in the tasks. This neuroimaging technique gives location of the source of the activity, the time-course of the neural activity, and the relationship of the brain activity to the psychological processes involved in the task. The use of this technique with infants has shown several characteristics of infant's head and brain that are strikingly different from adults and older children (myelination; skull thickness; brain material impedances; relation between skull landmarks and underlying brain lobes). This technique also has proven beneficial in locating the brain correlates of psychological processes in the young infant.

## *Methodological and Analytical Advances in Assessing Infants' Information Processing*

*(Regular Symposium, Attention, Memory and Learning)*

**Chair:** *Robin Panneton*

**Discussant:** *John Colombo*

**Robin Panneton**[1] Christopher Robinson[2] Vladimir Sloutsky[2] Robin Panneton[1] Michael Frank[3] Edward Vul[3] Scott Johnson[4] Derek Houston[5] David Horn[5] **John Colombo**[6]

*1. Virginia Tech, Blacksburg, USA; 2. The Ohio State University, Columbus, USA; 3. Massachusetts Institute of Technology, Boston, USA; 4. University of California at Los Angeles, Los Angeles, USA; 5. Indiana University School of Medicine, Indianapolis, USA; 6. University of Kansas, Lawrence, USA*

Despite advances in studying infant cognition, challenges continue in assessing a period of development involving participants with limited behavioral repertoires, who are undergoing rapid and extensive changes. This symposium highlights shortcomings in some methodological and analytical tactics used to assess infants' information processing, and offers potential solutions. Presentations involve improved measures of attention (e.g., psychophysiology, advances in eye-tracking), improved procedures (e.g., more sensitive design features), and improved analytic tactics (e.g., assessing individual subject performance).

Robinson and colleagues offer data from experiments in which infants were familiarized with visual, auditory, and visual+auditory events, and then tested with changes to novel stimuli. Attention to change was assessed via looking time and heart-change measures. The results show good correspondence between measures during visual processing, but that HR is a more accurate attention measure during auditory and multimodal processing.

Frank and colleagues offer data from different-aged infants and adults while freely viewing animated film clips. Using advanced eye-movement techniques (compared to simple looking time measures), these authors identified both within- and between-group differences in attention to various aspects of the films. Their results highlight developmental changes in visual attention to dynamic information (e.g., faces) to which more conventional approaches are not sensitive.

Using the Visual Habituation Procedure, Houston and colleagues manipulated both aspects of the testing phase (e.g., increased assessments) as well as different data-analytical treatments (e.g., autoregressive techniques) to generate a procedure that generates clear evidence for speech discrimination, both at group and individual subject levels. This hybrid design also benefits from low cognitive demands, and greater clinical utility.

The importance of these various suggestions for assessing and analyzing infants' attention to unimodal and multimodal information will be discussed by John Colombo.

### Modality-Dependent and Modality-Independent Measures of Attention

**Christopher Robinson**[1] Vladimir Sloutsky[1] Robin Panneton[2]

*1. Center for Cognitive Science, The Ohio State University, Columbus, USA; 2. Virginia Tech, Blacksburg, USA*

Infancy research relies extensively on looking behavior (i.e., visual fixations, preferential headturn, etc.) to examine visual, auditory, and cross-modal processing. For example, recognition of a visual stimulus is often assessed by familiarizing (or habituating) infants to a visual stimulus and then comparing looking times to new and old visual stimuli. A similar procedure is often employed to measure auditory and cross-modal processing. For example, in preferential head-turn procedures, infants are familiarized to an auditory stimulus and then infants' looking toward novel and familiar auditory stimuli is compared.

While infant looking is a well established measure, it may not be optimal for the study of auditory and cross-modal processing for two reasons. First, it is possible that most of the looking measures underestimate auditory processing or auditory attention because auditory input can be processed in the absence of looking. And second, it is impossible to establish a true unimodal auditory baseline. Therefore, amodal measures may be more accurate when examining auditory and A/V processing.

The current study examined modality-dependent (visual fixations) and modality-independent (Heart Rate) measures of attention. In one experiment we presented infants with auditory and visual unimodal stimuli. In a second experiment, we familiarized infants to an A/V compound stimulus. At test, we either changed the auditory or visual component. Looking times and duration of Heart Rate (HR) deceleration were recorded in both experiments. Decelerated HR is often associated with active processing of visual stimuli (Richards & Casey, 1992).

The results indicate that looking time and HR provide converging measures of visual processing. However, looking time underestimated auditory processing compared to HR measures of attention. This suggests that HR may be more accurate for estimating auditory and A/V processing. In the talk, we will discuss methodological implications of these findings for the study of auditory and A/V processing.

References

Richards, J. E., & Casey, B. J. (1992). Development of sustained visual attention in the human infant. In B. A. Campbell, H. Hayne, & R. Richardson (Eds.), Attention and information processing in infants and adults (pp. 30-60). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

### Comparing Attention to Faces Across Development Using Free-Viewing Eye-Tracking

**Michael Frank**[1] Edward Vul[1] Scott Johnson[2]

*1. Massachusetts Institute of Technology, Boston, USA; 2. Department of Psychology, University of California at Los Angeles, Los Angeles, USA*

There are very few experimental paradigms in which infants and adults can be compared directly. Here we present a set of methodological and analytic advances that allow such a comparison using advanced eye-movement analysis techniques; thus enabling us to reveal the trajectory by which infants reach adult competence. We applied these methods to study face perception. A preference for faces has controversially been claimed to be present at birth in some form (Johnson & Morton, 1991; Farroni et al., 2005), but the connection between this early competence and the adult state is largely unknown.

We recorded the free-viewing eye-movements of three-, six-, and nine-month-olds as well as several control groups of adults as they watched short clips from A Charlie Brown Christmas (an animated film). Using our novel computational tools we could assess within-group variability and between-group differences in which aspects of visual input attracted fixations for each age group. We found large differences in fixation patterns across age groups: Three-month-olds focused primarily on perceptually salient regions of the movies, and thus produced fixations which were spread broadly. However, by nine months infants showed a much more adult-like pattern of attention to faces. These results were further confirmed by a control demon-

strating that when the films were displayed with music rather than dialogue accompanying them (controlling for infants' lack of linguistic skills), adults' fixations were statistically identical to those of the nine-month-olds.

These results give evidence that, whether or not neonates prefer faces in highly restricted contexts, the development of a preference for faces in richer, more naturalistic contexts is far more gradual. More broadly, these results demonstrate that eye-tracking during free viewing of complex stimuli is a viable method for tracking the development of visual attention and information processing across a wide range of ages.

### Assessing Speech Discrimination in Individual Infants

**Derek Houston**[1] David Horn[1] Sara Tinter[1] Rachael Holt[2] Jonathan Ting[1] Rong Qi[1] Sujuan Gao[1]

*1. Indiana University School of Medicine, Indianapolis, USA; 2. Indiana University, Indianapolis, USA*

This talk will contribute to the symposium Methodological and Analytical Advances in Assessing Infants' Information Processing" by discussing developments of a novel variant of the Visual Habituation Procedure (VHP) for assessing speech discrimination in infants. Our work was motivated by the growing emphasis on early detection and intervention of language disorders and clinicians' need to evaluate the effectiveness of intervention strategies during infancy with special populations. Our goal was to develop a speech discrimination procedure that could detect speech discrimination in individual infants, had low cognitive demands, and had a short testing period.

In typical VHPs, infants are habituated to one sound and then presented with a novel speech sound to see if they show a novelty preference. VHP relies on an unconditioned response, and the testing period is usually only about 5 minutes. However, because the novelty response is by nature transitory, usually only one novel trial is presented - not enough to assess discrimination with statistical reliability.

We tested four variants of the VHP. Forty 9-month-olds were habituated to audiovisual repetitions of a nonword (seepug). The extended variant had 7 old (repetitions of seepug) and 7 novel trials (repetitions of boodup) during the test phase. The oddity variant had 10 old and 4 novel trials in random order. The stimulus alternation variant had 7 old and 7 alternating trials (repetitions of seepug and boodup). The hybrid variant had 10 old and 4 alternating trials. The hybrid variant was the most effective - 8 of 10 infants demonstrated statistically significant discrimination. Moreover, infants showed good test-retest reliability.

Ongoing work will test the hybrid variant with more difficult speech contrasts and assess discrimination of multiple contrasts in a single setting. The outcome will hopefully provide clinicians and researchers with a way of more thoroughly assessing the speech discrimination abilities of individual infants.

## *Utilizing Rich, Real-Time, Socio-Emotional Datasets to their Full Potential: The Dynamics of Infant Reactivity and Regulation using Complex Modeling Methods*

*(Regular Symposium, Emotional Development)*

**Chair:** *Heather Warren*

**Heather Warren**[1] **Cynthia Stifter**[2] **Michael Rovine**[2] **Ginger Moore**[2] **Erika Lunkenheimer**[3]

*1. George Mason University, Fairfax, USA; 2. Penn State University, University Park, USA; 3. University of Oregon, Eugene, USA*

Developmental research has moved from describing normative change to understanding individual differences in developmental processes. The use of statistics to describe these differences has not caught up to those used to address simple patterns of change. In the past, developmental research questions fit conveniently available methods. As development and intra-individual processes are dynamic, methods that model these processes over time should be considered. This symposium will introduce these methods to developmental data. Each dataset captures either real-time dyadic interactions or within-individual regulatory processes, and the authors will discuss the methodologies used to understand the dynamics they observed.

Our first paper looks at both individual- and dyad-level behaviors during the Still Face Paradigm and models these behaviors to understand the mother-child interaction styles more likely to predict self-regulation, attachment relationships, and marital and parenting quality. The second paper asks: can the dyad act as a mechanism of change in an at-risk sample? The authors examine whether positive, engaged interactions between parent and infant can improve self-regulation skill in childhood using dynamic systems methods. The third paper models the relationships between infants' behaviors and parents' attempts to soothe infants during episodes that induce stress in infants as well as within-individual regulatory processes. These models allow the authors to examine the important covariates that affect these within-dyad and within-individual processes, the success of regulatory strategies, and the degree to which parents and individuals are able to adapt.

Together these papers present various methodologies for understanding how a primary caregiver engages the child in real-time, the utility of modeling these processes to predict various outcomes, and within-individual regulation. The models presented here will move the developmental field forward by examining dynamic, rather than static processes at the individual and dyad, rather than group, level.

### Dyadic Indices of Parent-Infant Interaction: Measures and Meaning

**Ginger Moore**, Christopher Powers, Anneliese Bass

*Penn State University, University Park, USA*

Numerous measures of parent-infant interaction related to synchrony and contingent responsiveness are proposed to influence development of self-regulation, attachment relationships, and empathy (Feldman, 2007; Harrist & Waugh, 2001). Little is known about relations among measures, limiting understanding of what measures mean and whether they reflect characteristics of parents, infants, or dyads.

Mothers and 6-month-old infants (N = 140) affect and direction of gaze were coded at 1-s intervals during the reunion episode of the Still-Face Procedure. Measures were computed from time series of behavior codes. Individual measures included: state scores (ranging from least to most engaged), median duration of most engaged state, and infant latency to most engaged. Dyadic measures included: cross-correlations between partners states, % time in matched state,

contingent cross-correlations between partner states (e.g., mothers state with infants previous state), and range of, dispersion across, and transitions among possible dyadic states, computed using GridWare software (Lamey, et al., 2004).

Factor analysis revealed four orthogonal factors that were differentially related (Table 1) to parents marital relationship, infant physiological reactivity and temperament, attachment at 12 months, and parenting stress. Results suggest that various measures of parent-infant interaction reflect orthogonal qualities that independently predict characteristics of parents, infants, and dyadic relationships. Confirmatory factor analyses will be conducted in a second data set that includes father-infant interaction.

**Table 1.**

| Factor (% of variance) | Main factor Loadings/ Secondary factor loadings | Description | Predicts (values are Pearson correlation coefficients, all $p < .05$) |
|---|---|---|---|
| Flexibility (22.21%) | Range of, Dispersion across, and Transitions among possible dyadic states;Mother median duration of most engaged state (negative loading) | Dyad engaged in a wide range of states, does not remain in any one state for long periods of time, moves frequently among different states. Mothers bouts of high engagement are shorter. | - Greater marital conflict resolution (.22). - Infant less negative (.25) |
| Synchrony/ Affect-Sharing (13.20%) | Mother contingent to infant; Infant contingent to mother; | Dyad spends greater amount of time in matched state. Mothers and infants states change in concert with each other. Infants bouts of high engagement are longer. Infants reach first state of high engagement in a shorter amount of time. Mothers bouts of high engagement are shorter. | - Less infant physiological arousal/greater heart period (.29); higher vagal tone (.22)- Lower Soothability (-.35) and higher Distress to Limitations (.21)- Greater parenting stress (.19)- Infants less negative (-.43) and more positive (.57) |
| Contingent Responsiveness (6.8%) | Mother contingent to infant; Infant contingent to mother;Correlation between individuals states; Range of dyadic states (negative loading) | Mothers state changes in response to infants previous state and vice versa. Mothers and infants states change in concert with each other. Dyad engaged in a smaller range of states. | - Infants more distressed by mothers still-face (.28)- Greater proximity seeking (.20) and more likely to be securely attached (at 12 months in Strange Situation) |
| Low intensity engagement(6.3%) | Mother median duration of most engaged state (negative loading);Infant latency to most engaged state | Mothers bouts of high engagement are shorter. Infants take longer to reach first state of high engagement. | - Infants less positive (-.47) and more negative (.22)- Less parenting stress (-.25)- Less marital conflict (-.22) and greater marital intimacy (.19) |

## Positive Parent-Child Interaction in High-Risk Families and Growth in Children's Self-Regulation from Ages 2 to 4

Erika Lunkenheimer, Thomas Dishion, Charlotte Winter

*University of Oregon, Eugene, USA*

**Background and Aims:** Research demonstrates that early, coercive parent-child interactions contribute to stability in children's regulatory problems. We know less about how adaptive parent-child interactions contribute to the development of children's self-regulation for children at risk. The present study explored how positive parent-child interaction contributed to inhibitory control and externalizing problems in children enrolled in a longitudinal intervention study from ages 2 to 4.

**Method:** Participants were 731 low-income families from the Women, Infants, and Children (WIC) Nutritional supplement program in three American cities. After an in-home assessment including videotaped parent-child interaction and parent report of inhibitory control and externalizing problems, families were randomly assigned to the intervention (Family Check-Up) versus control condition at child age 2. The assessment was repeated at ages 3 and 4. Positive, engaged interaction (PEI) was modeled via State Space Grids (Lewis, Lamey, & Douglas, 1999) as the proportional duration of time the dyad spent in the positive-engaged quadrant of the state space.

**Results:** Longitudinal growth models in Mplus revealed that PEI predicted growth in inhibitory control over time (est = .55, SE = .13, $\beta$= .34), controlling for stability in PEI, child age, child gender, ethnic minority status, and parent education, $\chi^2$ (df = 20) = 36.04, p = .02; CFI = .98; RMSEA = .03. Further, there was a marginal mediation effect of the Family Check-Up promoting inhibitory control through improvement in PEI. PEI did not predict growth in externalizing problems, but predicted overall reduction from age 2 to 4 in post-hoc regression analyses.

**Conclusion:** The microsocial analysis of early, adaptive parent-child interaction can inform research on the development of children's self-regulation and illustrate the role of dyadic parent-child interaction as a mechanism of change in family preventive intervention.

## Self- and Caregiver-Supported Regulation: Using Latent Markov Models to Understand What Works and What Matters For Infant Coping

**Heather Warren**[1] **Cynthia Stifter**[2] **Michael Rovine**[2] Katerina Sinclair[2]

*1. George Mason University, Fairfax, USA; 2. Penn State University, University Park, USA*

Children move from external regulation of emotion (via the caregiver) (Diener & Manglesdorf, 2000) to internal regulators of emotion (Kopp, 1989; Thompson, 1994), with their recruitment of emotion regulation strategies becoming increasingly more organized and coherent (Bridges & Grolnick, 1995; Eisenberg & Fabes, 1992; Kopp, 1989; Sroufe, 1995). The current paper examines both the self-regulatory strategies used by the infant in a minimally responsive caregiving environment, and the co-regulatory dynamics of interactions between primary caregiver and infant.

Two longitudinal real-time datasets will be used to examine (a) infants' self-regulatory behavior in the absence of external caregiving support (5, 10 months) and (b) parents' attempts to soothe infants' distress (2, 6 months) in stress-inducing situations. Hidden Markov Models (Visser, 2005) were used to model changes in state for both datasets. Analyses of infant reactivity and self-regulation (part a) are forthcoming.

For part b, an infant's scheduled inoculation and soothing period was videotaped until 20 seconds of calm was observed. States were defined as probabilities of observing both infant distress and maternal behaviors. Fit indices indicated that a six state model fit the data well (AIC (139 parameters, 89 free) = 19310.5). The states differed in both the level of distress and in the soothing strategies used. The transition matrix (Table 1), indicating the likelihood of staying in one state (diagonal) or transitioning into another (off-diagonal), emphasized both stability and change over time. We will present the covariates that affect these within-dyad processes, the success of regulatory strategies, and the degree to which parents and individuals are able to adapt to the dynamics of the event. Our dynamic dyad level interaction model, unlike Yule's Q, will also allow for model fit estimation at the individual and dyad, rather than group, level. Together these datasets will provide a dynamic portrait of infant reactivity and regulation.

**Table 1. Transition Matrix for six-state model**

| | State 1 | State 2 | State 3 | State 4 | State 5 | State 6 |
|---|---|---|---|---|---|---|
| State 1 | .872 | .016 | | .007 | .096 | .009 |
| State 2 | .019 | .740 | .206 | .021 | .003 | .011 |
| State 3 | .014 | .057 | .674 | .231 | .012 | .012 |
| State 4 | .012 | .004 | .050 | .915 | .004 | .015 |
| State 5 | .006 | | | .010 | .985 | |
| State 6 | .014 | .023 | .020 | .032 | | .910 |

## *The Psychological Antecedents and Consequences of Powered-Mobility Training* *(Regular Symposium, Motor and Sensorimotor)*

**Chair:** *James Galloway*

**Discussant:** *John Spencer*

**James Galloway**[1] Sunil Agrawal[2] David Anderson[3] Joseph Campos[4] Ichiro Uchiyama[5] **John Spencer**[6]

*1. University of Delaware, Dept of Physical Therapy, Newark, USA; 2. University of Delaware, Dept of Mechanical Engineering, Newark, USA; 3. San Francisco State University, Dept of Kinesiology, San Francisco, USA; 4. University of California, Berkley, Dept of Psychology, Berkley, USA; 5. Doshisha University, Dept of Psychology, Kyoto, Japan; 6. University of Iowa, Dept of Psychology, Iowa City, USA*

Mobility is fundamental to human life. Its acquisition heralds a dramatic shift in self-mastery and provides for constant, dynamic interaction with the physical and social world. As such, mobility constrains how the infant structures her knowledge of the world including her relation to that world. We now have considerable evidence that self-produced locomotion (SPL) is related to dramatic shifts in a broad range of psychological phenomena. Paradoxically, however, we know very little about the psychological prerequisites that permit the onset of independent mobility in the first place. The primary aim of this symposium is to explore the interplay between the psychological antecedents and consequences of SPL, with particular reference to the acquisition of control over a powered-mobility-device (PMD) by infants with and without special needs.

We aim to highlight the psychological consequences of immobility in infants with disabilities and to reveal how views of children's cognitive competence have hampered their access to PMDs. We show convincingly that very young infants (with and without disabilities) readily control their self-movement in a PMD and we show unequivocally that training in a PMD can bring about significant changes in psychological functioning. We also aim to illuminate how developmental principles have been used to generate technological innovations that can facilitate infants' independent control over a mobility device. Throughout the symposium, we intend to underscore the challenges associated with providing early mobility to infants who are unable to locomote independently.

The presenters were chosen for this symposium because they are recognized as international pioneers and leaders in a diversity of academic disciplines, despite their common interest in the psychological antecedents and consequences of SPL. The symposium shows how researchers in Psychology, Kinesiology, Physical Therapy, and Engineering can collaborate to address issues that are of central importance to the field of infancy - issues that have both basic and clinical implications.

### Babies Driving Robots: Self-Generated Mobility For Young Infants

**James Galloway**

*University of Delaware, Newark, USA*

**Background and Aims:** For certain special needs children; exploration of the world requires a power wheelchair. One often-cited drawback to powered mobility training in young children is that they become highly mobile without the cognitive ability to safely negotiate the world. The conventional strategy is to simply delay training until they are 4-6 years of age or older, and can follow adult directions. This delay is particularly disturbing given the neural and behavioral changes during these early years, and the clear influence of mobility on general development. We believe this delay is both unnecessary given current robotic technology, and more importantly, likely impedes the developmental processes that powered mobility is designed to eliminate. This initial study sought to determine i) whether non walking infants would drive our mobile robot ('UD1'); and ii) how their driving would change over multiple sessions.

**Methods and Results:** One typically developing infant (7 months) and one infant with Down Syndrome (14 months with a motor age of 7 months) were provided seven weekly opportunities to drive UD1 in a childcare center gym. UD1 is equipped with an on-board computer, and infrared and sonar sensors that allow for collection of multiple performance variables. Both infants increased their total session time to over 15 minutes (80 & 170% increase), their percentage of session time spent driving (30 & 125%), and increased the total path length to over 60 meters per session (141 & 547% increase).

**Conclusions:** These results suggest young infants have the exploratory drive, the learning ability and the grasping ability to drive through open spaces. Importantly, they will do so for enough time and distance to learn to navigate more complex environments using the robot's smart technology such as around obstacles and outdoors. We predict and are assessing the direct and indirect influences of robot enhanced mobility on infant's behavior when they are out of the robot such as their visual perception, socialization, language acquisition and emotional regulation.

### Thinking Outside the Robot: Developmentally Inspired Technology For Teaching Real World Navigation

Sunil Agrawal
*University of Delaware, Newark, USA*

Newly locomoting infants quickly realize that real world navigation involves negotiating static and dynamic obstacles. Providing real world navigation for special needs infants with mobility impairments is the primary goal of our mobile robot project. Infants can drive our robot, "UD1' either independently or as assisted by UD1's smart technology (Hao and Agrawal 2005a, 2005b, Pathak and Agrawal 2005). This presentation focuses on how thinking developmentally resulted in the creative application of robotics to help infants learn to drive around obstacles.

One feature of UD1 is obstacle avoidance. Here whenever the infant drives too close to an obstacle, UD1's sensors detect the obstacle, the control system takes over joystick commands, plans a new path, and drives around the obstacle. Temporarily removing control from the inexperienced driver provides a measure of safety. The goal, of course, is for infants to independently execute obstacle avoidance. Thus, the mismatch between joystick motion and robot motion during the avoidance maneuver could make learning more difficult. UD1 needed a technology upgrade to maintain a tight action-consequence link, which the literature suggests is useful for rapid learning in early infancy.

The solution was to create a control system that maps the robot's avoidance path back onto a joystick equipped with motors. The result is that infants are provided with feedback in the form of resistance proportional to incorrect joystick motions (Agrawal et al. 2007). Specifically, when the joystick is correctly moved along the path that would result in the robot's ongoing avoidance path, they feel no joystick resistance - it is as if they are driving the robot around the obstacle. When the joystick remains still or is moved incorrectly, joystick motion is resisted proportional to the path error, and the joystick is nudged back towards the correct position. Moreover, the amount of resistance can be changed to facilitate learning based on the infant's skill and current abilities.

### Is Locomotor Experience a Mere Antecedent of a Cause of Psychological Development: Studies with a Powered-Mobility-Device

**Ichiro Uchiyama**[1] David Anderson[2] Joesph Campos[3]
*1. Doshisha University, Kyoto, Japan; 2. San Francisco State University, San Francisco, USA; 3. University of California, Berkeley, Berkeley, USA*

**Background and Aims:** An infant-controlled powered-mobility-device (PMD) offers a novel way to experimentally test the consequences of locomotor experience for psychological development. We have recently used this approach to show that 15 days of training in a PMD leads to significant improvements in the infant's ability to use specific patterns of optic flow for postural control. In the current experiment, we extend this work by examining whether PMD training leads to changes in wariness of heights in addition to changes in visual-postural coupling.

**Methods:** Fifteen 8 month-old infants were randomly assigned to either an experimental condition that received 15 days of self-controlled movement in a PMD for 10 min each day or a Control condition that spent 10 min during each of the 15 days in other activities. The PMD was a motorized radio flyer wagon that moved forward at 15 cm/s when a joystick mounted in front of the seated infant was pulled backward. The PMD training was conducted in a narrow corridor. Prior to and after the experimental manipulations, postural compensation to discrete movements of the side walls of a moving room was used to assess visual-postural coupling. Heart rate acceleration during lowering toward the deep side of a visual cliff was used to assess wariness of heights.

**Results:** The amount of forward movement in the PMD increased significantly over the 15 days of training. More importantly, the PMD group showed a significant improvement in visual-postural coupling, whereas the Control group did not. Similarly the PMD group showed a significant increase in heart rate acceleration upon being lowered to the deep side of the visual cliff, whereas the Control group did not

**Conclusion:** These most recent findings from our laboratory confirm that locomotor training in a PMD provides sufficient experience to bring about changes in both visual-postural coupling and wariness of heights. The findings further highlight the value of the PMD as a tool to examine the psychological consequences of locomotor experience.

---

## *Action and Understanding: The Thorny Issue of How to Interpret Infant Behaviour*

*(Regular Symposium, Theory, Methods and History)*

**Chair:** *Jeremy Carpendale*

**Discussant:** *Charlie Lewis*

**Jeremy Carpendale**
*Simon Fraser University, Burnaby, Canada*

The concepts of knowledge and understanding are foundational in developmental psychology, and the study of infant development in particular. Scholars as diverse as Piaget and Wittgenstein, as well as disciplines such as cognitive science and artificial intelligence, have grappled with how best to conceptualize knowledge. These debates have critical implications for infant research. It is well known that assessing understanding in non-linguistic organisms such as infants, is problematic and ingenious methodologies have been devised for its assessment. However, results of empirical research still need to be interpreted, and it is here that debate is ongoing. Classical developmental theories (e.g., Piagetian) made a distinction between earlier forms of practical knowledge and later forms of reflective understanding. Recently, though, there has been a tendency to conflate infants' early successful goal-directed activities with later forms of understanding. Nonetheless, various researchers have continued to search for ways to independently discuss early forms of knowledge, such as 'understanding in action'. This issue arises in many different areas of infant research, from object-permanence to joint attention.

The papers in this symposium will address these issues from different theoretical perspectives, by presenting new data and reviewing existing research. The author of the first paper draws on Wittgenstein to critique interpretations of the nature of young infants' knowledge, and argues that later reflective understanding must be grounded in earlier unreflective practice. The authors of the second paper found in an observational study that infant reactions to positive and negative directives in the first year of infancy did not support cognitive load interpretations of early compliance. The authors of the third paper focus on joint attention and draw upon work in artificial intelligence and primatology to critique insight models of understanding, and suggest an approach to conceptualizing joint attention as based upon situated activity patterns.

### Wittgenstein's Baby: Infants must Act Before they can Theorize

**Ulrich Mueller**
*University of Victoria, Victoria, Canada*

In the last decade, there has been a trend toward increasingly rich interpretations of infant behavior. For example, based on differences in looking time in the violation-of-expectation paradigm, infants are credited with sophisticated inferential and reasoning abilities (e.g., Luo & Baillargeon, 2005; Wang, Baillargeon & Brueckner, 2004). Furthermore, according to theory theory (Gopnik & Meltzoff, 1997), the infant is a little scientist who holds and tests theories that "involve abstract theoretical entities, with coherent causal relations among them" (Gopnik & Meltzoff, 1997, p. 41). This position implies that all kinds of knowledge-"even apparently 'ordinary' kinds of knowledge, like our knowledge that this is a jar and that is a table" (Gopnik & Meltzoff, 1997, p. 44)-are considered to be theoretical knowledge, based on "the application of everyday theories" (Gopnik & Meltzoff, 1997, p. 44). In addition, infants are said to behave like scientists in that they make predictions, produce interpretations, and give abstract, coherent, and causal explanations.

In this paper, I will critique rich interpretations of infant behaviors and the theory theory position drawing on an argument that has been forcefully made by Wittgenstein (1958) in the context of his discussion of rule-following. The upshot of the argument is that rich mentalistic interpretations of infant behaviors lead to an infinite regression because they essentially fail to ground meaning. Following the logic of Wittgenstein's argument, the infant cannot start out as a "scientist in the crib", pondering different theories and testing hypotheses; rather, the starting point must be an unreflected practice: "In the beginning was the deed" (Wittgenstein, 1969, § 402). Implications of Wittgenstein's argument for positively conceptualizing and interpreting infants' behavior will be indicated.

### Do's and Don't's in the First Year of Life: Adult Directives and Infant Compliance

**Kerry Hicks**, Vasudevi Reddy, Katja Liebal
*University of Portsmouth, Portsmouth, UK*

**Background and Aims:** Previous research in structured situations with infants in the second year of life suggests that Don't's (i.e., prohibitions) are present earlier in the first year and are easier for infants to grasp than are Do's (i.e., positive commands) (Braungart-Rieker, Garwood & Stifter, 1997; Kochanska & Aksan, 1995). Explanations focus primarily on presumed 'cognitive load' - believed to be heavier in the execution of actions, sometimes involving many sub-components, than in the suppression of actions. A focus on motivational factors would suggest a different scenario. The present research sought to test these findings in naturalistic contexts and in the first year of life.

**Method:** Data from infants in free play interaction with their parents in the home was collected at 9.5 months and 12.5 months of age. Coding of adult directives differentiated between Do's and Don't's; coding of infant responses differentiated compliance and non-compliance in both immediate responses and final outcome.

**Results:** Contrary to previous findings positive directives were significantly more frequent than negative at both ages. Although frequencies of positive directives did increase with age, there was no increase in the ratio of positive to negative directives. Also contrary to previous findings, there was no increase with age in compliance (either immediate or final) in either positive or negative directives. At both ages there was a significantly higher incidence of negative than positive directives that were made immediately 'redundant' by parents (e.g., not giving the infant an opportunity to comply), suggesting that parents judged Don'ts to be 'harder' than Do's. Even controlling for this, however, compliance was not greater to negative than to positive directives.

**Conclusions:** Naturally occurring interactions in the first year of infancy do not support cognitive load interpretations of early compliance. Early compliance and partial compliance occur equally early to both positive and negative directives, influenced by motivational and contextual factors.

### Joint Attention: One Insight or Many Skills?

**Maximilian Bibok**[1] Stuart Hammond[1] **Jeremy Carpendale**[2]
*1. Simon Fraser University, Burnaby, Canada; 2. Psychology Department, Simon Fraser University, Burnaby, Canada*

This paper addresses the issues raised in this symposium by taking joint attention as an example. Joint attention has generated a great deal of research as a key social ability that underlies further social development and language development. The conceptualization of joint attention as a unitary ability that underlies various different joint attention behaviours is widely accepted. Moreover, the ability of infants to understand various situations involving joint attention is claimed to be based on an insight that infants acquire sometime around their first birthday. However, there is evidence of nascent forms of joint attention that young infants demonstrate earlier in their first year, such as gaze following in simple situations, as well as more complex forms that infants come to master beginning in their second year. Although this research is debated, it can also be argued that the use of gestures during infancy can be observed to cumulatively and progressively increase in complexity. The question is what to make of such evidence from the perspective of an insight model of understanding? Models of understanding follow from epistemological assumptions. We draw on recent work in primatology (e.g., Hare & Tomasello, 2004) as well as artificial intelligence (Hendriks-Jansen, 1996) to argue that understanding is rooted in activity, and that early forms of social understanding are based on shared social practices. From this perspective, rather than thinking of infants' ability to understand situations involving joint attention as based on an insight, we should instead think of joint attention as a collection of various social skills or action patterns that gradually become coordinated resulting in increasing flexibility, that only later appears to be derived from a single common insight.

## *Mechanisms of Sequence Learning in Infancy: Rules, Statistics, and Their Interactions*

*(Fishbowl Symposium, Communication and Language)*

**Chair:** *Michael Frank*

**Discussant:** *Scott Johnson*

**Michael Frank**[1] Louann Gerken[2] Scott Johnson[3] Gary Marcus[4] Hugh Rabagliati[4] Jenny Saffran[5] Joshua Tenenbaum[1]

*1. Department of Brain and Cognitive Sciences, Massachusetts Institute of Technology, Cambridge, USA; 2. Department of Psychology, University of Arizona, Tucson, USA; 3. Department of Psychology, University of California, Los Angeles, Cambridge, USA; 4. Department of Psychology, New York University, New York, USA; 5. Department of Psychology and Waisman Center, University of Wisconsin-Madison, Madison, USA*

Research by Saffran, Aslin, & Newport (1996), Marcus et al. (1999), and others has revealed that infants can learn a wide range of regularities in sequential stimuli, but the nature of the learning abilities tapped by these results is still unknown. Proposals suggesting separate mechanisms for "statistical learning" and "rule learning" respectively have gained some support, but this type of proposal may fail to incorporate other results showing predictive dependency learning (Saffran, 2001; Gomez & Gerken, 1999). Other theorists have suggested that a single learning mechanism might be responsible for all of these phenomena (e.g., Christiansen & Curtin, 1999).

The goal of this symposium is to encourage debate over the nature of infants' sequence learning abilities and to spur discussion of the additional evidence needed to decide between competing proposals. The symposium comprises four empirical presentations and discussion by Marcus and Johnson. Gerken & Tenenbaum show evidence suggesting that rule learning is driven by mechanisms of hypothesis-testing; Frank & Tenenbaum provide a Bayesian computational model instantiating this proposal. Rabagliati & Marcus give evidence that infants and adults fail to learn statistical dependencies and abstract regularities in parallel, arguing against a single unified sequence learning mechanism. Saffran asks what is learned in "grammar learning" experiments, finding that statistical regularities govern the preferences of infants even in more complex, rule-based tasks that do not require generalization.

Together, these results offer a view of a field with growing consensus but a number of outstanding issues. Are there modality or domain restrictions on particular learning mechanisms? Are the mechanisms of rule-learning sensitive to statistical constraints? And what are the links between these mechanisms and the process of language acquisition? Our symposium aims to show the state of the art in this field and motivate discussion of these issues.

### A Rational Model of Sequential Rule Learning

**Michael Frank**, Joshua Tenenbaum

*Massachusetts Institute of Technology, Department of Brain and Cognitive Sciences, Cambridge, USA*

Infants and adults can learn abstract rules governing sequential stimuli (Marcus, Vijayan, Bandi Rao, & Vishton, 1999), but the nature of the abilities allowing this learning has been the subject of much debate. At issue have been both whether these abilities are modality- or domain-specific and whether they are guided by general laws of statistical inference or instead by more specific perceptual constraints.

Here we present a simple Bayesian model of rule learning and generalization. This model, based on the work of Tenenbaum & Griffiths (2001), evaluates the fit of hypotheses about the structure of sequences (including abstract hypotheses like "all strings are of the form ABB" and more concrete hypotheses like "all strings have the form wo fe fe") to data, preferring those hypotheses which minimally describe the observed data. Thus, it not only makes correct generalizations in the original ABA/ABB learning experiments by Marcus et al., it also predicts narrower patterns of generalization from more restricted sets of strings, as shown by Gerken (2005).

We additionally describe an extension of this model which incorporates basic principles of memory decay. This model predicts that repeated elements in the middle of strings should be more difficult to learn than repeated elements on the edges of strings (congruent with Endress, Scholll, & Mehler, 2005) and provides insight into the pattern of results on visual rule learning found by Johnson et al. (under review).

Our model is modality independent and relies only on basic principles of probabilistic inference. Thus, its success suggests that it may not be necessary to posit domain- or modality-specific mechanisms to explain infants' sequence-learning abilities. Instead, it points towards the possibility of a unifying rational account of sequence learning in infancy combining statistical segmentation results (e.g., Saffran, Aslin, & Newport, 1996) with results on generalization.

### Interactions Between Statistical and Rule Learning in Adults and Infants

**Hugh Rabagliati**, Gary Marcus

*Department of Psychology, New York University, New York, USA*

When acquiring a language, children learn many different regularities; research has increasingly focused on how children achieve this. It has been proposed that transitional probabilities between syllables are extracted by a statistical learning mechanism, while a rule learning mechanism extracts abstract rules generating sequences of syllables. Here we ask about the relation between the two regularities: when a single corpus could be captured in two different ways, do learners acquire both regularities automatically and in parallel?

In a series of studies with infants and adults, we exposed learners to speech streams generated by a grammar obeying an abstract rule and providing informative transitional probabilities; at test, participants discriminated between Familiarization items, and items violating the grammar on rule alone or TP alone.

In the adult experiments, we found a reliable negative correlation between scores for the TP-violation and Rule-violation conditions ($r(30) = -0.38$, $p = 0.03$); subjects that were good at recognizing rule violations (above chance) were poor (below chance) at recognizing TP violations and vice versa. While 28/32 subjects were at-or-above chance on one measure, only 5/32 subjects were at-or-above chance at both, indicating they were unable to detect both regularities in parallel.

Similar results obtained with infants. Fifteen 7- to 9-month-old infants were tested in a head-turn-preference procedure. Looking time to Familiarization items was compared with looking time to TP-violation and Rule-violation items. As a group, there was no reliable difference between the conditions, but splitting by learning preference, Rule-preferring infants ($n = 10$) listened reliably longer to Rule-violation items, but not TP-violation items. TP-preferring infants ($n = 5$), meanwhile, showed no reliable differences, but a marginal preference for TP-violating items.

In short, we observed a complementary relation between rule and statistical learning; learners preferentially attended to one or the other but could not track both in parallel.

### Exploring Bayesian Hypothesis Selection as a Learning Mechanism Available to Infants

Louann Gerken

*Department of Psychology, University of Arizona, Tucson, USA*

Previous research demonstrated that 9-month-olds familiarized with strings consistent with a narrow and broad generalization in a subset-superset relation made only the narrow generalization (Table). One explanation for this finding is that infants initially entertained both generalizations, but ultimately rejected the broad generalization, because continuing to encounter input consistent with the narrow generalization reflected a 'suspicious coincidence' if the broad generalization is indeed correct. This explanation is consistent with recent work on Bayesian inference. The previous finding is also consistent with the subset principle, in which learners consider the single most specific hypothesis consistent with the examples seen so far.

Three experiments asked whether infants entertain multiple hypotheses and if their basis for hypothesis selection is input-dependent. In two experiments, 9-month-olds familiarized with the same strings that led to only narrow generalization in previous research accepted the broad generalization when only three strings violating the narrow generalization were included near the end of the familiarization set. These studies suggest that infants had recently entertained the broad generalization. In a third experiment, infants who were familiarized with only a single string type made the broad generalization at test. This experiment rules out the view that infants always make the narrowest generalization. Taken together, the data suggest that infant learning is characterized by hypothesis generation and selection based on a form of rational statistical inference.

| A or B value | di | je | li | we |
|---|---|---|---|---|
| le | leledi (1/2) | leleje | leleli | lelewe |
| wi | wiwidi (1) | wiwije (2) | wiwili | wiwiwe |
| ji | jijidi (1) | jijije | jijili (2) | jijiwe |
| de | dededi (1) | dedeje | dedeli | dedewe (2) |

Table 1. Stimuli marked (1) support narrow and broad generalizations, but infants only make the narrow one. Stimuli marked (2) added in Experiments 1-2.

### Do Infants Track Statistics Over Grammar-Type Sequences?

Jenny Saffran

*Department of Psychology and Waisman Center, University of Wisconsin-Madison, Madison, USA*

The past decade has seen substantial progress in our understanding of how infants detect "grammatical" regularities in their linguistic environments. Throughout these studies, the critical test contrasts compare infants' responses to familiar (grammatical) versus novel (ungrammatical) sentences. While it is clear that infants have learned something about the patterns that differentiate grammatical from ungrammatical sentences, the nature of this knowledge remains unclear. Are infants detecting rule violations, violations of high-probability sequences, or a combination thereof?

In the current study, we began to investigate this issue by manipulating the ungrammatical test sentences. Twelve-month-olds were first exposed to a small artificial grammar. Critically, some of the transitions in the grammar were high probability (100%) while others were not (50%). One group of infants was tested on grammatical sentences versus ungrammatical sentences that violated a high-probability transition. A second group of infants was tested on grammatical sentences versus ungrammatical sentences that violated a low-probability transition. If infants were responding solely to grammaticality, then discrimination performance should be equivalent across the two groups, as the ungrammatical sentences both violated the same number of rules of the language and were matched for frequency of transitions. However, if infants were attuned to the probability of the transitions, we hypothesized that violations of the high-probability transitions should be more readily detected than violations of the low-probability transitions.

The data were consistent with the latter prediction: only those infants tested on violations of high-probability transitions discriminated between the grammatical and ungrammatical sentences. Importantly, data from a no-exposure control group confirmed that these results were not due to idiosyncratic features of the test items. These data thus support the hypothesis that at least when learning artificial grammars, infants are sensitive to the probabilities with which words (or possibly word classes) co-occur.

---

## *Processing and Learning of Allophonic Contrasts in Infancy*

*(Regular Symposium, Communication and Language)*

**Chairs:** *Amanda Seidl & Kristine Onishi*

**Discussant:** *Cynthia Fisher*

**Amanda Seidl**[1] **Kristine Onishi**[2] Amélie Bernard[2] Katherine White[3] Marcus Galle[4] **Cynthia Fisher**[5]

*1. Purdue University, West Lafayette, USA; 2. McGill University, Montreal, Canada; 3. University of Rochester, Rochester, USA; 4. University of Iowa, Iowa City, USA; 5. University of Illinois, Champaign, USA*

Young infants readily discriminate speech sounds that older infants and adults have difficulty discriminating (e.g., Werker & Tees, 1984). This basic finding leaves open a variety of questions about how our categories for sounds are both used and formed. Does the reduced ability to discriminate influence the learning of sound patterns that may depend on these categories? What type of learning contributes to the loss of the ability to discriminate? And, does all learning about sounds involve the collapsing of categories?

Bernard et al. demonstrate that infants with language-general vowel categories (4-month-olds) were able to learn novel sound sequence patterns that depended on a distinction that is allophonic in their native language and to generalize them to new segments within a class. By 11 months, infants no longer learn the same pattern. Thus, learning of sound sequences seems to be constrained by the collapse of sound categories. White et al. address how infants might learn to collapse sound categories by showing that 12-month-olds but not 8.5-month-olds can use distributional information alone to collapse previously existing sound categories (e.g., to consider /b/ and /p/ as instances of the same sound in the proper conditioning context). Finally, Galle and McMurray provide evidence that not all learning involves the collapsing of categories. Specifically, 12-month-olds showed an ability to discriminate changes in place of articulation as well as syllable position, but 8-month-olds only discriminated the former.

These studies focus on infants' use of and learning about sound categories prior to the onset of word learning. They show that early linguistic exposure shapes the phonological system and by examining what infants can easily learn, fail to learn, and how these propensities change with age and experience and thus they help us to better understand the nature of the phonological learning system.

### Learning of Allophone-Based Sound Sequences in Infancy

**Amélie Bernard**[1] Alejandrina Cristià[2] Amanda Seidl[2] Kristine Onishi[1]

*1. McGill University, Montreal, Canada; 2. Purdue University, West Lafayette, USA*

The languages we speak affect our speech perception. Adults discriminate phonemes (meaningful sound contrasts) more easily than allophones (non-meaningful sound contrasts). This influence is present early and is observed through a decline in sensitivity to non-native sound contrasts by 10-12 months for consonants and 4-6 months for vowels.

When phonemes participate in unfamiliar linguistic patterns, infants and adults quickly learn these patterns. While supporting the finding that adults can learn phoneme-based patterns, our recent work also suggested that allophonic exposure to a contrast (oral vs. nasal vowels in English) may be insufficient for learning patterns based on that contrast. Are infants who are less familiar (younger) and more familiar (older) with their language's segmental inventory able to learn allophone-based phonotactic patterns?

English 4- and 11-month-old infants were familiarized with consonant-vowel-consonant non-words in which final consonants were dependent on whether the preceding vowel was oral or nasal, vowel nasality being an allophonic contrast in English. Next, in a Head-turn Preference procedure, infants heard novel syllables that followed or violated the patterns. For half the infants, the novel syllables contained the same vowels as in familiarization; for the other infants, the vowels were new, allowing us to test for generalization of the patterns. Four-month-olds listened reliably longer to syllables that followed rather than violated the patterns whether they contained familiarization or new vowels. In contrast, 11-month-olds listened equally to syllables following and violating the patterns, with either familiarization or new vowels.

The fact that 4-month-olds could learn and generalize novel phonotactic patterns based on allophones, but that by 11 months infants no longer did so, suggests that tuning to the ambient language affected sound sequence learning. The results from the 11-month-olds mirror those found in adults, and suggest that linguistic exposure affects the phonological system during the first year of life.

### The Acquisition of Phonological Alternations Using Distributional Cues

**Katherine White**[1] James Morgan[2] Sharon Peperkamp[3]

*1. University of Rochester, Rochester, USA; 2. Brown University, Providence, USA; 3. Laboratoire de Sciences Cognitives & Psycholinguistique & Universite de Paris VIII, Paris, France*

A central issue in phonological and lexical acquisition concerns how infants learn to group perceptually distinct sounds into functional categories. In other words, how do infants learn that some segments are contrastive, but that others alternate as a function of the phonological context? This type of alternation occurs at multiple levels of language structure, including allophony (e.g. [p] and [$p^h$]). In a series of experiments, we have explored whether infants are sensitive to distributional patterns in the input that characterize such alternations, as well as the developmental time course of this sensitivity. In many cases, non-contrastive (alternating) sounds occur in complementary distribution (e.g. [$p^h$] occurs syllable initially, [p] does not).

Infants at 8.5 and 12 months were familiarized with artificial languages in which stops but not fricatives (or vice versa) displayed voicing alternations, according to distributional properties. For example, infants who learned the stop alternation heard familiarization sequences in which the voicing of the first segment in stop-initial words was conditioned on the voicing of the preceding segment, but the voicing in fricative-initial words was not. Both age groups showed evidence of learning the relationships between alternating sounds and their conditioning contexts. Only 12-month-olds additionally showed differential treatment of alternating and non-alternating segments.

These results suggest that, by 12 months, infants can use distributional cues in the input to determine the contrastive vs. non-contrastive status of segments. In follow-up work we have explored the nature of this learning (feature-based or segment-specific) and whether it is constrained by phonological principles, such as the degree of relatedness among the alternating segments. This approach, therefore, can reveal not only whether infants can use distributional patterns to learn alternations prior to the onset of word learning, but also provide insight into the nature of infants' early phonological knowledge.

### Early Discrimination of Positional Variants of Consonants: Acquiring Subphonemic Sensitivity

**Bob McMurray, Marcus Galle**

*University of Iowa, Iowa City, USA*

The acoustic instantiation of a given stop consonant differs between word-initial and word-final position, despite constancy in the perceived phonemic category (an *allophonic* difference). We asked when and how infants might learn what variation constitutes distinct phonemes and what constitutes acceptable allophonic variation. This bears on theories of development in that similarity-based models predict that the acoustic distinctiveness of positional variants should lead to greater discrimination, while gestural accounts should predict little discrimination.

Stimuli consisted of VCV tokens in which the consonant varied by both syllable position (final vs. initial) and place of articulation (velar /g/ vs alveolar /d/) resulting in 4 stimulus types (final: AG-A, AD-A; initial: A-GA, A-DA). Infants were familiarized to 128 repetitions of either AG-A or A-DA.

After familiarization, we examined infants' discrimination of tokens that varied in one feature, either place or position from the familiarization stimulus. For 12-month-olds (n=55), listening times for variants in both place (p=0.01) and position (p=0.001) were significantly different from the training stimuli, suggesting that infants are as sensitive to position as they are to place. Eight-month-old infants (n=35), however, discriminated only place differences (p=.001), and failed to discriminate differences in position (p>.2).

The dominant pattern of speech development is one of losing the ability to discriminate contrasts that are not phonemic in their language. Here, infants acquire such sensitivity (since positional variation is not phonemic in English)! Such sensitivity may be useful for word segmentation or as a cue to syllable structure. Previous studies have demonstrated sensitivity to subphonemic detail during infancy (Hohne & Jusczyk, 1994; McMurray & Aslin, 2006; Miller & Eimas, 1994), however, these findings could be accounted for by retaining sensitiv-

ity rather than acquiring it. The present study suggests the possibility that infants can also acquire sensitivity to useful subphonemic detail.

---

## *The Role of Auditory Stimuli and Labels in Infant Categorisation* *(Regular Symposium, Cognitive Development)*

**Chair:** *Kim Plunkett*

**Discussant:** *Daniel Swingley*

**Kim Plunkett**[1] Vladimir Sloutsky[2] Sandra Waxman[3] **Daniel Swingley**[4]

*1. Experimental Psychology, University of Oxford, Oxford, UK; 2. Ohio State University, Columbus, USA; 3. Northwestern University, Chicago, USA; 4. University of Pennsylvania, Philadelphia, USA*

Recent research has revealed a set of apparently conflicting findings regarding the impact of auditory stimuli and labels on the process of category formation by infants. For example, Fulkerson & Waxman (2007), building on an extensive series of earlier findings (e.g., Balaban and Waxman, 1997) have demonstrated that labels facilitate the process of category formation in infants as young as 6 months of age. In contrast, Robinson and Sloutsky (2007) report that both labels and non-linguistic auditory stimuli interfere with category formation in 8-month-olds. Another recent study by Plunkett et al. (2007) shows that labels do not overshadow visual stimuli in a category formation task with 10-month-olds but the same study fails to find a facilitating effect of labels. The aim of this symposium is to examine these diverse findings in detail and to identify the locus of the factors that lead to such different conclusions. Plunkett, Hu and Cohen will argue that both facilitating and interference effects can be observed depending on the perceptual similarity of the visual categorisation stimuli. Sloutsky and Robinson identify the source of the conundrum in the dynamics of cross-modal processing. Waxman highlights the privileged status of linguistic stimuli for infant category formation. Our discussant (Swingley) will attempt to integrate these different approaches.

**References:**

Balaban, M.T., & Waxman, S.R. (1997). Do words facilitate object categorization in 9-month old infants? Journal of Experimental Child Psychology, 64, 3-26.

Fulkerson, A.L., & Waxman, S.R. (2007). Words (but not tones) facilitate object categorization: Evidence from 6- and 12-month-olds. Cognition, 105, 218-228.

Plunkett, K., Hu, J.F., & Cohen, L.B. (2007). Labels can override perceptual categories in early infancy. Cognition.

Robinson, C.W., & Sloutsky, V.M. (2007). Linguistic labels and categorization in infancy: Do labels facilitate or hinder? Infancy, 11, 233-253.

### Impact of Labels on Categorisation in Infancy

**Sandra Waxman**

*Northwestern University, Chicago, USA*

Word learning, perhaps more than any other development achievement, stands at the crossroad of human conceptual and linguistic organization. Facing the conceptual domain, infants must form concepts that capture relations among the objects and events that they encounter. Facing the linguistic domain, infants must cull words from the ongoing stream of language that surrounds them. In the first year, infants make important advances in each of these domains. These advances are linked powerfully from the start, and become increasingly nuanced as infants discover how their language recruits distinct grammatical forms to convey distinct kinds of meaning. In this paper, I adopt a developmental framework to trace the trajectory of infants' increasingly specific links between words and concepts. On the linguistic side, key findings include infants' distinct treatment of a) linguistic vs non-linguistic stimuli, b) words presented in phrases vs. in isolation, and c) words from distinct grammatical categories (e.g., noun vs. verb). On the conceptual side, key issues concern fundamental conceptual distinctions including those distinguishing "individuals", "categories", and "relations". The evidence from infants ranging from 6 to 24 months reveals that early word learning represents far more than paired associations between auditory and visual stimuli. Instead, early word learning engages infants' emerging conceptual and linguistic capacities, as well as their growing symbolic and social capacities. Taken together, the evidence illustrates the conceptual consequences of word learning, and underscores the importance of considering the distinct developmental trajectories, conceptual prerequisites and linguistic entailments underlying infants' acquisition of a broad range of words.

### Exploring Mechanisms Underlying Effects of Words on Categorization

**Vladimir Sloutsky**, Christopher Robinson

*Ohio State University, Columbus, USA*

The ability to form categories by treating discriminable stimuli as members of an equivalence class is an important component of human cognition. This ability appears early in development, with very young infants ably forming basic-level and more global categories. It has frequently been also argued that auditory input may affect category learning. At least four positions have been put forward, and these positions are seemingly incommensurate. According to one proposal (e.g., Balaban & Waxman, 1997; Fulkerson & Waxman, 2007), words, but not non-linguistic sounds, facilitate category learning. These effects have been explained by suggesting that infants assume that words refer to categories. Another proposal (e.g., Roberts & Jacob, 1991) suggests that both words and non-linguistic sounds facilitate category learning- as long as presentation of auditory input is contingent on looking (Roberts, 1995). These effects have been explained by infants using co-varying sources of information as cues to categories. The third proposal (Robinson & Sloutsky, 2007) argues that words and sounds interfere with visual processing, with both hindering categorization compared to a silent baseline. Finally, the fourth proposal (Plunkett, et al., 2007) argues that when words correlate with category important features or relations, they facilitate the extraction of these features or relations. Plunkett, et al (2007) argue that words neither facilitate nor interfere, but they rather determine what will be learned in the course of category learning. This co-existence of vastly divergent research findings represents a conundrum, underscoring how little is known about effects of auditory input on category learning. In the talk we will review some of the existing and new findings and examine each proposal's ability to account for the reported effects. We will also try to propose a solution to the conundrum by grounding effects of auditory input on categorization in the dynamics of cross-modal processing.

### Labels, Perceptual Similarity and Infant Categorisation

**Kim Plunkett**[1] Jon-fan Hu[1] Leslie Cohen[2]

*1. Experimental Psychology, University of Oxford, Oxford, UK; 2. University of Texas, Austin, USA*

In a recent series of experiments (Plunkett, Hu and Cohen, 2007), we demonstrated that labels can have an impact on the manner in which 10-month-old infants categorise novel visual stimuli. In particular, when visual stimuli were presented together with the same single label, they demonstrated in a novelty preference task that they had learnt one category whereas when the same visual stimuli were presented with two labels the infants formed two categories. These findings provide counter-evidence to the claim that auditory stimuli overshadow the processing of visual stimuli in this type of task (Robinson and Sloutsky, 2007) because they show that infants paid attention to the pattern of correlations between labels and the features of the visual stimuli. However, we also found that labels did not have a facilitating effect on category formation because infants could, under appropriate conditions, form the same categories in the absence of a label. This finding contrasts with another body of literature that claims that labels act as invitations to form categories and have a facilitating effect on category formation (Balaban and Waxman, 2003; Fulkerson and Waxman, 2007). We present an alternative analysis of the original Plunkett et al. (2007) study and two new studies that attempt to reconcile these diverse findings by identifying the experimental contexts in which labels can either interfere or facilitate category formation. In particular, we demonstrate that infants are sensitive to the perceptual similarity of the familiarisation stimuli, such that labels facilitate categorisation when visual category members are perceptual similar but interfere with categorisation when they are dissimilar from each other. These findings indicate that the processes of category formation in young infants are heavily influenced by the perceptual load imposed by the need to process both auditory and visual stimuli simultaneously.

---

## *Olfaction, Emotion and Cognition*

*(Regular Symposium, Attention, Memory and Learning)*

**Chair:** *Nathalie Goubet*

**Discussant:** *Benoist Schaal*

**Nathalie Goubet**[1] **Benoist Schaal**[2]

*1. Gettysburg College, Gettysburg, USA; 2. Centre Europeen des Sciences du Gout, Dijon, France*

This symposium focuses on how odors experienced in the context of the relation with the mother affect emotional and cognitive processes early in infancy. Recent data will be presented on the importance of such early olfactory experience for the establishment of odor memory, for the optimization of self-regulation, and for turning on attachment.

The first talk by Maryse Delaunay-El Allam and colleagues will present results that demonstrate how newborns' early attunement to the olfactory context affects their later affective responses and behavioral choices. Newborns exposed to an odor in the reinforcing context of nursing manifested a preference for the familiar odor up to 18 months later. This long-term retention may have implications for later affective responses in food choices or social interactions.

In the second talk, Nathalie Goubet will present a series of studies demonstrating that pain responses in preterm and full-term newborns can be significantly attenuated by chemosensory familiarity. The interactions between olfaction and pain are based on the rapid learning of an odor and its association with a familiar context, either maternal or arbitrary. The familiarity of the odor then allows for self-regulation in the context of painful treatments.

In the third talk, Regina Sullivan will present an animal model to explore the neural bases of early attachment learning. Her lab's results suggest that a unique neural network controls the learning of a preference for a caregiver's odor and prevents the formation of olfactory aversion to that caregiver. Together, these three presentations attest to the role of the olfactory system in establishing early and crucial interactions with emotion and cognition.

Benoist Schaal will discuss these contributions along emotion-cognition interactions in newborns. He will underline the evolutionarily preserved value of olfaction in the early engagement of social attunement in young mammals, including human infants.

### Olfaction-Pain Interactions in Full-Term and Preterm Newborns

**Nathalie Goubet**

*Gettysburg College, Gettysburg, USA*

In this talk, I will first present a synthesis on the research to date on the interactions between olfaction and pain in full-term and preterm newborns. In a series of studies from our lab, we have hypothesized that the activation of pain responses can be significantly attenuated by chemosensory familiarity. Our data show that exposure to a familiar odor during and after a painful event lead full-term newborns to a quicker recovery compared to exposure to either no odor or to an unfamiliar odor. We also examined the determinants of the chemosensory familiarity effect, specifically the role of arousal and conditions of exposure. Our results indicate that during a capillary blood draw, low-aroused infants exposed to a familiar smell (via maternal or neutral environment) displayed little distress and more appetitive movements during the procedure compared to infants exposed to a new smell or no smell. Finally, we investigated the familiarity effect in a population of healthy preterm newborns undergoing either an acutely or a moderately painful blood draw. Infants exposed to a familiar non maternal odor and undergoing a moderately painful procedure showed no significant increase in distress during the procedure compared to infants exposed to an unfamiliar or no odor. Overall, these results support the role of chemosensory familiarity in pain relief and point to the mediating role of arousal. In the second part of the talk, I will review data on the interactions of various chemosensory stimulations (sucrose) and pain. I will focus in particular on a comparison of the differential activation potential of an analgesic/soothing response among several types of chemosensory stimulations. Finally, I will present suggestions on the underlying psychological and physiological mechanisms regulating these interactions. Support by a grant from Gettysburg College.

### Characterizing the Neural Circuit For Attachment Learning

**Regina Sullivan**

*University of Oklahoma, Norman, USA*

A neonatal infant must quickly learn an attachment to the mother to optimize the caregiving received. Within this attachment, the infant learns about the caregiver's face, voice and odor. Each maternal stimulus seems to evoke specific responses in the infant, with maternal odor resulting in optimal arousal in the infant that includes attenuation of crying, head turns towards the source of the odor and mouthing. This sequence of behavior appears to facilitate the initiation of nursing.

To facilitate this attachment, newborn infants show rapid, robust learning. Specifically, pairing a novel odor with simple tactile stimulation or injection is sufficient to produce an odor that acquired the ability to elicit behaviors normally elicited by maternal odor.

Using an animal model of attachment learning, we have been exploring the neural basis of this rapid attachment learning. Our results suggest that infancy is associated with a unique neural circuit that supports this learning. For example, in the neonatal rat, the hyperfunctioning locus coeruleus (LC - releases norepinephrine) enables the infant to learn rapid, robust preferences to the caregiver's odor. Conversely, lack of amygdala (emotional learning, especially fear) functioning appears to prevent the infant from learning aversions or inhibiting responses to the caregiver's odor. Recent work also suggests that maternal presence reactivates this early attachment learning in older animals to again permit the rapid learning required for infant attachment to the caregiver.

Although human attachment may not rely on identical circuitry to that described in the rat, the work reviewed here suggests a new conceptual framework in which to explore the neurobiology of human attachments. Characterizing the neural basis of attachment in infants may further our understanding of the enduring effects of infant experiences.

### Lasting Odor Memories Acquired While Sucking on the Mother's Breast

**Maryse Delaunay-El Allam**, Robert Soussignan, Bruno Patris, Luc Marlier, Benoist Schaal

*Centre Europeen des Sciences du Gout, Dijon, France*

Our understanding of the mechanisms and timing of early olfactory memory in humans remains unclear. Their appreciation is essential, however, to explain the conditions in which selective responses to odors do emerge and how they endure over life. The present study examined whether early experience with an odor in association with breastfeeding can favour the development of a lasting olfactory preference.

We took advantage of camomile-scented pomade (Ca) prescribed to prevent sore nipples. Two groups of infants, one exposed (Ca+) and one non exposed (Ca-) while breastfeeding, were compared for differential responses to Ca, control odorants or blank stimuli on age 3 days, and 7 and 21 months. At 3 days, infants underwent a double-choice test between Ca and a control odor. The Ca+ group displayed preferential head-orientation duration toward Ca, while the Ca- group showed undifferentiated response. At 7 months, the infants were sequentially presented 3 toys carrying either Ca, an unfamiliar scent (V), or a blank. Ca+ infants mouthed the Ca-toy longer than the V-toy, whereas Ca- infants mouthed them equally. At 21 months, toddlers were tested for their: 1) facial responses to Ca, 2) differential handling of 3 toys scented with either Ca, V, or nothing; 3) choice between 2 bottles odorized either with Ca or V. It came out that Ca- infants expressed more aversive faces toward Ca as compared with Ca+ infants. Further, Ca+ infants showed more proximal handling with the Ca-scented toys, and selected reliably the Ca-scented bottle.

These results demonstrate that breastfeeding can promote odor memories that can be recalled after more than 1.5 year of exposure discontinuation. Long-lasting affective responses in the food or social domains may thus be in part canalized by odour cues acquired in the earliest interactions with the mother.

Supported by a grant from Roudnitska Foundation.

## *The Role of Experience in the Development of Face Processing*

*(Regular Symposium, Perceptual Development)*

**Chair:** *Paul Quinn*

**Discussant:** *James Tanaka*

**Paul Quinn**[1] Viola Macchi Cassia[2] Jennifer Rennels[3] **James Tanaka**[4]

*1. University of Delaware, Newark, USA; 2. Università degli Studi di Milano-Bicocca, Milano, Italy; 3. University of Nevada Las Vegas, Las Vegas, USA; 4. University of Victoria, Victoria, Canada*

A number of investigative teams have been studying the early development of face processing. Some of these investigative efforts have been centering on the effects of experience on face processing in infants and young children. The present symposium will bring together three such efforts, including (1) a program of studies examining the spontaneous preferences and discrimination abilities displayed by different age groups within the first year for face gender and race information (Quinn, Kelly, Lee, Pascalis, & Slater), (2) an investigation of how experience with faces of different ages affects processing of face age in young children and maternal caregivers, thereby giving rise to an other-age effect (Macchi Cassia), and (3) a project that uses caregiver reports to document how much infants of different ages have contact with faces from different genders, races, and ages (Rennels & Simmons). The projects will be discussed by a scholar whose major area of interest is how experience influences the way in which objects in the world are perceived and recognized (Tanaka).

### Tuning into Face Gender and Race Information during Infancy

**Paul Quinn**[1] David Kelly[2] Kang Lee[3] Olivier Pascalis[2] Alan Slater[4]

*1. University of Delaware, Newark, USA; 2. University of Sheffield, Sheffield, UK; 3. University of Toronto, Toronto, Canada; 4. University of Exeter, Exeter, UK*

A program of research has been investigating how infants' face processing is tuned by experience with different classes of faces early in development. This research has revealed that different degrees of exposure to the categories of gender and race impacts how infants attend to and recognize individual faces within these general classes. In particular, early in development, infants may process a broad range of faces from different races and genders with equal facility. As infants develop and are selectively exposed to a limited number of face categories (i.e., one's own race and the gender of the primary caregiver) they come to demonstrate certain processing advantages (i.e., increased visual attention, superior within-category discrimination) for those predominantly experienced categories relative to categories of lesser experience.

Supporting evidence includes the findings that newborn infants do not demonstrate a preference for male versus female faces (Quinn et al., in press) or for same- versus other-race faces (Kelly et al., 2005). However, by 3 to 4 months of age, a preference for the gender of the primary caregiver has emerged (Quinn et al., 2002) along with a preference for own- versus other-race faces (Kelly et al., 2005; Kelly et al., 2007). In addition, while within-category discrimination for same- and other-race faces was shown to be equivalent at 3 months, superior within-category discrimination was observed for same-race faces relative to other-race faces between 6 and 9 months of age (Kelly et al., in press).

The developmental timing of the preference and discrimination results for the processing of race information suggests an account in which predominant exposure to faces from one racial group (i.e.,

own-race) induces familiarity and a visual preference for such faces. The preference for own-race faces produces greater visual attention to such faces, even when other-race faces are present in the visual environment. The advantage in visual attention for own-race faces may in turn facilitate the development of superior-recognition abilities for own-race faces.

### The Effects of Early and Later Experience on Face Recognition Abilities: Evidence from the Other-Age Effect

**Viola Macchi Cassia**

*Università degli Studi di Milano-Bicocca, Milano, Italy*

Face processing has been described as an experience-expectant developmental process through which the perceptual system becomes tuned to the type of faces seen most often in the environment. This approach finds support in findings regarding infants' ability to process monkey faces and faces of unfamiliar races, showing that the ability to discriminate between faces that are not consistently present in infants' early environment declines between 6 and 9 months of age. Recent evidence from adoption studies has shown that the recognition advantage for faces of our own as compared to another race, the classic "other-race effect", can be reversed in childhood granted there is a drastic change in the face environment at around the age of 6 years (Sangrigoli et al. 2005). These data suggest that the face recognition system retains some degree of flexibility even in childhood. Recent evidence from our laboratory supports this hypothesis, demonstrating that both adults and 3-year-old children are worse at discriminating newborn faces as compared to adult faces (an "other-age effect"), but this recognition disadvantage is not present in children who have a younger sibling. Interestingly, the effects resulting from the presence of a younger sibling vanish in adulthood, but can be reactivated by a new experience. This is shown by the finding that young adults who had younger siblings in early childhood perform like those without younger siblings, showing impairments in the recognition of newborn faces compared to adult faces. Importantly though, the presence of a younger sibling makes a difference in the recognition performance for newborn faces by mothers of 9-month-old infants. Overall, the findings will be discussed as showing that the face processing system is sensitive to experience in both childhood and adulthood, but the effects of experience at the two ages are not comparable.

### Facial Experience during the First Year

**Jennifer Rennels**, Rachel Simmons

*University of Nevada, Las Vegas, Las Vegas, USA*

A predominant theory of the development of face processing is that early exposure to particular types of faces facilitates the development of specialized processing for those facial types and deficits in processing other facial types (e.g., Nelson, 2001). Relatively little data are available, however, that examine infant experience with faces in their "natural" environment. One purpose of this study was to quantify infant experience with same-race/other-race individuals, mother and father, other females and males, and people of the same-age/other-ages as their primary caregiver. Another purpose was to determine how the infants' and unfamiliar individuals' characteristics affected the length of their interactions and infant attention toward the individual.

Parents of 2-, 5-, 8-, and 11-month-olds used two scales we developed to provide information about their infants' interactions with familiar and unfamiliar individuals during one week. The scales included items to note the demographics of the person interacting with the infant, the infant's distance from the individual, the length of the interaction, and the amount of attention the infant directed toward the individual during the interaction.

Results showed large discrepancies in the race, sex, and age of faces that infants experienced with the majority of their interactions being with their primary caregiver, females, and other individuals of the same race and age as their primary caregiver. Infant age and an unfamiliar individual's sex were predictive of their time spent interacting with one another. Moreover, an unfamiliar individual's sex was predictive of the attention infants allocated during social interactions. These differences in frequency and length of interactions with certain types of faces, as well as in infant attention toward certain individuals, have important implications for the development of specialized face processing during the first year.

## Poster Presentations, March 27 2008

### *Attention, Memory and Learning*

**Th1-01**

#### Face-Voice Synchrony Directs Selective Listening in Four-Month-Old Infants

**Lorraine Bahrick**, Melissa Shuman, Irina Castellanos
*Florida International University, Miami, USA*

**Background and Aims:** Adults routinely attend to one speech stream while ignoring concurrent speech nearby ("cocktail party phenomenon"). What guides this selective attention and how does it develop? Infant research has demonstrated that detection of amodal information (intesensory redundancy) such as audiovisual temporal synchrony guides and constrains early visual selective attention (Bahrick & Lickliter, 2000; 2002; Bahrick, Walker, & Neisser, 1981). Hollich, Newman, & Jusczyk (2005) recently extended this to auditory selective attention: 7-month-old infants attended to a female voice synchronized with a face while ignoring a nonsynchronous male voice of the same amplitude. The present study assessed younger infants under more difficult conditions to determine whether face-voice synchrony was sufficient for guiding selective attention to one of two identical nursery rhymes spoken concurrently, by two females, using infant-directed-speech.

**Methods:** Four-month-old infants (N≅36) were habituated to two female voices each speaking the same rhyme, while only one voice (target) was synchronized with a speaking face and the other (distractor) was asynchronous. Each infant received 3 types of test trials (order counterbalanced) each depicting the habituated face synchronized with a different female voice (target, distractor, and novel voice). Visual recovery to each voice synchronized with the familiar face was assessed. We reasoned that if audiovisual synchrony guides selective attention, infants would attend to the target voice during habituation and should thus treat the target voice test trials as familiar (no visual recovery) and the distractor and novel voice test trials as novel (visual recovery). Since the same face was played on all habituation and test trials, visual recovery could only be based on discrimination of voices.

**Results:** As predicted, infants showed significant visual recovery to the novel ($t(35)\cong3.01$, $p\cong.005$) and distractor voice test trials ($t(35)\cong2.40$, $p\cong.02$) but not to the familiar voice test trials ($t(35)\cong1.41$, $p>.05$). These results suggest that infants selectively attended to the voice synchronized with the face during habituation (and ignored the asynchronous distractor voice), allowing them to discriminate the target voice from the novel and distractor voices during test trials.

**Conclusions:** Intersensory redundancy provided by audiovisual synchrony can guide selective attention and promote processing of synchronous auditory information at the expense of concurrent nonsynchronous information by 4-months of age. These findings suggest that face-voice synchrony is sufficient to direct selectivity and provide a basis for separating concurrent speech streams when other cues such as differences in gender, tempo, amplitude and prosody are minimized.

**Th1-02**

#### Long-Term Recall of an Arbitrary Association in Young Infants' Deferred Imitation

**Amy Bullman**, Carolyn Rovee-Collier
*Rutgers University, New Brunswick, USA*

In this study, we used a deferred imitation task to document the maximum duration for which 6- and 9-month-olds can recall an arbitrary association that they had formed between two objects in a sensory preconditioning paradigm. This paradigm consists of (1) a preexposure phase, when subjects view two paired objects (S1+ S2), (2) a training phase, when subjects learn a distinctive response to one object (S1„_R1), and (3) a test phase to see if subjects transfer the learned response to the other object (S2„_R1?). Doing so indicates that subjects had associated the two objects in phase 1.

We modeled the procedure Barr et al. (2003). In phase 1, independent groups of 6- and 9-month-olds were pre-exposed to two paired hand puppets (S1+S2) on 2 consecutive days for 1 hr/day. In phase 2, which occurred after a progressively increasing delay, infants observed three target actions modeled on S1. In phase 3, infants received a 24-hr deferred imitation test with S2. Six-month-olds deferred imitation on S2 when 10 days separated phases 1 and 2, and 9-month-olds did so when 14 days separated them. In Experiment 2, we repeated the procedure but used only one 1-hr pre-exposure session. In contrast to the preceding results, infants of both ages recalled the association when only 3 days separated phases 1 and 2. In a follow-up experiment, we asked whether reducing the total pre-exposure time or removing the retrieval opportunity at the outset of session 2 was responsible for infants' poorer retention. To answer this, we repeated the previous procedure but pre-exposed infants to the paired puppets for two 30-min sessions separated by 5 hr. This manipulation held total exposure time constant but assured a retrieval opportunity. As before, we progressively increased the delay between phases 1 and 2 and tested infants 24 hr after phase 2. Testing is still underway but, thus far, infants of both ages have exhibited significant deferred imitation on S2 when 14 days separated phases 1 and 2. The magnitude of the retention benefit of retrieving the memory of session 1 was unexpected.

This study demonstrated that young infants are capable of forming an enduring association between two arbitrary stimuli and transferring it from one stimulus to the other during a deferred imitation test after a significant delay. Even more important was the finding that retrieving the memory dramatically increases how long young infants recall an association.

**Th1-03**

#### The Temporal Parameters of Visual Proprioceptive Perception in Infancy

**Stephanie Collins**, Chris Moore
*Dalhousie University, Halifax, Canada*

It has been proposed that the ability to recognize oneself in both a mirror and/or live video display is aided by the detection of the visually contingent relationship between the images (Lewis & Brooks-Gunn, 1979). Bahrick and Watson (1985) have also suggested that visual proprioceptive contingency is a basis for recognizing the self. Employing the preferential looking paradigm, they found that five-month-old infants were able to discriminate between a contingent live video display of their feet and a noncontingent video of either themselves or a peer. As previous studies have concentrated on comparing looking

times of the self from other, the current study aims to extend these findings by investigating the temporal parameters of discriminating between a live and delayed video feed. The goal is to determine the point at which children can discriminate between a delayed and a non-delayed image of their own face and head movements.

Thirty-six 12-month-old infants viewed two computer monitors while sitting on their mother's lap. Infants were randomly assigned to one of three delays. In this paradigm one monitor displayed a live transmission of the infant's face while the other monitor displayed an image of the infant's face delayed by either 1, 2, or 10 seconds. The monitor that displayed the delay was counterbalanced across infants. Infants looking time at both monitors was coded.

It is expected that infants will show a novelty preference for the delayed images, indicating that they can discriminate between the live and delayed feeds, by looking at the monitor with the delayed image longer than the live image. These results will allow us to better determine the age at which infants can integrate visual and proprioceptive information as well as at what age delay detection reaches adult-level speed and accuracy.

**Th1-04**

## Learning Two Parameters Acting on One Item: Evidence From Response to Novelty in an Eye Tracking Paradigm

**Juliet Davidow**, Dima Amso

*Sackler Institute for Developmental Psychobiology, WMC Cornell University, New York, USA*

We examined the emergence of the response to novelty as a learning index when 9-month old infants are presented with two interweaved sources of information acting on one item. We manipulated frequency of occurrence and co-occurrence parameters, reasoning that a stimulus can be novel because it is infrequent or because its occurrence is infrequent in a particular context. Infants were tested individually, seated 104 cm from a 50 cm monitor used to present the stimuli. Eye movements were recorded with a remote-optics corneal reflection eye tracker (Applied Science Laboratories Model R6). Each infant's point of gaze (POG) was calibrated prior to test. Participants were presented with one of two equally probable centrally presented cues (a cartoon octopus and turtle) that predict the location and identity of one of three targets (colorful cartoon fish to the right, above, or to the left of center) with varying probabilities. Cue 1 predicts target 1 on 75% of trials and target 2 on 25% of trials. Cue 2 predicts target 1 with a 25% probability, and target 3 with 75% probability. Simultaneously, we varied the frequency with which each target is presented throughout the task, independent of cue/target associations. Frequency of occurrence for target 1 is 50% and for target 2 is 12% over the entire task. Each cue was accompanied by a sound ("Ding" for Cue 1, and "Dong" for Cue 2) to return infants' attention to center screen after each trial. Both cues and targets were presented for 1 second, with no inter-trial interval between cue/target pairs. Subjects made eye movements to the location of targets, unaware of the task structure. The dependent measure was saccade latency to the frequently-presented relative to novel target occurrences and cue/target co-occurrences. Data showed that infants initially extract frequency-based information, as indicated by faster latencies to frequently-presented targets and slower latencies to novel targets. Learning cue/target co-occurrence information required more exposure and was evident later in the task, as indicated by relatively slower responses to novel cue-target pairings. Importantly, 9 month-olds' behavior indicated maintenance of the frequency of occurrence information even as their saccade latencies indicated acquisition of co-occurrence information about the same target item. This demonstrates flexibility in learning and efficient maintenance of information early in life.

**Th1-05**

## Modeling the Micro-Structure of Infant Looking Preferences

**Donna Fisher-Thompson**[1] **Joshua Goldberg**[2] Gregor Schöner[3]

*1. Niagara University, Niagara University, USA; 2. Indiana University, Bloomington, Indianapolis, USA; 3. Institut für Neuroinformatik, Ruhr-Universität Bochum, Bochum, Germany*

Individual infants display noisy patterns of looking during habituation and novelty preference tasks, patterns obscured when researchers present global measures of looking behavior. We believe this fine structure of looking is revealing of the processes through which infants control their own stimulation and explore their visual surround. We describe a process model of infant looking that generates highly variable patterns of looking similar to those found in many experimental situations. Our model derives from an earlier dynamical field model of habituation (Schöner & Thelen, 2006) updated to include a motor component that controls gaze direction.

Our model consists of a motor field that controls gaze and fixation, and a perceptual field that processes the attended stimulus. Thus the selection and timing of stimulation is controlled in real time by the model itself. Feedback from the perceptual to the motor field generates stimulus-specific differences in mean fixation durations that reflect the state of perceptual encoding of the stimulus. These changes in the stickiness of fixation, rather than in the attraction to visual locations of novel stimuli, provide an account for classical habituation and preference effects.

Simulations of the real-time behavior of the model account for fine-grained patterns of looking and looking away found in studies run within our lab. Infants under 5 months of age were presented with a continuous paired-comparison task in which one familiar stimulus was repeatedly paired with novel stimuli. Group novelty preferences emerged within the first minute of looking even though individual patterns of looking and looking away varied substantially, as did looking directed toward familiar and novel stimuli. As suggested by the model, infants were more likely to terminate looks when gaze was directed at familiar rather than novel stimuli, but direct shifts of gaze between stimuli (with no intervening look away) were no more likely for shifts to novel than to familiar stimuli. Durations of looks away, averaging about 2 seconds, also did not depend on whether the preceding or following look was directed at a novel or familiar stimulus.

Data from our simulations and laboratory tests suggest that infant novelty preferences emerge from control over when to shift gaze and look away from the display, rather than decisions of where to look. We argue that perceptual experience depends on, and in turn shapes, patterns of looking that yield an adaptive balance between examination and exploration.

**Th1-06**

## Speed of Recovering a Forgotten Memory after a Minimum-Duration Prime between 6 and 12 Months

**Amanda Hamilton**, Carolyn Rovee-Collier
*Rutgers University, Piscataway, USA*

The minimum duration of exposure to an effective prime is a measure of the accessibility of a forgotten memory. The longer a memory has been forgotten, the longer the minimum duration must be in order to recover it. The speed of recovering the primed memory is also considered a measure of its accessibility. At 6, 9, and 12 months of age, the minimum prime duration is constant (7.5 s), however, while the speed of recovery after a standard (2 min) prime decreases logarithmically. At 6 months, when infants are given a standard prime 1 week after forgetting an operant train task (3 weeks), the forgotten memory is recovered after 1 hr. At 9 months, when infants are given a standard prime 1 week after forgetting (7 weeks), the memory is recovered after 1 min; and at 12 months, after a standard prime given 1 week after forgetting (9 weeks), the speed of recovery is only 0-1 s.

This study examined this apparent discrepancy between the two measures of accessibility of a latent memory. Specifically, we asked whether the speed of recovering a forgotten memory after a minimum duration (7.5-s) prime is constant at 6, 9, and 12 months, or if it also decreases with age. We previously found that 6-month-olds given a 7.5-s prime exhibited no retention 1, 4, or 6 hr later but did exhibit retention 24 hr later. In the present study, we repeated the procedure with 9- and 12-month-olds. As before, data were collected from independent groups who were tested for evidence of renewed retention at different delays after priming. Because 9-month-olds given a 2-min prime exhibit renew responding after 1 hr, we began testing them after 1 hr. They exhibited no retention 1 or 4 hr after priming, mixed retention 6 hr afterward, and robust retention 24 hr afterward. Based on the 9-month data, we began testing 12-month-olds 4 hr after priming and completed the 24-hr test group. The intervening 12-month groups will be completed by December.

Finding that the speed of recovering a forgotten memory is constant between 6 and 12 months would provide convergent evidence that the minimum duration of an effective prime indexes the accessibility of a latent memory. Should it not be constant at all ages, however, then we would have to consider whether responding to the prime and responding to the retrieval cue that is presented during the test are dissociated.

**Th1-07**

## Infants Know Bad Dancing When They See It: Audiovisual Synchrony Perception of Music in 10-Month-Olds

**Erin Hannon**
*University of Nevada, Las Vegas, USA*

**Background and Aims:** Audiovisual musical experiences are prominent early in life, for example when infants observe caregivers singing, clapping, and moving to music. It is unknown, however, whether infants are capable of perceiving audiovisual synchrony in musical contexts. Prior work suggests that infants can detect audiovisual asynchronies in simple displays, such as the sight and sound of a ball bouncing (Lewkowicz, 1996), but detection of audiovisual asynchronies in music would require that infants infer the underlying temporal structure, or meter, from rich and complex audio and visual information. The current study aimed to investigate whether 10-month-olds can discriminate musical stimuli on the basis of audiovisual synchrony.

**Methods:** We recorded a woman dancing to both slow and fast songs. Infants were habituated to a 60-s audiovisual segment of fast or slow dancing, with speed counterbalanced between subjects. After habituation infants were presented with two novel movies. For the synchronous test stimulus, the audio track consisted of a novel segment of the habituation song, accompanied by the matching video track. The same music segment was used for the audio track of the asynchronous movie, but the video track was taken from the other song. For example, after habituation to the slow song, asynchronous test trials presented fast dancing to the slow song. Because the two songs were highly contrastive in tempo, infants could potentially discriminate test stimuli on the basis of visual information alone (i.e. differences in the speed of dancing irrespective of the music). A silent control condition was therefore included in which infants were presented with the same movies but without any accompanying music.

**Results:** Paired t-tests revealed that infants looked significantly longer during post-habituation trials in which dancing was asynchronous with the music ($p < .01$, M [asynchronous] = 19.95 s, M [synchronous] = 11.47 s). By contrast, infants in the silent control condition showed no preference ($p > .75$, M [asynchronous] = 16.57 s, M [synchronous] = 15.76 s). Because both test trials in the experimental condition contained the same segment of music, the absence of a preference in the silent condition indicates that audiovisual synchrony was the basis for discrimination.

**Conclusion:** The present findings lend support to the notion that infants, who do not yet dance to music themselves, can infer the underlying meter in music. Moreover, it provides the first evidence to date that infants can use this information to detect audiovisual asynchronies in rich and highly complex musical contexts.

**Th1-08**

## Operant Learning in 3-Month-Old Infants is Facilitated by Congruent Visual and Tactile Information

**Kimberly Kraebel**
*Dept. of Psychology, SUNY Cortland, Cortland, USA*

The current study examined infants' ability to utilize cross-modal information in a learning context (specifically, in Rovee-Collier's conjugate learning procedure; Rovee & Rovee, 1969). Studies have shown that human infants can detect equivalences across modalities and this detection is facilitated by multimodal presentation (Bahrick & Lickliter, 2004). Data from the animal literature demonstrates that infant rats show a greater disposition than adult rats to detect and use intersensory equivalences in learning paradigms (Spear & McKinzie, 1994). Combined, these findings suggest that human infants should likewise detect and use cross-modal information in an operant learning procedure and that detection of these correspondences should facilitate learning an operant task. The goal of the current study was to test this hypothesis.

Three-month-old infants learned to make an operant response (leg kicks) for reinforcement (movement of a toy mobile). During acquisition, a third of these infants held an object that matched the shape of the objects on the mobile (see cylinders while holding a cylinder), a third held an object that mismatched the shape of the objects on the mobile (see cylinders while holding a rectangular-shaped object) and a third did not hold any object (only see cylinders). All infants were then given an immediate test of learning. Preliminary results showed

that infants given corresponding shape information had a significantly higher kick rate at test than infants not given corresponding shape information and that learning was inhibited when infants were given mismatching shape information. These results suggest that infants not only detect but also use the cross-modal information available to them. These results are in agreement with and extend Bahrick and Lickliter's Intersensory Redundancy Hypothesis (2004) by showing the multimodal redundancy facilitates learning even when the redundancy is not present during test.

**Th1-09**

## Labels Can Override Perceptual Categories in Early Infancy: a Computational Model

Valentina Gliozzi[1] **Julien Mayor**[2] Kim Plunkett[2]

*1. Dipartimento di Informatica. Universita' di Torino., Torino, Italy; 2. Department of Experimental Psychology. University of Oxford, Oxford, UK*

We propose a neural network model that replicates recent findings (Plunkett et al. 2007) about the role of words on categorisation. According to Plunkett et al. (2007), labels have an impact on how infants form categories, as demonstrated in five experiments. The first two experiments replicate the results of Younger's (1985) study on visual categorisation (no labels): if infants are exposed to a set of visual stimuli in which different features freely combine ('Broad Condition'), they will form a single category, whereas if they are exposed to stimuli generated from two possible combinations of features ('Narrow Condition'), they will form two categories. Plunkett et al. (2007) conduct three more experiments in order to assess the role of language on categorisation. In the three experiments, infants are exposed to both visual and acoustic stimuli. The visual stimuli belong to the Narrow Condition. In experiment 3, two labels are presented, one for each category; in experiment 4 two labels are presented, randomly associated with the visual stimuli; in experiment 5 one single label is presented. Category formation is assessed by measuring the looking time of children when tested with two different kinds of visual test stimuli: modal stimuli (closer to images of one category) or average stimuli (equidistant from both categories). In experiment 3, infants formed two categories, in experiment 4 no category, in experiment 5 one category.

We replicated the five experiments using a neural network architecture consisting of two self-organised maps: the acoustic map receives acoustic stimuli, whereas the visual map receives both visual stimuli and the activation pattern of the acoustic map when receiving the corresponding label. Both maps are trained by presenting the stimuli only once, making them plausible models of infants' learning. Their performance is assessed by measuring the quantisation error on the same two visual stimuli used to test infants. The average ratio between the quantisation errors mimics the results of the experiments led with infants. The model demonstrates how an unsupervised learning system, which does not involve error feedback, can capture the impact of labels on infants' categorization in a plausible manner.

**References:**

K.Plunkett, J.Hu, L.Cohen (2007). Labels can override perceptual categories in early infancy. Cognition, in press.

B. Younger (1985). The segregation of items into categories by 10-mont-old infants. Child Development, 56, 1574-1583.

**Th1-10**

## Looking and Listening Patterns in 4- and 8-Month-Old Infants:

**Megan McIlreavy**[1] Robin Panneton[2]

*1. Department of Psychology, University of Georgia, Athens, USA; 2. Virginia Tech, Blacksburg, USA*

Extensive work within the field of infant attention has focused on the development of information processing in the visual domain. Two distinct classifications of infants' visual attending have been established; short-looking vs. long-looking infants, with short-lookers showing faster and more efficient processing of visual events (e.g., superior visual event recognition). Comparatively, little work has explored attention patterns occurring in other modalities, such as differences in infants' auditory processing. This project examined individual differences in an auditory recognition task at two different ages during infancy, and correspondence between auditory and visual recognition patterns.

Twenty 4-month-olds and 19 8-month-olds were tested on a visual recognition task followed by an auditory recognition task. First, infants were classified as long- or short-attenders based upon their peak-looking and peak-listening trials during 20 seconds of familiarization. Next, they were familiarized with an event for 20 seconds followed by 2 tests trials, containing the familiar and a novel event. In both age groups, there was no significant correspondence between attention classification (either visual or auditory) and recognition performance. Surprisingly, long-listening infants tended to listen longer to the novel melody whereas short-listening infants attended longer to the familiar melody. Further, there was little correspondence between infants' classification in one modality (visual) compared to the other (auditory). That is, short-looking infants were not necessarily short-listening infants. Results of this study are interesting in that they raise the probability that visual and auditory attention are not likely to show parallels in terms of infants' information processing.

Explanations for these results will be offered in terms of infants' attention processing across different modalities, procedural differences affecting recognition outcomes, as well as differences in the nature of the experimental events themselves (i.e. dynamic auditory events compared to static visual events).

**Th1-11**

## Computational Analysis of Motionese: What Can Infants Learn from Parental Actions?

**Yukie Nagai**, Katharina Rohlfing

*Bielefeld University, Bielefeld, Germany*

Motionese is parental modifications in their actions directed to infants versus adults. Parents enhance relevant features in actions so as to maintain the infants' attention and aid the infants' processing of the actions. Brand et al. (2002, 2007) revealed higher interactiveness, more enthusiasm, broader movements, simplification, and so on in infant-directed action (IDA). Computationally analyzing the task relevant actions, Rohlfing et al. (2006) found longer and more pauses between actions and decomposition of actions in IDA.

The aim of this study is to evaluate IDA from an infant-like viewpoint. Although the characteristics of motionese have been uncovered, we do not know yet how it can help infants to perceive and process the actions. Infants are supposed to have little semantic knowledge about the actions in comparison to adults. Their understanding of the

environmental, social, and psychological constraints on the actions is limited. In order to simulate such primal abilities of infants, we adopted a model of saliency-based visual attention (Itti et al., 1998) for the analysis of motionese. Saliency is defined as outstandingness from the surroundings in terms of color, intensity, orientation, flicker, and motion. That is, the model can simulate the bottom-up visual attention comparable to the early infant's.

We analyzed videotapes of 15 parents (5 fathers and 10 mothers) demonstrating a stacking-cups task first to their 8- to 11-month-old infants (M = 10.56, SD = 0.89) and then an adult. The videos were fed into the saliency model, and the locations attended to by the model in the IDA condition were compared with in the adult-directed action. Our analysis revealed that, in IDA:

(1) the cups attracted more attention before the task started and after it ended,

(2) the static features more contributed to the saliency of the cups, and

(3) the parents' face was attended to more often during the task.

The first two results indicate that motionese has the effect of highlighting the initial and final state of the task and the means of it. Our closer analysis on the third result showed that the parents gave social signals indicating the significant state changes in the actions, i.e., putting a cup into another. We suggest from these results that motionese may also enable infants to detect these information.

**Th1-12**

### The Role of Temporal Information For 12-Month-Olds' Processing of Self-Produced Actions

**Bianca Jovanovic**, **Gudrun Schwarzer**

*University of Giessen, Giessen, Germany*

Research has established that intentionally produced action-effect instances are perceived as being temporally closer to each other than non-intentionally produced instances (e.g. if movements are induced by TMS, Haggard & Clark, 2003). This phenomenon has been called "intentional binding", implying that the temporal relation between components of self-produced intended actions is enhanced. In the present study we examined whether for 12-month-old infants, in analogy to these findings, there is a temporal advantage for the processing of self-produced action-effect relations as compared to action-effect relations modelled by another agent. To this end, we presented infants with two tasks in which a specific action elicited a specific effect, and measured whether learning of this relationship in terms of number of actions produced is influenced by the agent producing the first action-effect instance and the temporal delay between action and effect. The "easy task" consisted of putting a ball into a broad bowl, which made the bowl light up. The "difficult task" setting consisted of an apparatus with a handle that, when depressed, caused a ball to be released from inside the apparatus and slide down a transparent tube. In the "no delay" condition, there was virtually no temporal delay between action (e.g. depressing the handle) and effect (e.g. releasing the ball); in the "delay" condition there was a 3 second delay. The factor "agent" was varied as follows. In the "self condition", the child himself manipulated the apparatus and as soon as he had produced the first target action, the number of actions produced during the subsequent 60 seconds testing-interval was measured. In the "model condition" an experimenter modelled the action once, and again the number of target actions produced by the infant at test was measured. If there was a temporal advantage for the processing of self-produced actions, infants in the self condition should perform better than infants in the model condition, especially when there is a temporal delay between action and effect. This idea is supported by the findings in the difficult task, where we found an overall advantage in the self condition, as well as a significant interaction between agent condition and time interval: infants in the self condition with delay produced more target actions than infants in the model condition with delay. The extent to which the relation between agent and time interval is affected by task difficulty will also be discussed.

**Th1-13**

### Long-Term Influence of Motor Status on the Flexibility of Memory Retrieval during Infancy

**Sabine Seehagen**, Julien Gross, Harlene Hayne

*University of Otago, Dunedin, New Zealand*

Rovee-Collier (1996) has hypothesised that independent locomotion enhances the flexibility of infant memory retrieval. In our ongoing longitudinal study, we have found support for Rovee-Collier's hypothesis: 9-month-old infants who had started crawling exhibited greater memory flexibility than did 9-months-olds who had not started crawling. Furthermore, 12-month-old infants who had started walking exhibited greater memory flexibility than their late walking counterparts. The primary question in the present experiment was: Do individual differences in the development of self-produced locomotion continue to influence individual differences in flexibility of memory retrieval?

To answer this question, we tested infants in our longitudinal sample in a deferred imitation procedure within 2 weeks of their second birthday. Infants took part in two sessions that were separated by 24 hr. In the baseline phase of Session 1, infants' spontaneous production of the target actions with one set of stimuli (rattle or animal) was assessed. Following the 60-s baseline phase, the experimenter demonstrated a three-step sequence of actions, 3 times in succession. The same baseline and demonstration procedures were repeated with a second, different, set of stimuli (rattle or animal). In Session 2, infants were tested with one stimulus that was the same as that used in the demonstration and one stimulus that was different.

Our results indicated that infants' memory performance at 2 years of age was still associated with their motor development. Infants who had started both crawling and walking early (early locomotors) exhibited a higher degree of memory flexibility than those infants who had started crawling and walking late (late locomotors). We conclude that infants' early locomotor development continues to affect their memory development into the second year of life.

**Th1-14**

### Spacing Effects of Extinction on Retention at 3 Months

**Christiana Shafer**, Carolyn Rovee-Collier

*Rutgers University, New Brunswick, USA*

This study examined the effect of a period of nonreinforcement (extinction) on young infants' memory of a previously learned response-outcome association. The extinction effect is a decrease in conditioned responding relative to an individual's response rate at the end of acquisition. A hallmark of the extinction effect is the renewal of conditioned responding with the passage of time (spontaneous recovery). This phenomenon is taken as evidence that extinction did not elimin-

ate original learning. Previous research from our lab demonstrated that when extinction immediately followed acquisition, 3-month-olds exhibited an extinction effect throughout the entire period that they otherwise remember the task (Shafer & Rovee-Collier, 2007). In the present experiments, we introduced extinction in a temporally discrete session and examined if spontaneous recovery would occur after delays of 1 day and longer. We hypothesized that distinguishing extinction from acquisition in separate sessions might facilitate spontaneous recovery. If infants remembered only what they had learned last, however, then this manipulation would have no effect.

Three-month-olds were trained in the mobile conjugate reinforcement task for two sessions and received a separate extinction session in which kicking did not move the mobile. In Experiment 1, extinction occurred 1 day after acquisition, and a 3-min retention test occurred 1-6 days later. Infants tested 1 day after extinction exhibited robust spontaneous recovery, indicating that their original learning was intact; infants tested after longer delays, however, exhibited no retention. Presumably, the more recent learning during extinction counteracted the original learning after longer delays. In Experiment 2, extinction occurred after progressively longer delays, and the retention test was always 1 day later. Because the nonmoving mobile at the outset of an extinction session cues retrieval of the training memory, and delaying retrieval of a memory strengthens it, we hypothesized that delaying the extinction session might strengthen the training memory and facilitate spontaneous recovery. It did. When extinction was delayed for 2-5 days after training, infants exhibited spontaneous recovery 1 day later. This result is counterintuitive: Infants were tested only 1 day after extinction but many days after original training--a time when the original memory representation should be weaker.

Together, these experiments reveal that the timing of extinction relative to original training influences whether very young infants remember what they had originally learned. Infants do not remember only what they learned last; rather, the strength of the original memory before extinction determines whether or not they remember it afterward.

**Th1-15**

### The Developmental Change of Joint Attention and Non-Joint Attention

**Megumi Shimizu**, Tamiko Ogura, Sanae Fukuda

*Kobe University, Japan, Kobe, Japan*

**Background and Aims:** During mother-child interaction, there are periods when they share attention (Joint Attention=JA) and do no share attention (Non-Joint Attention=NJA). There is no mention made of NJA in previous research literature on Joint Attention. However, from the fact that periods of JA and NJA are continuously changing, we found that NJA is important for understanding the context of JA. In particular, initiating JA by first looking in the direction of the object simply means that the mother or child finds the object first, whilst on the other hand, terminating NJA by following the eye direction of the other person means perceiving the eye direction of the other person and starting to share the object.

We analyzed NJA and JA between mothers and children in the period when JA appears in one-year old children (as discussed by Adamson & McArthur,1995; Behne, Carpenter, & Tomasello,2005 etc).

**Methods:** 5-minute interactions between 48 mother-child dyads of 14,17,and 21 month old children were observed in a play room at University. We analysed the data for periods of JA and NJA, focusing on the initiator/terminator, and length of time.

**Results:**

1. Initiator and terminator

After calculating the percentage of initiations and terminations by mothers and children for the total number of JA/NJA turns, we found a significant increase in the number of terminations of NJA as the child's age changes between 14 and 17 months ($F(2,45) = 5.88$, $p < .005$).

2. Duration

We calculated the average duration for JA and NJA for both mothers and children using ANOVA. There was a significant difference in average durations for both JA and NJA at 21 months compared to 14 and 17 months: JA length at 14 months 27.24 sec, 17 months 29.5 sec, 21 months 55.67 sec, $F(2,45) = 13.807$, $p < .00$).

**Conclusion:** The results of this research make clear the fact that between 14 months and 21 months there is an increase in establishing JA once NJA terminates. Furthermore, the duration of JA doubles. From these findings we show the importance of analyzing NJA for understanding the development of JA.

**Th1-16**

### The Effect of Narrative Cues on Toddlers' Imitation from Television and Picture Books

Kara Garrity[1] Rachel Barr[1] **Gabrielle Simcock**[2]

*1. Georgetown University, Washington, USA; 2. University of Queensland, Brisbane, Australia*

Television viewing and picture-book reading are prevalent activities during toddlerhood (Rideout, Vandewater & Wartella, 2003). Parents and teachers assume that toddlers can easily learn from these symbolic media by transferring new information from books or television to the real-world objects they encounter in their daily lives. Recent research has shown that toddlers' can imitate novel actions on real-world objects that were originally introduced via television (Barr & Hayne, 1999) or in picture books (Simcock & DeLoache, 2006). However, variations in methodology (e.g., presence or absence of narrative cues) used for television and book studies do not allow for comparisons between them. Thus, the purpose of the present study was to directly compare 24-month-olds' ability to imitate from books and television and to examine the effect of narrative cues on their performance. The toddlers were either shown a pre-recorded video or were read a picture book depicting an experimenter constructing a novel toy rattle. The videos and the books were professionally produced and had either full descriptive narration of the target actions or empty vague narration. Following a 10-min delay, the toddlers were given the depicted objects and were asked to make a rattle. Toddlers imitated more actions after exposure to a televised demonstration than a book reading demonstration and toddlers imitated more actions in the full narration than the empty narration group. Results supported the representational flexibility hypothesis in which Hayne (2004) argues the degraded perceptual attributes of media (i.e., size, depth cues) relative to the corresponding objects - in conjunction with the mismatch between the nature of the encoded information (2-D) and the retrieval objects (3-D) - makes learning from books and television challenging for toddlers. In this research, both the audio-visual cues from television and the narrative cues provided additional retrieval cues to the toddlers at the time of test. Cognitive flexibility influences the facility with which toddlers can use the information presented in 2D media, which has important theoretical implications for our understanding of toddlers' emerging representational insight (DeLoache, 1991). Further, these data have important practical im-

plications to help inform parents, teachers, and policy makers on the cognitive effects of media on early development.

**Th1-17**

## Influence of Visual Contextual Cues on Manual Discrimination of Orientations in 5-Month-Old Infants

Stéphanie Kerzerho[1] **Arlette Streri**[2]

*1. Laboratory Psychology for Perception, Paris, France; 2. Laboratory "Psychology for Perception", University Paris-Descartes, Paris, France*

**Purpose:** We investigated the crossmodal influence of vision on haptics in infancy by examining whether visual contextual cues influence the manual discrimination of orientations in 5-month-old infants. It has been recently found but only in adults that non informative visual cues could influence the haptic perception of orientations (Newport et al. 2002, Zuidhoek et al. 2004). In 5-month-old infants, the manual discrimination of spatial orientations has been demonstrated but without non informative visual cues (Gentaz & Streri, 2002, 2004, Kerzerho et al. 2005).

**Method:** A haptic familiarization (with a 60-s fixed-duration) / reaction to novelty procedure were used in three experiments. In experiments 1 and 2, an oriented visual context composed of alternate black and white stripes tilted to 20°-left was presented to infants while holding a rod with their right hand without possibility of seeing it. In experiment 1, a rod orientation tilted to 20° was proposed in the familiarization phase and two orientations (20°-left and 30°-left) were presented successively in the test phase. In experiment 2, a vertical orientation (0°) was proposed in the familiarization phase and two orientations (0° and 10°) were presented successively in the test phase. In experiment 3, a non oriented visual context composed of black dots was presented to infants while holding a rod with their right hand without possibility of seeing it: a vertical orientation (0°) was proposed in the familiarization phase and two orientations (0° and 10°) were presented successively in the test phase.

**Results:** In experiment 1, the presence of a congruent visual context (stripes tilted to 20°) improved the oblique rods discrimination: after a 20°-left oblique familiarisation, infants held longer the novel orientation (30°-left) than the familiar orientation (20°-left). Without visual context, previous studies showed no manual discrimination between these two spatial orientations (Gentaz & Streri, 2004). In experiment 2, the non congruent visual context disturbed the vertical perception: No significant discrimination was observed whereas a significant discrimination was usually observed without visual context (Gentaz & Streri, 2004). In experiment 3, the non oriented visual context also influences the rod discriminations: infants held longer the novel orientation (10°-left) than the familiar orientation (0°).

**Conclusions:** These results showed that the visual contextual cues influence the manual discrimination of orientations in 5-month-old infants. We discussed the implications of these results in the point of view of the crossmodal integration and the attentional level occurs in the perception of orientations multisensory integration.

**Th1-18**

## Food for Thought: Interfeed Intervals and Word Recognition Memory in Newborns

**Haley Tsui**[1] Ronald Barr[2] Philip Zelazo[3] Simon Young[4] Nicole Catherine[1] Rollin Brant[5]

*1. Center for Community Child Health Research, Child and Family Research Institute, Vancouver, Canada; 2. Department of Pediatrics, University of British Columbia, Vancouver, Canada; 3. Department of Psychology, McGill University, Montreal, Canada; 4. Department of Psychiatry, McGill University, Montreal, Canada; 5. Department of Statistics, University of British Columbia, Vancouver, Canada*

**Background and Aims:** A 'feeding effect' for enhancement of word recognition memory in human newborns has been demonstrated previously, suggesting that memory for spoken words fluctuates as a function of acute nutritional state. However, intervals between feeds vary among and within infants. More frequent feeds (and possibly less intake at each meal) may stabilize the fluctuation in glucose levels that occurs during pulse feedings separated by 2-3 hours. This study aims to determine whether interfeed intervals are a determinant of short-term word recognition memory in infants. More specifically, we hypothesized that performance is improved preprandially in infants who are temporarily fed every hour compared to every 3 hours.

**Method:** Seventy-two 6-10 day old infants were randomized to receive either 2 feeds three hours apart (long interval) or 4 feeds one hour apart (short interval) and to be tested preprandially or postprandially around the final feed. A habituation-recovery paradigm with a 100-second delay preceding recovery was used. Each infant was held between two speakers while an auditory word stimulus was presented repeatedly in 30-second trials from either side. Head turns of 45 degrees towards or away from the stimulus were recorded. Memory was measured as an absence of head turns towards the sound during recovery; forgetting as the presence of head turns towards. Only infants who turned towards a novel sound following recovery were considered valid subjects.

**Results:** Attention, rate of learning and re-orientation in novelty were similar across groups. Mean (SD) head turns towards in recovery were 74.3+26.5 [pre-long], 38.8+27.7 [pre-short], 23.4+21.2 [post-long] and 16.7+14.1 [post-short]. A 2 (prandial condition) x 2 (interval) ANOVA revealed significant main effects for both prandial condition [$F(1,68)=43.6, p<0.001$] and interval [$F(1,68)=14.6, p<0.001$], as well as a significant interaction [$F(1,68)=6.7, p=0.01$]. Preprandial memory was enhanced after short compared to long intervals [$t(30)=3.68, p=0.001$]. Relative to preprandial infants, memory enhancement occurred postprandially in both feeding interval conditions, but was similar between short and long interval feedings.

**Conclusion:** As predicted, preprandial infants fed with shorter interfeed intervals displayed better memory than with longer intervals, which may signify an attenuation of fluctuating glucose levels between feeds that facilitates the enhancement of word recognition memory typically displayed in babies tested postprandially. Indeed, postprandial infants displayed better memory than preprandial infants in both conditions, confirming previous findings. This study provides further evidence for a variation in auditory word recognition memory in infants that is partly contingent upon nutritional state.

**Th1-19**

## Investigating the Nature of Physiological Self-Regulation and its Relation to Learning during Infancy

**Heather Wallace**[1] Tara Wass[2]

*1. University of Tennessee, Knoxville, USA; 2. Formerly of the University of Tennessee, Denver, USA*

Self-regulatory abilities are imperative to learning during infancy because infants must regulate their physiological responses to stimuli in order to attend to and extract relevant and applicable features of presented information. The purpose of this study was to investigate the relation between infants' physiological self-regulation and learning abilities during a cognitive task. Measures of High Frequency Heart Period Variability (HFHPV) change and patterns of visual responding to stimuli presented during the Visual Expectation Paradigm (VExP) were used to examine the relationship between physiological self-regulation and learning in 117 healthy, full-term, 3.5-month infants.

To begin this study, the dynamic nature of physiological self-regulation during engagement in a cognitive task was examined. Results from cluster analyses supported the hypothesis that patterns of HFHPV change derive from the relationship between resting HFHPV and the direction of HFHPV change in response to and sustained throughout the VExP. Specifically, a negative relationship between resting HFHPV and the direction of HFHPV change (either increase or decrease) during the VExP was hypothesized and confirmed with chi-square analyses.

Previous research indicated that high resting HFHPV coupled with decreased HFHPV during a cognitive task, positively correlates with sustained attention necessary for extracting and integrating information from the environment and learning (Bornstein & Suess, 2000; Garcia-Coll, et al., 1984; Hansen et al., 2003; Richards, 1985 & 1987). Therefore, a negative relationship between HFHPV change during the VExP and VExP task performance was hypothesized. Results indicated that infants who decreased, rather than increased, HFHPV during the first half of the VExP task demonstrated better overall task performance. This study also expected HFHPV change throughout the entire VExP task to be a stronger predictor of learning than resting measures of HFHPV since HFHPV change reflects active physiological self-regulation and supports sustained attention and learning abilities. However, results from step-wise regression analyses did not support this hypothesis, noting that resting measures of HFHPV and HFHPV change during the first half of the VExP task were stronger predictors of learning during the VExP than overall HFHPV change.

Specifying the relationship between physiological self-regulation and learning abilities may afford researchers and practitioners the ability to detect and diagnosis infants who may be at risk for learning delays resulting from regulation disorders. Early detection of a regulatory disorder may in turn afford the ability to provide early intervention services that facilitate the child's acquisition of techniques useful for coping with the symptoms of a regulatory disorder.

**Th1-20**

## I'd Rather Do it Myself! The Role of Motor Practice in Infants' Causal Learning

**Dahe Yang, Emily Bushnell**

*Tufts University, Medford, USA*

Recent work on infants' imitation emphasizes their understanding of means and ends as separate and combinable components. For example, Yang et al., (submitted) observed that infants readily transfer a means learned with one object to another object to produce a different effect. However, infants in our recent work were unable to learn an alternative means to generate an effect they had produced earlier with a different strategy. Instead, they persisted with using the first means they had learned. Following Thelen and Smith (1994), performing the initial means may establish a motor "attractor", which then carries over to the infant's next turn even though a new means was demonstrated for it.

To examine the importance of motor practice to infants' persistence with the first means, we conducted a follow-up study with 32 additional 14- to 16-month-old infants. An experimenter initially demonstrated opening a wooden box either with her hand (n = 16) or with a novel tool (n = 16). Immediately after this demonstration, the experimenter demonstrated opening the box with the alternative means, and then the infant was given a turn with the materials. The only difference in procedure compared to the original study was that infants did not have a turn after the first demonstration.

All but 6 of the 32 infants (binomial test, $p < .001$) attempted to open the box by the second method the experimenter showed them - they essentially ignored the first means demonstrated. These results are radically different from those of the original study, in which 28 of the 36 infants persisted with using the first means on their second turn - they essentially ignored the second means demonstrated! It is also noteworthy that in both studies, after seeing two means, infants did NOT selectively opt to perform the easier or more efficient one.

The results of these studies together support a dynamic systems approach and emphasize the importance of motor practice for infants to learn means-ends behaviors. The role of motor practice was also implicated in our prior work on transferring the means. Performing a means after observing it may consolidate infants' understanding of the causal nature of the action. This knowledge may then serve as a platform for exploring new cause-effect relations, as in the case of transfer to new objects, and conversely it may inhibit learning new strategies for use with a given object, as in the case of persistence with the first means.

**Th1-21**

## Television Viewing Patterns in 6- and 9-Month-Olds: The Role of Infant-Parent Interactions and Joint Attention.

Elizabeth Zack, Ashley Fidler, Colleen Carr, Jenny Reyes, Joanna Lee, Rachel Barr

*Georgetown University, Washington, USA*

Infant-directed programming is a multi-million dollar industry. Many of these programs have been explicitly or implicitly marketed as educational. They also often include segments that encourage parents to co-view with their infants in order to enhance the potential educational value of the viewing experience (Garrison & Christakis, 2005). Little is known, however, about how infants and parents interact with these products.

Findings from a large telephone survey suggest that 8- to 16-month-olds' language development suffers as a result of increased baby DVD/video viewing (Zimmerman, Christakis, & Meltzoff, in press). However, a recent naturalistic study demonstrated that 12- to 18-month-old infants looked and responded more to an infant-directed video when parents provided high levels of scaffolding in the form of questions and labels/descriptions (Barr, Zack, Muentener, & Garcia, in press). This suggests that parental scaffolding during media viewing may positively influence infant learning.

In the present study, we extended Barr et al.'s method to examine younger 6- and 9-month-old infants. Forty infants and their parents were videotaped while watching Baby Mozart under naturalistic conditions. Parent-infant interactions were coded into 4 major categories: parent questions (10% of utterances), labels/descriptions (14%), attentional vocatives (18%), and off-topic verbalizations (31%). These categories comprised nearly 75% of parent utterances and occurred at a rate similar to that of parents of the 12- to 18-month-olds in Barr et al. (in press).

As before, the present study examined the relationship between parental interaction style during infant-directed program viewing and two outcomes, infant looking time and infant responsiveness. Cluster analysis based on parental verbalizations revealed two types of parental co-viewing styles: high and low scaffold. With younger infants, looking time and infant responsiveness were not related to parental scaffolding. This is despite the fact that overall attentiveness to videos (60%) was similar to that reported for 12- to 18-month-olds (65%).

It is possible that younger infants are differentially influenced by parental scaffolding because of the emergence of joint attention behaviors between 6 and 12 months. We are currently examining patterns of joint attention in the parent-infant dyads to explore this possibility. Together with other recent findings (e.g. Zimmerman et al., in press; Pierroutsakos & Troseth, 2003), the preliminary data analysis suggests that infants under 1 year of age may be processing information from television differently than infants over 1 year of age.

## *Biological Processes*

**Th1-22**

### Relationship Between Palpebral Fissure Size and Rate of Spontaneous Eye Blinking in Young Infants

**Leigh Bacher**, Tiffany Miller

*State University of New York at Oswego, Oswego, USA*

**Introduction:** Young infants blink spontaneous (SB) at low rates (less than 5 per minute) but the rate of SB increases gradually to 15-30 per min in adulthood. Lawrenson and colleagues (2005) argue that the low rate of SB in younger infants may be due to the smaller palpebral fissure size because larger fissures may promote faster eye drying. The present analysis tests whether individual differences in fissure size are related to differences rate of SB in 4 month old infants.

**Method:** Four month old infants (N=18, 7 female) were observed for 5-6 min in a quiet setting facing a large screen. Rate of SB was examined using slow-motion analysis of video recordings of infants' faces (inter-coder reliability was 87%). Several measures were used to estimate the size of the palpebral fissure from digital images of infants' eyes. Measures were sampled twice from each infant, and for each period, two successive measures were taken on adjacent images. Values from the 4 measurements were averaged. These data are part of a larger longitudinal study; about 30 infants' records are not yet analyzed.

**Results:** Individual differences in fissure size were wide: the largest area was twice that of the smallest. Rate of SB was not related to the 3 estimates of fissure size, $p>.15$; nor was fissure size related to shifts in gaze, $p>.50$. However, current body weight was inversely related to the size of the fissure, $r=-.60$, $p=.02$. Also, rate of SB was not related to body weight or rate of shifts in gaze. Previous analyses showed that SB can be manipulated by external conditions (via bottle feeding or attention to attractive stimuli).

**Discussion:** Although wide individual differences in both SB and fissure size were found, the present results do not provide evidence that the rate of SB infants at 4 mos is related to the size of the palpebral fissure. We found evidence that heavier infants may have smaller fissure size. Results suggest that factors other than eye surface features should be considered when explaining individual differences in rate of SB among same-aged infants. Other data from these infants indicates that rate of SB can be manipulated and may be linked to temperament. Given the evidence of central dopamine regulation of SB in adults, understanding the early development of SB could yield insights into behavioral systems that may be linked to dopamine system function.

**Th1-23**

### EEG Activity during Developmentally Appropriate Working Memory Tasks at 5, 10, 24, and 36 Months

**Martha Ann Bell**[1] Christy Wolfe[2] Katherine Morasch[1] Annie Cardell[1]

*1. Virginia Tech, Blacksburg, USA; 2. University of Louisville, Louisville, USA*

**Background and Aims:** One of the challenges of studying brain-behavior development in executive function skills, such as working memory (WM), is the use of developmentally-appropriate tasks, especially when the period of study is from infancy into early childhood. One strategy is to select tasks whose cognitive requirements are comparable at each developmental time period (Bell & Wolfe, 2007; Diamond et al, 1997). Here we examine EEG activity associated with a battery of WM tasks that share a set of common skills essential for successful performance: WM, inhibitory control, and sustained attention (Bell & Adams, 1999; Diamond et al, 1997).

**Methods:** 106 full-term healthy infants were recruited at 5 months for a longitudinal investigation of the integration of cognition and emotion across infancy and early childhood. Infants were seen at 5, 10, 24, and 36 months of age for behavioral and electrophysiological (EEG, ECG) assessments of cognitive and emotion tasks. EEG data during the WM tasks are the focus of this report. The 5- and 10-month WM task was a looking version of the A-not-B task. At 24 months, the WM tasks were looking A-not-B, and Mommy/Me Stroop-like task. At 36 months, WM tasks were Mommy/Me, Day/Night, and Yes/No Stroop-like tasks. EEG was recorded during resting baseline and during task performance at each age.

**Results:** Multivariate analyses of EEG yielded a main effect for Condition at 5 and 10 months (both $F's > 20.5$, both $p's < .001$) and a Condition by Region interaction at 24 and 36 months (all $F's > 3.26$, all $p's < .05$). The main effect for Condition at 5 and 10 months was associated with baseline to task EEG changes at each scalp location (all $p's < .05$). At 24 months, the A-not-B task showed task-related EEG changes only at central and occipital locations, whereas the Mommy/Me task showed task-related EEG changes at frontal, central and parietal locations (all $p's < .05$). At 36 months, EEG showed task-related changes at frontal, central, and parietal for Mommy/Me and Day/Night tasks, with frontal, central, and temporal changes for the Yes/No task (all $p's < .05$).

**Conclusion:** These EEG data suggest that there is widespread brain activation during WM tasks during infancy and that brain activity starts to become more localized in early childhood. These findings suggest developmental changes in cortical functioning across early years that may be indicative of developmental changes in brain specialization for higher order processes.

**Th1-24**

### The Rejection of Previously Accepted Foods in Infants: a Proposal For a Perceptual, Food Based Disgust Response.

**Steven Brown**, Gillian Harris
*University of Birmingham, Birmingham, UK*

Food neophobia, the fear of new foods, begins between the ages of 18 and 24 months (Harper & Sanders, 1975); both new and known foods are regularly rejected (Carruth, et al., 2004). The rejections occur on sight, suggesting the reason for this rejection is perceptual.

During infancy a facial disgust response varying in intensity occurs to some taste stimuli (Rosenstein & Oster, 1988). This response continues into adulthood where non-taste stimuli, e.g. cockroaches, can cause a similar reaction (Sullivan & Lewis, 2003). The non-taste response may also vary in intensity with each disgust factor having additive effects (Martins & Pliner, 2006). One of these additive effects might be fear about a stimulus (de Jong & Merckelbach, 1998). Furthermore, though research has shown disgust towards food is based on cognitive knowledge, i.e. nature of origin (Rozin & Fallon, 1987) recent research suggests aversive texture is more salient (Martins & Pliner, 2006). The similarities between taste and non-taste disgust responses led Rozin et al., (1999) to suggest disgust may develop from distaste.

A research based model is proposed in which perceptual food disgust develops from distaste around the time neophobia begins. Furthermore, that neophobia has an additive effect on disgust increasing the potential for a disgust response. The increased anxiety in relation to food increases the salience of the foods' perceptual features. The infant has prototypical, learnt expectations of the food given, and examples that provide a perceptual mismatch or are perceived to have aversive taste/textural properties are rejected on sight in a mild disgust response. This results in a perseverant response to prototypical foods. If rejected foods are force fed, the disgust response will increase. If there is no pressure to eat, modeling, exposure, widening of categories and reduced anxiety over time is likely to allow the foods to be re-introduced.

**Th1-25**

### Pre- to Postnatal Continuity in Physiological Responses to Infant Cries Among Women with Anxiety

**Elisabeth Conradt**, Jennifer Ablow, Jeff Measelle, Rose McMahon
*University of Oregon, Eugene, USA*

Beginning at birth, mothers must detect and respond to infants' emotional cues. Mothers with anxiety are at increased risk of responding to infant cues in an insensitive manner, which may make infants less likely to signal their needs. In an earlier study, we identified prenatal indicators of insensitive responding by measuring expectant women's autonomic reactions to recorded infant cries (Conradt, Ablow, & Measelle, 2007). Specifically, expectant women with more anxious symptoms showed significantly greater autonomic arousal to our simulated cry than did non-symptomatic expectant women; importantly, the magnitude of anxious women's response was suggestive of a fear-based response: atypically large rises in heart rate and near complete withdrawal of vagal control of the heart. The aim of the present study was to explore whether these prenatal patterns predicted postnatal arousal by investigating these same women's autonomic response to their own infants' cries. Our goal was to examine whether prenatal conditions of autonomic risk anticipate women's physiological reaction to their 5-month-old infant's emotional cues.

Heart rate (HR) and respiratory sinus arrhythmia (RSA) was collected for 95 mothers as they reacted to their 5 month-old infant's distress during the Still-Face Paradigm. Descriptively, our sample is 72% European American, 28% minority. The mean age is 21.6 years (SD = 3.9); the average level of education is 10.2 years (SD = 1.9). Consistent with our goal to recruit an at-risk sample, the mean household income of $9,634 per year is below the 2004 US Census Bureau's poverty line. The mean score on the Beck Anxiety Inventory during pregnancy was 11.68 (SD = 8.3), indicating moderate levels of anxiety; 28% of the sample reported clinically significant levels of anxiety while pregnant.

Preliminary analyses point to significant levels of continuity between women's prenatal and postnatal reactions to infant cries. Specifically, higher HR when responding to recorded cry while pregnant anticipated higher HR ($r = .49$, $p < .001$) when responding to one's own infant's distress during the still-face. Additionally, greater RSA withdrawal while pregnant anticipated greater RSA withdrawal ($r = .41$, $p < .006$) in response to one's own infant. Although preliminary, an analysis of variance indicates that women with clinically elevated symptoms of anxiety during pregnancy show significantly greater autonomic reactions in response to their own infant than did women who had been non-symptomatic while pregnant.

Our discussion will focus on physiological reactions to infant's emotional cues that enable or interfere with infant soothing behaviors.

**Th1-26**

### The Influence of Personality on the Association between Prenatal Maternal Anxiety and Child Behavioral Problems.

**Anouk de Bruijn**, Hedwig van Bakel, Anneloes van Baar
*Tilburg University, Tilburg, The Netherlands*

**Background:** Recent studies have shown that prenatal maternal state anxiety is associated with behavioral problems in children. Neurobiological, genetic or social interaction processes may be involved. Information on the role of maternal personality traits in the relation between prenatal anxiety and child development may indicate whether more general characteristics are associated, or especially prenatal anxiousness.

**Methods:** A sample of healthy pregnant women (N=456, M= 30.7 years, sd =3.7) answered the State-Trait Anxiety Inventory (STAI) during the three trimesters in pregnancy. Their personality was prenatally assessed with the Five Factor Personality Inventory (FFPI). Items on the FFPI can be clustered into 5 dimensions: Extraversion, Agreeableness, Conscientiousness, Emotional Stability, and Autonomy. When the children were between 14 and 54 months of age (M = 29.4, sd = 10.5, 239 boys, 51.4%), behavioral problems were assessed with the Child Behavior Checklist (CBCL) by their mothers.

**Results:** The three prenatal STAI measures were highly correlated (r range between .54-.64) and were combined. Results show significant correlations between mothers' mean prenatal anxiety and CBCL Total (r = .26), Externalizing (r = .26) and Internalizing (r = .23) scales. Personality characteristics of the mothers are also significantly correlated with CBCL scores, especially Extraversion (r between -.21 and -.24), Emotional Stability (r between -.27 and -.32) and Autonomy (r between -.22 and -.28). Hierarchical regression analyses were performed with confounding variables (current emotional complaints and educational level of mother, prenatal maternal smoking) in the first step, prenatal anxiety and the five dimensions of the FFPI in the

second step and finally interaction terms between anxiety and each of the FFPI dimensions in the third step. Emotional Stability is found to show a significant main effect on total behavioral problems ($\beta$ = -.23, $p < .01$), externalizing ($\beta$ = -.22, $p < .01$) and internalizing ($\beta$ = -.17, $p < .05$) problems. Moreover, significant interaction effects are found between prenatal anxiety and maternal Extraversion on total behavioral problems ($\beta$ = .17, $p < .05$) and internalizing ($\beta$ = .18, $p < .05$) problems. No main effects of prenatal anxiety are found in any of these regression analyses.

**Conclusions:** Personality characteristics of mothers, in particular Extraversion and Emotional Stability, are important in the association between prenatal exposure to maternal anxiety and behavioral problems of children.

**Th1-27**

### Infant Habituation to Repeated Maternal Separations

**Carolina de Weerth**[1] Jan Buitelaar[2]

*1. Dept. of Developmental Psychology - Behavioural Science Institute - Radboud University Nijmegen, Nijmegen, The Netherlands; 2. Dept. of Psychiatry - University Medical Center Nijmegen, Nijmegen, The Netherlands*

**Background and Aims:** Infants are often separated from their mothers and left with extra-familial caregivers. Initially, these separations will provoke behavioral and physiological stress reactions in many infants, but over time most infants habituate to the situation. When habituation to stressors does not occur, chronic stress can arise. The goal of the present study was to determine infants' behavioral habituation to maternal separations, and to find out whether infants' behavioral reactions were a good indicator of the underlying physiological reactions.

**Methods:** The subjects were 105 healthy firstborn infants; complete data sets were obtained for 89 infants. Three weekly 1-hour maternal home separations were carried out when the infants were 9 months old. The infants were left with an unfamiliar female caregiver and an unobtrusive assistant that videotaped the session. The caregiver responded sensitively to infant distress (i.e. following a standard soothing protocol), but generally ignored the infant when non-distressed. The following behaviors were scored: latency to cry/fuss, fussing, crying, positive/neutral vocalizations, and infant being held by caregiver (most intense levels of soothing). Infant cortisol reactivity to the separation was determined by calculating the mean of 4 saliva cortisol samples taken during each separation.

**Results:** The behavioral variables over the separations were relatively stable for the individual infants (Spearman correlation coefficients varying between .33-.69). For the group as a whole, 2-tailed Wilcoxon signed ranks tests showed that infant behavioral reactivity was strongest in the second separation. The latency to cry/fuss was shorter than in the first separation ($p=.03$), and infants were held by the caregiver longer than in both the first ($p=.02$) and third ($p<.001$) separations. Also, infants tended to fuss more than in both the first ($p=.06$) and third ($p=.08$) separations. Mean cortisol decreased significantly from the first to the third separation ($p=.04$). With respect to the relations between behavioral and cortisol reactions, only crying during the first separation positively predicted the mean cortisol of that separation ($R^2=.15$, $\beta=.39$, $p<.001$). Finally, changes (i.e. increases/decreases) in stress-related behavior and cortisol over the separations were largely independent from one another.

**Conclusions:** Infants appeared to behaviorally habituate from the second to the third separation. Cortisol decreased from the first to the third separation. However, behavior and cortisol were only related in the first separation, and the changes over weeks occurred independently in both. In this setting, behavioral stress reactivity and habituation do not appear to be good indicators of underlying cortisol physiological processes.

**Th1-28**

### Visual Performance in Infants Related to Dietary Intake of Lutein and Zeaxanthin

**Melissa Dengler**, Janet Frick, Billy Hammond, Lisa Renzi, Krisztina Varga

*University of Georgia, Athens, USA*

Macular pigment (MP) is comprised of the dietary carotenoids lutein and zeaxanthin (LZ) and is known to protect the eye through an antioxidant and filtering mechanism. In addition, MP is part of the eye's dioptric apparatus and, as such, influences visual input. Both the protective and optical functions of the MP have been well-studied in the adult eye, but little information exists regarding the developing eye. This information is critical, because MP is concentrated in areas of the retina (central macula and fovea) that mature most quickly during the first year of life; thus, altered visual input during this period would be meaningful. The retina is also most susceptible to the kind of damage that MP protects against during the first year of life. Infants vary dramatically in the amount of LZ in their retina, based mostly on feeding method, since breast milk contains LZ but commercial formulas (in the USA) do not. The purpose of our study is to determine the consequences of this variation.

A modified Teller Acuity Card Method will be used to measure contrast sensitivity, using stimuli which should be maximally influenced by MP optical filtering. We created a 460nm background, heavily absorbed by MP, with monochromatic test stimuli not absorbed by MP. The variable wavelength test stimulus was created using a monochromator, and the background was rendered monochromatic using a narrow-band interference filter. Since MP reduces background relative to the test stimulus, the contrast (and thus visibility) between the two should be sensitive to MP differences. A spectral sensitivity curve for each infant will be obtained by determining thresholds at three test stimulus wavelengths: 460, 540, and 610nm. We will also assess infant and maternal diet through a nutritional survey, to determine whether maternal dietary intake of carotenoids affects contrast sensitivity in breastfed infants. The biggest difference we expect to see is between breast-fed and formula-fed infants.

Testing with infants is underway, but preliminary results have been obtained using adults. College students were tested for their detection of a stimulus consisting of a mid-wave grating (540nm) on a blue background (480nm). MP optical density was determined using flicker photometry, and was almost perfectly related ($n=7$, $r=0.95$) to contrast sensitivity when using similar conditions to the optical system created for testing infants. Thus, we expect that our method will provide important new information about environmental correlates of infant visual contrast sensitivity.

**Th1-29**

## Maternal-Rated Sex Differences in Emotion at 10 Months: Infant Self-Regulation and Frontal EEG Asymmetry

**Anjolii Diaz**[1] Katherine Morasch[1] Christy Wolfe[2] Martha Bell[1]

*1. Virginia Polytechnic Institute and State University, Blacksburg, USA; 2. University of Louisville, Louisville, USA*

**Background and Aims:** Mothers are more expressive toward their infant daughters than toward their infant sons (Malatesta et al, 1989). Because mothers express their own feelings more freely to their girls, thus providing them with a greater exposure to emotional displays, mothers may be teaching their daughters a wider range of behavioral choices that are available in various situations (McClure, 2003). If so, then there may be sex differences in early emotion reactivity and in emerging regulatory skills that are due to these socialization processes. It may be, however, that these early sex differences in emotional reactivity and regulation are physiologically based and it is the infant's physiology that is influencing mother's interactions (Kivijarvi et al, 2005). In this study we focused on early reactivity and regulation using a psychobiological developmental framework.

**Methods:** 100 full-term, healthy infants (half girls) and their mothers participated in a longitudinal study. This report focuses on the research visit at 10 months. Baseline EEG was recorded and frontal asymmetry scores were computed. Positive asymmetry scores indicated left frontal activation and negative asymmetry scores indicated right frontal activation. Mothers completed the IBQ (Rothbart, 1981) and infant self-regulatory skills were observed after arm restraint (Stifter & Jain, 1996).

**KeyResults:** Girls and boys did not differ in baseline frontal EEG asymmetry. Mothers rated girls as more fearful than boys [$F(1,94)= 6.05$, $p=.016$]. Girls' frontal EEG asymmetries were correlated with mother-rated fear ($r =-.283$, $p =.054$), distress ($r=-.334$, $p= .022$), and sadness ($r= -.4$, $p=.005$). Each of these negative correlations meant that higher maternal ratings of negative emotion were associated with greater right frontal asymmetry values (Fox, 1994). Girls relative to boys were more readily self-regulated after the arm restraint task by refocusing attention [$F(1, 92) = 3.75$, $p=.056$].

**Conclusions:** These data suggest that there are early sex differences in emotion reactivity as rated by mother, as well as early sex differences in observed regulatory abilities. The correlations between maternal ratings of negative emotion and infant frontal asymmetry were specific to girls. Perhaps mothers become more skilled at reading girls' emotional messages (McClure, 2003) and thus rate girls' levels of emotional behavior more accurately. Why this would be exclusive to negative emotion and corresponding correlations with frontal asymmetries will be discussed.

**Th1-30**

## Fetal Heart Rate Reactivity: Associations with Birth Weight and Maternal Position during Testing

**Lynn Evans**[1] Michael Myers[2,3] Catherine Monk[2]

*1. SUNY Oneonta, Oneonta, USA; 2. Columbia University Medical Center, New York, USA; 3. New York State Psychiatric Institute, New York, USA*

Epidemiological studies addressing the possible fetal origins of adult disease show that lower birth weight is linked to higher risk for adult cardiovascular disease, diabetes, and obesity. These results are based on retrospective studies; none have investigated the possibility that there are physiological characteristics of the fetus that presage these long-term changes in disease vulnerability. In the current study, we measured changes in fetal heart rate in response to maternal challenge in three samples ($n = 26$, $n = 57$, $n = 31$), and then asked whether this measure of fetal reactivity was correlated with birth weight. In the third sample, we also assessed heart rate in a novel environment at 4 months of age. Our hypothesis was that babies with the lowest birth weights would have exhibited greater heart rate increases as fetuses during maternal stress and would exhibit the highest heart rates in a novel environment during infancy. One-hundred twenty women in the third trimester of pregnancy completed assessments of trait anxiety, and then the heart rates of their fetuses were monitored while they performed a laboratory-based psychological challenge (Stroop color word-matching task). Results in the first two samples show that there is a significant negative correlation between fetal heart rate changes during maternal stress and birth weight ($r = -.44$, $p < .05$; $r = -.37$, $p < .01$). In these two samples, this relationship remained after controlling for maternal anxiety as well as maternal physiological responses to the Stroop challenge. In the third sample, the relationship between fetal heart rate changes and birth weight did not hold ($r = .05$, $p = .8$), but a significant negative correlation was found between birth weight and heart rate in a novel environment at 4 months of age ($r = -.42$, $p < .05$). In a retrospective evaluation of the procedures used with these three samples, it was determined that the position of the pregnant woman during the fetal heart rate evaluation in the third sample was different from that in the first two samples. These results suggest there may be *in utero* physiologic markers of birth weight and, in turn, subsequent disease vulnerability. However, assessment of these markers, in particular fetal heart rate reactivity, may be sensitive to maternal position.

**Th1-31**

## Links Between the Psychobiology of Stress and Emotional Behaviors in Toddlers: a Multi-System Measurement Approach

**Christine Fortunato**, Amy Dribin, Douglas Granger, Kristin Buss

*Pennsylvania State University, State College, USA*

A multi-system, measurement approach (Bauer et al., 2002) is applied to examine associations between the psychobiology of the stress response and emotional behavior during the toddler period. Recent developments enable measurement of sympathetic nervous system (SNS) activity non-invasively in saliva (Granger et al., 2006). Investigations with older children reveal alpha-amylase (sAA) reactivity to stress, associations between sAA and externalizing behaviors, and that links between the hypothalamic-pituitary-adrenal (HPA) axis (salivary cortisol) and behavior are moderated by sAA levels and reactivity (Granger et al., 2007). Specific aims were to (1) extend this multi-system approach to the toddler period, (2) determine whether sAA and cortisol are associated with specific emotional behaviors, the dominant emotional behavior, or overall emotional arousal, and (3) test whether Bauer and colleagues' "additive" or "interactive" models explain how the HPA and SNS concurrently act to influence children's emotional behavior.

Eighty-seven two-year-old toddlers (48 females) participated in a laboratory visit that included twelve, novel tasks, including low-threat/pleasure (e.g., balls-in-basket) and fear (e.g., strange approach) episodes. Visits were digitally recorded, and children's behaviors were coded for positive affect, distress, shyness, and boldness. Saliva samples collected pre-task, immediately post-task, and 20-minutes post-task were assayed for sAA and cortisol.

On average, the predominant emotions across the tasks series were boldness (*M*=2.79, *SD*=.53) and positive affect (*M*=2.46, *SD*=.47) versus distress (*M*=1.65, *SD*=.48) and shyness (*M*=2.01, *SD*=.51). Regression analyses (controlling for time since waking and health status) revealed that pre-task sAA levels predicted positive affect and boldness (β=.28, *t*(47)=2.66, *p*<.05; β=.40, *t*(47)=3.00, *p*<.01, respectively). Average levels of toddlers' behavioral distress and shyness predicted post-task cortisol levels (β=.27, *t*(83)=2.53, *p*<.01; β=.20, *t*(47)=1.88, *p*<.06, respectively). Consistent with Bauer's interactive model, baseline sAA moderated the relationship between cortisol and positive affect and boldness, high sAA and cortisol predicts positive affect and boldness (β=2.08, *t*(43)=1.99, *p*<.05; β=3.91, *t*(43)=4.17, *p*<.001, respectively).

These findings are the first to demonstrate the sAA and cortisol are associated with different emotional behaviors in toddlers. Specifically, in contrast to cortisol, sAA is associated with predominant rather than specific emotional behavior. Moreover, interactive rather than additive effects between the SNS and HPA influence emotional behaviors in toddlers. Overall, this study's multi-system approach fosters our understanding of how the correlated and dissociated interplay between SNS and HPA reciprocally influences emotional behaviors in toddlers.

**Th1-32**

## Infants' Brain Responses to Simple and Complex Motion Patterns Differ From Adults

**Rick Gilmore**[1] Chuan Hou[2] Anthony Norcia[2] Adam Christensen[1]

*1. Penn State University, University Park, USA; 2. Smith-Kettlewell Eye Research Institute, San Francisco, USA*

Patterns of motion aid observers in extracting environmental layout, object shape and trajectory, and for moving observers, heading direction and speed of movement. While some data suggest that infants develop sensitivity to certain aspects of complex motion from shortly after birth (e.g., Ball 71), others suggest that complex motion perception develops over an extended period (e.g., Gilmore 04). In a series of studies, we examined steady-state visual evoked potentials (SSVEPs) from infants and adults in response to different types of motion in order to examine how complex motion processing develops in early childhood. In Experiment 1, we examined evoked responses to three types of optic flow: expansion/contraction, left/right translation, and rotation around the view axis. In Experiment 2, we compared evoked responses to motion patterns in which the speeds of random dots were uniform across the display, but directional coherence varied. In Experiment 3, we examined evoked responses to motion patterns in which the 2D shapes of simple objects appeared or disappeared based on the directional coherence of the moving dots. In all three studies, SSVEPs were recorded either from five electrode sites (PO7, O1, Oz, O2, PO8) referenced to Cz or in some cases from a high density (124-128 channel) array. Fourier spectra at integer harmonics of the two driving frequencies (F1 & F2) were extracted from the coherently averaged signals. Adults showed distinct response patterns to the different types of flow in Experiment 1, with large, lateralized responses to expansion/contraction especially at the driving frequency (1F1). In contrast, infants showed systematic responses only to the simplest flow type (left/right translation). Furthermore, the tuning profiles of infants' and adults' responses to coherent versus incoherent motion (Experiments 2 and 3) also differed in terms of the spatial and temporal frequencies that elicited the strongest responses. Taken together, the results suggest that the infant brain processes both simple and complex patterns of motion in ways that differ substantially from adults. Moreover, the cortical networks engaged in extracting object form and observer heading from complex motion may have a prolonged developmental time course.

**Th1-33**

## Does Maternal Stress and Coping during Pregnancy Impact Fetal and Infant Stress Reactivity?

**Katrina Johnson**, Eugene Emory, John Dieter

*Emory University, Atlanta, USA*

**Background and Aims:** Previous studies report associations between maternal stress during pregnancy and increased risk for adverse perinatal and developmental outcomes. The primary aim of the current study was to investigate the impact of prenatal maternal stress and coping on the fetus and infant. It was hypothesized that offspring of prenatally stressed mothers would be more reactive in response to stimulation and would be less adept at regulating their reactivity and that maternal coping may serve as a protective factor.

**Methods:** Pregnant women (N=49) between 33-36 weeks gestation completed self-report measures of life events, perceived stress, pregnancy-related stress, coping, social support, depression, anxiety, and negative emotionality. Correlated stress and coping measures were combined by converting raw score totals to z-scores and calculating a mean to derive a single stress index and single coping index, which were used in all analyses. Fetal heart rate was measured continuously in response to vibroacoustic stimulation. Measures of response magnitude (i.e., reactivity) and recovery to baseline (i.e., regulation) were calculated using customized software. Mother-infant pairs (n=30) participated in a follow-up visit at one-month postnatally. Maternal stress and coping measures were re-administered and infant neurobehavioral status was assessed using the Brazelton Neonatal Behavioral Assessment Scale (NBAS). Indices of infant reactivity and regulation in response to increasing levels of stimulation were of primary interest (i.e., NBAS Range of State and Regulation composites).

**Results:** To test study hypotheses, correlational analyses and hierarchical linear regression were utilized. Results revealed that prenatal maternal stress was associated with increased fetal heart rate reactivity in response to vibroacoustic stimulation (r=0.32, p=0.04). Higher prenatal maternal stress was associated with poorer or less adaptive infant regulation, after controlling for significant covariates including postnatal stress and coping (β=-0.41, p<0.05, $R^2$Ð=0.08). Prenatal maternal coping was associated with greater or more adaptive infant regulation, after controlling for significant covariates including postnatal stress and coping (β=0.43, p<0.01, $R^2$Ð=0.15).

**Conclusions:** These results suggest that maternal stress during pregnancy predicts neurobehavioral functioning in the fetus and infant such that high maternal stress is associated with greater physiological reactivity and poorer or less adaptive regulation. Maternal coping may serve as a buffer against the deleterious effects of stress on the mother and offspring. Results are discussed in terms of the importance of the intrauterine environment as a potential influence on fetal and infant development.

**Th1-34**

### A Possible Gene-Enironment Interaction: Parenting Stress as a Moderator of Taste Sensitivity to 6-n-Propylthiouracil (PROP) as a Biological Marker Predicting Social Support Seeking

**Deann Jones**[1] Lori Roggman[2] Gina Cook[2] Cora Price[2]

*1. Utah State University, Providence, USA; 2. Utah State University, Logan, USA*

**Background and Aims:** Propylthiouracil (PROP) is a chemical that people taste as either very bitter, moderately bitter, or completely tasteless. The ability to taste PROP has been tested as a possible biological marker for characteristics such as stress reactivity (Epel & Bartoshuk, 2002; Jones & Roggman, 2005), negative emotionality (Macht & Mueller, 2007), depression (Whittemore, 1986; 1990), and neuroticism (White & Longo, 2004). This study examined the moderating effect of early parenting stress on a link between the biological marker and social support seeking behavior.

**Methods:** Mother-child pairs (n = 180) were tested for the biological marker in two longitudinal samples, a low-income (n = 107), and a middle-income sample (n = 73). Mothers filled out the Parenting Stress Index (PSI-Short Form) when the infant was 14 months old and completed the Family Crisis Orientation Personal Scales (F-COPES) as a measure of their social support seeking behavior and a PROP taste sensitivity scale (at 2nd grade for the low income sample and 8th grade for the middle income sample). Biological markers are stable over time and can thus be measured at any time point in longitudinal research (Menard, 1990). PROP taste sensitivity ratings and early parenting stress scores were standardized, multiplied to create an interaction term, and then analyzed in multiple regression models in relation to later support seeking. Concurrent parenting stress and social support seeking were also analyzed for the low income sample at 2nd grade. The low-income and middle-income samples were analyzed separately and combined.

**Results:** Interactional analyses revealed that early parenting stress moderated the link between the biological marker and social support seeking. When parenting stress had been low, the biological marker did not predict mothers' reports of social support seeking. However, when parenting stress had been high, mothers without the biological marker (who could not taste PROP) reported more social support seeking behaviors, whereas mothers with the biological marker (who tasted PROP as intensely bitter) reported less social support seeking behaviors. Results were in the same direction in both the low-income and middle-income samples as well as for the concurrent 2nd grade time point.

**Conclusion:** Results suggest that mothers with the biological marker may need more help seeking and obtaining support during times of stress. Parents' willingness to seek support early in handling parenting stress may establish later patterns of support seeking.

**Th1-35**

### Adult versus Adolescent Preterm Birth: A Comparison of Complication and Intervention Rates Across Age Groups

**Andrea Clements**, **Kellye Lingerfelt**

*East Tennessee State University, Johnson City, USA*

**Background and Aims:** Estimates of the rate of prematurity in the US range from 6% to 15% of all births (Slattery & Morrison, 2002). One factor found to be related to preterm birth in some studies is age. In this study we sought to determine whether the rates of certain pregnancy and birth complications and interventions differ between adult and teenage mothers who have given birth prematurely.

**Methods:** This chart review studied all infants born prematurely who were cared for at an Appalachian teaching hospital during 1993 and 1994 (n = 241; 46 under age 20 and 195). A grid containing 46 pieces of data was used to collect data from charts. Two trained data collectors were used throughout the study. For this study only information recorded by medical personnel was extracted from charts. Mothers under 20 years of age were considered to be adolescent, while those 20 and over were considered to be adults. These ages are recognized by federal funding agencies as well as local adolescent prenatal clinics.

**Results:** Several pregnancy and birth complications and interventions were compared for births of premature infants born to adolescent and adult mothers (e.g., PIH, PPROM, Preeclampsia, betamethasone administration). Only the c-section rate differed significantly with 25% of infants of adolescent mothers born by c-section compared to 45.8% of adult mothers' infants.

**Conclusion:** The proportions of the investigated categories of pregnancy and birth complications do not differ significantly between adolescent and adult mothers who have given birth to preterm infants. Only the rate of infants delivered by c-section differed with adolescents more likely to deliver preterm infants vaginally.

**Reference:**

Slattery, M. M. & Morrison, J. J. (2002). Preterm delivery (Review). The Lancet, 360, 1498-.

## *Communication and Language*

**Th1-36**

### The Effect of Dialect on Toddler Identification of Imaged Words

Karen Mulak[1] **Catherine Best**[1,2] Julia Irwin[1] Michael Tyler[2]

*1. Haskins Laboratories, New Haven, USA; 2. MARCS Auditory Laboratories, University of Western Sydney, Sydney, Australia*

**Background and Aims:** Toddlers of 19-20 months prefer listening to familiar words (early vocabulary) over unfamiliar words (adult low-frequency) as spoken not only in their native dialect but also in an unfamiliar nonnative dialect. Children aged 14-15 months fail to show this preference for the nonnative dialect, suggesting a perceptual shift in word recognition from a focus on phonetic details to abstract phonological structure (Tyler & Best, 2006). To assess the time course of word recognition in native and nonnative dialects, we examined the eye gaze of sixteen 19-20 month-old American English learning toddlers (*N* male=8) during a word recognition task.

**Methods:** Six disyllabic words that appear in >50% of early toddler vocabularies (MacArthur CDI; Rescorla et al., 2001) were selected from the previous study's recordings of one female speaker each of Connecticut English (native dialect) and of Jamaican Mesolect English. Two photographs of each word's object were selected, matched for size, clarity, and visual salience. In each trial, a four-second silent visual familiarization of the target object and a distractor (on the left or right of the screen) was followed by a second presentation of the pair accompanied with four different tokens of the auditory target. Between presentations, a visual loomer was shown to draw gaze to the center of the monitor. Participants completed two tests, one per dialect, each consisting of 12 counterbalanced trials. Eye gaze was recorded with a remote mounted ASL eyetracker, and the proportion of fixations to

the target and distractor was calculated around each of the four auditory tokens.

**Results:** A 2 x 2 x 4 repeated-measure analysis of variance on dialect (familiar, unfamiliar), look location (target, distractor), and word repetition revealed a three-way interaction of dialect, look location, and word repetition, $F(3, 42)=3.34$, $p < .05$. Looks to the target for the native Connecticut dialect words increased over the course of the trial, but remained around chance for the nonnative Jamaican dialect words.

**Conclusion:** Previous research indicates toddlers of 19-20 months prefer listening to familiar over unfamiliar words in both native and unfamiliar nonnative dialects. The current findings indicate that while toddlers also recognized the word-object parings in their native dialect, they were significantly poorer at this with the nonnative Jamaican dialect. That is, although they *prefer* listening to familiar over unfamiliar words in both dialects, they are still hindered in *identifying* those words when uttered in the nonnative dialect.

**Th1-37**

## Happy, but Not Sad Dynamic Speakers Facilitate Word Recognition in 11-to-13-Month-Old Infants

**Naureen Bhullar**[1] Robin Panneton[2]

*1. Department of Psychology, Widener University, Chester, USA; 2. Department of Psychology, Virginia Polytechnic Institute and State University, Blacksburg, USA*

**Background and Aims:** Two sources of information that get communicated to infants throughout their first postnatal year are: (1) indexical, involving information that promotes recognition of caregivers and (2) affective, involving information that communicates emotional intent (e.g., positive emotion in the face and voice). The bulk of research on communicative development has involved infants' perception of the linguistic aspects of speech, with indexical/affective information often ignored. The current study addressed the issue of whether communicative affect impacts infants' attention to speech by examining the influence of positive (happy) and negative (sad) emotion on word learning in 11-to-13-month-old infants. Emotion information was conveyed in both the face and voice of a female speaker (a digital movie) as infants were habituated to utterances that contained a target nonsense word. After habituation, infants were presented with the same carrier sentences, containing either the same word (familiar) or a new word (novel).

**Method:** Auditory-visual recordings of a female native English speaker articulating two nonsense words ('neem' and 'boog') in two carrier sentences in both a happy and sad manner were recorded. Fifty 11- to 13-month-old infants were tested; 25 in the Happy condition, and 25 in the Sad condition. All infants were habituated to either the happy or sad movie, and then tested with the same movie, or a new movie that displayed the same emotion, same carrier sentences, but a novel target word. Habituation was defined as a 50% reduction in infants' looking time for two successive trials relative to the duration of the mean of the first two trials. All testing consisted of 4 familiar and 4 novel trials.

**KeyResults:** Comparisons of average looking times on prechange trials (the two trials preceding the beginning of the testing phase) and novel trials for infants in the two emotion conditions showed a significant difference in the Happy condition but no significant difference in the Sad condition. No significant differences in average looking time during the beginning trials of the habituation phase or the number of trials to habituation were found between the two emotion conditiong.

**Conclusions:** The results show significant word recognition in 11-to-13-month-old infants who viewed a happy female speaker, but no evidence of word recognition in those who viewed a sad female speaker. Thus, negative emotional tone (both facial and vocal) prevented infants from effectively processing word content, although attention overall was as high as that in the happy condition.

**Th1-38**

## Academic Outcomes of Very Low Birthweight Infants: the Influence of Mother-Child Relationships

**Lisa Boyce**, Gina Cook, Kim D'zatko

*Utah State University, Logan, USA*

Very low birthweight (VLBW) infants are at risk for poor cognitive functioning and academic performance. Well over half of VLBW infants are diagnosed with learning disabilities, attention deficit/hyperactivity disorders, and behavioral problems (Aylward, 2002; Taylor, Klein, & Hack, 2000). Parent-child relationships that are marked by mutual affection, warmth, trust, and minimal conflict, however, positively influence children's optimal social, cognitive, and emotional development (Bornstein & Tamis-LeMonda, 1989; Kelly, Morisset, Barnard, Hammond, & Booth, 1996; National Institute of Child Health and Human Development [NICHD] Early Child Care Research Network, 1999; Taylor, et al.). Several studies have reported significant positive correlations between maternal interactive behaviors and infant-toddler cognitive outcomes (Letourneau, 1997; Olson, Bates, & Bayles, 1984; Tamis-LeMonda & Bornstein, 1989). A better understanding of the combined influences of medical risk at birth and maternal behaviors from birth to school-age on the academic ability of school-age VLBW children is necessary to inform intervention in the school system as well as prevention efforts in early intervention programs.

This longitudinal study followed twenty VLBW infants recruited from the University of Utah neonatal intensive care unit (NICU) through school entry to examine the influence of early medical risk and parent-child interactions on later academic achievement. On average, infants in this sample were born at 27 weeks gestation and weight 1033g at birth. These infants spent an average 22 days on a ventilator over an average 81 days in the NICU. Our results suggest that the severity of complications at birth as indicated by the number of days on a ventilator, were significantly negatively related to applied problem solving, oral language, listening comprehension, and vocabulary when children were tested at school entry. In addition, ratings of mother-child interactions around play and problem-solving tasks indicated that maternal intrusiveness was negatively associated with these school outcomes while mutual enjoyment was positively related to these child school readiness outcomes.

Tests of mediation models suggest that mutual enjoyment mediates the negative impacts of medical risk at birth on school achievement. Mothers' perceptions about feeding, medical, behavioral, and communication hassles surrounding the care of their VLBW infants at discharge from the NICU and one year later significantly predict later mutual enjoyment during play and problem-solving interactions. Intervention strategies to support parents in their care of these VLBW infants to promote positive parent-child relationships as a means to facilitate later school achievement will be discussed.

**Th1-39**

### Infants' Processing of Morphophonemic Variations during Verb Learning

**Marilyn Cyr**, Rushen Shi

*Dept. of Psychology, University of Quebec in Montreal, Montreal, Canada*

Developing a mental lexicon requires infants to learn to well represent the phonemic components of words. Perceptual experiments showed that by 17 months of age infants indeed do so when learning to map novel word forms to concepts (e.g., Werker, et al., 2002). On the other hand, infants must also learn that certain phonemic changes do not alter the basic meaning of some words. In French, *"répète"* and *"répéter"* are variations of the same verb. Not only is there a vowel suffix (infinitive marker) for *"répéter"*, the second vowel for the two forms also undergoes phonemic changes. This type of alternation is frequent and highly regular in French. The present study examines infants' interpretation of such variations during early verb learning.

**Methods:** We tested 20-month-old French-learning infants using a preferential looking procedure. During training, a monitor presented trials of a scene of different fish moving over a barrier versus trials showing the fish moving under the barrier. Infants heard a nonsense verb *"brécher"* during one scene, and *"pas brécher"* (*"not brécher"*) during the other scene. The test phase contained trials each presenting simultaneously the same two scenes with an auditory instruction *"Regarde"* ("Look") followed by a word: *"brécher"*, *"brèche"*, or *"bré"*. If infants understood that *"brèche"* is a variant of *"brécher"*, they should assign this word to the scene trained with *"brécher"*, but not to the other scene.

**Results:** Looking time to the scene previously trained with *"brécher"* was greater after hearing the same word than before hearing it during the trial. Looking times to the two scenes before versus after hearing *"brèche"* (same-verb variant of *"brécher"*) were not different, i.e., neither a preference for the *"brécher"* scene nor for the other scene. Thus, although infants were not certain if *"brèche"* had the same meaning as *"brécher"*, they did not regard it as a different verb either. However, for the unrelated but phonemically similar form *"bré"*, infants preferred the other scene, suggesting that they definitively interpreted *"bré"* with a different verb meaning than *"brécher"*. We conclude that 20-month-olds can map actions to verbs when word forms are invariant, and are beginning to accept their legal variants as possibly having the same meaning while considering unrelated, phonemically similar forms as different verbs. Given that infants start extracting vowel-initial suffixes months earlier (Mintz, 2004), we suggest that the perception of these suffixes is a determining factor in infants' understanding of morphophonemic variations.

**Th1-40**

### Is it All About Imitation? the Development of Culturally Conventional Gestures and Modeled Infant Signs in 10 Infants

Maria Fusaro, **Claire Vallotton**

*Harvard Graduate School of Education, Cambridge, USA*

**Introduction:** Preverbal infants learn culturally conventional gestures (pointing, nodding) that they will use throughout their lives. They can also learn infant sign language (i.e. "eat": tapping fingers to mouth) which will diminish as they learn to speak. The relationship between adult modeling of signs and child use has not been determined. Is infants' signing based simply on exposure and imitation? Or are there developmental constraints on certain signs resulting in more or less use than expected, given exposure?

We describe the use of conventional gestures and infant signs among infants and their caregivers to address three questions:

1. Do children learn culturally conventional gestures more readily than infant signs?
2. Does infants' use of gestures and signs reflect the frequency of caregiver modeling?
3. How do the relative frequencies of gesture and sign use change throughout infancy?

**Methods:** We followed 10 typically developing infants in a childcare center where caregivers systematically used infant signs in addition to conventional gestures. We videotaped infants an average of 40 times each over eight months during interactions with caregivers. Coders recorded each gesture and sign by caregivers and children.

**Analyses:** To answer Question (1), we compared the age children began using each gesture/sign with the average age of first use across all gestures. For Question (2), we compared the children's frequency of each gesture/sign with the frequency of exposure to each (caregivers' gesture use). For Question (3), we used growth modeling to describe the developmental trajectories of the frequency and variety of gestures/signs from 6 to 19 months of age.

**Results:** Together, the 10 infants used a total of 4 conventional and 31 symbolic gestures, a subset of 74 gestures used by their caregivers. Overall, children began using conventional gestures one month before infant signs, however, this varied by gesture: point and wave were used prior to most signs, while yes and no were not observed until much later. Children used culturally conventional gestures at significantly higher rates than caregivers, as well as signs for animals and those related to separation from parents. Average frequency of signs decreased after 17 months, while both frequency of gestures and variety of signs increases over the 6-19 month period.

**Conclusion:** Infants' use of gestures and signs is influenced but not determined by exposure to adult modeling. The differing developmental courses of conventional gestures and infant signs likely indicate their unique relationships to language.

**Th1-41**

### 6-Month Olds are More Sensitive to Variations in F1 than F2 in Vowels

**Dan Hufnagle**[1] Suzanne Curtin[1] Lori Holt[2] Scott Kiesling[3]

*1. University of Calgary, Calgary, Canada; 2. Carnegie Mellon University, Pittsburgh, USA; 3. University of Pittsburgh, Pittsburgh, USA*

**Background:** Infants at six months have already begun to organize vowel categories according to their native language based on the fact that they are less able to perceive non-native vowel contrasts (Kuhl et al., 1992). However, it is unclear how far young infants have progressed in figuring out the vowel system of their native language. We test which cues to vowel category (here, F1 and F2) they are most sensitive to.

**Methods:** Adults from the area were recorded to determine the parameters of the local vowel space, and we determined the center of the vowel space for each category in terms of F1 and F2 based on these measurements. We then synthesized nine /u/ and nine /I/ vowels that varied along F1 and F2: the vowel from the center of that space (centroid), four vowels that varied along F1 (with centroid F2), and four that varied along F2 (with centroid F1). Ten 6-month-old infants heard trials that contained four tokens of the /u/ or /I/ centroid vowel, followed by four instances of a variant, followed by four more centroid

tokens (task adapted from Best & Jones, 1998). All infants heard two pretest trials (a non-varying trial for each phoneme) followed by all 16 variable trial types and the two non-varying trials for comparison in random orders. Looking time after the first switch was recorded using the Sequential Looking Preference procedure (Cooper & Aslin, 1990). The hypothesis is that infants who notice vowel changes in a given trial (and thus, discriminate among the tokens) will look longer.

**Results:** A repeated-measures ANOVA revealed a main effect of formant: $F(1,9) = 8.74$, $p = .016$, with infants listening significantly longer to F1 variations (mean = 3.54 s) than to F2 variations (mean = 3.08 s). Other effects and their interactions were not significant.

**Conclusions:** These results support our hypothesis that infants are likely to be more sensitive to variations in F1, which roughly translates to variations in vowel height. No vowels border /I/ or /u/ along F2 (roughly, the front-back dimension), so infants should be more tolerant of this variation. On the other hand, both /I/ and /u/ have neighboring vowels along F1, making it more likely that infants would be sensitive to this dimension. Our results support the idea that infants are quite sensitive to the individual cues to vowel category membership, even at six months of age.

**Th1-42**

## Deaf and Hearing Infants' Preference For American Sign Language and Non-Linguistic Biological Motion

**Ursula Krentz**[1] Lindsay Klarman[2] Jennifer Brinkley[2] David Corina[3] Patricia Kuhl[2]

*1. Seattle Pacific University, Seattle, USA; 2. University of Washington, Seattle, USA; 3. University of California, San Diego, USA*

A recent study conducted by Krentz and Corina (in press) examined whether the bias for linguistic signals in hearing infants is specific to speech, or reflects a general bias for all human language, spoken and signed. In this study, they presented preferential-looking data from non-sign exposed hearing infants towards American Sign Language and non-linguistic pantomime. Results from this study indicate that 6-month-old infants prefer an unfamiliar, visual-gestural language (ASL) over non-linguistic pantomime, but 10-months-old do not. Given the well-documented decline in sensitivity to non-native phonemic contrasts in both spoken and signed languages (Baker, Golinkoff, and Petitto, 2007; Werker, Gilbert, Humphrey & Tees, 1981; Werker & Tees, 1984), it is possible that the 10-month-old infants may have lost sensitivity and interest to the linguistic patterns of ASL, a non-native language. It is also possible that the older infants' attention to the pantomime reflects a newly sophisticated social-cognitive ability. Older infants may be able to parse the pantomime sequences into intentional actions and have a more sophisticated appreciation for the pantomime as an attempt to communicate (Baldwin, Baird, Saylor, & Clark, 2001; Namy, 2001; Namy, Campbell and Tomasello, 2004; Namy and Waxman, 1998).

A powerful way to tease apart the possible contributions of linguistic specialization and social cognition would be to test infants whose native language is ASL. We might expect that infants who are exposed to ASL from birth from Deaf, signing, parents may not lose interest in ASL over non-linguistic biological stimuli, despite an increased ability to parse and sequence pantomimed action. The present study investigates data from this unique population. By using this same preferential looking paradigm and stimuli, we investigated whether sign-exposed infants show a preference for their native language (ASL) at both 6 months-of-age and 10 months-of-age. Our preliminary results do support this trend: both younger and older infants prefer the ASL over non-linguistic pantomime. A continued interest in the ASL in the older age group suggests that these infants are still sensitive and show interest to the language patterns of their native language. These results also indicate that is likely that the older hearing infants in the Krentz and Corina study (in press) do not show this continued preference because of a honed interest in only the linguistic properties of their native language-- and modality-- resulting in a loss of sensitivity to the linguistic properties of a visual-gestural language, American Sign Language.

**Th1-43**

## Rhythms of Dialogue in Infancy and Attachment Narratives in Childhood

**Sara Markese**[1] Beatrice Beebe[1] Stanley Feldstein[2] Joseph Jaffe[1]

*1. New York State Psychiatric Institute, Columbia University, New York, USA; 2. University of Maryland, Baltimore, USA*

We previously reported that mother-infant and stranger infant coordination (contingency) of vocal rhythms during 4-month face-to-face play predicted 12-month infant attachment and cognition. We now investigate this same 4-month vocal rhythm coordination as well as 12-month vocal coordination, in relation to 4-year attachment narratives (Attachment Story Completion Task, Bretherton, Ridgeway & Cassidy, 1990). Coordination of durations of adult-infant "pause" and " switching pause" at the point of the turn exchange was assessed by time-series analysis in 41 infants in 4 conditions: with mother and the stranger, at home and lab, at both 4 and 12 months. At 4 years, children completed narrative story stems with a novel examiner in the lab. Linear and non-linear multiple regression analyses related vocal coordination and attachment narratives. Predicting from vocal coordination in infancy to attachment narratives in childhood, Analysis I showed that, across 4 and 12 months, and across pause and switching pause variables, (1) for stranger-infant interactions in the lab, midrange stranger coordination with infant predicted secure 4-year attachment narratives, lowered stranger coordination predicted "avoidant" (A) and "resistant" (C) narratives, and heightened stranger coordination predicted C narratives; (2) for mother-infant interactions, midrange mother coordination with infant predicted secure 4-year attachment narratives, lowered mother coordination predicted C narratives, and heightened mother coordination predicted A narratives. Analysis II predicted from attachment narratives in childhood to vocal coordination in infancy. The 4-year narratives were recoded construing lowest scores as D, moderately low scores as C, highest scores as overly organized "avoidant" (A), and midrange scores as "secure" (B). Children who told both A and D narratives at 4 years were found to have4-month vocal rhythm interactions in the lab in which strangers had lowered their vocal rhythm coordination with infants. Thus, a midrange degree of vocal rhythm coordination, especially in the 4-month stranger-infant interaction, predicted 4-year secure attachment narratives. Both lowered and heightened patterns of stranger coordination with infant were related to insecure (A, C, D) attachment narratives in childhood. This study replicates and extends our previous work. It highlights the importance of the stranger-infant interaction and the novel context as probes into infant social development, and the power of an optimal midrange model of coordination for attachment security.

**Th1-44**

## Young Children's Sensitivity to New and Known Information in Answering Questions

**Dorothé Salomo**, Elena Lieven, Michael Tomasello

*Max-Planck-Institute for Evolutionary Anthropology, Leipzig, Germany*

**Background and Aims:** Children as young as two years old are sensitive to the discourse availability of referents using the immediate linguistic context when choosing referring expressions (e.g., Clancy, 1997; Allen, 2000). One highly special discourse context is questions, since they indicate both what is known to the speaker and which piece(s) of information s/he is seeking. Studies have shown that young children's choice of referring expressions in answers to adults' questions is strongly influenced by whether the intended referent was already lexically given in the question (and, therefore, known to the interlocutor) or not (e.g. Campbell et al., 2000; Wittek & Tomasello, 2005; Matthews et al., 2006). However, those studies focused on a single referent only, which was always a noun phrase. In our study we had two referents of interest: a transitive action and a patient. By varying the newness/givenness of these elements in the preceding context and by using a question-type that asked for both of them (predicate-focus question), we investigated how these two factors jointly determine children's answers.

**Method:** We presented 28-month-old German children with video clips each consisting of a sequence of three scenes, all showing transitive actions acted out by toy animals. In this sequence of events, all elements remained constant but one. While watching the clips, the first two scenes were verbally described by the experimenter ("AGENT is VERB-ing PATIENT"), whereas during the third scene the experimenter asked: "What's the AGENT doing now?" There were two conditions: 1) Action-New: an agent does three different actions to the same patient; 2) Patient-New: an agent does the same action to three different patients.

**Results and Conclusion:** We found in the Action-New condition that the children's answers included a verb most of the time (96.9%), while the patient was mainly dropped (75% null referents). However, when the patient was the new element (Patient-New condition), it was expressed most often by a lexical noun phrase (87.5%), but the verb was often included as well (68.8%), though significantly less than in the Action-New condition ($p<0.05$). Thus, children are responding to the type of question as well as to the given/new dimension since predicate-focus questions pull very strongly for a verb. These findings suggest that in formulating answers to an adult's question, young children are sensitive to what is new information and what is already known information for that adult, based both on the preceding context as well as on the information requested in the question.

**Th1-45**

## Learning to Form Word-Object Associations with Phonetically Similar Words: Links to Language Development

**Julianne Scott**[1] Nenagh Kemp[2] Janet Werker[1] Barbara Bernhardt[1] Carolyn Johnson[1] Linda Siegel[1]

*1. University of British Columbia, Vancouver, Canada; 2. University of Tasmania, Hobart, Australia*

**Background and Aims:** To begin to comprehend and produce language, infants must have established the speech sound categories of their native language and have at least a burgeoning knowledge of the rules for mapping these sounds onto meaning. Recent research suggests that the minimal pair "switch" word-object association task, a task that assesses infants' ability to apply these conjoint abilities, may be a sensitive index of infants' early language development (e.g. Bernhardt et al., 2007; Werker et al., 2002). The chief limitation of the research that has been carried out to date is that it has been conducted with small, demographically homogeneous samples of typically developing children. The purpose of the current study, the first phase of a larger-scale study, was to examine the relationships that might exist between infants' performance on the switch task and their concurrently developing language in a larger, more demographically diverse sample of participants with a more varied range of current and potential language abilities.

**Methods:** The participants were 64 (28 males and 36 females) 19-month-old infants recruited from a range of socioeconomic areas in urban and rural British Columbia. Twenty-five of the 64 participants had a family history of language impairment (i.e., a first degree relative with a diagnosed or suspected language delay). In addition to administering the minimal-pair switch task, three measures of language development, the Auditory Comprehension (PLS-AC) and Expressive Communication (PLS-EC) subtests of the Preschool Language Scale and the Production Vocabulary scale of McArthur-Bates Communicative Development Inventories (CDI-Prod) were administered over two testing sessions.

**Results:** Bivariate correlations revealed that infants' performance on the minimal-pair switch task was significantly correlated with their performance on the two measures of expressive language development (i.e., the PLS-EC and CDI-Prod, $rs = .26$ and .25, respectively), but was not significantly correlated with their performance on the measure of receptive language (i.e., the PLS-AC, $r = .09$).

**Conclusion:** The results of the first phase of this longitudinal study suggest that the skills tapped by the minimal pair switch task are a potentially sensitive index of infants' concurrently developing language -- specifically infants' expressive language. Research currently underway will examine the utility of the switch task as a predictor of children's language development at 3 years of age and early literacy development at 4 years of age from their performance on the minimal-pair switch task, as infants, at 18 months of age.

**Th1-46**

## The Effects of Infant-Directed Speech on Brain Activity to Produced and Unknown Words at 20 Months of Age

**Elizabeth Sheehan**[1] Renate Zangl[2] Debra Mills[1]

*1. Emory University, Atlanta, USA; 2. Standford University, Stanford, USA*

It is commonly known that adults, regardless of their experience with infants, modify their speech when talking to infants compared to when talking to adults. This type of speech is called infant-directed speech (IDS). It differs from adult-directed speech (ADS) in that it is higher and more variable in pitch, more repetitive, slower in tempo, and simplified vocabulary and syntax. Some have posited that the function of IDS may change over the first year of infancy from focusing on directing and maintaining attention to facilitating language learning (Fernald, 1992; Fernald & Simon, 1984; Fernald et al., 1989). Prior research with 6- and 13-month-olds indicates that infants with varied language exposure (based on age) exhibit different patterns of brain activity to familiar and unfamiliar words depending on whether the words are presented in IDS or ADS (Zangl & Mills, 2007). At 6 months, IDS served to boost neural activity to familiar words, but at 13 months, IDS increased neural activity to both familiar and unfamiliar words.

The purpose of this study was to extend this research by examining the effect of speech prosody (IDS or ADS) on patterns of brain activity to produced and unknown words for infants who have increased experience with language comprehension and production.

Event-related potentials (ERPs) were recorded while 20-month-olds (n=34) listened to produced and unknown words in infant-directed speech (IDS) and adult-directed speech (ADS). The main component of interest was the N200-400, an index of word meaning. We hypothesized that, in this time window, we would see a difference to produced and unknown words for ADS, but not for IDS. IDS would serve to boost the neural activity to unknown words so that unknown words would have the same amplitude as produced words that are already familiar to the infant. Preliminary analyses revealed an interaction between speech prosody (IDS or ADS) and word production (produced or unknown), $p < 0.01$, for the N200-400. Patterns of brain activity to produced and unknown words did not differ when presented in IDS. However, when presented in ADS, produced words elicited a more negative N200-400 than unknown words. These findings were in support of our hypothesis indicating that IDS may increase the perception of familiarity for unknown words. When combined with the data from 6- and 13-month-olds, this provides further evidence that processing of IDS and ADS changes over language development in conjunction with language experience.

**Th1-47**

## Read My Lips: Japanese and American Infants' Patterns of Conversational Gaze

**Elena Tenenbaum**[1] Megan Blossom[2] Reiko Matsunaka[3] Kazuo Hiraki[3] James Morgan[1]

*1. Brown University, Providence, USA; 2. University of Kansas, Lawrence, USA; 3. University of Tokyo, Tokyo, Japan*

Infants' gaze in conversational interactions plays an important role in language learning: It drives attempts of adults to engage infants in communicative acts and provides information about messages being presented. Whereas interest in faces is widely documented in infant research, the precise focus of infants' attention while hearing speech is less understood. In our lab, we have been using eye tracking to investigate patterns of conversational gaze across development for American infants watching a talking face. As infants become more active communicators between 10 and 14 months, their focus shifts from the eyes to the mouth. The goal of the current experiment was to extend this research cross-culturally, to examine the universality of infant conversational gaze patterns.

It is often suggested that the norms governing eye contact during conversation differ across cultures. For example, looking someone in the eyes in America is considered a sign of attention or interest, whereas in Japan, the same gaze may be interpreted as impertinent, especially when addressing one's superior (1). If patterns observed in American infants parallel those of infants in a cultural and linguistic environment as different as Japan, it would suggest that the original findings might be cross-culturally general.

In a setup paralleling the study with American infants, 14-month-old Japanese infants were shown video clips of a Japanese woman speaking in highly animated infant-directed speech. Infants' fixation patterns were tracked using a Tobii system during eight 15-second video clips. We then calculated proportion of looks to areas of the face. As with American 14-month-olds, Japanese infants at this age focused predominantly on the mouth and lower areas of the face; proportional looking to mouth vs. eyes was not different in Japanese and American infants. In follow-ups, we are extending this study to 6- and 10-month-old Japanese infants for comparison with younger American infants. Given the potential for cultural differences in eye contact, the shift to the mouth may emerge earlier in Japanese infants.

The extension of the original findings to Japanese infants helps to establish the external validity of our original results. Knowledge of developmental patterns of conversational gaze is important because it may facilitate early recognition of aberrant patterns. Research with children and adults, for example, suggests that atypical patterns of gaze are strong predictors of autism (2-3). Further understanding of standard patterns of conversational gaze for normally developing infants may therefore facilitate early detection of autism.

**References**:

1. McCarthy, A., Lee, K., Itakura, S., & Muir, D.W. (2006). Cultural Display Rules Drive Eye Gaze During Thinking. Journal of Cross-Cultural Psychology, 37, 717-722.
2. Pelphrey, K. A., Sasson, N. J., Reznick, J. S., Paul, G., Goldman, B. D., & Piven, J. (2002). Visual Scanning of Faces in Autism. Journal of Autism & Developmental Disorders, 32(4), 249-261.
3. Speer, L.L., Cook, A.E., McMahon W.M., & Clark, E. (2007). Face processing in children with autism: Effects of stimulus contents and type. Autism, 11, 265.

**Th1-48**

## Acoustic and Linguistic Features of Infant-Directed Speech Predict Infants' Phonetic Discrimination Performance

**Feng-ming Tsao**[1] Huei-mei Liu[2] Ching-yun Li[1]

*1. Department of Psychology, National Taiwan University, Taipei, Taiwan; 2. Department of Special Education, National Taiwan Normal University, Taipei, Taiwan*

**Bacground and Aims:** The acoustic-phonetic modifications of infant-directed speech (IDS), including longer vowel duration, stretched vowel space, and exaggerated F0 range, are associated with "intelligible speech." These features could facilitate the speech perception development in early infancy, e.g., expansion of vowel articulations is concurrently correlated with infants' consonant discrimination performance. However, it is still unclear if the features of early IDS are predictive of later infants' speech perception performance. Besides, compared with adult-directed speech (ADS), the IDS is characterized with simpler syntax and more restrict words. This study aimed to test the hypothesis that exaggerated speech input and simple linguistic features in Mandarin IDS play important roles in facilitating infant speech perception development.

**Methods:** Sixteen mother-infant dyads, with infants aged 7 months (boys = 10, girls = 6), participated in the speech recording. Mother's speech samples were acoustically analyzed to measure F0, F0 range and tone duration, the acoustic correlates of lexical tones in Mandarin IDS. The linguistic features of IDS, i.e., number of words, type-token ratio, and mean-length-utterance (MLU), were calculated using the CHILDES. At 11 months, the follow-up infants' phonetic discrimination abilities were assessed in a conditioned head-turn procedure using the most difficult tone contrast, Tone 2 vs. Tone 3, of Mandarin tone contrast.

**Results:** The F0 height, F0 range, and duration of lexical tones are exaggerated in IDS than in ADS. The correlation analysis further demonstrates that the longitudinal association between early IDS and later infants' speech perception performance. Significant associations (one-tailed Spearman's rho, $p < .05$) are obtained between percent corrects of tone discrimination and vowel duration ($rs = .505$), F0 range of

Tone 3 (rs = .508) and average F0 range (rs = .505). Besides, negative associations are obtained between tone discrimination and IDS type of words (rs = -.628) and MLU (rs = -.657), suggesting that mothers used fewer words and shorter utterances facilitate infants to learn the lexical tones. Among acoustic and linguistic features of IDS, a stepwise regression model (R2 = .455, p = .004) shows that the F0 range of IDS Tone 3 is the primary predictor for later tone discrimination.

**Conclusions:** The results demonstrate the longitudinal association of early IDS acoustical augmentation and linguistic simplification to later infants' speech perception performance. This study provides supportive evidence to the hypothesis that IDS with acoustically more distinct and linguistically simpler features facilitate the development of phonetic perception in infancy.

**Th1-49**

### Lexical/segmental Influence on Tone Accuracy in Mandarin-Speaking Children: A Longitudinal Case Study

**Jie Yang, Barbara Davis**

*The University of Texas at Austin, Austin, USA*

**Background and Aims:** In line with Ferguson and Farwell (1975), a recent longitudinal study of tone acquisition in two typical-developing Mandarin-speaking children from 12 to 27 months indicated that early tonal acquisition was carried out in a lexical-dependent fashion where a tone was produced accurately on some but not all target lexical items attempted by children (Yang 2006, Yang and Lee 2006). However, potential factors influencing accurate tonal production on different lexical items were not analyzed. The present study assessed the relationship between both segmental and lexical level complexity in the early stages of speech development.

**Methods:** Eighteen-hour longitudinal speech data of one of the children in Yang (2006) were used. Recognizable utterances were extracted and transcribed perceptually. 1,462 syllables were included in the present analysis. Relationships between tone and segmental accuracy over sessions were examined to evaluate the claim that tones are acquired earlier than segments (Li and Thompson 1977). Segmental level variables (Whole-Word Segment Accuracy, Onset Accuracy, Whole-rime Accuracy and Target/Child Phonetic Complexity) and lexical variables (Adult Input Frequency, Child Output Frequency and Productive Tone Neighborhood Density) were assessed to account for inter-word variation of tone accuracy within the same tone category.

**Results:** Pearson correlation test showed no significant correlation between tone accuracy and segmental accuracy [r= - .054, p> .05]. Independent sample t-test showed that tone accuracy is significantly lower than segmental accuracy [t = -3.925, p <.05]. The assessment of each variable showed that lexical items with smaller number of tone contrastive minimal pairs in child production or low in Productive Tone Neighborhood Density tend to have higher tone accuracy.

**Conclusions:** Results of this case study suggest relative independence of segmental and suprasegmental acquisition in Mandarin children. Contrary to earlier descriptive findings, this study provides quantitative data showing that tones might not be acquired earlier than segments with regard to accuracy. Results also suggest that lexical factors related to perceptual distinctiveness rather than segmental factors influence the likelihood that the target tone of particular lexical item will be produced accurately, providing further evidence for the lexical-dependent hypothesis of tonal acquisition in the early stages of speech development (Yang 2006, Yang and Lee 2006). Longitudinal analysis of a larger group of children in this developmental period is needed to assess the generality of this case study.

## *Emotional Development*

**Th1-50**

### Mothers' Emotional Talk Influences Infants' Attention to Fearful Stimuli

**Rebecca Brooker**[1] Elizabeth Kiel[2] Kristin Buss[1]

*1. Department of Psychology, The Pennsylvania State University, University Park, USA; 2. Department of Psychological Sciences, University of Missouri-Columbia, Columbia, USA*

Examinations of inhibition suggest that fearful children are more attentive to and less able to disengage with negative and fear-eliciting stimuli (Pérez-Edgar et al., 2005;2006). Mothers play a role in scaffolding the regulation of their infants (Spinrad et al., 2004). We expect that this would include shaping this attentional bias and may be indicated by mothers' emotional talk with infants. Specifically, we will investigate speech as a mechanism by which mothers influence children's attention to fearful stimuli.

The current study will examine the relationship between mothers' emotional speech and children's attentiveness to fearful stimuli for two samples of 18- to 20-month-old infants. Sample one includes 92 infants (40% girls) and their mothers observed during a modified Risk Room episode. Sample two includes 100 infants (50% girls) similarly observed. Video of the visits was used to code infants' attention to fearful and non-fearful objects, tentativeness of play, amount of play with each object, and compliance to an experimenter's play requests. Mothers who remained otherwise uninvolved in the episode were coded for affective quality of vocalizations (i.e., affective vs. non-affective) and for the degree to which speech was presented spontaneously or was solicited by infants.

Analyses from sample one reveal that children who attended more to the scary mask during the first 3 minutes of the episode showed more tentativeness of play when asked by the experimenter to play with each object in the room ($r = 0.320$, $p < 0.01$). In addition, the frequency of mothers' spontaneous emotion talk positively predicted the proportion of time that infants attended to high-threat stimuli ($\beta = 0.236$, $p<0.05$). Furthermore, mothers' solicited non-affective talk predicted less tentativeness of play during the episode ($\beta = -0.258$, $p<0.01$). Moreover, children high in tentativeness were less compliant to requests from the experimenter to engage in play with the scary mask ($r = -0.388$, $p<0.01$). An interaction between tentativeness of play and mothers' solicited non-affective talk was marginally significant ($\beta = -0.016$, $p=0.086$) in predicting children's compliance when asked to touch the mask, suggesting that a moderating relationship may be present but that we are without the power to detect in a single sample; thus, this will be further explored using the addition of sample two. In addition, because past research indicates different associations of distress to mother-based behaviors for boys and girls (e.g., Buss, Brooker, & Leuty, in press) we will explore the influence of gender on these relationships.

**Th1-51**

## Economically Strained Mothers' and Fathers' Use of Internal State Language with their 18-Month-Olds

**Laura Marie Armstrong**, Pamela Cole
*The Pennsylvania State University, State College, USA*

Internal state language (ISL) appears to be an important component of developing socio-emotional competence (Dunn, Brown, & Beardsall, 1991; Saarni, 1999). However, most ISL research has focused on children from middle class, educated, advantaged homes. The present study focuses on (a) parental ISL before children have acquired these terms and (b) in a sample of 105 economically-strained families (M income to needs ratio = 2.33; SD = .86). Specifically, we examined two sets of predictors of mothers' and fathers' ISL: (1) child characteristics, namely gender, language status (vocabulary production and comprehension), and temperament (negative emotionality, and surgency) and (2) parent characteristics, namely education status and parenting quality (sensitivity and warmth). ISL data were drawn from 20 minutes of naturalistic home observations when the children were 18 months old; family speech was audio-recorded, transcribed and coded using Dunn and Hughes' (2004) ISL system, which yielded ISL data for 105 mothers and 94 fathers. Mothers spoke an average of 481.92 words of which 23.75 (4.93%) were internal state terms, whereas fathers spoke an average of 223.79 words of which 9.61 (4.29%) were internal state terms. Mothers spoke significantly more than fathers, $t(93) = 6.87$, $p < .05$, and the percentage of speech that referred to internal states was significantly greater for mothers than for fathers, $t(88) = 2.28$, $p < .05$. However, further analyses indicated that the percentage of internal state terms used across different categories (desire, emotion, perception, or cognition term) and forms (question, contrastive, explanation, or prediction) of ISL did not differ as a function of parental gender. Zero-order correlations indicated that maternal ISL was associated with both parents' education, maternal parenting quality, and child vocabulary comprehension. For fathers, only parenting quality was related. Hierarchical regressions, conducted separately for each parent, modeled child and parent characteristics to predict parental ISL. For mothers, after other predictors were considered, only maternal sensitivity predicted ISL. For fathers, with the same model, only paternal positive affect predicted ISL. The frequency of ISL terms used by parents in this sample is somewhat lower than reported by Dunn (1987), perhaps because of the economic status of the families (Hart & Risley, 1995). However, income to needs ratio was unrelated to either parent's ISL, whereas aspects of parenting quality, trumped even parental education in accounting for ISL usage. Findings are discussed in terms of future directions for this type of work.

**Th1-52**

## Infant-Mother and Infant-Father Attachment as Predictors of Triadic Family Interaction: The Role of Attachment Concordance

**Geoffrey Brown**, Cynthia Neff, Aya Shigeto, Sarah Mangelsdorf
*University of Illinois at Urbana-Champaign, Champaign, USA*

**Background and Aims:** Although many studies have examined the individual-level outcomes of attachment quality in infancy (Thompson, 1999), few have explored the relationship between attachment and triadic family interaction patterns. Moreover, little research has investigated how similarity or differences in the quality of infant-mother and infant-father attachment contribute to family dynamics at the triadic level. This study adopts a family systems perspective on attachment (Cowan, 1997) by examining how various constellations of dyadic infant-parent attachment relationships are related to later family interaction patterns.

**Methods:** At 12- and 13-months of age, 110 families participated in two laboratory visits during which infant-mother and infant-father attachment were assessed. Trained coders rated attachment security following the Strange Situation Procedure (Ainsworth et al., 1978). At 3 years of age, families were observed at home in a triadic (mother-father-child) interaction task that consisted of building a playground from a set of building blocks. Using family interaction coding systems (Lindahl & Malik, 2001; Paley et al., 2001), independent observers coded the following dimensions of family interaction: sensitivity, positive affect, negative affect, detachment, intrusiveness, cohesiveness, and alliances.

**Results:** Three groups representing concordance/discordance of infant-mother and infant-father attachment security were formed: 1) secure with both parents, 2) secure with one parent and insecure with the other parent, and 3) insecure with both parents. Preliminary one-way ANOVAs indicated that these groups differed at age 3 on family sensitivity ($F = 9.388$, $p < .01$), detachment ($F = 5.71$, $p < .05$), positive affect ($F = 6.78$, $p < .05$), intrusiveness ($F = 5.23$, $p < .05$), and cohesiveness ($F = 4.40$, $p < .05$). Post-hoc trend analyses revealed a distinct pattern wherein the discordant group (secure/insecure) differed from both concordant groups (secure/secure and insecure/insecure). Specifically, families in which infant-mother and infant-father attachment were discordant exhibited higher levels of detachment and intrusiveness, and lower levels of sensitivity, positive affect, and cohesiveness than families in which infant-mother and infant-father attachment were concordant for security or insecurity. Additional analyses indicated a lower proportion of balanced family alliances in families with discordant infant-mother and infant-father attachment (54.5%) than in families with concordant-secure (75%) or concordant-insecure (80%) attachment patterns.

**Conclusion:** Findings suggest that the quality of family interaction is compromised when the child's attachment relationship with one parent provides greater security than their relationship with the other parent. Results are discussed in terms of how attachment to multiple caregivers may impact family structure, processes, and dynamics, including the marital and co-parental relationships.

**Th1-53**

## The Role of Positive Affect and Regulation in Predicting Adaptive Outcomes

**Jessica Dollar**, Cynthia Stifter
*Pennsylvania State University, University Park, USA*

While there has been a plethora of research showing the effects of negative emotionality on social and psychological adjustment (e.g., Rubin et al., 1995; Eisenberg et al., 1996), the importance of positive emotionality is widely unknown. A predisposition towards positive emotions, generally measured in terms of happy, cheerful mood, is thought to be adaptive and has been shown to be related to peer competence and prosocial behavior (Denham et al., 1990; Eisenberg et al., 1996). However, children exhibiting intense, high levels of positive affect have been linked to externalizing and conduct problems (Eisenberg et al., 1996; Putnam & Stifter, 2005). While positive affect may serve as a protective factor for some children, problematic behaviors could develop for those who cannot regulate their positive arousal by not being able to control their intense levels of exuberance and excitement. Therefore, it is possible that the difference in positive and

maladaptive social and psychological outcomes for children showing high levels of positivity could be the child's ability to regulate his/her emotions. The goal of the present study is to investigate the role of a child's ability to regulate positive emotions in predicting later behavioral adjustment. More specifically, this study will examine the importance of a child's use of gaze aversion as a form of regulating positive emotions.

One hundred and twelve infants participated in a peek-a-boo task with their mothers at 6 and 12 months of age. This task was continuously coded for levels of positive reactivity (low, moderate, and high). Currently this task is being coded continuously for the presence of gaze aversion during and immediately following the presence of positive affect. When children were 24 months, their mothers and fathers completed the Child Behavior Checklist (CBCL) and the Toddler Behavior Assessment Questionnaire (TBAQ).

Preliminary analyses showed that infant's level of positivity in the peek-a-boo task was stable from 6 to 12 months of age, $\beta$=0.265, $p<.01$. Additionally, regression analyses revealed that positivity at 6 months of age directly predicted parent rated externalizing, $\beta$=-3.415, $p<.001$, and internalizing behaviors, $\beta$=-2.483, $p<.001$, at 24 months. Infants with higher levels of positivity at 6 months of age exhibited fewer externalizing and internalizing behaviors at 24 months. Future analyses will assess if infant's ability to use gaze aversion as a form of regulation immediately following high levels of positivity predicts more adaptive behaviors when they are 24 months.

**Th1-54**

### Perceptual and Acoustic Analysis of Vocalizations during Temper Tantrums

**James Green**[1] Pamela Whitney[1] Michael Potegal[2]

*1. University of Connecticut, Storrs, USA; 2. University of Minnesota, Minneapolis, USA*

Although the cries of newborn infants have been studied extensively, little is known about how cries differentiate during development and about the roles they may play in emotional development and emotion regulation. Recent work has shown that infants often scream in protest of maternal prohibitions by the end of the first year of life, and that screams become more frequent during protests, at least through 18 months of age. During this age period, the first temper tantrums appear, and tantrums become frequent by 2 years. Here, we examine the tantrum vocalizations of 2-year-olds, focusing both on perceptual classification and acoustic analysis. Our intent is to take some initial steps in building a quantitative model of how these emotions are expressed during tantrums and in relating tantrum vocalizations to earlier expressions of protest.

High quality, naturalistic audio recordings were obtained for 25 at-home temper tantrums from 13 different 2- and 3-yr-olds. The microphone/transmitter of a wireless digital recording system was contained in a small pouch sewn into a "onesie" worn by the child, maintaining a relatively constant mouth-microphone distance and allowing recordings with a minimum of parental intrusion. Audio files were analyzed using Praat software. Tantrums ranged in duration from 111 to 1150 sec and included a total 1,521 vocalizations uncontaminated by other voices or noises.

Each vocalization was categorized as fuss, cry, whine, yell, or scream; these categories were derived from a review of the literatures on crying and anger expressions and constituted the vast majority (> 90%) of the vocalizations. Interobserver agreement was high using this scheme, kappa = .91. Initial acoustic analysis of these categories, using one factor ANOVAs, showed significant differences in duration, relative energy, frequency with the great amplitude (peak frequency), harmonic structure, fundamental frequency, and relative energy in high versus low frequency bands. Screaming and shouting were longer, with higher peak frequencies and more energy in higher frequency bands. The cry sounds recorded during tantrums had characteristics similar to newborn cries, with an average fundamental frequency of 397 Hz, duration of 1.8 sec, and more than half of the total energy in the range from 100 to 1000 Hz.

Ongoing analyses are focusing on the temporal distribution of the high intensity sounds (screaming and yelling) during temper tantrums and on whether the acoustic features alone are sufficient to derive groupings of sounds that correspond to our perceptual groupings.

**Th1-55**

### Toddlers' Responses to Another Person's Request: Its Motivation and the Effect of Another Person's Positive and Negative Emotional Displays

**Takahiro Hisazaki**

*Faculty of Humanities, Kyushu Lutheran College, Kumamoto, Japan*

**Background and Aims:** Previous study has suggested that children at 18 months offered an object preferred by not themselves but another person whenever his/her preference differed from theirs (Repacholi & Gopnik, 1997). It is unclear, however, whether such behavior is based on altruistic motivation and which influenced such behavior, another person's positive or negative emotion.

Study 1: Younger (17- to 19-month-olds, n=16) and older (21- to 24-month-olds, n=10) children participated in both of two conditions. In the preference-matched condition, an actor expressed pleasure with snacks children preferred and disgust with vegetables, and vice versa in the preference-mismatched condition. Subsequently in each condition, she requested some food. Older children who offered vegetables in the preference-mismatched condition offered significantly more snacks than vegetables in the preference-matched condition ($\chi^2$=5.66, $p<.05$), however, younger children didn't. Moreover in the preference-mismatched condition, younger children offered vegetables significantly faster than snacks, but older children didn't ($F(1,22)=6.59$, $p<.05$). These results suggested that, with altruistic motivation, children by at least 2 years might respond correctly to another person's preference.

Study 2: Eighteen 12- to 15-month-olds (younger), thirteen 20- to 25-month-olds (middle), and thirteen 30- to 36-month-olds (older) participated in an experimental session that included 4 affective-preference conditions. In the positive-matched condition, an actor directed positive reactions to one kind of toy the children preferred and no attention to another kind of toy they didn't prefer, and vice versa in the positive-mismatched condition. In the negative-matched condition, the actor directed negative reactions to one kind of toy the children didn't prefer and no attention to another type of toy they preferred, and vice versa in the negative-mismatched condition. Subsequently in each condition, she requested some toys. In preference mismatched conditions, younger children tended to respond more correctly than middle and older children ($F(2,21)=6.76$, $p<.01$). This result was quite a contrast to Repacholi & Gopnik's result. Irrespective of actor's affective valence (matched: $F(1,21)=2.44$, ns.; mismatched: $F(1,21)=2.35$, ns.), children were more likely to respond correctly in preference matched conditions than in mismatched (positive: $F(1,21)=46.66$, $p<.01$; negative: $F(1,21)=6.21$, $p<.05$). This finding didn't show which influenced children's correct responses, another person's prior positive or negative emotion.

**Conclusion:** These two studies showed that, without both positive and negative emotional cues, toddlers couldn't respond correctly to another person's preference which was different from theirs even if they might be altruistically motivated. These results will be discussed in terms of possible mechanisms underlying correct responses.

**Th1-56**

### Mothers and Toddlers: Adaptations and Stresses

**Claire Kopp**
*Los Angeles, USA*

The toddler years represent extraordinary developmental change (e.g., locomotion, coordination, self consciousness, social/self language, play, aggression, empathy) reflected in agency, intentionality, and use of regulatory processes (e.g., behavioral inhibition, controlled attention) for intra/interpersonal goals. Although parents welcome these competencies, they also report increasing annoyance, stress, and occasional anger because the more capable child is not necessarily obedient nor shuns tantrums, whining, and physical aggression.

This poster integrates findings from an intensive, longitudinal study of 30 low-risk middle-class mothers and toddlers (5x, 15 to 30 mo) revealing attempts to cope with periodic conflicting goals. Drawing upon our published and unpublished data obtained from home and laboratory interviews/observations, the material includes mothers' descriptions of child strengths and demonstrations of self awareness; their own emphases on child independence, rule requests along with specific prohibitions, instances of child persistent non-compliance, and behaviors that most annoyed them. Home/laboratory visits provided observations of child compliance to requests, knowledge of everyday rules, language skills including words related to self, and play.

Three perspectives provided conceptual foundations: a) an expansive version of family investment models that posits parenting includes commitments to physical, emotional, and instructional supports (e.g., language, socialization) enabling child integration into social contexts-along with effective dealing with one's own child-related stresses; b) a developmental systems approach suggesting salient dimensions of children's repertoires organize their behaviors; c) developmental evolutionary approaches that emphasize the conserved nature of certain behaviors including toddler locomotion and aggression-both requiring consistent caregiver management. Related premises included: a) mothers initially invest in safety rules because walking/exploration dominates young toddlers' behaviors, sometimes dangerously; b) as toddlers' balance/extremity strength improve, their frustrations may be associated with aggression leading to new parental prohibitions; c) later, toddlers' self-evaluation will also become associated with decreased aggression; d) as toddlers emphasize self and intentions, parental interpersonal rules will increase with goals of helping the child balance self and others' goals.

Converging data support largely support these premises, albeit maternal and toddler group trends were rarely unidimensional. Typically, mothers expanded their rule systems, tended to be annoyed with certain behaviors such as whining, and child persistent non-compliance varied across ages, but often represented unsafe acts, physical aggression, and touching prohibited items. These and other findings will be elaborated in the poster. This rich data set provides a complex view of mothers and their toddlers' emotional/social development that have implications for additional study.

**Th1-57**

### Smoking in Pregnancy and Maternal Psychopathology: Effects on Parenting Stress during Infancy

**Mary Ellen Lynch**, Julie Carroll, Katrina Johnson, Julie Kable, Montinique Pierre, Claire Coles
*Psychiatry, Emory University School of Medicine, Atlanta, USA*

**Background and Aims:** Current public health messages and the medical community discourage women from smoking during pregnancy due to potential negative outcomes for infants. Women who do smoke during pregnancy despite these public health warnings tend to have higher levels of psychopathology and to experience more environmental stressors than women in the general population (e.g., Wakschlag et al., 2003). In this study, we hypothesize that smoking during pregnancy will be related to maternal psychopathology and will have a negative impact on parenting stress at six months of age.

**Methods:** Participants were recruited after birth from two hospitals in Atlanta. At the hospital interview, mothers answered questions concerning amount and timing of smoking during pregnancy. Mothers and their infants were seen at the university laboratory when infants were six months of age for an evaluation of infant development and a maternal interview/questionnaire session to evaluate the quality of the caregiving environment. Questionnaires included the Parenting Stress Index (PSI) (Abidin, 1993) and the Symptom Checklist 90-R (SCL-90-R) (Derogatis, 1993), a well-validated measure of psychopathology including scales for Somatization, Obsessive Compulsive, Interpersonal Sensitivity, Depression, Anxiety, Hostility, Phobic Anxiety, Paranoid Ideation, Psychoticism, and a Global Severity Index. The sample includes 230 mothers in three groups: 1) mothers who did not report smoking during pregnancy, 2) mothers who reported smoking 1-14 cigarettes/day, and 3) mothers who reported smoking 15 or more cigarettes/day.

**Results:** Between groups analyses of variance were completed for scales on both the Parenting Stress Index and the SCL-90-R. Significant differences among the three exposure groups occurred on the following PSI scales: Total Parenting Stress ($F(2,219) = 6.61$, $p < .01$), Parent Distress ($F(2,229) = 9.17$, $p < .01$), and Parent-Child Interaction Difficulty ($F(2,229) = 4.04$, $p = .02$). Linear contrasts also were significant, supporting a dose-response relationship between cigarette smoking during pregnancy and parenting stress (all p's $\leq .05$). On the SCL-90-R, significant effects for smoking group were found for all subscales except one. A linear dose-response relationship was found on every parameter of the measure, suggesting higher levels of psychopathology in heavier smokers.

**Conclusion:** These data show that maternal smoking during pregnancy is positively related to maternal psychopathology and parenting stress reported at six months. Results suggest that infants of mothers who smoked during pregnancy may experience a less positive caregiving environment, which may be associated with some negative behavioral outcomes in children.

**Th1-58**

### Neural Correlates of Maternal Response to Infant Emotional Cues (in Depressed and Non-Depressed Women)

**Ida Moadab**, Heidemarie Laurent, Erica Musser, Hannah Banagale, Jennifer Ablow
*University of Oregon, Eugene, USA*

**Introduction:** Previous research suggests that depressed mothers have impaired interactions with their infants (Murray & Cooper, 1997).

Withdrawn-depressed mothers express less positive and more negative affect and are less sensitive to their infant's cries (Donovan, Leavit, & Walsh, 1998). In turn, infants of depressed mothers show deficits in social and emotional engagement as well as in neural activation patterns and physiological indicators of self-regulation (Field et al 2005). A few studies have identified the neural correlates of normal maternal response to infant faces and expressions (see Bartels & Zeki, 2004; Leibenluft et al., 2004). Lorberbaum and colleagues (1999, 2002) examined maternal response to infant cry and found activation in thalamocingulate circuitry that was specific to cry. While research determining the neural basis of normal maternal behavior is emerging (see Mortimer 2007), researchers have yet to explore the possible neural mechanisms underlying depressed mother's responses to infant distress signals. The aim of this study was to examine neural response to cry using fMRI in depressed and non-depressed mothers in order to better understand the basis of depression-related deficits in response to infant distress.

**Method:** Eight women were recruited from a larger prospective study of relational psychobiology and infant development. Four participants met diagnostic criteria for at least one lifetime major depressive episode and were elevated on the CESD (>16) in at least two of the assessment periods. The control women did not meet diagnostic criteria for any disorder, and were not elevated in depressive symptoms at any of the assessments. While in an fMRI scanner, participants listened to 10 counterbalanced presentations of 21-second blocks of their own baby's cry, an unfamiliar baby's cry, and a control sound.

**Results:** Preliminary analyses suggest very different patterns of activation in depressed and non-depressed mothers' response to their own baby's cry vs. a non-cry control sound. Areas of activation in medial, particularly thalamic, and cerebellar regions were found to characterize the non-depressed mothers' response to their own infant's cry whereas depressed mothers showed no significant differences in activation associated with their infant's cry (when compared to the control sound). Results from the complete sample will allow us to more fully demonstrate functional differences in depressed mothers that may explain insensitivity to their infant's emotional needs.

**Conclusion:** While the non-depressed mothers appear to exhibit activation in areas previously linked to maternal behavior, depressed mothers displayed no significant differences in activation while listening to their infant's cry vs. a control sound.

**Th1-59**

## Temperamental Differences in Electrophysiological Responses to Auditory Novelty in 3-Year-Old Children

**Bethany Reeb**[1] Peter Marshall[2] Nathan Fox[1]

*1. University of Maryland Human Development Department, College Park, USA; 2. Temple University Psychology Department, Philadelphia, USA*

Behavioral reactivity to novel stimuli in the first half-year of life has been identified as a precursor of approach and withdrawal tendencies to novelty in later infancy and toddlerhood (Calkins & Fox, 1992; Calkins, Fox, & Marshall, 1996; Kagan & Snidman, 1991). However, very few studies have examined individual differences in infant reactivity in relation to the underlying neural activity as indexed by event-related potentials (ERPs). In the present study, we examined individual differences in ERP responses to auditory novelty in selected groups of 3-year-old children who differ temperamentally by their levels of affective reactivity to stimulation observed at 4 months of age. A total of 849 infants were screened for emotional and motor reactivity to novelty at 4 months of age. Three groups of infants were selected: one group who displayed extreme motor activity and positive affect (high positive), one group who displayed extreme motor activity and negative affect (high negative), and a randomly chosen group of infants who did not display extreme motor activity or affect (control). At 3 years of age, EEG was collected from 187 of these children and 107 children had usable ERP data. EEG was recorded while children passively listened to three types of auditory stimuli: 456 standard tones, 72 deviant tones, and 72 unique complex novel sounds. Peak amplitude and latency for the P3a component elicited by the novel complex sounds were scored between 100-400 ms. Repeated measures ANOVA with site (Fz, Cz, and Pz) as the within-subjects and temperament group (high positive, high negative, and control) as the between-subjects measures revealed an overall main effect of group for P3a amplitude [$F(2,104)=3.239$, $p<.05$]. Post-hoc analyses showed that the high negative group had significantly lower amplitude compared to the high positive group at both central and parietal electrode sites ($p<.05$) but did not significantly differ from the control group. Frontal sites showed a similar pattern but the difference between high negative and high positive children was only marginally significant ($p=.078$). No significant differences were found for P3a peak latency although there was a trend for high negative children to have a shorter latency compared to high positive or control children. These preliminary results suggest that individual differences in behavioral reactivity measured at 4 months of age are related to neural differences in novelty detection measured almost 3 years later.

**Th1-60**

## The Effect of Cumulative Risk Factors on the Quality of Infant Attachment

**Luis Richter**[1] Kathrin Hartmann[2] Janice Zeman[3]

*1. The Virginia Consortium Program in Clinical Psychology, Norfolk, USA; 2. Eastern Virginia Medical School, Norfolk, USA; 3. College of William & Mary, Williamsburg, USA*

**Background and Aims:** Although maternal sensitivity was originally posited as the primary antecedent of infant pattern of attachment, recent meta-analytical studies have only found modest effect sizes (Atkinson et al., 2000; De Wolff & Van Ijzendoorn, 1997; Van Ijzendoorn, Shuengel, & Bakermans-Kranenburg, 1999). Consequently, studies such as this one have examined other potential antecedents of attachment. This study examined the predictive value of contextual variables and of variables inherent to the mother on the quality of infant attachment. The contextual variables included maternal social support (Crockenberg, 1981) and stress (Jarvis & Creasy, 1995), while the variables inherent to the mother included prenatal maternal perceptions of infant emotions (Lodge et al., 1993) and perceptions from her own childhood (George & Solomon, 1996). In addition, the study explored possible effects of cumulative demographic risk factors (Huth-bocks et al., 2004) and infant developmental abilities (Rode et al., 1981) on the quality of infant attachment.

**Method:** This study used archival data (n = 56) derived from interviews and assessment questionnaires originally used in The Parent-Infant Development Program (PIDP) (Blackwood et al., 1985); and from Strange Situation data from Kveton's (1989) follow-up study. Social Support, maternal perceptions from her own childhood, and cumulative risk factors were assessed using composite scores derived from a prenatal questionnaire. Maternal stress was assessed using the Parental Stress Index (Abidin, 1986) and the infant's developmental abilities from the Bayley Scales of Infant Development (Bayley, 1969). Finally, the accuracy of maternal perceptions of infant emotions was

assessed using an experimental scoring system for the IFEEL picture deck cards (Applebaum, Butterfield, & Culp, 1993).

**Results:** A statistical multiple regression analyses demonstrated that as a set stress, perceptions of childhood, and cumulative risk factors significantly predicted infant quality of attachment $F(1,40) = 8.118$, $p < .01$, $R = .41$, and Adj. $R2 = .15$. However, when weighing the contribution of each of the variable only the number of risk factors was identified as a significant predictor ( $\beta = -.41$, sri2 = .17).

**Conclusion:** The major finding of this study is that the cumulative effect of demographic risk factors such as poverty, low maternal educational achievement, and teenage pregnancy emerged as the most powerful predictor of infant quality of attachment, even when risk factors by themselves may not have been significantly correlated.

**Th1-61**

## A New Method to Observe Infants' Internal Emotion; a Still Face Study Using Telethermography Video

**Yohko Shimada**[1] Nobuko Komori[1] Kayako Nakagawa[2] Michiteru Kitazaki[3] Shoji Itakura[1]

*1. Kyoto University, Kyoto, Japan; 2. Osaka University, Osaka, Japan; 3. Toyohashi University of Technology, Toyohashi, Japan*

**Background and Aims:** It is difficult to observe emotional change of infants. Facial expression may well tell their emotion, however, internal change of emotion have not observed enough. Previous study showed that infants' temperature dropped in their forehead skin during separation from mother (Mizukami et al., 1987). It might reflect change of autonomic nerves or internal secretion during stress. The present study suggests a method using telethermography to reveal infants' internal emotion during standard still face paradigm.

**Method:** Twenty 5-month-old infants participated in one of the two conditions. The mother faced to the infant on a baby sheet. The telethermography video camera captured the infant's face with three 5mm squared aluminum foils on their forehead. In the still face condition, the mother interacted to the infant for 2 minute and suddenly stopped any movement for a minute. Then she restarted to interact with the infant for 2 more minutes. In the control condition, the mother interacted with the infant for 5 minutes. One of the aluminum marks was chased and temperature around the mark was calculated.

**Results:** The temperature of forehead dropped during one minute of still face compared to the first 1minut of interaction ($t = 2.99$, $p < .05$, mean dropped degree C was -0.35, SD = 0.37). Four infants showed recovery of temperature (M = 0.35, SD = 0.47) during the second interaction phase (after the still face), while six showed far more drop (M = -0.23, SD = -0.16). During the 5 minutes of interaction in control condition, no significant change was shown.

**Discussion:** The results showed that change in facial temperature of infants would be an efficient measure of their internal emotions. Expressive smiles which were often seen during the still face phase might be their effort for reengagement. The possibility of the method and internal emotion of infants would be discussed. The analysis would be demonstrated to discuss the advantage and problem of the method.(This reserach was supprted by Nissan Science Foundation)

**Th1-62**

## Maternal Responsivity as a Predictor of Toddlers' Use of Emotional Regulation Strategies Across Contexts

**Kassondra Silva**, Tracy Spinrad, Cassandra Charlot

*Arizona State University, Tempe, USA*

The ability to regulate emotions is a major developmental accomplishment and has been associated with future social competence in toddlers (Spinrad et al., 2004). A variety of behavioral strategies can be employed by toddlers as a means to regulate their emotions. Attentional and self-comforting behaviors in particular have been found to be effective in the regulation of emotions (Stifter & Braungart, 1995). Further, the influence of parental socialization and responsiveness has been examined in relation to how children learn and utilize these strategies (Buss & Kiel, 2004). The purpose of this study was to investigate the relations between maternal interactive style (i.e., responsivity) and toddlers' emotional regulation strategies across contexts and over time. We predicted that mothers' responsivity would predict toddlers' increased use of attentional and self-comforting behaviors, and these relations would hold over time. Further, we examined whether the relations of maternal responsivity to toddlers' self-regulation strategies would differ depending on the context (i.e., during anger- versus fear-provoking tasks).

Participants were 256 toddlers (115 girls; mean age 17.79 months) at T1 and 230 toddlers (102 girls; mean age = 29.8 months) at T2 who were part of an ongoing longitudinal study. At both times, toddlers' use of attentional and self-comforting behaviors was observed in response to an anger-eliciting task (i.e., toy removal) and in response to fear-inducing tasks (i.e., scary masks, jumping spider). Toddlers' anger or fear was coded and used as a control variable. Maternal behavior was observed during a free play activity.

Preliminary results suggested that maternal socializing behavior was related to toddlers' regulation strategies within and across time. Specifically, maternal sensitivity was positively related to concurrent self-comforting during the masks at T1 and T2, $rs(253, 227) = .15$ and .18, $ps < .05$ and .01, and was positively related to self-comforting during spider task at T1, $r(253) = .17$, $p < .01$. Maternal intrusiveness at T1 predicted lower self comforting during the masks concurrently and over time, $rs(253, 227) = -.16$ and -.18, $ps < .05$ and .01, and predicted lower self comforting during the spider task over time, $r(227) = -.21$, $p < .01$. Interestingly, maternal behavior was unrelated to toddlers' regulation strategies during the anger task at both time points. These finding are discussed in terms of toddlers' emotional regulation across contexts. Future analyses will examine potential bidirectional relations between maternal behavior and emotional regulation.

**Th1-63**

## Positive and Negative Emotionality of Mothers and Toddlers: Relations with Mother-Toddler Interaction in Two Contexts

**Maria Wong**[1] Nancy McElwain[2] Jennifer Engle[2]

*1. Dept. of Psychology, University of Illinois, Urbana-Champaign, Champaign, USA; 2. Human and Community Development, University of Illinois, Urbana-Champaign, Urbana, USA*

**Introduction:** Previous research has highlighted the importance of a two-dimensional approach to the study of emotionality among infants (Belsky, Hsieh, & Crnic, 1996) and adults (Diener, Smith, & Fujita, 1995). This works suggests that positive and negative emotionality

appear to be related but distinct constructs. Nonetheless, research has focused predominantly on child negative emotionality as a correlate of mother-child interaction, and little is known about the degree to which child positive emotionality or mother positive and negative emotionality relate to the quality of mother-child interaction. This investigation addresses these gaps by examining the unique and joint contributions of mother and toddler positive and negative emotionality to the prediction of mother-toddler interaction across two contexts.

**Method:** Mothers and their 2-year-old children ($N$ = 128, 66 girls) participated in a 90-minute visit to the laboratory playroom which included a series of interactive sessions, including a 15-minute free play and a 7-minute snack. The following were coded from the play and snack sessions: toddler-mother positive affect, conflict/negativity, and coordination/responsiveness, and maternal sensitive/engagement. Information on positive emotionality (PE) and negative emotionality (NE) for mothers (SEFQ; Halberstadt et al., 1995) and toddlers (TBAQ; Goldsmith, 1994) were collected via parent reports.

**Results:** To examine the unique and joint contributions of mother and toddler emotionality to the quality of mother-toddler interaction in the free play and snack sessions, multiple regression analyses were conducted with mothers' and toddlers' PE and NE as predictors in step 1, and mother X child PE and mother X child NE interactions as predictors in step 2. Results were largely consistent across sessions. Namely, more toddler NE was associated with greater mother-toddler *conflict/negativity* ($\beta = .23$, $p < .01$, for both play and snack). Further, less toddler PE ($\beta = -.25$, $p = .01$ for play, $\beta = -.18$, $p = .07$ for snack) and less maternal NE ($\beta = -.18$, $p = .06$ for play, $\beta = -.20$, $p = .03$ for snack) were associated with more *sensitive engagement* by mothers. Finally, Toddler NE ($\beta = -.32$, $p = .001$) and the mother x toddler interaction for PE ($\beta = -.18$, $p = .05$) uniquely predicted *coordination/responsiveness* during the play session. Simple slope analyses indicated that mothers' PE was associated with higher levels of coordination only when toddlers were low in PE. Surprisingly, neither toddler nor mother emotionality was related to observed mother-toddler *positive affect* in either session.

**Conclusions:** These findings highlight the distinct roles that positive and negative emotionality may play in the mother-toddler relationship. Toddler negative emotionality was associated with more conflict and less coordinated interaction. Similarly, mothers' negative emotionality was associated with less maternal sensitive engagement. In contrast, results for positive emotionality were somewhat counterintuitive and underscore the need to consider both dimensions of emotionality as predictors of the mother-child relationship.

**Th1-64**

### Can Neonates Triangulate?

Helene Tremblay

*Universite de Rouen, Rouen, France*

**Background and Aims:** Previous work showed that triadic interactions (adult-adult-3.month-old.infant) were facilitated after one adult looked away, smiled and talked at another person rather than an object. The mechanism that drives such triadic sensitivities was expected to be observed in neonates' communicative behaviours with mothers and fathers in an adapted version of the « exclusion paradigm ».

**Methods:** A sample of 20 family triads was videotaped when neonates were 3 days old. All were full-born and healthy babies. The parents were seated on both sides of the newborn's crib at a distance of 30 cm from the baby's head. The infant sat up supported by a headrest. The interactive session was divided in three periods. First, the mother interacted 2 minutes with the newborn producing verbalisations and either mouth opening or tongue protrusions. Second, the father interacted 2 minutes with the newborn producing verbalizations and a different facial expression than the one chosen by the mother. Third, the parents looked at each other and talked together 1 minute. Parents' actions and neonates' looks, mouthing, mouth opening, tongue protrusion and head orientation were coded, with one second unit, independently. Then, the 3 participants' behaviours and looks were analyzed sequentially freeing successive social directed behaviours linked together.

**Results:** During the 5 minute session, all neonates looked at both mothers and fathers equally, significantly more when parents produced facial expressions than verbalizations/vocalizations. Neonates' mouthing, mouth opening and tongue protrusion accompanied by looks to a parent were more frequent when parents produced facial expressions than verbalizations/vocalizations. Infants were also sensitive to changes in the parents' head and eye direction when they turned to talk together.

**Conclusion:** Neonates' ability to distribute their attention between two partners and to undergo dyadic communicative exchanges with two other persons within a short time window may suggest that dyadic and triangular communicative competences develop simultaneously from birth.

**Th1-65**

### Restoring Exclusive Dyadic Interaction Following Jealousy Evocation among Securely and Insecurely Attached Dyads

Sybil Hart, Kazuko Behrens

*Texas Tech University, Austin, USA*

**Background and Aims:** Previous research has shown that infants are disturbed when maternal attention is directed toward another infant, or jealousy-evocation (JE). The present study explored the challenging process of re-establishing exclusive dyadic interaction following JE, and whether its quality differs with attachment status.

**Methods:** N=34 dyads were videotaped when the infants were 10 and 12 months of age. During the first visit, infants were exposed to a 7-episode procedure that included two Doll episodes, Stranger-Doll and Mother-Doll, involving the target infant, the mother, a stranger, and a doll representing another infant. During the Stranger-doll condition, the doll was placed on the stranger's lap. In the Mother-doll condition it was on mother's lap. During both conditions the target infant was ignored by mother and stranger as they directed positive attention toward the doll. Each Doll episode was followed by an Emotional Reunion episode involving only the mother and target infant and in which mothers' and infants' responses were spontaneous. Infant and maternal behaviors during the four episodes were coded by observers who were blind to the hypotheses and unaware of attachment status. During the 12-month visit the dyads were observed in the Strange Situation procedure.

Results revealed that the mother-doll condition was more disturbing than the stranger-doll condition, especially to infants whose attachment status was later identified as Insecure-ambivalent (C). During the reunion episode following the mother-doll episode, C infants were found less easily soothed; their mothers showed lower quality offers of affection and attention, suggesting that re-establishing exclusive dyadic interaction is especially challenging among these dyads.

**Conclusions:** Findings will be discussed in terms of implications for insight into the infant's regulation of jealousy, and into the poorly understood attachment classification of C.

**Th1-66**

### Sibling Jealousy in Early Childhood: Family and Child Correlates

Denise Kennedy, Lisa Jackey, Brenda Volling
*University of Michigan, Ann Arbor, USA*

**Background and Aims:** Jealousy is a social emotion that occurs in triadic interaction contexts and has been observed in children as young as 6-12 months of age (Hart et al., 2006). Volling and her colleagues (2002) examined sibling jealousy between toddlers and their older siblings using observationally-based triadic paradigms where parents altered their attention from one sibling to the other. They found that older siblings' jealous behavior was correlated with marital conflict, temperamental anger, greater emotional understanding and insecure attachments to mother and father. The toddler siblings' jealous affect was correlated with angry temperament, whereas their jealous behavior was related to sibling rivalry. The main aim of the current study was to examine family (e.g., attachment, marital functioning, parent characteristics) and child (e.g., gender, temperament, and age) correlates of 2-year-olds' jealousy in triadic interactions with their older siblings and parents.

**Method:** Two-year-old children, their older siblings, and mothers and fathers in 58 families participated. Parent-sibling triads were observed in 9-min triadic paradigms and parents completed questionnaires assessing parent, child, and family characteristics.

**Results:** Both siblings intruded on the interaction between parents and sibling if there was more marital conflict and less marital love. Older siblings were more negative toward their younger sibling and/or parent if they had higher scores on anger/frustration, lower scores on inhibitory control, and their mothers were more affectionate toward them than their younger siblings; they were less likely to intrude on parent-sibling interaction if their mothers used more control with them compared to their younger sibling. Toddler siblings monitored parent-child interaction and sought comfort from mothers when marital conflict was high and they were more negative toward sibling/parent if they had higher temperamental anger and lower social fear scores.

**Conclusion:** Discussion centers on the role of family dynamics in the development of jealous behavior and affect.

## *Cognitive Development*

**Th2-01**

### Plural-Masculine-Singular-Feminine All in a Word: Spanish-Learners' Processing of Grammatical Cues during Spoken Language Understanding

**Natalia Arias-Trejo**[1] Casey Lew-Williams[2] Virginia Marchman[2]
*1. Universidad Nacional Autonoma de Mexico (UNAM), Mexico; 2. Stanford University, Stanford, USA*

In morphologically-rich languages, grammatical cues are available that assist in the interpretation of ongoing speech. For example, in Spanish, articles agree in gender and number with the upcoming noun. Hence, when hearing the sentence *Encuentra la...* (Find the[fem., sing.]...), the listener knows that the possible target of the speaker's utterance is likely to be la galleta, and probably not *el* perro or *los* gatos. Furthermore, as in many other languages, the article indicates whether the noun has been referred to directly (definite article) or is new to the discourse (indefinite article). Extensive work in adult psycholinguistics shows that skilled listeners are faster and more accurate to process sentences when these grammatical cues are informative. At the same time, adult learners of a second language often have difficulty with the use and processing of grammatical forms. Investigations of the development of grammar in first language learners conventionally explores children's production of appropriate morphosyntactic forms, but much less is known regarding the processing of grammatical cues during real-time language comprehension. Even fewer studies have specifically explored Spanish.

This symposium presents three studies on the processing of grammatical cues by Spanish-speakers during real-time spoken language understanding. The first (Lew-Williams & Fernald) examines the exploitation of grammatical gender in both child and adult learners. Second, we compare young children's use of definite and indefinite articles to find a target between two options (Arias et al.). The third contribution examines children's processing of number cues in the copula and determiner (Marchman et al.). Each of these studies extends our understanding of the processing advantages and challenges faced by learners of a richly inflected language like Spanish. Finally, our discussant (Waxman) will provide an analysis of these findings within the context of current views of language acquisition and processing.

**Th2-02**

### Spanish Article-Noun Agreement Acquisition

**Natalia Arias-Trejo**, Alberto Falcon-Albarran, Elda Alva-Canto
*Universidad Nacional Autonoma de Mexico, Mexico, Mexico*

**Background:** Recently, Lew-Williams & Fernald (2007) found that children learning Spanish take advantage of gender-marker articles as referential cues in spoken language by the age of 34-42 months. These authors presented regular article-noun associations. In the current study, we introduced a more challenging scenario in which we presented both regular and irregular article-noun associations and compared young children's use of definite and indefinite articles.

**Participants:** 24-, 30- and 36-month-olds from monolingual Spanish-speaking families.

**Experiments:** Two preferential looking (Golinkoff et al., 1987) experiments were performed. Children were presented with two different-gender images in ten trials. In Experiment 1, infants could use the definite article (la-feminine/el-masculine) as a clue to anticipate which of the two displayed images would be referred to. In Experiment 2, infants had to perform the same task but the items were introduced by indefinite articles (una-feminine/un-masculine).

**Results:** Experiment 1 showed significant effects in response to the gender article and in performance between ages. Although children did not seem to associate the article with the correct object, the differences in gender article and age suggested a lexical stage in which they are sensitive to some article-noun associations probably as an effect of familiarity or statistical regularity. Experiment 2 showed that children's ability to look at the target object from the onset of the indefinite masculine or feminine article was above chance levels.

**Conclusions:** This data indicates important differences in the masculine vs. feminine acquisition agreement as well as in the recognition of definite versus indefinite determiners. Overall, the analyses showed a

more accurate response in performance to indefinite articles within a developmental trend. These results are explained as based on phonological clues found in the stimuli, exposure patterns to definite and indefinite articles and the lexical environment of the Spanish learning infants (Smith et al., 2003).

Golinkoff, R. M., Hirsch-Pasek, K., Cauley, K. M., & Gordon, L. (1987). The eyes have it: Lexical and syntactic comprehension in a new paradigm. Journal of Child Language, 14(1), 23-45.

Lew-Williams, C., & Fernald, A. (2007). Young children learning Spanish make rapid use of grammatical gender in spoken word recognition. Psychological Science, 18(3), 193-198.

Smith, P., Nix, A., Davey, N., & López-Ornat, S. (2003). A connectionist account of Spanish determiner production. Journal of Child Language, 30, 305-331.

**Th2-03**

## Spanish-Learners Use Cues to Grammatical Number to Facilitate Online Language Comprehension

**Virginia Marchman**, Nereyda Hurtado, Grace Budde, Anne Fernald

*Stanford University, Stanford, USA*

When interpreting spoken language, children and adults process speech incrementally from moment-to-moment, using linguistic and non-linguistic information as it becomes available to narrow the potential referents in a visual scene. In a "looking-while-listening" procedure where children look at pictures while hearing a sentence about one of the pictures, two-year-olds shift their gaze to the appropriate picture before hearing the noun when a verb is semantically related (*Cómete la galleta* "EAT the cookie"), compared to a verb that is unrelated (*Mira la galleta* "SEE the cookie"). In a richly-inflected language like Spanish, listeners also benefit from gender information on the pre-nominal article. For example, when viewing pictures with names of either the same (*la pelota*[f], "ball", *la galleta*[f], "cookie") or different gender (*la pelota*[f], "ball", *el zapato*[m], "shoe"), listeners shift their gaze earlier in the different vs. the same gender condition, doing so soon after the determiner *la* uniquely identifies the appropriate picture.

Here we ask whether young Spanish-speakers utilize grammatical *number* information during spoken language understanding. While Spanish-learners produce number-marked copulas and determiners by 3-4 years, less is known about the time-course of processing number information during real-time language comprehension. In the looking-while-listening procedure, Spanish-speaking 3-4 yr-olds (n=18) heard six plural or singular nouns in sentences with *one* vs. *two* pre-nominal number cues: *¡Mira EL gato!/Encuentra LOS carros!* vs. *¿Cuál ES EL gato?/Cuáles SON LOS carros?* Pre-nominal number information is available in both conditions, but occurs ~500 ms *earlier* in the two-cue condition. Results indicate that children shifted to the target significantly faster, by nearly 150 ms, in the two-cue (M=1017 ms) than in the one-cue (M=1155 ms) condition ($p < .05$). Thus, Spanish-speaking children at the beginning phases of development track language-specific grammatical information that is helpful for interpreting the meaning of the speech that they hear.

**Th2-04**

## 2-Year-Old vs. 20-Year-Old Spanish Learners: a Side-By-Side Comparison of Online Language Processing

**Casey Lew-Williams**, Anne Fernald

*Stanford University, Stanford, USA*

**Background:** Nouns in Spanish have grammatical gender, with obligatory gender-marking on preceding articles. Adult native speakers of languages with grammatical gender exploit this cue in online sentence interpretation (Dahan et al., 2000; Wicha et al., 2004). However, this ability may hold only for first-language learners. Guillelmon & Grosjean (2001) found that word recognition was faster when gender information was present for adult L1 French-speakers, but not for adult L2 French-learners. How do young children, in comparison to adult L2 Spanish-learners, begin to take advantage of informative referential cues in spoken language processing?

**Participants:** 2-year-old children from monolingual Spanish-speaking families; native Spanish-speaking adults; native English-speaking adults with 1-10 years of Spanish instruction.

Experiment 1: Participants saw pairs of pictures with names of either the same (la pelota[f], 'ball', la galleta[f], 'cookie') or different grammatical gender (la pelota[f], el zapato[m], 'shoe'), as they heard sentences referring to one picture (Encuentra la pelota, 'Find the ball'). Eye-movements were recorded and coded offline with 33-ms resolution to monitor the time-course of sentence interpretation. If participants can take advantage of the gender-marked article as a cue to the upcoming noun, we predicted faster reaction times on different-gender than same-gender trials. Results showed that children and L1 adults-but not L2 adults-were significantly faster to orient to the correct referent on different-gender trials.

Experiment 2: Children, L1 adults, and L2 adults used informative verbs (e.g., Cómete la galleta vs. Encuentra la galleta, 'Eat/Find the cookie') to establish reference more rapidly.

**Conclusions:** Spanish-learning children with only a few hundred words in their productive vocabulary already use morphosyntactic and semantic information as dynamic cues in establishing reference, while L2 adult learners only show efficient use of semantic information. The present studies reveal differences in the naturalistic moment-to-moment processing of listeners with graded levels of experience and expertise.

**References:**

Dahan, D., Swingley, D., Tanenhaus, M. K., & Magnuson, J. S. (2000). Linguistic gender and spoken-word recognition in French. Journal of Memory & Language, 42, 465-480;

Guillelmon, D., & Grosjean, F. (2001). The gender marking effect in spoken word recognition: The case of bilinguals. Memory & Cognition, 29, 503-511;

Wicha, N. Y. Y., Moreno, E. M., & Kutas, M. (2004). Anticipatory words and their gender: An event related brain potential study of semantic integration, gender expectancy, and gender agreement in Spanish sentence reading. Journal of Cognitive Neuroscience, 16, 1272-1288.

**Th2-05**

### Infants' Knowledge of Abstract Same/Different Relationships

**Caspar Addyman**, Denis Mareschal
*Birkbeck, University of London, London, UK*

One of the simplest abstract concepts is the two item same/different (S/D) relationship. When considering pairs of items AA, BB, CD, EF, the first two pairs share the relationship of sameness and by contrast the last two have the common property of difference. For this relationship to hold at an abstract level, it should be detected irrespective of the actual items used. Only a few experiments have investigated this ability in infancy. Tyrrell and colleagues (Tyrrell, Stauffer & Snowman, 1991; Tyrrell Zingaro & Minard, 1993) have shown that 7 month old infants are sensitive to S/D relationships in paired preference tests but used only a small number of test items. It is arguable that 8 month old infants succeed on the artificial grammar task of Marcus, Vijayan, Bandi Rao & Vishton (1999) due to an awareness of the S/D features of the stimuli. We present a set of experiments that investigate the S/D abilities of 8 month old infants in more detail using two alternative paradigms.

In Experiment 1a infants were habituated to pairs of pictures of inanimate objects (drawn from a set of 25) that were either identical (Same condition) or distinct (Different condition). Upon habituation they were tested with two sets of trials that contrasted the relation they had been habituated to. These infants also took part in experiment 1b. This used the anticipatory eye movement paradigm of McMurray & Aslin (2004). On each trial two simple coloured geometric shapes (a yellow circle and a blue square) appeared at the bottom of the screen and moved upwards. They disappeared behind an inverted T-shaped occluder and reappeared in either the upper left or right part of the screen, depending on whether the two shapes were the same or different from each other. Infants received 3 blocks of 16 trials to learn this dependency followed by a further block that tested generalization with novel coloured shapes.

The 15 infants who completed experiment 1a showed a strong dishabituation to the novel test trials $F(1,13) = 11.7$, $p<0.005$. Crucially there were no significant interactions indicating that the performance is not driven by the greater complexity of displays with two different items. Initial analysis of the eye tracking data suggests that infants can learn the dependency but do not transfer this to novel exemplars. Taken together these results support the idea that infants can use abstract concept of same/different.

**Th2-06**

### Priming Effects in 10-Month-Old Infants in a Manual Search Task

**Jie Li**, **Renee Baillargeon**
*University of Illinois at Urbana-Champaign, Champaign, USA*

Violation-of-expectation (VOE) findings suggest that infants who have identified a variable as relevant to an event category (e.g., the variable height in containment events) include information about the variable when representing events from the category, and consider this information when reasoning about the events. In contrast, infants who have not yet identified the variable typically fail to include information about it; however, if primed to include this information, through contextual manipulations, infants then take it into account when reasoning about the events. The present research sought converging evidence for these VOE findings in action tasks.

The point of departure for our experiments was VOE evidence that the variable height is identified at about 7.5 months in containment events, but only at about 14 months in tube events. In Experiment 1, 10-month-olds were first encouraged to inspect a tall Cookie Monster toy with large yellow fuzzy toes, and either a short and a tall container (container condition) or a short and a tall tube (tube condition); each container/tube had a small window at the bottom of its front surface. During the test trial, the toy and containers/tubes were hidden behind a large screen, which was then removed to reveal a platform on which rested the two containers/tubes, each with yellow fuzzy toes protruding from its window. Infants were encouraged to search for the toy they had played with earlier. Consistent with previous VOE findings, infants in the container condition were reliably more likely to reach for the tall than the short container, whereas infants in the tube condition reached about equally for the two tubes.

In Experiment 2, infants were tested with the same procedure as in the Tube condition except that they first received a priming trial designed to highlight height information: they saw three Cookie Monster toys of different heights, arranged monotonically. Consistent with prior VOE findings, infants now searched for the toy inside the tall as opposed to the short tube. This effect was not due to additional exposure to Cookie Monster toys: infants who received a priming trial with three identical Cookie Monster toys reached randomly during the test trial, as in Experiment 1.

The present research thus provides converging evidence from action tasks that infants who have not yet identified a variable in an event category typically do not attend to the variable, but can do so if primed by contextual manipulations that highlight the variable.

**Th2-07**

### Infants' Spatial Reasoning Strategies in a Whole-Body Tool-Use Task

**Sarah Berger**[1] Alisan Kavookjian[2] Karen Adolph[2]
*1. The College of Staten Island, Staten Island, USA; 2. New York University, New York, USA*

In a series of whole-body tool-use experiments, 16-month-old walking infants successfully used handrails as tools to walk across wide and narrow bridges (Berger & Adolph, 2003; Berger, Adolph & Lobo, 2005). They used a sturdy, wooden handrail to walk across narrow bridges, but refused to cross without one. Infants also demonstrated their understanding of the consequences of the material properties of tools by devising alternative bridge-crossing and handrail-use strategies to use suboptimal, "wobbly" handrails. Tool-use also demands knowledge that tools must be in proximity to the target object. Infants use handheld tools to bring distant objects within reach, but spatial understanding in the context of whole body tool use has yet to be studied (Chen & Siegler, 2000). The present study investigated infants' spatial reasoning by asking them to judge whether handrails can function as a tool based on their location relative to a bridge.

Twenty-eight 16-month-olds (13 male) were encouraged to walk across 16 or 36cm wide bridges. A wooden handrail spanned the length of the walkway. The location of the bridge varied between trials (flush with handrail, middle of walkway, far side of walkway).

Generally, infants attempted to cross and succeeded significantly more often on wide than on narrow bridges and used the handrail more frequently on narrow bridges. However, infants paid special consideration to the location of the 16cm bridge. Infants attempted to cross and succeeded more often on the middle 16cm bridge than when it was far from or flush with the handrail. It was nearly impossible for babies to reach the handrail when the 16cm bridge was far,

and there was insufficient room to maneuver their bodies when the 16cm bridge was close to the handrail, but infants devised novel handrail-use strategies at the middle location. Infants leaned their bodies forward and outstretched their arms to reach the handrail as they walked across the bridge significantly more often (>50% of trials) than usual (<10% of trials).

Infants understood that tools must be appropriately situated in space in order to be useful, and were successful because they devised clever strategies to accommodate the spatial demands of the experiment. Older infants often have difficulty using tools separated in space from a target object (Shapiro & Gerke, 1930/1991). Perhaps having infants make decisions about their own bodies relative to tools, rather than having to arrange items external to their own bodies, facilitated their understanding of the spatial requirements of tool-use.

**Th2-08**

### Inferring the Existence of Hypothetical Objects Based on Object Motion

**Szilvia Biro**

*Leiden University, Leiden, The Netherlands*

There is ample evidence that infants are capable of representing the existence of occluded objects. However, in all these studies the objects had been visible before they were occluded. In the current study, we investigated infants' ability to construct novel (hypothetical) representations of objects that they have never perceived directly. Specifically, we tested in two studies whether infants can infer the existence of an object behind an occluder to explain the violation of the physical principles of gravity and inertia.

Using the violation of expectations paradigm, 12- and 9-month-old infants in both studies were shown video-recorded events. A ball was released by a hand and rolled down from the top of a ramp. The middle part of the ramp was occluded by a screen. The ball abruptly stopped rolling when its right half disappeared behind the screen, leaving its left half visible. Adult observers explained the sudden stop of the ball - a violation of the physical principles of gravity and inertia - by stating that an obstacle behind the screen must have stopped the ball from rolling further down. Following the familiarization, infants saw three test events. The screen was raised and revealed that (1) a box stood right next to the ball, or (2) a box was present but not in contact with the ball and (3) nothing was behind the screen.

We found that 12-month-olds (but not 9-month-olds) looked significantly longer ($p<0.05$) in test event (2) than (1) and tended to look longer ($p<0.08$) in (3) than (1). This suggests that infants inferred the existence and position of an "object" behind the occluder in order to explain the apparent violation of the principles of gravity and inertia.

Furthermore, the result of a control experiment excluded the possibility that infants had an inherent preference to see (2) over (1) and supported the idea that infants' inferences were not based on seeing the stationary positions of the ball and the object after the screen was raised but on witnessing the ball stop abruptly.

Finally, the finding of the second study in which the ball was removed by a hand after it stopped behind the screen, suggests that by 12 months infants can also (although less robustly) remember the inferred presence of a hidden object.

**Th2-09**

### The Interrelation Between Language Ability, Social Referencing Skills and Infants' Goal Understanding at 9.5 Months of Age

**Rachel Brainerd**[1] Catharyn Crane[2] Jessica Sommerville[2]

*1. Kalamazoo College, Kalamazoo, USA; 2. University of Washington, Seattle, USA*

**Background and Aims:** Many have noted that a number of key socio-cognitive behaviors, including social referencing, language ability, and goal understanding emerge around 9 months. Are these skills related? Some suggest that the skills develop independently, unrelated to future theory of mind development (Barresi & Moore, 1993, 1996), whereas others suggest that the skills develop simultaneously, connected to a nascent theory of mind (Carpenter, Nagell, & Tomasello, 1998). We investigated interrelations in socio-cognitive skills in the context of a habituation paradigm.

**Methods:** 9.5-month-old infants ($n$ =32) took part in a habituation paradigm modeled after Woodward (1998), designed to assess infants' ability to extend agent goals across contextual changes.

Infants were habituated to an event in which an actor repeatedly selected one of two toys, and received test trials in another room. On test trials the location of the toys were reversed and the actor pursued another toy in the same relative location as her initial toy (new toy trials) in alternation with test trials where the actor reached for the same target toy from habituation, now in a new relative position (new path trials).

We assessed social referencing behavior during habituation trials by coding the number of looks to the parent produced by infants. We assessed language comprehension by summing the number of words infants reportedly understood on the MacArthur vocabulary short form completed by parents.

**Results:** On the goal understanding task, infants showed a significant novelty preference for trials in which the actor pursued a new toy ($t$ (31) = 5.44, $p$ < .001), indicating they extended the actor's goal across contexts.

Correlational analyses revealed that the extent of infants' sensitivity to the change in the actor's goal (calculated by subtracting looking to the new path trials from looking to the new toy trials) was positively related to social referencing during habituation trials, $r$ (31) = .482, $p$ < .01. Goal understanding was also positively related to language comprehension, $r$ (31) = .387, $p$ < .03. Finally, total language comprehension and social referencing occurrences were also positively correlated, $r$ (30) = .45, $p$ < .01.

**Conclusion:** These findings suggest that goal understanding, social referencing, and language are interrelated, at least by 9 months of age. The interaction of these skills likely plays an important role in the development of complex communicative and social abilities.

**Th2-10**

### Young Infants' Understanding of Failed Actions

**Amanda Brandone**, Henry Wellman

*University of Michigan, Ann Arbor, USA*

By the end of their first year, infants recognize specific human actions, such as reaching for and obtaining an object (Phillips & Wellman, 2005), as goal-directed. Intriguingly, older infants (15 months) infer the intention of an object-directed action even from failed acts, when the goal of that action is unfulfilled and thus non-apparent in the

physical movements (e.g., trying unsuccessfully to hang a ring on a hook; Meltzoff, 1995; Johnson, Booth, & O'Hearn, 2001). Can younger infants infer goal-directedness for failed acts and at what age?

Building off the design of Phillips and Wellman (2005), 8-, 10-, and 12-month-old infants were habituated to a video in which an actor reached over a barrier with an arcing reach for a ball; because the barrier was in the way, the actor's reach was unsuccessful. After habituation, infants saw two test displays in which the barrier was removed. In the direct test event, the actor reached directly for the ball and, because the barrier was removed, successfully obtained it; the arm traced a new path, but the action was consistent with the previously unsuccessful goal of reaching the ball. In the indirect test event, the actor reached in an arcing path (even though the barrier was no longer present) and successfully obtained the ball; the arm movement was identical to that in habituation, but the action was no longer consistent with attempting to reach the goal as directly as possible. If infants were able to infer the goal-directedness of an unsuccessful reaching action, they should look longer at the indirect than the direct test event, just as they do when habituated to successful reaches.

Even without witnessing the completion of the reaching action, 10- and 12-month-old infants looked significantly longer at the indirect than at the direct test event, $p = .001$. Thus, by 10 months of age, infants are able to infer the goal-directedness of a failed object-directed action. Eight-month-olds, however, looked equally at both test events. They were only able to infer the goal-directedness of a successful reaching action, $p = .021$ (extending results such as those from Phillips and Wellman (2005) to considerably younger children). These results suggest that during the development of the 'intentional stance,' infants' understanding of successful intentional actions precedes that of failed intentional actions: Infants first work backwards, deducing intention from successful goal-directed actions and only later are able to predict the intention of failed attempts.

**Th2-11**

### 24-Month-Olds' Tool-Function Mappings: Mutual Exclusivity for Tools?

**Krista Casler**, Kerry Whiteman
*Franklin & Marshall College, Lancaster, USA*

**Background:** When adults encounter a novel artifact being used in a particular way, they typically fix that observed function to the object. Past research has demonstrated that even 24-month-olds return to a particular demonstrated object as "for" a particular function (Casler & Kelemen, 2007), and by 30 months, toddlers who have very briefly observed and tried a tool for one task will furthermore reject using it for alternative feasible tasks. Instead - like adults - they select a new object for a new job (Casler & Kelemen, 2005).

Here we consider a previously unexplored but significant question: Why and how do very young children make such rapid and exclusive tool-function mappings? Does this bias signify early developing, artifact specific knowledge? Or do children have few expectations about artifacts per se but avoid giving two functions to an object simply because it makes pragmatic sense in many social situations (using a sort of "mutual exclusivity for tools" rule)? To distinguish between these possibilities, we observed 24-month-olds' exploitation of social-pragmatic cues when mapping various types of information to novel objects.

**Methods:** Twenty-four-month-olds (n=18) completed three types of object-mapping tasks - label to object, fact to object, and function to object - utilizing standard methodology from the mutual exclusivity literature. They were familiarized with one object that was assigned a label ("See this? This is a dobby!"), a fact ("See this? My mommy gave this to me!"), or a function ("See this? Wow!" said while ringing a bell). An alternative object was also explored, but no label, fact, or function was explicitly assigned to it, and children then were asked to distinguish between the two objects (e.g., label: "Can you give me the sither?"). Children completed a total of 12 trials, 4 of each type.

**Results and Conclusions:** Toddlers utilized pragmatic information and chose the new / unidentified object significantly more often than predicted by chance in both the label (62%) and fact (67%) conditions, $ps < .05$. In sharp contrast, in the function condition children did not prefer using the object for a new task (i.e., crushing crackers rather than ringing a bell) - an outcome that additionally did not reflect memory limits or an overall inability to make object-function mappings. These results are taken to suggest that teleo-functional reasoning is early-developing and artifact-specific, not reducing to other available domain general learning mechanisms.

**Th2-12**

### A Question of Trust: Infants Attribute True Beliefs Only to Reliable Lookers

**Virginia Chow**, Diane Poulin-Dubois, Amanda Guay, Alla Sorokin
*Concordia University, Montreal, Canada*

There is a raging debate concerning infants understanding of the mentalistic nature of another person's gaze. In order to understand whether infants understand the subjectivity of gaze, a recent study used a novel approach to demonstrate that 16-month-olds' exposure to the reliability of a person's gaze influences whether or not they follow the gaze of the person behind barriers (Chow, Poulin-Dubois, & Lewis, in press). The present study examined whether 16-month-olds ($n = 43$) use the past reliability of a person's looking behavior to predict whether the same person will develop true beliefs. Infants were first administered a Search Task adapted from Repacholi (1998) in which they observed, over 4 trials, an experimenter show excitement while looking inside a box that contained either a toy (Reliable Looker condition) or was empty (Unreliable Looker condition). Infants were then administered a True Belief Task (Onishi & Baillargeon, 2005) in which they watched as the experimenter hid and reached for the toy in one of two locations. In the test trial, infants witnessed the experimenter search for the toy in a location that was consistent (Congruent condition) or inconsistent (Incongruent condition) with her belief about where the toy was hidden. Results for the Search Task indicate that infants in the Unreliable Looker condition took longer to examine the content of the box in the last trial ($M = 9.47$, $SD = 9.36$) as compared to the first trial ($M = 4.56$, $SD = 3.37$; $p < .01$), whereas no such differences exist in the Reliable Looker condition (first trial: $M = 3.31$, $SD = 2.17$; last trial: $M = 3.13$, $SD = 2.25$, $p = .90$), suggesting that infants have developed an expectation about the contents of the container over time. As predicted, results from the True Belief task indicated that only the infants in the Reliable Looker condition looked longer at the incongruent display ($M = 7.63$, $SD = 7.44$) than at the congruent display ($M = 4.09$, $SD = 2.45$, $p < .05$), whereas infants in the Unreliable Looker condition looked equally long at both displays (congruent: $M = 6.06$, $SD = 3.85$; incongruent: $M = 2.83$, $SD = 1.78$; $p = .11$). These findings extend our understanding of infants' ability to generalize their knowledge about what a person can see from one context to another and of their ability to attribute true beliefs to others.

**Th2-13**

### Infant's Brain Activity during Observation of Possible and Impossible Events on TV

**Naoko Dan**[1] Kazuo Hiraki[2] Goh Matsuda[2] Hirokata Fukushima[3] Reiko Matsunaka[4] Michiko Miyazaki[3]

*1. The University of Tokyo, Tsukuba-city, Japan; 2. The University of Tokyo, Meguro-ku, Japan; 3. The University of Tokyo, Yokohama-city, Japan; 4. The University of Tokyo, Sagamihara-city, Japan*

**Background and Aims:** Recently, some studies using violation of expectation method show that infant's brain can detect physical error in an impossible event. Although most of these studies have been conducted using stimuli presented via television, how infants recognize images on television rarely have been discussed. In the present study, we measured infants' neural activities with electroencephalogram (EEG) when infants were presented non-search object permanence task with both real and TV stimuli, and demonstrated difference of infants' brain activity between them.

**Methods:** Participants were 4-6 month-old infants. They were randomly assigned to the real or TV conditions.

They were presented 2 kinds of events: the possible event and impossible event. In the possible event, a blue and red cup were placed up side down and side by side on the table, and a toy dog was placed in front of one of them. Then hands appeared, and lifted up both cups. And the hands put them down in front of their previous location, so that one of the cups hid the dog. Then, the cup which had not hidden the dog was lifted up again and the infants found nothing under it. The impossible event was identical to the possible event except that the cup which had hidden the dog was lifted up. In the real condition, these events were presented in the real world. In the TV condition, on the other hand, they were presented via TV. Infants' looking times and EEG were measured in parallel.

**Results:** <Looking time> Infants in both condition tended to look longer at the impossible event than at the possible one.

<EEG> In both conditions, differences in oscillatory EEG between events was found at gamma band frequency (25-40 Hz) around the occipite-temporal site. This difference was larger in the TV condition than the real.

**Conclusion:** The oscillatory EEG activity in gamma band frequency is suggested to reflect the processing of perceptual integration or active maintenance of environmental information. Thus the pattern of EEG observed in this study may indicate that infants' brain can differentiate an expected event from unexpected one. The EEG result might reflect some uniqueness in infant's cognition of physical event via TV.

**Th2-14**

### Connections Between Number and Space in Infancy

**Maria Dolores de Hevia**, Elizabeth Spelke

*Harvard University, Cambridge, USA*

Adults' representations of space and number are known to be connected in the form of a 'mental number line'. Evidence suggests that adult numerical representations are built on a primitive system of analogue magnitude, fully functional in early infancy. However, little is known about the origins of the mapping of numbers onto space: is this relationship the result of mathematical instruction, or is it present already in early infancy? We tested the hypothesis of a fundamental connection between number and space in 8-month-old babies. We reasoned that the transfer of the discrimination from numerical quantities to spatial length would support the hypothesis that representations of number and space are subserved by a common underlying mental representation.

Infants (N=24) were habituated to increasing or decreasing sequences of five numerical displays that differed by a 1:2 ratio (respectively, 4, 8, 16, 32, 64, and 64, 32, 16, 8, 4). Overall area in numerical displays was kept constant by varying item size inversely to number. Half of the infants were randomly assigned to the increasing condition. Each trial consisted of a repeating cycle of the series of numerical displays, with each numerical display presented for 1.5 seconds. Following habituation, infants were shown six test trials consisting of a line whose length either increased or decreased through five successive steps, doubling or halving in length at each step. Trials with increasing vs. decreasing length were presented to all the infants in alternation, and the order of presentation of increasing and decreasing test trials was counterbalanced.

Overall, infants looked longer to the series of line lengths that followed a novel order in magnitude change (M=14.5 s), in contrast to the familiar order (M=10.3 s); 19/24, p=.007, binomial test. A repeated-measures ANOVA with trial-pair and test showed a significant effect of test ($F(2,23)=6.78$, $p=.016$), while the effects of pair, and the interaction, were not significant ($F<1$).

This study shows that infants successfully generalize the discrimination of numerical changes to changes in spatial length. Research in progress is replicating and extending this conclusion through a second method, in which number and length appear simultaneously and change in quantity either congruently or incongruently. The findings of the first study, and preliminary findings of the second suggest a common system of magnitude devoted to the computation of these dimensions. Adults''mental number line' therefore may derive from a fundamental, early relationship between representations of numerical magnitude and spatial length.

**Th2-15**

### Toddler's Memory For Sources of Action

**Suzanne Hala**[1] Alisha Brown[1] Valerie SanJuan[2]

*1. University of Calgary, Calgary, Canada; 2. University of Toronto, Toronto, Canada*

The two studies reported here provide a window into the early emergence of source monitoring abilities. Children as young as 3 years of age do well on simple versions of action based source monitoring tasks. Research with even younger children, however, remains lacking. In the first study we extended the age range downward to 2 year olds. We also included a novel condition designed to make the task easier to better assess very early emergence of source monitoring.

**Study 1:** Our participants were children between 30 to 36 months. For the procedure we used an action based task in which children and experimenter took turns constructing a model farm. After construction, children were administered a surprise memory test in which they were asked who had placed each item. Two conditions were included. In the *no context condition*, few contextual cues are available - the farm is covered from view and the children are shown the test farm items in isolation. In the *context condition*, context cues remain intact - children are tested with the constructed farm in view. As predicted, children in the context condition were more accurate in recalling the source of actions. Nevertheless, children in both conditions performed very well on the source questions indicating a surprisingly early age of emergence for this ability.

**Study 2:** We then went on to examine the relation of memory for sources of action to other emerging cognitive abilities, including inhibitory control and working memory. The usual error found for preschool children (and our toddlers in Study 1) is the incorrect response that they placed some of the experimenter's items. In other words, young children show an "I did it" bias. We predicted that children who had greater inhibitory control would be more able to inhibit this "I did it" bias. Conversely, we expected no strong relation for source monitoring and working memory. This is because studies that have included distracter items find no evidence of a link between recognition memory and source monitoring, suggesting that source monitoring is a different type of memory ability. We tested a new group of toddlers using the *no context* version of the farm task to ensure sufficient variability. We also included a battery of inhibitory control and working memory measures appropriate for use with toddlers. Working memory measures: six box scramble and the beads task. Inhibitory control: snack delay, reverse categorization and shape stroop tasks. As predicted, all three inhibitory control measures were significantly correlated with performance on our source monitoring task, but the working memory measures were not. These correlations held even when controlling for age. Taken together, these findings indicate that source monitoring abilities begin to develop very early and are related to advances in inhibitory control.

**Th2-16**

### Goal Emulation in 2-Year-Olds

**Elizabeth Hallinan**, Valerie Kuhlmeier

*Queen's University, Kingston, Canada*

**Introduction and Aims:** It is clear that children's perception of the intention of the demonstrator seems to play a role in imitation (Carpenter, Akhtar, & Tomasello, 1998). In fact, children often imitate intentional actions even when they are aware of a more efficient way of accomplishing the same goal. Horner and Whiten (2005) found that preschoolers reproduced both necessary and unnecessary actions in order to retrieve a prize from a box. However, when younger children are given a physical reason why the demonstrator uses an inefficient action, they do not imitate that action but rather use a more efficient way to solve the task (Gergely, Bekkering, & Kiraly, 2002). We asked if toddlers would over-imitate a demonstrator's actions when faced with the paradigm from Horner and Whiten (2005).

**Procedure:** 2-year-olds saw a demonstrator use two actions (one necessary, one not) to fish a toy out of a box. Two types of boxes were demonstrated, one opaque and one clear, such that actions on the clear box were easily identifiable as necessary or unnecessary to the task, while such a distinction was more difficult with the opaque box. Children then had 3 trials for each box in which they could retrieve the toy themselves.

**Results:** We found a high proportion of children (69%) included the unnecessary action in baseline trials, which occurred before witnessing a demonstration. However, unlike the 3- to 5-year-old children in Horner and Whiten (2005), we found a much smaller proportion of 2-year-old children included the unnecessary action after demonstration (2-yr-olds: 40%; 3- to 5-yr olds: 76%). A repeated-measures ANOVA also revealed a significant effect of sex, with girls imitating at higher rates than boys ($F(1,12) = 9.48$, $p = 0.01$; girls: 67%, males: 12.5%). There was no effect of box type or box order.

**Conclusions:** Similar to previous findings, we found that children did not change their rates of imitation based on whether the mechanism of the boxes was opaque or not. However, we found that with younger children, only the girls were willing to imitate the unnecessary action when retrieving the toy. We hypothesize that girls (and perhaps the older children in Horner and Whiten (2005)) may be more attentive to social cues, and are thereby more willing to see the unnecessary action as important for imitation. Ongoing experiments are testing this hypothesis.

**Th2-17**

### Infants Attribute Social Referencing to Others

**Elizabeth Hallinan**[1] Valerie Kuhlmeier[1] George Newman[2]

*1. Queen's University, Kingston, Canada; 2. Yale University, New Haven, USA*

**Introduction and Aims:** In an extension of Repacholi (1998), we used a looking-time paradigm to ask whether infants are able to attribute social referencing to others. It is clear that infants themselves can learn from others, even such abstract concepts as intentions (Meltzoff, 1995) and emotions (Klinnert, Emde, Butterfield, & Campos, 1986). Additionally, even young infants seem to track another individual's attention (Tomasello & Haberl, 2003) and perception (Luo & Baillargeon, in press). We were interested in whether 17-month-old infants were able integrate these abilities to predict correctly whether an individual would have knowledge attained from another person.

Procedure: In familiarization trials, a demonstrator used one positive ("yummy!") and one negative ("yucky!") emotion to describe the contents of two containers. Infants were assigned to one of two conditions; half the infants watched these events in the presence of a target actor (present condition) and half in the presence of a distracter actor (absent condition). In test trials for both conditions, the target actor reached for each box on alternating trials. We hypothesized that if infants are able to ascribe social learning of these unseen properties to others, they should expect the target actor to avoid the box labeled with "yucky" contents.

**Results:** Preliminary results suggest that infants in the present condition looked longer when the target actor reached for the "yucky" box than when she reached for the "yummy" box ( $t(16) = 1.93$, $p = 0.07$, 12 out of 17 subjects). However, infants did not show this result when the target actor had not witnessed the emotions: infants in the absent condition looked equally at reaches directed toward either box ( $t(9) = 1.00$, $p = 0.34$, 3 out of 10 subjects looking longer at the "yucky"box).

**Conclusions:** This suggests that 17-month-old infants understand that individuals can acquire knowledge of unseen properties from others. Additionally, our results suggest that infants can assign such knowledge to individuals correctly, based on their presence or absence from a demonstration event. While this is not the first evidence that infants understanding that "seeing is knowing", these findings hint that this understanding might be very flexible. Here, infants needed to reason about the actor's knowledge from her past experience, rather than from her current perception. Additionally, it provides evidence that infants can track not only goals (Buresh & Woodward, 2007), but also knowledge across individuals.

**Th2-18**

## Baby Do - Baby See - Baby Learn: How Action Production and Action Perception Facilitate Subsequent Actions during Infancy

**Petra Hauf**

*St. Francis Xavier University, Antigonish, Canada*

Human beings act and interact with their social environment. Social interactions emphasize that one's own actions affect the behaviour of the person towards whom they are directed and actions of others affect our own behaviour. Thus, it is important not only to understand other individuals' actions, but also to control one's own actions. The present study investigates the early development of action understanding by focusing on the bidirectional linkage between action production and action perception in infancy. Previous studies have shown that action production influences subsequent action perception (Hauf et al., 2007) and that infants selectively use the information of other persons' actions to control their own actions (Hauf, subm.). Nevertheless, recent studies indicate that the bidirectional influence is stronger for production on perception than for perception on production (Hauf, 2007; Sommerville et al., 2005). The aim of this study was to explicitly investigate the bidirectional influence of action production and action perception in an ongoing interchange. To investigate this, 9 and 11 month old infants (n=40 each) first took part in an action production phase where they played with a toy for 90s (car or ribbons). During the subsequent action perception phase the infants watched two video clips simultaneously on two screens. Both clips showed the same two adults sliding either the car or waving the ribbons (90s); thus demonstrating a particular action for each of both objects. Following this both toys were presented within reach of the infants for another action production phase (90s). Playing and looking time was assessed for each production phase; preferential looking time was measured for the perception phase. Nine- and 11-month-olds preferred to look at the same-toy video during the perception phase, replicating the findings of Hauf and colleagues (2007). During the subsequent production phase infants at both ages also played longer with the same toy they had already experienced before. Interestingly, the infants additionally reproduced the modeled action during this production phase which was not the case in a previous study (Hauf, subm.). These findings suggest that active experience with objects is influencing subsequent interest in watching same-toy actions. Even more important, active experience in combination with observational experience is facilitating further performance of actions indicating a sequential influence of action production on action perception and on production again.

**Th2-19**

## The Role of Language in Guiding Infants' Interactions with People and Objects

**Katherine Kinzler**[1] Emmanuel Dupoux[2] Elizabeh Spelke[1]

*1. Harvard University, Cambridge, USA; 2. Laboratoire de Sciences Cognitives et Psycholinguistique, EHESS, Paris, France*

Previous research suggests that infants' social preferences for native over foreign language speakers influence their early interaction interactions with others. Ten-month-old infants selectively accept one of two identical toys when offered by a speaker of their native language over a foreign-language speaker. This result was obtained even though language was never directly paired with the objects presented (Kinzler, Dupoux, & Spelke, 2007).

The present work probed both the generality and specificity of this native-language preference. Experiment 1 investigated whether infants selectively choose one of two different toys when it was merely modeled, but not offered, by a native speaker. 10-month-old infants were presented with videos of a native speaker and a foreign speaker, each holding a different toy while two real exemplars of the toys were present in the testing room. When given a chance to reach for one of two toys, infants preferentially chose the toy that was modeled by the native speaker. This suggests that infants' preference for native speakers influences their preference between two objects.

Experiment 2 investigated whether infants' early social interactions are equally influenced by any dimension of social familiarity. White 10-month-old infants were presented with a White and a Black actress who each offered identical toys. Infants accepted toys equally from both actors. A comparison of the present findings with those of past research using the same method, in which toys were offered by two same-race speakers of different languages, suggests that language plays a greater role than race in guiding infants' early social preferences. Together, these results provide evidence for the robustness of infants' attention to language in guiding their early interactions with both people and objects.

**Th2-20**

## Multiple Influences on Infants' Category Learning

**Kristine Kovack-Lesh**[1] Lisa Oakes[2] Bob McMurray[1]

*1. University of Iowa, Iowa City, USA; 2. University of California, Davis, USA*

**Background and Aims:** Previous research has shown that several factors influence infants' categorization. For example, opportunities to compare items influences infants' formation of categories (Kovack-Lesh & Oakes, in press; Oakes & Ribar, 2005; Younger & Furrer, 2003), presumably because such opportunities help infants recognize the commonalities among items. Previous experience also has been found to influence infants' categorization of and memory for individual exemplars (Bar-Haim, Ziv, Lamy, & Hodes, 2006; Quinn, Yahr, Kuhn, Slater, & Pascalis, 2002). Kovack-Lesh, Horst, and Oakes (in press) further found that 4-month-old infants' responding to the category of cats was jointly influenced by their previous experience and their level of on-line switching. In the present investigation, we examined if this finding was mediated by the alignability of the cat stimuli during familiarization.

**Methods:** Four-month-old infants (approximately half with cats at home) were familiarized in a visual-paired comparison procedure with 6 pairs of different pictures of cats (e.g., Siamese and Tabby). All infants saw 12 unique exemplars during familiarization. Half the infants saw all the stimuli in standing positions and the other half saw some standing, some lying down, and some sitting. All infants then received 2 test trials with a novel within category item paired with a novel out-of-category item (a dog). Because we were interested in the joint influence of infants' previous experience with cats and their amount of on-line switching (as determined by a median split of their average amount of switches during each familiarization trial), infants were divided into 4 groups: Cat/High Switching, Cat/Low Switching, No Cat/High Switching, and No Cat/Low Switching.

**KeyResults:** We calculated preferences scores by dividing the looking time to the novel item by the total looking time to the novel and familiar items for each of the two test trials and then took the average of these two. One sample t-tests comparing infants' average novelty preference scores to chance (.5) revealed that only infants who had cats at home and had high levels of switching during familiarization

significantly preferred the novel item (M = .61, SD = .21), t (20) = 2.35, p < .05, two-tailed.

**Conclusions:** The results replicate the findings of Kovack-Lesh et al. (in press) and also show that the alignability of the stimuli did not interact with the other factors to influence infants' categorization. This study also had additional power compared to Kovack-Lesh et al. and found that it was specifically having a cat at home and not just having a cat or a dog that interacted with their on-line level of switching to influence infant categorization.

**Th2-21**

### Contributions of Mother-Infant Interactions to Concurrent and Later Social Cognitive Reasoning

**Jennifer LaBounty**[1] Henry Wellman[1] Sarah Lopez-Duran[2] Betsy Hamilton[3]

*1. University of Michigan, Ann Arbor, USA; 2. Bard College, Annandale-on-Hudson, USA; 3. NYU, New York, USA*

We examined (a) mother-infant interaction (and proto-conversation) in relation to (b) infant understanding of persons in a laboratory looking-time paradigm. We then examined how (a) and (b) relate to preschoolers theory of mind. Arguably the insights about people evident by infants in laboratory looking-time research are the outcomes, in part, of their interactions with people early in life. Moreover, both mother-infant interaction measures (Meins, et. al., 2002) and infant looking-time measures (Wellman, et. al., 2004, in press) predict later child theory of mind in the preschool years. Yet very little research has compared indices of mother-infant interaction to social-cognitive understanding either concurrently (as indexed by looking-time studies) or longitudinally (as indexed by theory of mind measures).

Eighty-nine 10- to 12-month-old infants participated in an intentional action habituation task (see Wellman et. al., in press) and a mother-infant interaction task which included 5 minutes of free play followed by 30 minutes of teaching/play with novel toys. At age 4, 45 children returned for the Wellman (2004) theory of mind scale.

Results demonstrate a link between the aggregates of quality of interaction and infant socially oriented behaviors (r = 0.34, p < .05) within the mother-infant interaction episodes. Both of these aggregates were also positively related to decrements in attention (see Bornstein, et. al., 1986) during the habituation/familiarization phase of the infant looking time study (quality: r = 0.29, p < .05; socially-oriented: r = 0.25, p < .05). Finally, maternal references to their infants' thoughts positively correlated with theory of mind understanding at age 4 (r = 0.49, p < .05). Future regression analyses will further reveal the direction and strength of these relationships.

Thus we show that the quality and content of mother-infant interactions during the first year of life are related to both concurrent (here operationalized as infant attention to intentional action) and future social cognitive understanding.

**Th2-22**

### Do 8-Month-Old Infants Consider Situational Constraints When Interpreting Others' Gaze as Goal-Directed Action?

**Yuyan Luo**

*University of Missouri-Columbia, Dept. of Psychological Sciences, Columbia, USA*

Some actions of agents are ambiguous in terms of goal-directedness to young infants. If provided with reasons why an agent performed these ambiguous actions, would infants then be able to perceive the actions as goal-directed? Prior results show that infants younger than 12 months cannot encode a human agent's action of looking at an object as goal-directed. In the present experiments, however, 8-month-old infants were found to interpret an agent's action of looking at object-A as opposed to object-B as evidence for her goal directed towards object-A, if it was clear that the agent could only look at the object but not directly approach it, either because a barrier prevented her from doing so, or because her hands were already occupied. The infants therefore expected the agent to continue looking at object-A even when the positions of object-A and object-B were reversed, and were surprised when the agent looked at object-B instead. In contrast, when it was unclear why the agent chose to look at the object when she could use her hands to approach it, the infants did not encode the relationship between the agent's looking behavior and the target of her gaze. As a result, they formed no prediction as to which of the two objects, object-A or object-B, that the agent should look at when the two objects were in reversed positions.

The present results suggest that infants can consider situational constraints when interpreting agents' otherwise ambiguous actions as goal-directed: they realize that within given situational constraints, agents perform these actions as efficient ways to achieve their goals directed towards a particular object. Therefore, at least by 8 months of age, infants are sensitive to reasons why agents choose certain actions to achieve goals. These results thus provide further support for prior findings indicating that infants can attend to why agents select one particular goal-directed action over another under some circumstances.

**Th2-23**

### Perception and Production of Means-End Goal Structures in Eight-Month-Old Infants

**Neha Mahajan**[1] Amanda Woodward[2] Lauren Eisenband[2]

*1. Yale University, New Haven, USA; 2. University of Maryland, College Park, USA*

Adults readily interpret hierarchical action sequences in terms of an ultimate goal, which is critical to discerning others' intentions, allowing us to categorize and interpret novel events and predict future actions based on our perception. Recent findings suggest that infants' understanding of others' means-end actions coincides with the emergence of their own means-end abilities. In a visual habituation paradigm designed to assess infants' interpretation of others' actions as means to an end, 12-month-olds' responses indicated a means-end interpretation (they looked longer if an actor's ultimate goal changed than if her means to achieving that goal changed); in contrast, 10-month-olds' responses suggested a lower level of analysis (Sommerville & Woodward, 2005). Furthermore, 10-month-olds' tendency to interpret others' actions as means to an end correlated with their tendency to produce means-end sequences.

Although these findings indicate a relation between producing and perceiving means-end action structure, they leave open the question of whether there are causal relations between these aspects of development. To address this issue, we tested whether infants' own means-end actions influence their perceptions of others'. We trained 8-month-olds to pull a cloth in order to retrieve a toy. This training increased infants' tendency to produce well-structured means-end actions; they produced more successful attempts post-training than pre-training ($t(11)=2.382$, $p<0.036$). Further, it influenced their subsequent responses to observed means-ends actions in a habituation study. Post-training, infants showed a significant looking-time pattern indicating that they represented the means-end structure of an

observed cloth-pulling event (t(11)=2.747, p<0.02). A control group of infants, who had not undergone training, responded randomly in the habituation paradigm (t(10)=7.96, p<0.445).

Given these results, it remains uncertain whether infants' own actions provided insight into the structure of the observed sequence, or whether instead, infants learned by observing the effects of their actions. To investigate this question, we demonstrated successful cloth-pulling sequences to another group of 8-month-olds, and then tested them in the same habituation paradigm. This group responded randomly (t(10)=3.87, p<0.706), but since infants only saw a handful of successful cloth-pulling sequences, this leaves open the possibility that increasing the duration of the observed sequences might yield results similar to those of the active condition.

These results provide evidence that infants' interpretation of others' actions is supported by developments in their own actions. The nature of this effect (whether it is based on the generation of action plans or the observation of their own actions) requires further study.

**Th2-24**

### 20-Month-Olds Understand What Others Can and Cannot See

**Henrike Moll**[1] Danielle Matthews[2] Michael Tomasello[3]

*1. Institute for Learning and Brain Sciences, University of Washington, Seattle, USA; 2. Max Planck Child Study Centre, Manchester, UK; 3. Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany*

**Background and Aim:** To know what others refer to in communication sometimes requires an understanding of what they can and cannot see. Previous research suggests that children below two years of age might not have such an understanding. In a study by Moll and Tomasello (2004), 18-month-olds did not understand which of two objects they could see an adult could not see because a barrier blocked her view to it. In the current study, a modified version of Moll and Tomasello's (2004) task was used with 20-month-old infants.

**Methods:** Infants (n = 64) were presented with an adult either searching for an object (Search Condition) or excitedly requesting an object from them (Excited Request Condition). There were two candidate objects: one object was visible for the adult (visible object) and the other was hidden from the adult's view by large shelves (hidden object). All infants knew the location of the objects, but only half of the infants could see the objects at test. For the other half of the infants, the objects were placed inside the shelves so they could not see them at test.

**Results:** T-tests revealed that infants who saw the objects at test chose the hidden object significantly more often in the Search than in the Excited Request Condition, $p < .05$. Infants who did not see the objects at test chose the hidden object equally often in both conditions, $p > .6$. Infants generally preferred the visible object (choices of this object exceeded a level of 70 % in three out of four conditions).

**Conclusion:** The results indicate that by 20 months of age, infants possess some understanding of what others can and cannot see. This is the youngest age for which this ability has been demonstrated using active response measures (see Sodian, Thoermer, & Metz, 2007, for positive findings with 14-month-olds using looking time measures). However, infants' visual perspective-taking abilities seem considerably limited at this age. When the adult searched, infants needed to perceive the hidden object in order to counteract their bias for the visible object. It needs to be explored in future studies why visual perspective tasks seem relatively challenging for infants, who show an earlier competence in other social-cognitive domains, such as knowledge regarding what they have experienced with others in the past.

**Th2-25**

### New Measures of Barrier Detour Ability: Developmental Sensitivity in a Cross-Sectional Design

**Julia Noland**, Carol Whaling

*Vanderbilt Kennedy Center and Department of Psychology and Human Development, Nashville, USA*

**Background and Aims:** The emerging ability to retrieve a toy from behind a transparent barrier may reflect development of the frontal cortex (Diamond, 1991). There is evidence of developmental sensitivity of the Object Retrieval task with longitudinally tested infants, but little in cross-sectional designs. In the current study, we investigated the developmental sensitivity of new measures of barrier detour ability. We compared the performance of cross-sectional samples of 9 and 11-month-old infants.

**Methods:** Separate groups of 9 month-old (n=25) and 11-month-old (n=21) infants were recruited. Each infant was presented with six timed trials in which a Plexiglas box formed a barrier to a toy. The toy and box configuration of the six trials included four from the Object Retrieval task and two from prior studies. The complexity of the detour reach required varied based on the position of the box opening (Top Open, Side Open, Front Open) and the position of the toy within the box (Shallow versus Deep). Two trials of each box opening were presented consecutively, with the toy position alternating. Within these constraints, the trial orders were counterbalanced. Trials were coded with frame-by-frame video review. A trial was coded correct if the infant touched the toy within the time limit (20 seconds) and a total number of trials with contact score was given. The first time the infant's hand entered the box and the time of the first contact with the toy were both marked. Latency-to-enter and latency-to-contact scores were calculated. For trials in which there was no entry and/or contact, the latency score was the full 20 seconds.

**Results:** The total trials with contact score for the 11-month-old group (mean = 4.3 trials) was higher than for the 9-month-old group (mean = 2.8 trials), t (44) 4.4, p<.001, Cohen's d = 1.29. The latency-to-enter score for the 11-month-old group (mean = 8.8 sec) was lower than for the 9-month-old group (mean = 12. 5 sec), t (44) 4.2, p<.001, Cohen's d = 1.3. The latency-to-contact score for the 11-month-old group (mean = 9.7 sec) was lower than for the 9-month-old group (mean = 13.2 sec), t (44) 4.3, p<.001, Cohen's d = 1.27.

**Discussion:** The older infants were more successful and faster at beginning the detour around the barrier and contacting the toy. These findings suggest that the new detour ability measures may be useful in investigating delay of executive functioning in at-risk infants even when weekly or bi-weekly assessment is not possible.

**Th2-26**

### Learning Words from Videos: Extension and Disambiguation

**Jason Scofield**[1] Amie Williams[1] Douglas Behrend[2]

*1. University of Alabama, Tuscaloosa, USA; 2. University of Arkansas, Fayetteville, USA*

Though children often learn words from a human speaker, children are known to learn from other sources as well - such as a television or computer video. Unknown however is whether a word learned from a speaker and a word learned from a video are used differently. The current study used two standard word learning tasks, extension and disambiguation, to examine how words learned from videos are used.

Eighteen 2-year-olds completed four trials in each of three conditions (i.e., Baseline, Extension, and Disambiguation). In each condition, 2-year-olds watched a short animated video in which a novel object appeared on a computer screen. The object was labeled with a novel word three times by a prerecorded audio track (e.g., "This is a fep.") and then disappeared. Two additional objects appeared in its place.

In the Baseline condition the two objects included a replica of the original object and a novel distracter and children were asked to select the object that best matched the original novel word (e.g., "Can you find the fep?") In the Extension condition the two objects included a similar example (i.e., exemplar) of the original object and a novel distracter and children were again asked to select the object that best matched the original novel word. In the Exclusivity condition the two objects again included a replica of the original object and a novel distracter and children were asked to select the object that best matched a new novel word (e.g., (e.g., "Can you find the lug?")

Of interest was whether 2-year-olds would: a) successfully a learn word from a video and b) extend and disambiguate a newly learned word. Results indicated that: a) 2-year-olds did reliably learn a word from a video, b) 2-year-olds did reliably extend a newly learned word to a similar object, and c) 2-year-olds did not reliably disambiguate a newly learned word.

Though previous studies have shown that 2-year-olds can learn a word from both a speaker and a video, the current study suggests that the two examples of learning may not be the same. Specifically, when learning from a speaker, 2-year-olds have been shown to both extend and disambiguate a novel word. This was not the case when learning from a video. These results are discussed in terms of children's word learning strategies and the role of a speaker in providing social and contextual cues.

**Th2-27**

### Which Object is Easier For the Agent to Retrieve? Rationality Effects in 16-Month-Old Infants

**Rose Scott**, Renee Baillargeon

*University of Illinois, Champaign, USA*

Infants expect agents to approach their goals via the shortest path available, suggesting that they expect agents to act in a rational or efficient manner (Gergely & Csibra, 2003). The present research examined the scope of infants' concept of efficient action. If two identical copies of an object are available, and one can be retrieved by a simpler sequence of actions than the other, then reaching for the more easily retrievable object is more efficient. The present experiment asked whether 16-month-olds consider this issue when reasoning about goal-directed actions.

During the first two familiarization trials, an agent watched an experimenter place two identical toy pigs onto two identical supports; the agent then pulled a support, grasped the pig, and paused until the trial ended. In the next two familiarization trials, the pigs were placed in identical containers on the supports; the agent pulled the other support and again grasped the pig (establishing that she did not prefer a specific pig). During test, the experimenter placed one pig on a support and covered it with a transparent cover; she then placed a transparent container on the second support and lowered the second pig inside it. The agent then grasped either the support beneath the cover (cover event) or beneath the container (container event) and paused until the trial ended. If infants (1) expected the agent to act efficiently and (2) realized that obtaining the pig inside the container required a simpler sequence of actions (pull support, grasp pig inside container) than obtaining the pig under the cover (pull support, lift cover, grasp pig), then they should expect the agent to pull the support under the container. Infants looked reliably longer at the cover than at the container event, confirming this prediction.

In a control condition, infants saw similar events except that the objects were a toy pig and a toy apple and the agent consistently reached for the apple during familiarization. During test, the apple was placed under the cover and the pig inside the container. Because the apple was the agent's preferred object, infants now expected her to pull the support under the cover, and they thus looked reliably longer at the container than at the cover event.

Together, these results suggest that by 16 months of age infants consider the complexity of an action sequence when evaluating the efficiency of an agent's goal-directed actions.

**Th2-28**

### The Role of Maternal Skills in Infant Pretence at 12, 15 and 18 Months

**Maria Legerstee**, Raluca Barac, **Vanessa Skrainka**, **Giulia Zucal**, **Gabriela Markova**

*York University, Toronto, Canada*

**Background and Aims:** Research shows that by 12-13 months infants are beginning to engage in pretence with their mothers. However, many studies have not separated spontaneous pretence from imitation of pretence of their mother, thereby inflating the infant's ability to pretend. In addition, not much is known about the various maternal skills that may influence pretence in infants. The present study investigated the effect of maternal pretence, maternal imitation and verbal prompts, and maternal mental state language on infant abilities to imitate maternal pretence and to engage in spontaneous pretence with her during the second year of life.

**Method:** Twelve, 15-, and 18-month-old infants (N = 48) were examined in a cross-sectional study. At each age infants interacted with their mothers in two conditions, natural (MN) and experimental play (ME). In ME the experimenter asked mothers to engage in pretence. In MN no instructions were given. Infant play responses were coded for spontaneous pretence and imitation of maternal pretence. Maternal responses were imitation, pretence, verbal prompts and mental state language (emotion, desire, cognition, moral judgment and certainty/uncertainty words).

**Results:** Infant pretence increased with age, while imitation increased from 12 to 15 months, and then decreased. Infants displayed similar amounts of pretence in ME and MN. However, increases in maternal pretence boosted infant imitation of pretence at all ages. Maternal prompts did not have an effect on infant responses in the MN condition, but in the ME condition it increased child pretence at 18 months. Exposure to certain mental state words related to infant pretense at all ages.

**Discussion:** The findings are interpreted to suggest that during the second year of life infant pretence is influenced by maternal pretence and mental state words and that infant imitation is a mechanism that facilitates pretence in toddlers.

Th2-29

## Shaking Things Up: Young Infants' Use of Sound Information for Object Individuation

**Tracy Smith**, Teresa Wilcox

*Texas A&M University, College Station, USA*

**Background and Aims:** Object individuation, the capacity to determine whether two perceptual encounters belong to the same object or two different objects, is one of our most basic cognitive abilities and provides a foundation for infants' understanding of the physical world. Wilcox et al. (2006) were the first to investigate infants' use of sound information to track the identity of objects. The results obtained with a violation-of-expectation task suggested that 4.5-month-olds use sound information to individuate objects, but that they are more sensitive to some types of sounds (property-rich) than others (property-poor). The present research sought converging evidence for these findings use a search task.

**Methods:** Infants aged five to seven months sat in a parent's lap and were presented with an occlusion sequence involving an experimenter shaking an object during which it produced a sound, sliding the object across a platform through an occlusion behind a fringed screen, then sliding it to the opposite edge of the platform, and shaking it a second time, producing a second sound. After the occlusion sequence, the platform was pushed forward, and infants were allowed to search. Infants were tested in one of three conditions: (1) **property-rich sounds**, those intrinsically tied to the object's physical properties, (2) **property-poor sounds**, electronically produced sounds ambiguously tied to the object, or (3) conjugate, property-poor sounds, that were electronically produced and temporally synchronous with the object's motion. The conjugate condition controlled for the possibility that infants were sensitive to the property-rich or property-poor distinction between the sound types of Experiments 1 & 2 rather than sounds simply being conjugate or nonconjugate with the object's motion. The session was video-taped and later coded to analyze infant actions directed towards the object and the screen. If infants used the two different sounds to individuate, they were expected to search more towards the fringed screen for a second, hidden object, than reaching towards the object-in-view.

**KeyResults:** The infants in the property-rich condition spent significantly more time reaching towards the screen than the visible object, suggesting that they perceived two objects involved in the different-sounds event, with one hidden behind the screen. In contrast, infants in the property-poor condition reached equally to the screen and the object, suggesting an ambiguous interpretation and failure to individuate. Infants in the property-poor, conjugate condition, reached equally towards the screen and the object, suggesting that they failed to individuate based on different property-poor sounds, as in Experiment 2.

**Conclusions:** The current results suggest that infants' ability to individuate objects using sound depends on how closely the sound is related to the object's physical properties, not just temporal synchrony with the object's motion.

Th2-30

## Infants' Sensitivity to Geometric Features of Path in Spatial Events

**Lulu Song**[1] Rebecca Seston[2] Weiyi Ma[1] Wendy Shallcross[3] Roberta Golinkoff[1] Thomas Shipley[3] Kathy Hirsh-Pasek[3]

*1. University of Delaware, Newark, USA; 2. Boston University, Boston, USA; 3. Temple University, Philadelphia, USA*

Finding event boundaries is central to how we navigate our world and represent it through language. Path, one component of an event, refers to the trajectory a figure takes relative to a ground or reference object (Talmy, 1985). For example, in "The dog is running out of the house," the dog is the figure, the house is the ground object, and the path is out of the house. Path is a critical construct, expressed universally, in verbs (e.g., to climb) and prepositions (e.g., over). Perceiving paths may also contribute to an understanding of the causal direction of events. Thus, path may be a primary "bottom-up" tool for carving events into usable units that will form the basis of early language. But how do infants find the units in events?

Adults segment events by detecting spatiotemporal geometric features, such as "path curvature extrema," i.e., large changes in motion direction (Shipley & Maguire, in press). Would infants prove sensitive to geometric information like curvature extrema in deciding whether they are viewing a single event or an event with two components? Infants (7-9; 10-12; 13-15 months) were habituated in silence to a single or two-part event. In the single event, a yellow ball moved on a path across the screen resembling a gentle waving arc; in the two-part event, the yellow ball moved on a bumpy path with a curvature extremum, i.e., two curves joined by a cusp point. Following habituation, and in counterbalanced order, all infants saw two new events: One with a single path and one with a two-component path.

Looking times in the last three habituation trials, the same-type and the different-type test trials were compared (Bornstein, 1985). Results showed that the oldest group reliably dishabituated to the new path of a different type at test while the middle age group dishabituated to the new path of the same type. The youngest group showed no dishabituation at test. Thus, the two oldest groups were sensitive to curvature extrema that often mark the boundaries of motion events or subevents.

This work has the potential to illuminate how infants come to carve the world into event units, prior to developing sensitivity to actor intentions (Baldwin et al., 2001). Although other research has begun to probe how infants evaluate different types of events with paths (e.g., Lakusta's work), understanding how they find events at all is foundational information.

Th2-31

## Toddlers Use Disjunctive Syllogism and Fast-Mapping to Learn Multiple Novel Labels in a Single Session

**Chad Spiegel**, Jennifer Zosh, Justin Halberda

*The Johns Hopkins University, Baltimore, USA*

Children as young as 3 years old appear to use the logical inference Disjunctive Syllogism to motivate the mapping of a novel label to a novel object (Halberda 2006). That is, children presented with a known and a novel object will point to the novel object upon hearing a novel label. Although evidence suggests that children in such situations can use Disjunctive Syllogism to decide where to point, it remains open whether performing this computation just once, within the context of

a single experimental trial, actually forms a stable word-object mapping. In other experimental contexts children can â¤œfast map,â¤Ω to rapidly learn new words given minimal exposure (Carey, 1978; Mervis & Bertrand, 1994; Jaswal & Markman, 2001). But these fast-mapping demonstrations used ostensive naming rather than requiring children to make a logical inference. Here we asked: when children perform Disjunctive Syllogism, are they also fast-mapping, such that a single trial can support maintenance of an enduring word-object pairing?

We tested the speed and accuracy by which 2.5-year-olds can learn multiple novel words in an ambiguous setting during a single test session. Children saw images of familiar and novel objects on computer screens. On ambiguous naming trials, one familiar and one novel object appeared and a voice asked the child to â¤œpoint at the [e.g. dax].â¤Ω Following label onset, children had a total of 3 seconds in which to infer and point to the correct object, after which time the objects disappeared and a new trial began. Six different novel target objects appeared over the course of 28 trials along with a number of unnamed novel objects and both labeled and unlabeled known objects. Each novel object appeared only once during the study and no feedback was given. On the post test trial, all 6 previously seen novel targets appeared and children were again asked to, â¤œpoint at the [e.g. dax].â¤Ω This trial assessed whether children had in fact learned the names of the novel targets from the single 3-second exposure. Results suggest that not only can children fast-map novel labels to novel objects after a minimal amount of experience, but that children can also learn multiple novel words in this manner over the course of a single test session.

**Th2-32**

### Searching the Object Attended or Ignored By the Others: Efficient Search For Ignorance By the Young Chimpanzees (Pan Troglodytes)

**Masaki Tomonaga**, Tomoko Imura

*Primate Research Institute, Kyoto University, Inuyama, Japan*

**Background and Aims:** From the comparative-developmental perspective, many studies have been conducted to address the question whether and how nonhuman primates perceive and recognize the other's gaze (or attentional states). However, most of the studies involved the gaze (attention) toward the observer. Few studies addressed how they process the other's gaze or attention directed not to the observer but to the other person or object. In the present studies, we tested this issue with the young chimpanzees under the laboratory context.

**Methods:** Three young chimpanzees (*Pan troglodytes*) aged at 5-7 years old participated in the visual search experiments. They lived in a captive community with their own biological mothers and other community members. They had long experiences of computer-controlled cognitive experiments since they had been 1-2 years old. In each trial, LCD display presented the several pictures, one of which was assigned as target. Chimpanzees were required to touch the target picture to obtain the food reward.

**Results and Discussion:** In the first experiment, the target object and distractor objects were held by the familiar humans in the search display. In one condition, the target object was gazed at by the holder while the distractors were ignored by them, and vice versa in the other condition. All the three chimpanzees exhibited efficient search for the ignored object among attended distractors than attended target among ignored distractors. This efficient detection of ignored object is replicated in the two subsequent experiments. In the last experiment, chimpanzees were required to find the front-view person with object among persons attending to or ignoring the object. Participants found the target faster when the distractor persons were ignoring the objects than when they were attending to them. These results may suggest that expectancy violation concerning the other's attentional behavior captures the young chimpanzee's attention.

**Th2-33**

### Predictive Gaze to Novel Animate and Inanimate Entities in Adults and Infants

**Tania Tzelnic**, Valerie Kuhlmeier, Sarah Latimer, Randy Flanagan

*Queen's University, Kingston, Canada*

**Background and Aims:** Recent eye-tracking research has suggested that infants and adults will look predictively towards an action's end state when the actor both (1) appears human, and (2) is engaged in a repetitive action task such as stacking blocks (FalckYtter et al, 2006; Flanagan & Johansson, 2003). That is, when watching human actions, observers' eyes tend to proactively saccade to the end state prior to the completion of the action. We extend these findings by examining the gaze patterns of adults and infants to novel, computer-animated stimuli that are typically interpreted as being animate and goal-directed or inanimate and non-goal-directed (e.g., Kuhlmeier et al. in prep).

**Methods:** 32 adults and 11 12-month-old infants watched videos presented on a Tobii eye-tracker. In the two Animate conditions, participants first saw 6 familiarization trials in which an animate red ball approached one of two possible objects. At the end of 6 trials, the locations of the two objects were switched, and half of the participants saw 6 more trials in which the red ball approached the same object as it had in familiarization, and half saw it approach the other object. All events in the inanimate condition were the same, except that the red ball appeared inanimate.

**Results and Discussion:** Adults and infants looked predicively toward the end states of both entities, irrespective of animacy cues. However, systematic "errors" in prediction reveal that participants encoded the end states differently across the conditions. Adults in the animate condition perseverated on the red ball's previous end state, even when the location of this object had changed; suggesting that they had encoded the ball as going towards a particular goal ($\chi$ (1) = 5.53, p = .02). However, adults who saw the inanimate red ball, however, did not exhibit the pattern of results, looking instead to the location the red ball was approaching, irrespective of which object was now at that location (8/16 adults looked towards the new goal). Preliminary data from the infants in the animate condition suggest that they may show a similar pattern as adults, with 2/5 infants making the same adult "error" in looking incorrectly at the ball's previous end state even when the location of this end state had changed. These data suggest that infants and adults encode the end states of actions differently based on whether the actor appears to be animate or inanimate.

**Th2-34**

### One or Two Humans? 10-Month-Olds' Use of Ontological and Featural Information to Individuate Objects

**Di Wu**, Renee Baillargeon

*Dept. of Psychology, University of Illinois at Urbana-Champaign, Champaign, USA*

When two different human-like objects emerge successively from behind a screen, which is then removed to reveal a single human-like

object, 10-month-olds fail to detect this violation; infants do succeed, however, when a human-like and a non-human object are used (Bonatti et al., 2000). One interpretation of these findings has been that infants encode ontological but not featural information about the objects; hence, in the first scenario, infants do not recognize that two different objects are present. However, another interpretation is that infants encode both ontological and featural information about the objects, but can only map the ontological information from the first (occlusion) to the second (post-occlusion) event. The present research tested this alternative interpretation.

In Experiment 1, 10-month-olds saw two different objects emerge successively from behind a screen. These objects consisted of a toy head on an identical support. There were either two different human heads (e.g., a black and a white human; different-human condition), or an animal and a human head (e.g., a rabbit and a white human; animal-human condition). Next, the screen was lowered to reveal a single human-like object (e.g., the white human). Results replicated Bonatti et al. (2000): infants in the animal-human condition looked reliably longer than those in the different-human condition, and this and control results suggested that infants in the different-human condition failed to detect the violation they were shown.

Experiment 2 examined whether the infants in the different-human condition failed because they did not encode the featural differences between the two humans, or because they could map ontological but not featural information from the first event to the next. One condition was identical to the different-human condition in Experiment 1 except that when the screen was lowered, a second, transparent screen was revealed; the single human-like object stood behind this transparent screen. Because a screen was still present, infants faced an ongoing occlusion event, so any featural information they had encoded should still be available (e.g., Wilcox & Chapa, 2002). In another condition, the same human appeared on both sides of the screen (same-human condition). Infants in the different-human condition looked reliably longer than those in the same-human condition, and this and control results suggested that infants in the different¨Chuman condition now detected the violation they were shown.

Together, these results provide evidence that young infants may be able to map ontological but not featural information from one event to another.

**Th2-35**

### Attention to Features in Object Labeling

**Rachel Wu**[1] David Rakison[2]

*1. Centre for Brain and Cognitive Development, Birkbeck College, University of London, London, UK; 2. Carnegie Mellon University, Pittsburgh, USA*

**Introduction:** Previous studies have demonstrated that young children attribute the same name to objects with the same overall shape (i.e., placing them in the same lexical category), despite differences in other attributes (Landau et al., 1988). Research with non-lexical categorization, however, shows that infants do attend to parts of objects, such as wheels and legs (Rakison & Butterworth, 1998). This study investigated (in infants and adults) whether this part-bias also exists in lexical categorization.

**Method:** Participants saw four counterbalanced object-sets, consisting of one exemplar and four test objects. Exemplars had distinct parts, bodies, and global shapes. Test objects varied from the exemplar in parts, part location, and body. There were four trials, one per object set, consisting of 1) an exploratory phase, which introduced the participant to the exemplar, the test objects, and the novel label associated with each exemplar (e.g., "Dax"), and 2) a test phase. During the test phase, infants (fourteen 16-month-olds and six 24-month-olds) were prompted to hand the experimenter another 'Dax'. Order of the objects handed over was recorded. For adults (44 undergraduate students), the experimenter presented the test objects and labeled them A-D. Participants ranked the objects and indicated the objects they considered also to be a 'Dax'. The first letter written down was included in the final analysis.

**Results:** 16-month-olds showed no differences between objects. 24-month-olds handed over objects without parts significantly less often than those with different part locations, $t(6) = 3.46$, $p = .02$ and different parts, $t(6) = 2.91$, $p = .03$. Marginal effects were noted for objects with different part locations, different parts, and different bodies. Adults selected objects with different part locations significantly more than those with different bodies, $t(44) = 11.82$, $p < .01$, different parts, $t(44) = 3.52$, $p < .01$, and no parts objects, $t(44) = 13.92$, $p < .01$. Adults also first chose those with different parts more frequently than objects with different bodies, $t(44) = 6.12$, $p < .01$ and objects without parts, $t(44) = 6.99$, $p < .01$.

**Conclusion:** The homogeneity of choices in 16-month-olds, along with the selective choices in 24-month-olds and the clear choices in adults, provides evidence of a developmental trajectory based on attention to multiple attributes, including global shape, body, and parts of objects. Maturation may allow word learners to categorize objects based on compounding multiple cues, in this case, of shapes, bodies, and parts.

**Th2-36**

### Limits on Infants' Ability to Update Working Memory Representations

**Mariko Yamaguchi**, Lisa Feigenson

*Johns Hopkins University, Baltimore, USA*

Infants can update the status of object arrays even when those arrays are out of sight. For example, after seeing 1 object hidden behind a screen, then another 1 added, infants expect to see 2 objects when the screen is lifted (Wynn, 1992). Such tasks show that infants can update a set in memory as long as they maintain attention to that set (e.g., when 1 + 1 objects are placed behind a single screen). However, events in daily life are less predictable; one might attend to toys in a basket, shift attention to toys on the bookshelf, then shift attention back when a new toy is added to the basket. Can infants update their representation of the basket while still maintaining the representation of the toys on the bookshelf?

Here we compared infants' ability to update objects currently held in their focus of attention, and their ability to update objects once attention has moved on to a different location. Eleven-month old infants saw 3 objects hidden behind 2 screens. In Experiment 1, objects were hidden such that infants did not need to shift their attention back to a previously attended location (i.e., 1 object behind Screen A, a 2nd object behind Screen A, 1 object behind Screen B). When both screens were simultaneously lifted, infants looked significantly longer when a total of only 2 objects (10.2 seconds) were revealed than when 3 were revealed (8.2 seconds), showing that they successfully maintained their representation of what was behind each screen. In Experiment 2, object number and presentation duration were identical to those in Experiment 1, but objects were hidden in alternation (i.e., 1 object behind Screen A, 1 object behind Screen B, a 2nd object behind Screen A). In this case, when attention was shifted away from a stored representation before the update was performed, infants did not discriminate the two outcomes (8.0 seconds at 2 objects, 9.2 seconds at

3). Experiment 3 ruled out low-level causes for this failure by showing infants objects hidden at 3 locations, yet requiring no shifts of attention back to a previously attended location.

Collectively, these results suggest that although infants can update object representations in working memory, this ability is limited. Eleven-month old infants can update representations currently held in the focus of attention, but cannot update their representation at the first location once attention has moved on elsewhere.

**Th2-37**

## Prior Animal Exposure Impacts Infants' Attention to Specific Animals in a Preferential Looking Task

**Barbara Younger**[1] Kathy Johnson[2] Kerry Shaver[1] Nicole Pikaard[1]

*1. Purdue University, West Lafayette, USA; 2. Indiana University Purdue University Indianapolis, Indianapolis, USA*

A long-standing question in the field of infant cognition has been the degree to which prior experience impacts infants' performance in laboratory tasks. Previous approaches to the question have been correlational in nature (Kovack-Lesh, et al., 2005) or have employed a context-setting manipulation in the lab immediately prior to task administration (Mareschal & Tan, 2007). In this study, we adopted a more naturalistic approach by inviting parents and infants to participate in 1 of 4 classes offered in conjunction with zoo educators. Infants then participated in a preferential looking (PL) task involving static pictures of animals and vehicles. Testing took place either immediately following the zoo class (immediate test; IT) or 24 hours later (delayed test; DT). In light of debates over the global or basic nature of infants' concepts (Rakison & Oakes, 2003), we included specific animal contrasts as well as animal-vehicle contrasts in the PL test.

Participants were 20 13-month-old infants. Subsequent to their exposure to 1 of 4 target animals in the zoo class, infants were tested individually using a laboratory PL procedure. Across 2 blocks of 4 trials, infants were presented with 2 animal-animal contrasts (hedgehog-cockatoo, ferret-tortoise) and 2 animal-vehicle contrasts (horse-tractor, goose-boat). Roughly equal numbers of infants attended classes featuring each of the four target animals, thus each animal-animal pair served equally often as "trained" and "untrained" contrasts in the PL task.

Analyses were performed on percentage scores derived from looking time data. Our primary interest was in the comparison of "trained" and "untrained" animal contrasts. An ANOVA revealed only a main effect of contrast, $F(1, 16) = 9.71$, $p < .01$. Regardless of the timing of the test, infants distributed their looking equally across the animals in the "untrained" contrast (*M*s = .51 and .48 for the IT and DT groups), but exhibited a reliable preference for the target animal (from their zoo class) in the "trained" contrast; *M* [IT] = .57; *M* [DT] = .62. Results pooled across the animal-vehicle trials differed significantly for infants in the IT and DT groups, though neither mean differed significantly from chance; *M* [IT] = .54, *M* [DT] = .43.

Animal exposure in a "zoo class" does impact infants' subsequent allocation of attention in a laboratory task, even after a 24-hour delay. The nature of the effect was quite specific in biasing infants' attention toward the kind of animal introduced in the class the child attended.

**Th2-38**

## Beyond Vocabulary Checklists: Parental Reports of Cognitive Development

Merideth Gattis[1] **Elena Sakkalou**[1] **Elena Hoicka**[2] Katie Alcock[3] Merideth Gattis[1]

*1. School of Psychology, Cardiff University, Cardiff, UK; 2. University of California, Santa Cruz, USA; 3. Department of Psychology, Lancaster University, Lancaster, UK*

Parent report measures such as the Communicative Development Inventory have been a successful method to learn about infants' and toddlers' language development. The advantage of parental reports is that they can reveal aspects of infants' and toddlers' development which would otherwise be difficult to capture in a laboratory environment due to factors such as behaviors being rare, children being shy, and equivalent testing taking too long. Parental reports need not, however, be confined to vocabulary. In the current symposium, three new studies from three different labs use parental report measures in order to investigate infants' and toddlers' cognitive abilities in a variety of contexts.

Sakkalou, Perra, and Gattis looked at the copying behavior of 14 to 18 month old infants through a questionnaire and compared this parental report of spontaneous imitation to a measure of elicited imitation in an intention understanding task. The results suggest that infants' with higher spontaneous imitation also perform well on the intention understanding task. Hoicka and Akhtar found that 25-30-month-olds make jokes (a socio-cognitive process), and tend to laugh and look for a reaction when doing so. Furthermore, Hoicka and Akhtar found that parent reports of toddler humor production did not reflect McGhee's (1979) stages of humor development, but did show developmental trends in the diversity of joke types used by toddlers.

The discussion will evaluate these results in comparison to vocabulary measures (Alcock, 2007), and other parent report measures of cognitive development (Baker et al., 2007).

Together these two studies demonstrate that parent reports can be used to learn about more than vocabulary. In particular, parental reports can be used to obtain thorough and detailed information about infants' and toddlers' cognitive development.

**Th2-39**

## Beyond Vocabulary Checklists: Parental Reports of Cognitive Development

**Elena Sakkalou**, Oliver Perra, Merideth Gattis

*School of Psychology, Cardiff University, Cardiff, UK*

**Background and Aims:** Several types of social learning have been proposed to play a role in the development of humans, including imitation and mimicry. Imitation refers to occasions when an observer copies the actions of another selectively, based on an understanding of the intentions of the actor, whereas mimicry refers to occasions when an observer copies the actions of another with precision, but without an understanding of the intentions of the actor.

The present study utilised a parent report form to assess the occurrence of different imitative and mimicking behaviours by children, as well as parental contribution to these behaviours. The primary aim of the study was to evaluate the external validity of a subscale of the inventory, Tendency to Imitate, by comparing parent report on that subscale with infant performance on an experimental measure of intention understanding.

**Methods:** Parents filled out the questionnaire which included information about infants' facial and vocal expression, bodily gestures and

actions on objects. Infants also took part in an intention understanding task that uses imitation as a dependent measure.

**Results:** The results suggest that the ability to imitate correlates with other abilities such as the ability to mimic, and also awareness of imitation and parental encouragement. The results also showed a relationship between parental report of imitation and actual imitation performance on the intention understanding task.

**Discussion:** Developmental research has not always clearly distinguished between imitation, mimicry, and thus we do not have a clear understanding of the contribution of each of type of social learning to cognitive development. Understanding the developmental contribution of the different types of social learning is important not only for a better theoretical understanding of cognitive processes, but also because it has many potential benefits for educational and therapeutic approaches for both typically and atypically developing children.

**Th2-40**

### Beyond Vocabulary Checklists: Parental Reports of Cognitive Development

**Elena Hoicka**, Nameera Akhtar

*University of California, Santa Cruz, USA*

Toddlers have a socio-cognitive appreciation of others' humor from 2 years (Hoicka & Gattis, in press). However there is little empirical research on toddlers' humor production. McGhee (1979) proposed 3 stages of toddlers' humor production; however these have no empirical support. As humor production is difficult to elicit in a lab, we asked parents whether and what kinds of jokes toddlers produce and the cues toddlers give to indicate they are joking.

All parents of 21 25-30-month-olds reported that their toddlers had joked. Seventeen had engaged in action-based (e.g. silly walking) and 16 in verbal (e.g. mislabeling) humor. Mapping to McGhee's stages, nine had purposefully misused objects (Stage1, e.g. putting underpants on head), 11 had purposefully mislabeled (Stage2, e.g. calling water "milk"), and 13 had described conceptual incongruities (Stage3, e.g. dinosaurs eat the wall). Eleven toddlers' data were consistent with McGhee's stage order (Stage1 preceding Stage2, preceding Stage3). McGhee predicted Stage1 humor at 18 months, Stage2 at 2 years, and Stage3 at 3 years, thus most toddlers in this study should have produced Stages 1 and 2, but not 3. McGhee's age predictions were consistent with only one child. Older toddlers produced significantly more kinds (stages) of humor than younger toddlers ($F_{1,19}=5.49$, $p=.030$. Most common cues to joking included laughter (13) and reaction-seeking (12).

By 2 years toddlers produce jokes. Fewer than half of toddlers' humor production was consistent with McGhee's stage order, and only one child followed McGhee's age predictions. These results suggest that McGhee's stages do not accurately portray toddlers' humor production. However age was related to the overall number of stages toddlers produced, suggesting developmental trends towards joke diversification. Parents tend to use laughter and reaction-seeking to interpret toddlers' actions as jokes, the latter of which suggests that toddlers see joking as a social process.

## *Communication and Language*

**Th2-41**

### The Acquisition of Phoneme Categories in Bilingual Infants: New Data From a New Paradigm

**Barbara Albareda**[1] Ferran Pons[1] Núria Sebastián-Gallés[1,2]

*1. Grup de Recerca Neurociència Cognitiva, Universitat de Barcelona, Esplugues, Spain; 2. Parc Científic de Barcelona, Esplugues, Spain*

**Background and Aims:** Previous research has shown bilingual infants' acquisition of certain native phonetic contrasts follows a U-shaped pattern. It is characterized by the absence of a discriminatory response at 8 months of age that is regained at 12 months (Bosch & Sebastián-Gallés, 2003). In the present study we further explore this lack of discrimination. For this purpose we adapted the anticipatory eye movement methodology (McMurray & Aslin, 2004) to investigate phonetic discrimination.

**Method:** In experiment 1, sixteen 8-month-old infants were tested on the discrimination of /e-u/, a vowel contrast distinguished by infants at this age (Bosch & Sebastián-Gallés, 2005). Infants were exposed to a visual stimulus that hides behind a T-shaped occluder and re-emerges to the top right or top left of the occluder predicted by the auditory stimulus played simultaneously ([deð] or [duð]). Looking times to the correct and incorrect side of reappearance were measured while the visual reinforcer was occluded. To appraise discrimination, we assessed infants' ability to anticipate the re-emergence of the visual reinforcer. The experiment was divided in three blocks. If learning to anticipate the reinforcer takes place it should be observed in the last block. Thus, infants' performance should show improvement between the first and the third block of trials.

In experiment 2, 8-month-olds from Catalan (n=16), Spanish (n=16) and Catalan-Spanish bilingual (n=16) families were tested on the Catalan /e-ɛ/ vowel contrast. 8-month-old bilingual infants did not show a discriminatory behaviour with this contrast in previous studies (Bosch & Sebastián-Gallés, 2003).

**Results:** Experiment 1 demonstrated that infants anticipated the re-emergence of the reinforcer in the last block of the experiment. In experiment 2 only infants from Catalan and bilingual environments were able to anticipate the reinforcer in the third block of the experiment. This learning reveals their ability to discriminate the Catalan vowel contrast. Spanish infants did not achieve learning in this last block, showing no evidence of discrimination.

**Conclusions:** The results of experiment 1 evidence that our adaptation of the anticipatory eye movement paradigm is useful to study phonetic discrimination in infants. The results of experiment 2 indicate that 8-month-old bilingual infants being tested with a more sensitive technique show discrimination of the Catalan /e-ɛ/ contrast. These results add another piece of data to the current understanding of bilingual acquisition.

Th2-42

## Computer-Based Receptive Language Training for Infants

Joseph McCleery[1,5] Mikaela Kinnear[2] **Karen Burner**[3] Aubyn Stahmer[4] Leslie Carver[2] Rita Ceponiene[2] Laura Schreibman[2]

*1. Children's Hospital Boston, Boston, USA; 2. University of California, San Diego, La Jolla, USA; 3. University of Washington, Seattle, USA; 4. Rady Children's Hospital, San Diego, San Diego, USA; 5. Harvard Medical School, Boston, USA*

**Background and Aims:** The results of several studies indicate that infants 15 months old, but not younger, can be trained to associate pictures of objects with words in as few as 12 pairings using a computer training program (Schafer & Plunkett, 1998). It has been suggested that these findings reflect an emerging mnemonic capacity that supports the receptive language burst that typically occurs between 16 and 20 months of age. However, language learning requires *long-term* memory and previous studies have assessed picture-word association memory *immediately* following training; so, it is not clear that this previously observed mnemonic capacity can truly support language learning. Here, we assess long-term memory for object-word associations following intensive computer-based training in 15-month-olds.

**Methods:** The MacArthur-Bates Communicative Development Inventory and the Reynell Language Scales were used to identify known and unknown words for each infant. Then, matched sets of unknown words equated for frequency, age typically learned, class (e.g., vehicle, animal), and phonological complexity were randomly assigned to training (4 words) and non-training control (4 words) conditions. Using a within-subjects design, preferential looking was then used to assess knowledge of picture-word associations separately for known, trained, and non-trained control words both before and 24 hours or more after intensive computer-based training.

**Results:** For known words, infants spent significantly more time looking at the picture that matched versus mismatched the word presented during the preferential looking task (mean = 0.15, s.e. = 0.06, $p<0.05$). Before training there was no difference in the time spent looking at the matching versus mismatching picture for the training versus non-training control words (training mean = 0.03, s.e. = 0.08; non-training mean = 0.01, s.e. = 0.11; $p=0.42$). However, following training there was a significant difference in the time spent looking at the matching versus mismatching picture for training versus non-training words (training mean = 0.14, s.e. = 0.05; non-training mean = -0.03, s.e. = 0.08; $p<0.05$).

**Conclusions:** These results provide evidence that 15-month-old infants remember associations between objects presented in pictures and their auditory labels over long intervals following intensive computer-based training. These data provide support for the hypothesis that developmental changes in basic mnemonic abilities may support the vocabulary spurt that occurs during the second year of life. The current paradigm may prove fruitful for the assessment and treatment of infants with language-learning difficulties, including infants with autism and infants with receptive language delays.

**Support:** Cure Autism Now (PI: Schreibman).

Th2-43

## The Alignability of Events Influences Verb Learning

**Jane Childers**

*Trinity University, San Antonio, USA*

A central problem in verb acquisition is deducing how a particular verb is used to refer to specific aspects of an event. Children could use information available across situations by structurally aligning and comparing them (e.g., Gentner, 1983; 1988). These studies examine whether children are influenced by the extent to which events can be aligned.

In Study 1, alignability was manipulated by varying the similarity of objects across events. Twenty 2 1/2-year-old children were shown 2 sets of events with very similar objects (Close comparisons) and 2 with more varied objects (Far); order of Close and Far sets was counterbalanced. In each set, children saw an initial event and then were shown 3 comparison events. Test objects included a highly similar object (Close response), a more varied object (Far response), and a distractor.

A repeated measures ANOVA with Order (Close First, Far First) as a between-subjects factor, and Set (Close, Far) and Response type (Close, Far, Distractor) as within-subjects factors (dependent measure: proportion of responses) revealed an effect of Response type, $F(1, 18) = 15.57$, $p=.001$, a Set by Response type interaction, $F(1, 18) = 6.45$, $p< .03$, and a Condition by Set by Response type interaction, $F(1, 18) = 6.74$, $p< .02$. Post-hoc tests showed that, as predicted, children were influenced by the type of comparison events they saw, and experience with similar objects influenced responses on varied sets.

In Study 2, 36 2 1/2-year-old children saw alignable events (same number of elements), less alignable (different number of elements across events) or a control condition (single event). Each set (of 4) had a target event and 3 comparison events. At test, children were given a new object to reproduce the result (extension) and a distractor.

A repeated measures ANOVA with Condition (Alignable, Less alignable, Control) as a between-subjects factor, and Response type (extension, distractor) as a within-subjects factor revealed a main effect of Response type, $F(1, 33) = 52.85$, $p<.001$ and a significant Condition by Response type interaction, $F(2, 33) = 5.04$, $p< .02$. Post-hoc tests showed that, as predicted, there were significantly more extensions in the alignable than in the less alignable condition ($p< .05$), and more distractor responses in the less alignable condition than in the other conditions.

Two studies examine the structural alignment and comparison view, which may be an important mechanism in verb acquisition.

Th2-44

## Temperament Moderates Novel Word Learning at 15 Months

**Wallace Dixon, Jr.**[1] Allison Lowe[2] Betsy Caldwell[1] Hannah Lawman[3] Andrea Clements[1]

*1. East Tennessee State University, Johnson City, USA; 2. East Tennessee State University, Bristol, USA; 3. University of South Carolina, Columbia, USA*

Researchers have been reporting temperament-language correlations in infants for 10 years. However, in order to identify directions of effects between temperament and language, methodologies besides correlations need to be developed. The "competition attention paradigm" is an effort to sidestep some of the direction-of-effect issues by asking infants to learn novel words in the context of environmental distractions designed to tap into children's temperaments. The purpose of the present study was to explore whether environmental

distracters would differentially impact 15-month-olds' novel word-learning as a function of children's temperamental profiles.

Twenty-eight 15-month-olds were asked to learn 4 novel words. Novel word learning consisted of initially familiarizing children with two novel objects, and then mapping a novel label to only one of the novel objects five times. Novel word comprehension was tested by asking children to select the newly-labeled object from the pair of novel objects across 4 test trials. A remotely-controlled mechanical spider competed for children's attention during object familiarization on two of the words. Half the children were distracted on the first two words, half were distracted on the last two. Temperament was assessed via parental reporting using the Early Child Behavior Questionnaire.

The environmental distractions did not impact children's word-learning directly. However, order of distraction presentation did [$F(1, 23) = 7.16$, $p = .014$], such that children who were distracted on the first two words performed higher overall than children who were distracted on the last two. Results involving temperament were complex, yielding many significant interaction effects with factors impacting children's word-learning. For example, children high in fear demonstrated better word-learning in the absence of the spider than in its presence, whereas the spider had no effect on low-fear children, but only when learning the first word in the pair [$F(1, 23) = 5.20$, $p = .032$]. Other temperament factors found to impact novel word-learning included attentional focus, cuddliness, impulsivity, frustration, and high intensity pleasure.

The results of the present investigation contribute to a growing body of research linking temperament to word learning. The competition attention paradigm suggest ways through which word learning may be impacted by dimensions of temperament. Although not presentable here due to space limitations, the pattern of results also points to attentional focus as playing a central moderating role over other dimensions of temperament. Finally, the present results are the first to link temperament to language acquisition at 15 months.

**Th2-45**

## Temperament Moderates Responsiveness to Joint Attentional Bids at 11 and 14 Months

**James Todd**[1] **Wallace Dixon, Jr.**[2]

*1. University of Toledo, Toledo, USA; 2. East Tennessee State University, Johnson City, USA*

An increasing number of researchers have begun to identify relationships between dimensions of infants' and toddlers' temperament and their language development. Proclivities to engage in joint attention have also been implicated in children's language development. The purpose of the present investigation was to explore whether aspects of children's temperament typically associated with linguistic performance could be observed to moderate the joint attentional responsiveness of 11- and 14-month-olds in a controlled laboratory setting.

Forty-seven infants (22 females, 25 males) were drawn from a larger study investigating infants' gaze-following abilities, and included 25 11-month-olds and 22 14-month-olds. In a laboratory setting, two identical objects were placed on opposite sides of the room to the right and left of the infant, respectively. Colorful shower curtains served as background contexts for the objects, and differed in pattern. Experimenters looked at either the right or left object, and infants were scored as to whether they followed the gaze of the experimenter during 1) an initial training phase of 8 trials, and 2) a subsequent testing phase of 8 more trials. Background contexts were switched for half the children during test trials.

Temperament played a considerable role in moderating children's gaze-following at both ages, contributing to 15 significant interactions with factors affecting gaze-following. At 11 months, gaze-following was primarily associated with temperament dimensions reflecting surgency and executive control. For example, perceptual sensitivity, a subcomponent of surgency, entered into a significant 3-way interaction [$F(1, 21) = 8.00$, $p = .010$] with training phase (initial versus test) and contextual condition (familiar versus novel). Evaluation of the means vis-à-vis post hoc comparisons indicated that children high in perceptual sensitivity decreased their gaze-following over time in both contexts, whereas children low in perceptual sensitivity exhibited a decrease in gaze-following in only the familiar context. At 14 months, in contrast, negative affectivity was primarily involved. Here, low negative affect children exhibited less gaze-following than high negative affect children during the novel test condition, but the reverse obtained in the familiar test condition [$F(1, 18) = 4.56$, $p = .041$].

Our results provide additional evidence of the utility of taking children's temperament into account when exploring their language development. These findings fit within a model of language development in which children's temperament influences their language development, at least in part, by virtue of its impact on children's responsiveness to joint attentional bids.

**Th2-46**

## A Phonological Account of Place of Articulation in Early Word Production and Perception

Clara Levelt[1] **Paula Fikkert**[2] **Tania Zamuner**[2]

*1. Leiden University, Leiden, The Netherlands; 2. Radboud University, Nijmegen, The Netherlands*

A typical phenomenon in the early word productions of young children is that specific types of consonants always go together with specific types of vowels. Two accounts have been presented, a motor account (MacNeilage and Davis) and a phonological account (Levelt (1994), Fikkert & Levelt (in press)). It will be shown that an account in terms of phonological features and underspecification is able to capture both the Place of Articulation (PoA) make-up of early productions and the asymmetrical behavior in perception studies, of infants acquiring Dutch.

For infants, the entire word is thought to be the unit of specification for PoA features in the lexicon, leading to homologous consonants and vowels in production. Furthermore, Coronal is unspecified in the lexicon and low vowels do not support PoA specifications. The stressed vowel of the target adult word determines the PoA representation constructed by the child. If the target vowel is low, PoA information is provided by the target onset consonant. In perception, asymmetric behavioral patterns are found when presenting 14 months old infants with nonce word-pairs /bɪn-dɪn/, /bɔn-dɔn/ and /pan-tan/. This asymmetric behavior is expected in the phonological account: perceived features can never mismatch or conflict with features that are unspecified in the underlying representation.

| Target Poa Pattern | Child's representation | Production | Perception |
|---|---|---|---|
| bɪn (vowel = Coronal) | Ø | [dɪn] | bɪn-dɪn: no |
| dɪn (vowel = Coronal) | Ø | [dɪn] | |
| bɔn (vowel = Labial) | Labial | [bɔm] | bɔn-dɔn: yes |
| dɔn (vowel = Labial) | Labial | [bɔm] | |
| tan (vowel = low) | Ø | [tan] | pan-tan: no if trained on /tan/, yes if trained on /pan/ |
| pan (vowel = low) | Labial | [pam] | |

The above results show that information from two different sources, production and perception, from the same age group convergence on a single phonological analysis. Phonological universals, like the unmarked structure of coronals, thus appear to control both production and perception from the earliest stages.

**Th2-47**

### Perception of the Stop-Fricative Contrast in Early Word Learning

**Paula Fikkert**[1] Suzanne van der Feest[2] Nicole Altvater-Mackensen[1]

*1. Radboud University Nijmegen, Nijmegen, The Netherlands; 2. University of Pennsylvania, Department of Psychology, Philadelphia, USA*

**Background:** In their first year of life infants show improved sensitivity to native-language contrasts. However, reduced sensitivity to these same contrasts has been reported in word learning experiments (Stager & Werker 1997, Fikkert, in press). This implies that there is an important difference between discrimination in the prelexical stage based on phonetic properties, and the comprehension of words in the lexical stage of development, which may be largely based on phonological properties. Often, children's productions show a strong preference for one member of a phonological contrast. An important issue is whether such asymmetries are also found in comprehension.

This study investigates infants' perception of the stop-fricative contrast in familiar words. It is a well-known fact that fricatives are seldom produced in babbling (Goldersleeve-Neumann et al. 2000) and children often replace target fricatives by plosives in early word production, but not vice versa. This suggests that this contrast is not easy to produce, and may not show strong embodiment yet. We tested (a) whether children are able to detect changes from stop to fricative, and vice versa; (b) whether we find any asymmetries in the perception of this contrast as we find in children's productions; and (c) whether our results are consistent with the attested production patterns.

**Method:** 24 Dutch 18-month-olds were tested in a mispronunciation detection task, using a preferential looking procedure in which subjects were presented with correctly pronounced or mispronounced well-known words (Swingley & Aslin, 2000; Van der Feest, 2007). Children were randomly assigned to one of two experimental groups: they were either tested on targets with initial plosives, or on targets with an initial fricative. Target words were pronounced correctly (CP) or with a mispronunciation (MP) of manner (plosives being mispronounced as fricatives, and fricatives as plosives).

**Results:** We found a difference between the two groups for the mispronunciations of manner: an ANOVA with target consonant (fricative or plosive) and condition (CP vs. MP) as variables showed a significant interaction between consonant type and condition ($F=6.8$, $p=0.02$). Children only detected manner mispronunciations on fricative-initial target words, but not on plosive-initial targets.

**Conclusion:** We argue for a phonological account where plosives are considered the default manner of articulation and remain unspecified in the lexical representation of a word. Such an interpretation would be able to account for both the asymmetries in the current perception study as well as for the patterns found in early word production.

**Th2-48**

### Individual Differences in Korean Infants' Vocabulary Development: From 12 Months to 18 Months

Keumjoo Kwak, Yeonsoo Kim, Jieun Park, Yumi Choi

*Seoul National University, Seoul, Korea*

**Background and Aims:** Preverbal communication has an important role as a precursor of language development before beginning of verbal expression (Butterworth, 2001). Even in preverbal period, infants gradually use pointing, showing, referential gestures, and random symbolization. Such behavior is an expressive tool as well as a reaction to others' communicative intentions.

We investigated the relationship between individual differences in preverbal communication and future vocabulary development longitudinally on Korean infants from 12 month to 18 month.

**Method:** 116 South Korean mothers with 12-month infants participated in this study. PICS(Pictorial Infant Communication Scale, Delgado et al., 2001) was used for measuring 12-month-infant's preverbal communication ability. Based on PICS score, infants were classified to high group(n=36) and low group (n=35), and their vocabulary development was measured with Korean MCDI (Korean McArthur Communicative Development Inventories, Pae et al., 2004) at 12, 15, and 18month. Their preverbal communication score and total score of productive vocabulary and receptive vocabulary were calculated and analyzed.

**Results:** 12month infants did not show sex differences in preverbal communication and vocabulary size. The productive and receptive vocabulary tended to increase as months of the classified infants increase ($F=5.95$, $p<.01$). However, the infants who showed more preverbal communication in 12month had more productive vocabulary at 12, 15, and 18month, and more receptive vocabulary at 12 and 15month. The group differences in productive vocabulary were increased at 15month but decreased at 18-month. Also, both groups showed positive correlation between early preverbal communication frequency and later receptive and productive vocabulary, respectively.

**Discussion and Conclusions:** The results suggest that individual differences in preverbal communication are closely related to future vocabulary development. Regarding the relationship between preverbal communication and phonic language development, preverbal communication frequency was positively correlated with receptive vocabulary and productive vocabulary. In other words, infants with more preverbal communication at 12month tended to have more productive and receptive vocabulary at 12, 15, and 18month. The differences of high and low groups in productive vocabulary was maximized by 15month, and decreased at 18month. This indicates that the early individual differences in preverbal communication decrease around 18month implying the relationship with rapid vocabulary growth. In conclusion, preverbal communicative ability seems closely related to the early vocabulary development during infancy. Further research on the relationship between preverbal communication and future language development would be very useful.

**Th2-49**

### Speech Perception is Not Species-Specific at Birth

**Alia Martin**[1,2] Athena Vouloumanos[1,2] Marc Hauser[3] Janet Werker[4]

*1. Department of Psychology, McGill University, Montreal, Canada; 2. Department of Psychology, New York University, New York, USA; 3. Department of Psychology, Organismic & Evolutionary Biology, and Biological Anthropology, Harvard University, Cambridge, USA; 4. Department of Psychology, University of British Columbia, Vancouver, Canada*

The dominant perspective in the study of human language acquisition is that speech is special, perceived in unique ways from the earliest stages of development, and instrumental in setting up our species-specific capacity for expressed language. Support for this hypothesis comes from studies showing that human infants prefer listening to natural speech over artificial signals and manipulated speech signals from birth. To date, however, there are no tests that distinguish between a specialization for speech as opposed to a more general specialization for biological or natural acoustic signals.

In the current study, we presented infants with speech and the vocalizations of another primate, the rhesus monkey. We examined whether infants demonstrate a preference for speech over rhesus monkey calls by testing neonates and 3-month-olds in preferential listening procedures in which they control the presentations of different sounds. Neonatal listening preferences were quantified by means of a high-amplitude (HA) sucking procedure in which the presentation of different sounds was contingent on the newborn delivering a HA suck. Thirty neonates were presented with a sound whenever they applied suction in the upper 80% of their range. Three-month old infants were tested in an infant-controlled sequential preferential looking procedure in which infants controlled trial onset and offset by looking at or away from a monitor displaying a fixation checkerboard.

Neonates showed no preference for speech over rhesus calls, responding equivalently to both. The three-month-olds, however, showed a preference for speech compared with rhesus calls, listening longer during speech trials than trials of rhesus calls.

In contrast to the claim that humans are endowed with a set of specialized processors exclusively dedicated to speech, these results demonstrate that neonates' listening biases privilege utterances from both humans and at least one nonhuman primate, the rhesus monkey. It is unclear whether this pattern extends to all biologically natural signals or is restricted to species that show more human-like spectral filtering. However, our results suggest that infants' initially species-broad listening biases become attuned to speech over rhesus calls by the third month. These findings parallels recent results on face processing and cross-modal matching: human infants begin life with no bias, but by 9 months preferentially process human faces over the faces of other species.

**Th2-50**

### Effects of Voice Quality and Face Information on Infants' Speech Perception in Noise

Jessica Versele[1] Linda Polka[2] Susan Rvachew[2] **Robin Panneton**[1]

*1. Department of Psychology, Virginia Tech, Blacksburg, USA; 2. School of Communication Sciences and Disorders, McGill University, Montreal, Canada*

A recent study by Polka and Rvachew (in press) found that 6- to 8-month-old infants discriminated a simple native CV contrast (/bu/ v./gu/) when familiarized and tested in quiet, but not when familiarized in the presence of background noise (i.e., recordings of crickets' and birds' chirping), even when testing was conducted in quiet. Because the noise was filtered to not overlap with the frequencies of the phonemes, infants' failure to encode the familiarization phoneme could be due to a disruption in attention than to energetic masking effects. Importantly, during the familiarization phase, infants watched a checkerboard while listening to either /bu/ or /gu/ spoken by a male using adult-directed speech. Thus, the context during familiarization was minimally engaging in terms of attention. Because infants learn speech under natural conditions involving noise and distraction, it is important to identify factors that may enhance attention to speech under non-ideal listening conditions.

The current study investigated if the addition of a dynamic adult face would enhance infants' speech processing during noise. Six-month-old infants were habituated to a native phoneme (e.g., /baba/) accompanied by the same background noise as in Polka and Rvachew (in press). In the current study, however, infants watched a movie of a female speaker producing the phoneme in an adult-directed manner. After habituation, infants were tested with alternating trials of the familiar phoneme (/baba/; 3 trials ) and a novel phoneme (e.g., /gaga/; 3 trials), accompanied by a colored bulls-eye and in quiet. Phoneme discrimination was measured by recording infants' looking times at the familiar and novel speech sounds.

Preliminary findings on 9 infants (5 females) indicate that infants do not discriminate /baba/ from /gaga/ when familiarized with one of the phonemes in noise, even in the presence of a female, adult speaker. The average looking time on the prechange trials (M=18.03, SD=5.01) was not significantly different from that on novel trials (M=11.02, SD=5.17) or familiar trials (M=11.22, SD=5.1, $F(2,14)=1.54$, $p>.05$). This lack of improvement in the presence of a face may be due to the female speaker's adult-directed manner. We are also examining infants' discrimination of a phoneme presented in noise in the presence of a female speaker using infant-directed speech. We predict that a dynamic female speaker using an ID style will engage infants' attention to speech in noise such that discrimination of this phoneme contrast will be successful.

Polka, L., & Rvachew, S. (2007). Perceiving speech in the presence of other sounds poses a cognitive challenge for young infants. Infancy, in press.

**Th2-51**

### Are there Individual Differences in the Way in Which the Vocabulary Spurt Impacts the Organization of the Communicative System?

**Meaghan Parlade**, Jana Iverson

*The University of Pittsburgh, Pittsburgh, USA*

**Background and Aims:** From a dynamic systems perspective, transition points in development are times of increased instability, during which certain behavioral patterns (particularly those involving novel behaviors) are susceptible to temporary decoupling (Thelen & Smith, 1994). The vocabulary spurt is one such point in communicative development (e.g., Gershkoff-Stowe, 2001, 2002). Infants and young children frequently coordinate gestural, affective, and vocal expressions; at the vocabulary spurt, however, production of coordinated expressions decreases temporarily. However, there are substantial individual differences in vocabulary growth, suggesting that relative instability may also vary (e.g., Dale & Goodman, 2005). This study examined whether individual differences relate to the way in which the vocabulary spurt impacts communication patterns. Relative to infants whose vocabulary growth shows continuous incremental change, infants

who exhibit a more dramatic transition in rate of vocabulary development should show evidence of greater instability and therefore decreased frequency of coordinated communicative expressions in general, and newly emerging behaviors (i.e., words) in particular.

**Methods:** Eighteen typically developing infants were videotaped during play with a primary caregiver one month before, at, and one month after the onset of the vocabulary spurt. Achievement of the vocabulary spurt was determined using data from the MacArthur-Bates Communicative Development Inventory (CDI; Fenson et al., 1993), collected bi-monthly from 2 to 19 months of age. Two discrete patterns of vocabulary growth were identified using statistical modeling techniques (Ganger & Brent, 2004). Infants were classified into one of two groups based on whether their rates of word acquisition were best modeled by a logistic function with a discrete transition point ("logistic spurters"), or a quadratic function, illustrating continuous change ("quadratic spurters"). All gestures, vocalizations, words, facial affective expressions, and communicative coordinations (i.e., instances in which there was some degree of temporal overlap between communicative behaviors) were coded from the videotapes.

**Results:** As expected, logistic spurters demonstrated a reduction in overall coordination of communicative behaviors, $F(2, 34) = 7.26$, $p = .003$, and a decrease in words produced in coordination, $F(2, 34) = 3.63$, $p = .038$. In contrast, quadratic spurters exhibited relatively little change across sessions.

**Conclusions:** These data are consistent with the notion that infants who experience more dramatic vocabulary growth exhibit greater disruption within the communicative system. Findings are discussed in terms of understanding transitions as an opportunity for developmental change. Implications of individual differences in vocabulary acquisition for theories of language development are also considered.

**Th2-52**

## Syllable Weight Determines Stress Pattern Preference in Spanish-Learning Infants

**Ferran Pons**, Laura Bosch

*Grup de Recerca en Neurociència Cognitiva, Universitat de Barcelona,Spain*

**Background and Aims:** Previous research with English-learning infants has indicated that stress cues can have a powerful influence on early word segmentation. Jusczyk, Cutler and Redanz (1993) observed that nine-month-old American infants, but not six-month-olds, showed a preference toward Strong-Weak (trochaic) versus Weak-Strong (iambic) words. Next, Turk, Jusczyk and Gerken (1995) demonstrated that syllable weight was not a necessary component for this trochaic preference. Recently, Pons and Bosch (2007) have found that 9-month-old Spanish infants do not show a preference for any specific stress pattern as English infants do, although they can discriminate trochees versus iambs (Pons & Bosch, 2007; Skoruppa et al., 2007). Crucially, Spanish differs from English in the predominance of trochaic words; only around 65% of disyllabic words are trochaic). In the present study we explore Spanish-learning infants' preferential stress patterns when the stressed syllable is heavy.

**Method:** A total of forty 9-month-old Spanish-learning infants were used (twenty in each experiment). A slightly modified version of the head-turn preference procedure previously used by Bosch and Sebastián-Gallés (2003) was used to measure the preference for lists of nonsense words with trochaic or iambic stress. In Experiment 1 lists of nonsense words with a CVC.CV structure were presented, where the syllable weight falls into the first syllable. In Experiment 2, the nonsense words used had a CV.CVC structure, where syllable weight falls in the second syllable.

**Results:** Data analyses revealed that (Exp. 1) infants listened longer to CV.CVC iambic than trochaic word lists [$t(19) = 2.428$, $p = .025$], and (Exp. 2) they preferred to listen to CVC.CV trochaic than iambic word lists [$t(19) = 2.543$, $p = .020$]. Our results indicate that Spanish-learning infant's preference for a specific stress pattern is determined by syllable weight.

**Conclusion:** The present results indicate the fundamental role of syllable weight in lexical stress preference by Spanish-learning infants, suggesting that very early on these infants take into account prosody as well as syllable structure factors in developing preference for the stress pattern of words. We discuss the difference between our results and the previous ones by Turk and collaborators (1995) as a consequence of the different frequency of trochees and iambs in Spanish and English.

**Th2-53**

## How Frequency Might Modulate the Acquisition of Morphosyntactic Dependencies

**Marieke van Heugten**, Elizabeth Johnson

*University of Toronto, Mississauga, Canada*

**Background and Aims:** In natural languages, morphosyntactic elements often establish relationships between words or phrases. In the course of language development, acquiring these relationships is an important step in acquiring the structure of one's language (Morgan, 1996). These elements, however, need not be (and are often not) adjacent. Some studies have suggested that non-adjacent dependencies may be particularly difficult to learn (Newport & Aslin, 2004). Nevertheless, artificial language studies have shown that infants as young as 15 months of age can track grouped remote dependencies (Gomez & Maye, 2005) and that 18-month-olds are able to differentiate between grammatical and ungrammatical verbal nonadjacent dependencies in English, German, and Dutch (Santelmann & Jusczyk, 1998; Höhle et al., 2006; Wilsenach, 2006 respectively). In this study, we extend this work to frequent articles and suffixes.

**Methods:** Dutch-learning 24-month-olds were tested using the Headturn Preference Procedure (Kemler Nelson et al., 1995). Children listened to lists of diminutive noun phrases. In Dutch, diminutives are often formed by adding the suffix *-je* to a noun. In addition, the definite article preceding the noun is changed into *het* (e.g., *de hond*, 'the dog'; *het hondje*, 'the doggie'). This results in a nonadjacent dependency between the article *het* and the diminutive suffix *-je*, interceded by the noun itself. In this study, grammatical trials thus consisted of diminutive nonsense nouns combined with the correct article *het* (e.g., *het* kag*je*) while ungrammatical trials consisted of diminutive nonsense nouns combined with the other, incorrect, definite article *de* (e.g., *de* kag*je*).

**Results and Conclusion:** If children have acquired the dependency between the article *het* and the suffix *-je*, they should listen longer to grammatical than ungrammatical trials. Our results show that this is indeed the case, indicating that sensitivity to remote dependencies at an early age is not restricted to verbs only. Moreover, these results are particularly interesting because Dutch-learners at this age have yet to acquire the adjacent dependencies between articles and nouns (Johnson & Diks, 2005), suggesting that it is easier to learn the nonadjacent but frequent dependency between article and diminutive suffix than the adjacent but less frequent article - bare noun dependency. We are

currently examining whether these results also hold for plural dependencies (for which the definite article *de*, but not *het*, is grammatical; e.g., *de honden*, 'the dogs'). At the same time, we are testing younger infants to determine when this sensitivity to article-suffix dependencies first develops.

**Th2-54**

### Understanding Early Communication Signals in Autistic Spectrum Disorder: a Study on Perception of Cry in Infancy

Paola Venuti, **Gianluca Esposito**, **Simona de Falco**

*University of Trento, Rovereto (TN), Italy*

**Background and Aims:** Autistic Spectrum Disorder (ASD) affects language and social skills to varying degrees. While many studies have concentrated on examining the patterns of behavior and development in the context of speaking and interacting, very few studies have investigated the specificity of cry in infants with ASD. And this is very peculiar considering that cry can be viewed as both the first communicative system and the first social structure in human development. Furthermore an anomalous pattern of cry can lead to a misinterpretation of the cry itself from the parental prospective. Aim of this study is to investigate how episodes of cry of ASD infants are perceived.

**Methods:** A total of 40 women, of age comprised between 25-35 years old (mean = 31; st.dev. =3,2) participated in this study (20 non-mothers and 20 mothers- inclusion criteria in this subgroup was to have a child younger than 3 years old). A "Listen-and-Response" experiment was carried out. Participants were asked to listen 12 episodes of cry of infants with ASD, developmental delay (DD) and typical development (TD) of two different ages (13 & 20 months) and then answer three questions. 1) to guess the age of the infants who was crying; 2) to guess the reasons which led them to cry; and, 3) to describe what they felt in hearing the episode of cries.

**Results**: Our data have showed that cry episodes of ASD were considered to be the same as those of younger TD or DD both from mother and non-mother. Balanced for age, ASD cries elicited negative patterns of emotional states as compared to parents' responses to the cries of DD and TD infants. These data highlight that the cry of infants with autism are not well identified. Moreover, the autistic cries elicited negative feelings.

**Conclusion:** The results of this study support the view of autism as related to a problem of expressing and sharing emotions. ASD cries have ambiguous patterns, and therefore may not seem easily understandable. This difference can be an additional cause of difficulty in sharing feelings and developing inter-subjectivity processes.

**Th2-55**

### 21-Month-Olds Learn Distributional Facts About a New Verb Via Listening Experience

**Sylvia Yuan**[1] Rose Scott[1] Cynthia Fisher[1] Toben Mintz[2]

*1. University of Illinois, Champaign, USA; 2. University of Southern California, Los Angeles, USA*

Verbs are choosy about the sentence structures they accept - e.g., 'drop' can be transitive, whereas 'fall' is intransitive. Children readily learn syntactic/semantic combinatorial facts about verbs, and use them to guide sentence comprehension (Snedeker & Trueswell, 2004) and production (Tomasello, 2000). How do children acquire these facts? Do children need to know a verb's meaning to learn its syntactic properties? Or can these facts be acquired through distributional evidence alone?

Using a head-turn listening preference task, we tested whether 21-month-olds could learn combinatorial facts about novel verbs from hearing sentences containing those verbs. In the study phase, children listened while 2 novel transitive and 2 novel intransitive verbs were presented in 6 sentences each (Table 1). Next, each verb was presented in two multiple-sentence test trials: In one the verb appeared in new transitive sentences, and in the other in new intransitive sentences. Thus, half of the test trials matched the grammatical pattern presented in training, while half did not.

Low-vocabulary 21-month-olds listened equally to all types of test trials. In contrast, high-vocabulary 21-month-olds listened reliably longer to intransitive (grammatical) than to transitive (ungrammatical) sentences containing intransitive verbs, but listened about equally to transitive and intransitive sentences containing transitive verbs.

Thus, high vocabulary 21-month-olds learned combinatorial facts about unknown verbs from hearing the verbs used in sentences, and generalized these facts to new sentences: they preferred intransitive verbs used in new intransitive, but not transitive, sentences. Why did this effect emerge only for intransitive verbs? It is possible that the new transitive verbs were harder to learn quickly due to the greater complexity of the transitive sentences. In a follow-up study, 21-month-olds were trained and tested with only two novel verbs (one transitive, one intransitive). Preliminary results indicate that when the learning load is reduced, the grammaticality effect extends to both transitive and intransitive verbs.

Together, these results demonstrate that children can learn combinatorial facts about a verb before assigning it semantic content.

| STUDY PHASE | | |
|---|---|---|
| | INTRANSITIVE Verbs | TRANSITIVE Verbs |
| | I want to seb with a mouse. | Can you norp the cat? |
| | Can you seb at some fish? | He wants to norp some birds. |
| | ... | ... |
| | I can lonk for grandma. | I want to crast a frog. |
| | He was lonking with Sarah. | Can you crast Joe? |
| | ... | ... |
| TEST PHASE | | |
| | INTRANSITIVE Sentences | TRANSITIVE Sentences |
| INTRANSITIVE Verbs | He sebbed to Grandma. | *She's gonna seb some bears. |
| | She can seb for a bunny. | *He can seb grandpa. |
| | ... | ... |
| | She can lonk to the baby. | *He lonked a bunny. |
| | Can you lonk at a frog? | *I can lonk Nancy. |
| TRANSITIVE Verbs | ?He's gonna norp at grandpa. | He was norping the baby. |
| | ?I can norp with a mouse. | She norped a frog. |

| | | |
|---|---|---|
| | ... | ... |
| | ?She was crasting to the cats. | He's gonna crast a cow. |
| | ?He can crast at some bears. | He crasted Mary. |
| | ... | ... |
| | | |

## *High Risk and Pediatric Issues*

**Th2-56**

### Adolescent Mothers Providing Massage to Their 0 to 3 Month-Old Infants

**Mariana Bianchi de Aguiar**, Barbara Figueiredo, Ana Guedes, Rute Magarinho, José Pombeiro
*Minho University, Oporto, Portugal*

**Background:** Adolescent mothers and their infants are at risk for poor health and developmental outcomes. Massage is a relatively simple strategy to improve mother's sensibility to the infant's cues.

Aim: The aim of the study was to analyse how massage can improve infant's sleeping habits and reduce their teenage mothers' psychopathological symptoms.

**Methods:** A sample of 30 adolescent mothers and their infants were recruited at the Júlio Dinis Maternity Hospital (Porto, Portugal) just after delivery. A socio-demographic Questionnaire was completed at the time. Premature infants (gestational age < 37 weeks or weight < 2.500) and infant with chronic illness (impeditive of regular sleep habits), as well as mothers with twins, and mothers that do not know how to read and write in Portuguese were excluded from the study. Two weeks after recruitment, the Children's Sleep Habit Questionnaire (Owens et al., 2000), the State-Trait Anxiety Inventory (Spielberg et al., 1970) and the Edinburgh Postnatal Depression Scale (Cox et al;) was administrated to the mothers (pre-test). A Massage Instruction Manual and a Massage Booklet were also provided. The massage was taught to an experimental group of 15 mothers. At 3 months postpartum the mothers completed again the Sleep Chronogram, the CSHQ, STAI and EPDS.

**Results:** Infant's receiving massage by their mothers show better sleep patterns and better sleep habits, and the mothers who provided the massage show less anxiety and less depression at 3 months postpartum.

**Conclusion:** Adolescent mothers providing massage to their 0 to 3 months-old infants present less postpartum anxiety and depression and their infants seem to sleep better.

**Th2-57**

### The Effects of Mother-Infant Skin-To-Skin Contact on Postpartum Depression and Maternal Behavior during Feeding

**Ann Bigelow**
*St. Francis Xavier University, Antigonish, Canada*

The benefits of early mother-infant skin-to-skin contact (SSC) were investigated in a 3-month longitudinal study of mothers and their full-term infants (N = 108 dyads). Although previous research shows the benefits of SSC to infants, the effects on mothers and maternal behavior are less well researched. Mothers in the SSC group provided approximately 5 hours of daily SSC to their infants in the first week (M = 5.16 hours), then 3 hours per day until infants were one month (M = 2.95 hours). Mothers in the control group provided little or no SSC (1st week M = .44 hours; 2nd - 4th weeks M = .35 hours). Dyads were seen when infants were one week, one month, two months, and three months. The current report focuses on the mothers' scores on two postpartum depression scales: Edinburgh Postnatal Depression Scale (EPD) and Center for Epidemiological Studies Depression Scale (CESD), and on the caregiver items on the NCAST (Nursing Child Assessment Satellite Training) Feeding Scale. Although the means of both the SSC and control groups were below the risk score for postpartum depression on each of the postpartum depression scales, mothers in the control group reported significantly higher depression on both scales when their infants were one week of age. When the infants were one month of age, mothers in the control group still tended to report higher depression than the mothers in the SSC group (EPD: p = .06; CESD: p = .13). By the time infants were 2 and 3 months, there were no differences in the mothers' self reported feelings of depression. Mothers in both groups reported less depression as the infants aged. The NCAST was used to assess maternal behavior during feeding; it assessed maternal sensitivity, nurturing, and fostering of social-cognitive growth. When the infants were one week, mothers in the SSC group had higher NCAST scores on the caregiver items. Differences between groups were not apparent when the infants were older than one week. Mothers in both groups achieved higher NCAST scores on the caregiver items as their infants aged. Results indicate that during the infants' first week of life, mothers who engaged in SSC with their infants experienced less feelings of postpartum depression and demonstrated more maternal behavior during feeding, which is a primary activity where the mother-infant relationship is forged.

**Th2-58**

### Stability and Continuity of Preterm Infant Temperamental Characteristics: A Cross-Cultural Comparison

Charlene Hendricks[1] **Marc Bornstein**[1] Nancy Auestad[2] Deborah O'Connor[3]
*1. NIH/NICHD, Bethesda, USA; 2. Kellogg, Battle Creek, USA; 3. University of Toronto, Toronto, Canada*

**Background and Aims:** Temperament is most often referred to as a behavioral style exhibited in response to a range of stimuli. There is ample evidence to suggest that temperament, especially during the first year of life is, in part at least, a reflection of transactions between infant and caregiver. Further, numerous studies have found mean differences on temperament scales between children in different cultures, and accounts of cultural differences in parenting practices are frequently reported. This investigation seeks to add to the current literature by analyzing maternal reports of temperamental characteristics of preterm infants from three countries - Chile, the U.K., and the U.S.

**Sample:** Preterm infants with birth weights of 750 to 1805 g and whose gestational age was less than 33 weeks were eligible for enrolment (Ross Preterm Infant Study; O'Connor 2001). Infants with serious medical conditions or congenital abnormalities that could affect growth and development were excluded. The final sample consisted of 141 preterm infants and their mothers, 47 from Chile, 44 from the U.K. and 50 from the U.S. Study visits were based on preterm infants' term-corrected ages.

**Methods:** Individual rank order stability and mean level continuity across time of infant temperamental characteristics at 6 and 12 months were measured using the Infant Behavior Questionnaire (IBQ; Rothbart, 1981). Behavior ratings were used to derive 6 scales: Activity

Level, Distress to Limitations, Duration of Orienting, Fear, Smiling and Laughter, and Soothability. In addition to birthweight, infants' Apgar scores, a measure of maternal intelligence, and an index of HOME environment were evaluated as covariates for all analyses.

**Results:** The majority of stability estimates were moderate to strong, ranging from r = .15 to .67, and were relatively consistent across country. Estimates for continuity showed significant main effects of country and age as well as interactions. Overall, significant differences were found primarily for Chilean mothers' reports of their infants versus the U.K. and U.S. mothers. Chilean mothers reported greater levels of soothability, duration of orienting, activity level, and fear.

**Conclusions:** Our findings provide support for the importance of culture in examining temperament-parenting relations. Further work will extend current knowledge and enhance the development of useful parenting programs and strategies.

**Th2-59**

## Preliminary Findings on Mother-Infant Interactions From a Randomized Pilot Study Comparing the Efficacy of Two Parenting Interventions For Substance Abusing Mothers: the Mothers of Infants Program (MIP), an Attachment-Based Therapy Program, and a Parent Education Program (PEP)

**Cindy DeCoste**, Nicole Castiglioni, Nancy Suchman
*Yale University School of Medicine, West Haven, USA*

Low responsiveness and high intrusiveness are frequently observed in substance abusing mothers' interactions with their children. MIP is based on research that suggests such maladaptive behaviors may have deep roots in the mother's own experiences of emotional neglect. It focuses on encouraging the mother to reflect on her own emotional needs and to mentalize about her child's (i.e., maternal reflective functioning; MRF). MRF is thought to influence the development of secure attachment, and has been empirically linked to sensitive caregiving.

Using pre and post data from 11 MIP and 11 PEP completers, we hypothesized that: 1) MIP mothers would show greater improvement in caregiving behavior than PEP mothers, 2) infants of MIP mothers would show greater improvement in self-regulatory behavior (i.e., their elevated efforts to engage their mothers would decrease to within normative range post MIP), 3) improvement in MRF would be associated with improved infant self-regulatory behavior, and 4) the association described in #3) would be mediated by improvements in caregiving behavior.

Measures were: The Parent Development Interview coded for MRF and the NCAST Teaching Scale coded for mother and infant behaviors.

Hypotheses were tested in a series of paired t-tests and linear regressions. Meaningful t-test (d) and regression ($R^2$) values were identified by effect size due to the small sample (d of .50=medium effect; $R^2$ of .25=large; Cohen, 1988).

At baseline, mothers in both MIP and PEP scored significantly (>1 SD) below the NCAST normative mean on Responsiveness to Infant's Distress (RID) (MIP; M=7.90, SD=.83, and PEP; M=8.00, SD=1.48) and Total Caregiving Behavior (TCB) (MIP; M=37.65, SD=2.54, and PEP; M=36.09, SD=2.95). Following 12 weeks of treatment, MIP mothers showed significant improvement in mean RID (M=8.57, SD=.92, t=-2.12, p=.06, d=.54) and TCB (M=39.82, SD=2.70, t=-2.32, p=.04, .59), whereas PEP mothers showed no significant improvement in RID (M=8.57, SD=.99, t=-1.36, p=.20, d=.32) or TCB (M=36.14, SD=3.08, t=-.05, p=.96, d=.01).

Comparing infants of MIP and PEP mothers, the former showed larger decreases toward normative means in their efforts to engage their mothers. This finding may be partially explained by baseline differences. However, considering the improvements in MIP caregiving behavior, it may also suggest that children required less effort to signal their needs to their mothers after maternal RID and TCB improved.

MIP mothers but not PEP mothers showed promising improvement in MRF after 12 weeks. Increased MRF was associated with improved TCB ($R^2$=.89) and improved child behavior ($R^2$=.27). Improved TCB was associated with improved child behavior ($R^2$=.22). Change in TCB mediated 81% of effects of change in MRF on change in child behavior.

Implications for identifying and understanding high-risk mother-infant interactions will be discussed in relation to intervention development.

**Th2-60**

## The Relation of FR Behaviour to AAI Scales

**Elspeth Evans**, Sandi Bento, David Pederson, Greg Moran
*The University of Western Ontario, London, Canada*

**Background and Aims:** The FR theory developed by Main and Hesse (1990, 1999) proposes that unmonitored parental behaviour, or frightened, frightening and dissociative (FR) behaviour, stemming from a history of Unresolved/disoriented (U/d) trauma, disorganizes the attachment relationship. The parent is a source of fear and is thus unavailable as a source of safety and protection. Previous work has found a link between Disorganized infant attachment, characterized by odd behaviours toward the parent, and FR parental behaviour (see Madigan, Bakermans-Kranenburg, van IJzendoorn, Moran, Pederson, & Benoit, 2006). The current work explores the discriminant validity of FR behaviour in relation to the scales of the Adult Attachment Interview (AAI; George, Kaplan, & Main, 1985) in an adolescent mothers sample that is high in childhood trauma. In particular, this study investigates whether FR behaviour is related specifically to Unresolved/disoriented adult attachment, characterized by lapses in monitoring of reasoning or discourse during discussions of childhood abuse or loss, or whether it is also related to other AAI scales.

**Method:** Adolescent mothers (n = 50) were interviewed with the AAI at 6-months of infant age. Scales of interest to the present analysis include the experience and state of mind scales, the loss and abuse scales, and U/d classification. Mothers and their 9-month old infants were observed at home during feeding and free play (with no toys and toys). Maternal behaviour was coded from videotapes using the FR coding system (Main & Hesse, 1992, 1998), which yields scores on 6 dimensions of behaviour, an overall level of FR behaviour on a 9-point scale (where 9 = severe behaviour) and an FR classification. All measures achieved appropriate levels of interrater reliability.

**Results and Discussion:** Thirty-six percent of mothers were classified as U/d and 46% were classified as FR. Mean level of FR behaviour was 4.48 (SD = 2.03). Level of FR behaviour was higher in mothers classified as U/d (M = 5.53, SD = 1.87) compared to not-U/d (M = 3.89, SD = 1.90), F (1, 48) = 8.66, p < .01. U/d with respect to loss, but not to abuse, was correlated with FR, r = .36, p < .05. Maternal experiences of love, rejection, role reversal, pressure to achieve and neglect were not correlated with the level of FR. The level of FR was significantly correlated with coherence of mind on the AAI (r = -.33, p < .05) and overall derogation (r = .29, p < .05). In particular, FR dimension I (frightening behaviour) was correlated with overall derogation (r = .34, p < .05). Overall, these findings suggest that it is the scales associated with U/d state of mind that predispose a mother toward displaying FR behav-

iour, rather than general experiences or other states of mind, lending support for the FR theory. These findings will be discussed in the context of future directions for attachment theory research.

**Th2-61**

### Changing Knowledge and Behavior Concerning Infant Crying and Shaken Baby Syndrome: A Randomized Controlled Trial

**Takeo Fujiwara**[1] Ronald Barr[1] Marilyn Barr[2] Nicole Catherine[1] Jocelyn Conway[2]

*1. Centre for Community Child Health Research, Child and Family Research Institute, Vancouver, Canada; 2. British Columbia Shaken Baby Syndrome Prevention Program, Vancouver, Canada*

**Background:** Infant crying is particularly frustrating to caregivers in the first few months of life and the most common trigger for shaking and abuse. The *Period of PURPLE Crying* prevention materials (DVD and booklet) are designed to educate caregivers about the normal properties of crying and the negative consequences of shaking an infant. The aim of this study was to assess the effectiveness of the *PURPLE* materials in increasing knowledge and behaviors related to crying and the dangers of shaking in mothers of newborns.

**Methods:** In a randomized controlled trial, 1279 parents received either treatment or analogous control materials on infant safety from public health home visitor nurses blind to the intervention within 2 weeks of birth. At 5 weeks, participants completed the Baby's Day Diary (Barr et al, 1988) for 4 consecutive days to measure infant/parent behaviors. At 2 months, participants completed a predefined 20 minute telephone structured survey by an independent firm to assess knowledge and behavior.

**Results:** Scores on crying knowledge scales (out of 100) increased significantly in the *PURPLE* group [63.7 (*PURPLE*) vs. 58.6 (Control), $p<0.001$], while safety knowledge increased in the Control group (84.1 vs. 85.6, $p<0.05$). The *PURPLE* intervention uniformly shifted percentiles to higher scores across the whole range on the crying knowledge scale. Crying knowledge was accurate in 5.4% to 23% more PURPLE mothers depending on the specific scale item. The *PURPLE* group rate of "walk away with unsoothable crying" on diary was higher (0.067 vs. 0.039, $p<0.05$). Sharing of information increased by 8% for crying in the *PURPLE* group, walk away advice by 13%, and shaking dangers by 13% ($\chi^2$=6.3, 17.3, and 17.1 [all $p<0.05$], respectively). The contact (carrying and holding) duration per day when the infant was distressed and the rate of pick-up of a distressed child were not significantly different between *PURPLE* and Control groups (both $p>0.3$).

**Conclusions:** Crying knowledge, walk away behavior and sharing of infant crying and shaking information with others were significantly higher for those who received *PURPLE* materials. *PURPLE* materials may be useful for informing caregivers about the properties of infant crying and helpful in changing some behaviors related to infant crying and shaking.

**Th2-62**

### Social Preference in 24-Month-Children with and Without Autism

**Jeslin Hancock**[1] Noah Merin[2] Gregory Young[1] Mary Beth Steinfeld[1] Sally Ozonoff[1] Sally Rogers[1]

*1. University of California, Davis M.I.N.D. Institute, Sacramento, USA; 2. University of California, Davis Medical Center, Sacramento, USA*

**Background:** The earliest reports of children with autism emphasize their lack of interest in other people. Lack of typical social orientation is central to the diagnosis of autism and has been hypothesized as a pivotal difference that causes a cascade of other developmental deficits in the disorder.

Objectives: The goal of the present study was to examine social versus nonsocial attentional preferences in 24-month-olds with autism compared to two age matched comparison groups, using eye-tracking technology to examine visual attention with fine-grained spatial and temporal resolution.

**Methods:** A video based social preference task (SPT) was designed and administered to three groups of 24-month-old infants. Groups included typically developing 24-month-olds at low risk for autism because they had no siblings with autism (Low Risk Typicals; n=23), typically developing 24-month-olds at higher risk for autism because they had an older sibling with autism (High Risk Typicals; n=47), and 24-month-olds with an autism diagnosis (n=8). Participants sat in front of Tobii ET-17 eye-tracker and viewed the SPT, which consisted of six trials of paired stimuli - social (videos of infants) and nonsocial(objects) presented to the infant for approximately 15 seconds each. The proportion of looking time to social stimuli (i.e., infants) vs. objects was used as a dependent variable.

**Results:** An Analysis of Variance (ANOVA) revealed that the infants with autism looked significantly less at the social stimuli compared to both the Low and High Risk Typical infants ($F(2,75)=3.897$, $p<.01$). There was no significant difference in mean looking time to the social stimulus for the high risk group compared to the low risk group, and their mean scores were in fact identical: M=.58 (SD=.12). The mean looking time at the social stimuli for infants with autism was M=.45 (SD=.14).

**Conclusions:** Twenty four month old infants with autism spent significantly less time attending to the social stimuli compared to both groups of typically developing comparison infants. SPT appears to be a sensitive measure to differences in visual social preference in autism at 24-months of age, raising questions about how early this difference develops and its potential causal role in other developmental impairments of autism.

**Th2-63**

### Iron Supplementation in Infancy and Neurocognitive Functioning at 10 Years: Evidence of Long-Term Facilitation in Frontally-Mediated Executive Processes

**Angela Lukowski**[1] Marcela Castillo[2] Betsy Lozoff[1]

*1. Center for Human Growth and Development, University of Michigan, Ann Arbor, USA; 2. Psychology Unit, Insitute of Nutrition and Food Technology, University of Chile, Santiago, Chile*

**Introduction:** Iron deficiency is the most common single nutrient disorder in the world. Infants are disproportionately affected, which is concerning given the pervasive effects of this nutrient insufficiency on the developing brain. Early iron deficiency impacts the developing hippocampus and the dopamine system, with associated negative behavioral and developmental outcomes long after iron repletion. We recently found that 19-year-olds in Costa Rica who had chronic, severe iron deficiency in infancy performed less well on tests of executive function mediated by prefrontal-striatal circuits relative to unaffected individuals; differences were not apparent on hippocampus-based recognition memory tests. We used some of the same measures in the present study to determine whether the receipt of supplemental iron in infancy facilitated neurocognitive performance at 10 years.

**Method:** Subjects were participants in a longitudinal study in Chile concerning the effects of iron supplementation in infancy on behav-

ior and development. Assignment to iron supplement or no-added iron in infancy was random. At 10 years, 149 children were tested on 6 subtests of the Cambridge Automated Neuropsychological Test Assessment Battery. The focus was executive function and recognition memory: Motor Screening Test, two tests of visual recognition memory (Pattern Recognition Memory and Spatial Recognition Memory), two tests of working memory, planning, or executive function (Stockings of Cambridge and Spatial Working Memory), and one test of visual attention (Rapid Visual Information Processing).

**Results:** Children who received supplemental iron as infants spent more time planning their first move on the most difficult problems of the Stockings of Cambridge subtest relative to children who did not receive additional iron. Children who received iron required fewer moves to successfully complete problems on this task relative to those who did not receive supplemental iron. Group differences were also found on Rapid Visual Information Processing, such that children who received additional iron in infancy made fewer false alarms and more correct rejections relative to children who did not. Differences in performance by iron supplementation status were not apparent on the other subtests.

**Conclusions:** Iron supplementation in infancy facilitated planning abilities and the rapid processing of visual stimuli almost 10 years after its receipt. Our combined results indicate that chronic, severe iron deficiency in infancy is associated with long-lasting impairments in planning (Costa Rica at 19 years), whereas iron supplementation in infancy facilitates performance in childhood (Chile at 10 years). In addition, children in Chile who received supplemental iron in infancy were more accurate at responding to rapidly-presented visual stimuli. A related effect on speed of processing was observed in infancy: infants who received supplemental iron spent less time examining novel stimuli during the Fagan Test than did infants who did not receive iron, for the same degree of novelty preference, suggesting more rapid information processing. Taken together, these data suggest that the benefits of supplemental iron in infancy are long-lasting, affecting performance on prefrontal-striatal tests of executive function as well as those that require the rapid processing of visual information.

**Th2-64**

### How Risky is it Being a Child of an Adolescent Mother?

**Carla Martins**[1] Isabel Soares[1] Bárbara Figueiredo[1] Inês Jongenelen[2]

*1. Universidade do Minho, Braga, Portugal; 2. Universidade Lusófona, Porto, Portugal*

The focus of this poster is on developmental outcomes of infants of adolescent mothers, during their first year of life.

Adolescent childbearing tends to be associated with a string of risk factors, such as unfavourable social and economic conditions, lower maternal IQ and educational level, limited job opportunities, poor or absent conjugal relationship, lack of or inadequate social support, few early prenatal care, and postnatal health risk for mother and baby (e.g., Borkowski et al., 2002). Moreover, there is empirical evidence that children of teen mothers tend to be at risk for a variety of negative developmental outcomes such as lower cognitive ability, developmental delays, or conduct and emotional problems (Brooks-Gunn & Furstenberg, 1986; Jaffee et al., 2001). Contrastingly, recent literature has suggested that, despite the risk factors associated with being a child of an adolescent mother, it is possible to identify individual differences that contribute to positive adjustment. For instance, Rhule and colleagues (2006) found out that 89% of the children in their sample displayed positive adjustment in at least one domain of functioning (behavioural, social or academic).

The main goal of our study is to characterise the development of infants of adolescent mothers through their first year of life. Fifty six infants born to adolescent mothers were followed from birth until 12 months of age. The sample was recruited during the last trimester of pregnancy in public hospitals in the North of Portugal. All adolescents were eighteen years old or less (Range=13-18, Med=17) and were primiparous. More than 90% of the sample comes from low socio-economic background. The majority (80.4%) of adolescents had not planned their pregnancy and 29.1% of these were considered at-risk for medical reasons, such as hypertension, diabetes, or infections. A fifth of the babies were born prematurely (<38 weeks), but for most of the sample (92.2%), birth weight was normal (>2.500grs). Babies and their mothers were assessed at birth, at 3 months postpartum and at 12 months, when a variety of demographic, medical, cognitive, emotional and contextual variables were collected. The goal is twofold: a) to characterize the development of this high-risk group of infants, and b) to identify individual differences associated with better cognitive and emotional outcomes.

**Th2-65**

### Assessment of Appetitive Behaviours in Infants with Failure to Thrive

**Maria Ramsay**[1] Mafalda Porporino[1] Marie-claude Geoffroy[2]

*1. The Montreal Children's Hospital, Montreal, Canada; 2. University of Montreal, Montreal, Canada*

**Background and Aims:** Failure to thrive (FTT) is a serious medical condition affecting 1-5% of the paediatric population. With a better understanding of the causes of FTT, appetitive behaviours have become important parameters in assessing FTT (Wright et al. 2007). This paper reports on a clinical study using a recently developed Appetite History Scale (AHS), designed to assess four elements of appetitive behaviours in infants from birth.

**Method:** Infants referred to the FTT/Feeding Disorders Clinic who fulfilled the criteria for this study were enrolled consecutively. The criteria were: a) age: 6 to 36 months, b) full term, c) birth weight over 2400g, d) no history of medical disorders. The AHS is part of the routine intake assessment, which is a semi-structured interview. The AHS was designed to capture four elements of appetitive behaviours:1. Signalling hunger, 2. Consuming age-appropriate quantities, 3. Concentrating on feeding, and 4. Feeding under 30 minutes. These appetitive elements were identified at 4 different age levels:1. 0-6 months, 2. 7-12 months, 3. 13-24 months, 4. 25 months and over. Each element was rated (never, sometimes or always) by the mother, and, based on 20 years of clinical experience, assigned a weighed score to give a total appetite score.

**Results:** 54 infants (24 boys, 30 girls) are enrolled so far with an age range between 6 and 35 months. Twenty-five infants were diagnosed with normal growth and 29 with FTT. There was no significant difference in the birth weight of the two groups (mean birth weight=3430g, normal growth group vs. 3191g, FTT group). The total appetite score significantly differentiated the two groups at level 1, $p<.003$ and level 2, $p<0.008$ but not at levels 3 and 4. Signalling hunger alone did not differentiate the two groups. Significant differences were found between the two groups in the amount of food consumed per feeding ($p<0.001$, level 1, $p<.013$, level 2), concentrating on feeding ($p<.015$, level 1) and duration of feeding ($p<.006$ level 1, $p<002$ level 2, $p<.008$ level 3). Correlations of each element of appetitive behaviours over 4 age levels ranged from .425 to .910 at $p=.05$.

**Conclusion:** These preliminary results suggest that, except for signalling hunger, elements of appetitive behaviours differentiated normally growing infants from infants with FTT in the younger age groups. Further analysis of the data and growth trajectories will contribute to a more comprehensive understanding of appetitive behaviours in infants with FTT.

**Th2-66**

### Learning Program of Nursing Focused on Physiological Jaundice

Hiroko Tsujimoto[1] **Sanae Saitoh**[2] Hiroko Kashiwado[3] Mayumi Satou[4] Kimiyo Suehara[5]

*1. Women and Newborns Health Center, Hashimoto City, Japan; 2. Kansai University of Social Welfare, Ako City, Japan; 3. Toyonaka Nursing School, Toyonaka City, Japan; 4. Osaka Prefectural Hospital Organization Osaka Medical Center & Research Institute for Maternal & Child Health, Osaka, Japan; 5. Kimiyo Suehara School of Nursing, Osaka Prefecture University, Osaka, Japan*

**Background:** The birth rate in Japan has dropped significantly since 1990. In addition, infants now have a greater right to privacy. Hence, the availability of newborns for educating nurses has become severely limited and is rapidly approaching a point of crisis.

Jaundice is the most common condition requiring medical attention in newborns. Physiological jaundice is common to newborns, whose liver is immature. Jaundice is prevalent among newborns, and unless quickly diagnosed and treated, could lead to extensive brain damage. Traditional training prescribes the significant "hands-on" experience with newborns for the trainees to learn the distinguishing characteristics of physiological jaundice. In its absence, however, an effective alternative training program becomes imperative.

PurposeÅFWe propose an instructional program that will provide nursing students with high-quality clinical training in neonatal care comparable to that offered when newborns are readily available.

**Methods:** First, we specified knowledge and skills necessary for the nursing of newborn infants with jaundice, and then based on that information we discussed what the nursing students should learn and created contents for them, using photographs, illustrations, and moving images. Finally, we systematized the contents and showed them in a flowchart form. To ensure validity, four midwives with more than ten years of experience in practicing and teaching nursing discussed the structure of the program and developed the contents. Their supervisor made a final check on the contents and offered suggestions.

**Results:** The learning program consists of "explanation of the program" and the "main parts", the latter divided into six parts: (1) physiological jaundice of newborns, (2) assessment of neonatal jaundice, (3) nursing to promote the adjustment made by the newborn baby, (4) nursing process using the nursing of normal newborn babies as a model, (5) neonatal jaundice problem sets, (6) technical terms. (1) was designed to teach nursing students the mechanisms and characteristics of physiological jaundice of newborns. (2) allowed the students to learn when new neonatal jaundice appears, different types of neonatal jaundice, some contributing factors, the color tones of jaundice, where jaundice appears, things that one should be careful about, and blood data.

**Conclusion:** The proposed program can accommodate all aspects of neonatal care and will be an effective alternative to traditional training. The developed heuristics will be made available as a computer assisted learning system equipped with detailed characterizations, flow charts, moving images, and photographs of newborns at various stages of their growth.

**Th2-67**

### Preterm Birth, Maternal Symptomatology, and Infant Negativity in the Context of Rural Poverty

**Kristin Voegtline**[1] Cynthia Stifter[1] Family Life Project Key Investigators[1,2]

*1. Pennsylvania State University, University Park, USA; 2. University of North Carolina-Chapel Hill, University Park, Chapel Hill, USA*

Preterm infants are a population of biological risk, as they are characterized by neurological immaturity and a host of medical complications; all of which may undermine their ability to modulate their physiological and behavioral responses to environmental stimuli. However, past research suggests mixed results with respect to preterm-term differences in infant negativity, a salient behavioral manifestation of infant temperament. One plausible mechanism for this is methodological; degree of partiality in the measurement of negativity (e.g. observer v. mother). The stress of a preterm birth places mothers at-risk for developing symptoms of depression and anxiety, which in turn, has implications for maternal connotations about her infant's behavior.

The current investigation explores differences in infant negativity and maternal symptomatology by term status in a predominately low-income, rural sample of 132 infants (66 preterm) and their mothers. The Missouri Assessment of Genetics Interview for Children (MAGIC) was used to index prematurity (gestational age < 37 weeks). Preterm and term infants were group-matched by race, income-to-needs ratio, and maternal age from demographic grids. Maternal depression and anxiety symptoms were measured by self-report with the Brief Symptom Inventory 18 (BSI-18) when infants were 2 and 6 months. Mothers who scored in the top quartile of symptomatology at both time points were labeled as experiencing chronic symptoms. Finally, also at 6 months, infant negativity was assessed by global observer ratings from an adapted version of the Infant Behavior Record (IBR), maternal ratings from the Infant Behavior Questionnaire (IBQ), and microanalytic behavioral coding of fear and frustration eliciting tasks (Lab-TAB).

Results indicate that after controlling for infant age at the 6 month assessment, preterm status predicted higher negativity in maternal ratings, $t(123) = 3.90$, $p < .001$, but not global observer ratings or microanalytic coding, of infant temperament, despite a significant positive association across the three measures. Further, there was evidence for partial mediation as mothers of preterm infants reported more elevated and chronic symptoms of depression and anxiety, $t(130) = 3.22$, $p < .01$, which in turn, was related to concurrent maternal ratings of their infant's negativity, $t(121) = 2.34$, $p < .05$, controlling for infant age and preterm status. Overall, these results highlight the psychometric advantage of comparing behavioral accounts of infant negativity from multiple methods. Unlike impartial observers, mothers of preterms may rate their infants as more negative due to, in part, their concurrent emotional state.

**Th2-68**

### Developmental Assessment at 2 years of age: Ask the Parents

**Dieter Wolke**[1] Samantha Johnson[2] Neil Marlow[2]

*1. University of Warwick, Coventry, UK; 2. University of Nottingham, Nottingham, UK*

**Background and Aims:** Parental questionnaires afford inexpensive alternatives to standardised testing for neurodevelopmental outcome measurement. The Parent Report of Children's Abilities has previ-

ously been revised and validated for use with very preterm infants (PARCA-R). We have re-investigated the validity and diagnostic utility of the PARCA-R for assessing cognition at 2 years in a larger and more inclusive sample of very preterm infants.

**Methods:** 164 children born 23 to 31 weeks gestational age were evaluated using the Mental Development Index (MDI) of the Bayley Scales of Infant Development II (BSID-II) at 2 years corrected age. Parents completed the PARCA-R questionnaire.

**Results:** Significant correlations between PARCA-R (PRC) and MDI scores ($r = 0.77$, $p < 0.01$) demonstrated good concurrent validity. A ROC-determined PRC cut-off score < 44 had optimal discriminatory power (AUC 0.92) for identifying MDI < 70 with 85% sensitivity (CI 0.58 to 0.96), 87% specificity (CI 0.81 to 0.92), 98% NPV (CI 0.95 to 1.0), and 37% PPV (CI 0.22 to 0.54). Children with false positive PARCA-R scores had borderline MDI scores.

Conclusions: The PARCA-R has good concurrent validity and diagnostic utility for identifying cognitive developmental delay in very preterm children. It is a useful and cost-effective tool for outcome measurement and developmental screening at 2 years corrected age in epidemiological studies and community programmes.

**Th2-69**

## Feeding Attitudes and Practices of Low-income Mothers: Correlates of Early Weight Gain?

**John Worobey**, Maria Islas Lopez, Monica Medina

*Rutgers University, New Brunswick, USA*

**Background and Aims:** Child obesity has reached alarming proportions. Indeed, even infants appear to be at risk for overweight, as one recent study that tracked growth patterns from 1981 to 2001 indicated an increase from 10% to 17% in infants at the 85th percentile or more in weight-for-length at 6-months of age (Kim et al., 2006). The present study explored the feeding attitudes and practices of low-income, formula-feeding, minority mothers as they might relate to weight outcomes for their infants.

**Methods:** We recruited 92 Hispanic and 32 Black mothers at 1-month postpartum, who answered questions regarding their attitudes toward feeding and infant size. Mother-infant dyads were visited in their homes when the infants were 3- and 6-months of age. During the home visits, infants were weighed and measured and mothers were instructed in completing a 24-hour feeding diary.

**Results:** As sub-groups, Black and Hispanic infants were similar in terms of birth weight and in amounts of weight gained from birth to 6-months. The Black mothers were more educated but their attitudes were similar, the only difference in behavior being that the Hispanic mothers (mostly Mexican immigrants) provided one more feed per day on average relative to the Black mothers, at both 3- and 6-months. Interestingly, analyses of amounts of formula and solid food consumed indicated that despite more frequent feeds, significantly fewer calories were ingested by the Hispanic infants relative to the Black infants.

**Conclusion:** This counterintuitive finding is particularly intriguing since approximately 23% of the Hispanic infants but only 13% of the Black infants exceeded the 90th percentile of weight-for-length at 6-months. Those who discuss feeding issues in childbirth education classes, with immigrant mothers in particular, should address infant feeding patterns as well as their caloric intake.

Work on this project was supported by grants R03 HD39697 and R01 HD47338 to the first author.

**Th2-70**

## Infants Exposed Prenatally to Methamphetamine: Screening for Developmental Delay at 9 Months of Age

**Trecia Wouldes**[1] Linda LaGasse[2] Lorraine Coelho[1] Barry Lester[2]

*1. University of Auckland, Auckland, New Zealand; 2. Brown Center for the Study of Children at Risk, Providence, USA*

**Aim:** To determine whether standardized developmental screeners could identify those infants at greater risk for developmental delay due to being born to mothers who had used methamphetamine (MA) during their pregnancy.

Sample: Participants included 50 infants and their mothers, 27 born to mothers who had used MA during their pregnancy and 23 born to mothers who had not used MA.

**Method:** Three standardized measures were used to screen for developmental delay at 9 months of age: the Bayley Infant Neurodevelopmental Screener (BINS), the Ages & Stages Questionnaire (ASQ), and the Ages & Stages Questionnaire: Social-Emotional (ASQ:SE). The BINS was administered by an examiner blind to whether the infant was exposed to MA. The ASQ and ASQ:SE was administered by a trained interviewer.

**Results:** Data were examined in two ways: First, the clinical cut-off scores were computed and compared between the MA exposed infants and the non-exposed infants on the totals computed for each measure and for individual scales. Second, Independent t-tests were used to compare the two groups on the continuous measures. Overall there was a trend for the infants exposed to MA to be classified as more at risk on the BINS than non-exposed infants. Only 8% of the infants exposed to MA were classified as Low Risk compared to 21% of the non-exposed infants. There was also a higher percentage of MA infants classified as Moderate (44% vs 35%) and High Risk (48% vs 44%) than non-exposed infants. An examination of the individual scores on the BINS found that MA exposed infants did more poorly on those tasks testing cognitive processes ($t(46) = 2.001$, $p = .051$). The trend for MA exposed infants falling below the cut off on the ASQ scales was found in two of the scales, Fine Motor and Communication (15% vs 4% for both scales). The ASQ:SE found MA exposed infants scored significantly lower than non-exposed infants on social and emotional development ($t(48) = 2.28$, $p = .027$).

**Conclusions:** These are preliminary results from a small sample, therefore, they must be interpreted with caution. However, it does appear that standardized screeners can detect differences between infants at risk of developmental delay due to being born to a mother who has used MA. At present, it appears that early cognitive processes that require attention and memory and early social and emotional processes may be the most at risk for developmental delay.

## *Early Environments and Social Policy*

**Th3-01**

### Infants Fail at a Transfer of Learning Task from 2D to 3D and from 3D to 2D

**Elizabeth Zack**[1] Rachel Barr[1] Lauren Shuck[1] Elisabeth Sperle[1] Gina Shroff[2] Kelly Dickerson[2] Stacie Miller[2] Peter Gerhardstein[2] Andrew Meltzoff[3]

*1. Georgetown University, Washington, USA; 2. Binghamton University, Binghamton, USA; 3. University of Washington, Seattle, USA*

Processing Information From Screen Media During Infancy: Unpacking The Video Deficit Effect.

Infants learn less from televised demonstration than from a live demonstration; this difference is termed the video deficit effect. The video deficit may arise because television provides fewer perceptual cues or because infants have difficulty transferring information across dimensions due to non-overlapping representations of 2D and 3D presentations. The present study tests these competing hypotheses using touchscreen technology to examine 15-month-olds transfer of learning across 2D/3D dimensions.

Fifteen-month-old infants were randomly assigned to one of 4 experimental conditions within dimension (2D/2D, 3D/3D) and cross dimension (3D/2D and reverse) conditions. For the within dimension conditions, an experimenter pushed a virtual button on a 2D screen or a button on a 3D toy and infants were immediately given the opportunity to imitate her action using the same object. For the 3D/2D condition, an experimenter pushed a button on the real 3D object. Following this demonstration, infants were immediately given the opportunity to reproduce the action on a 2D touchscreen image of the object with a virtual button and vice versa for the 2D/3D condition. Infants produced significantly fewer target actions in both cross dimension conditions (2D/3D, 3D/2D) compared to their performance on within dimension (3D/3D and 2D/2D) conditions. In a second experiment, the cross-dimension conditions were replicated, but the objects were given the novel labels "dax" and "modi". Imitation performance did not change as a function of the novel label.

These findings suggest that it is the cognitive load associated with transfer of information across dimensions that is an important factor in the video deficit effect rather than perceptual processing limitations. These findings are consistent with a broader theory of cognitive flexibility, suggesting that older infants are more able to generalize information across situations. These findings will have important implications for infants relating 2D video information to the real world.

**Th3-02**

### The Impact of Background Television on the Allocation of Infants' Attention

Alissa Setliff, Ashley Murphy

*Memorial University, St. John's, Canada*

Processing Information from Screen Media during Infancy: Unpacking the Video Deficit Effect.

The increasing exposure to television experienced in the typical family has prompted concern about its impact on young children who are not the target audience and for whom television is "background". Exposure to background TV (BTV) is extensive as 37% of American children live in homes where the TV is on "most of the time" or "always". While little is known about the effects of BTV on infants' concurrent activities, research points to a potentially negative impact on their attention during toy play and on their attempts to engage the parent. We examined these possibilities in a longitudinal study in which infants were exposed to BTV during free play.

Forty-eight 6- and 12-month-olds engaged in 20 minutes of toy play. During either the first or second half of the session, a child-educational, child-action, or an adult TV program was available for viewing. Infants' attentional engagement with toys, TV, and parent were examined using behavioral (looking) and psychophysiological (heart rate) measures. Looking was coded as focused or casual attention.

The results of repeated measures ANOVAs indicated that across program types: (1) infants at both ages looked longer at the toys than at the TV, especially those who viewed TV in the first half, whereas the frequency of infants' looks to the TV was high overall, (2) 12- month-olds but not 6-month-olds showed significantly less focused attention and smaller heart-rate deceleration to the toys when TV was on than off, and (3) attention to the parent was low in all conditions, especially when TV was on.

In sum, though BTV does not appear to hold infants' attention when novel toys are available it attracts frequent looks, perhaps distracting infants during play. The quality of play indexed by focused attention and heart rate deceleration is diminished by the presence of BTV in 12-month-olds.

**Th3-03**

### Looking at Sesame Street: Age Differences in Eye Movements during Video Viewing

**Heather Kirkorian**, Daniel Anderson, Rachel Keen

*University of Massachusetts, Amherst, USA*

Processing Information From Screen Media During Infancy: Unpacking The Video Deficit Effect.

Prior research has indicated that children under 18 months of age appear to be insensitive to the edited nature of television and respond similarly to comprehensible shot sequences and random sequences of the same shots. This insensitivity should be reflected in differential eye movement patterns which are indicative of online processing. No published study has previously documented eye movements of children or adults watching professionally produced video.

This study recorded eye movements in 1-year-olds, 4-year-olds, and adults (N=61) while watching Sesame Street (20min), utilizing an ASL 6000 Series eye-tracking system. The system employs corneal-reflection technology with remote pan/tilt optics, video head-tracking, manufacturer-claimed spatial accuracy of .25°, and temporal resolution of 60Hz. Fixations lasted 380ms on average with similar positive-skewed distributions for all participants. Despite these similarities, variability in the spatial distribution of fixations decreased with age [$F(2,58)=14.57, p<.001$]; when considering fixations across subjects at a single video frame, infants were less likely than were older viewers to look at the same area of the screen as their peers. Furthermore, viewers' use of cuts between shots to guide fixations increased with age [$F(4,116)=5.55, p<.001$]. Specifically, the two older groups fixated closer to the center of the screen following cuts. Moreover, adults fixated closer to the center following cuts to new scenes than following cuts to new shots within the same scene. This suggests a developmental trend in integration of content preceding and following cuts, a crucial ability to understanding video.

While the underlying mechanisms driving eye movements during video viewing seemingly remain stable, there are age differences in the spatial variability of fixations and the use of cuts to guide attention. This supports earlier research in demonstrating that infants use

video in a fundamentally different way than do older viewers and extends earlier work by demonstrating age differences in online processing of video.

**Th3-04**

### An Investigation of the Continuity of the HOME from Infancy to Adolescence

Teresa Harmon[1] Bethany Craig[2] **Diane Wille**[2]

*1. IU Southeast, Louisville, USA; 2. IU Southeast, New Albany, USA*

The Infant Toddler Home Observation for Measurement of the Environment (IT-HOME) and Early Adolescent-HOME (EA-HOME) are used to investigate the continuity of the emotional and physical quality of the home for infants and adolescents. A continuity of the emotional quality of the home from infancy through adolescence from mothers and fathers is hypothesized as well as a continuity of the physical quality of the home from infancy to adolescence.

Seventy families with six-month old infants participated in this longitudinal study, which included home visits when the child was 6-months, 18-months, and 14-years of age. At the 6- and 18-month home visits, total IT-HOME and physical environment subscale (organization, play materials, and daily stimulation) scores were obtained using the standardized procedure developed by Caldwell and Bradley (1984) with the mother as the primary figure. The mother and father were also scored separately on the emotional quality subscales; emotional and verbal responsivity, avoidance of restriction and punishment, and involvement with child.

At the 14-year home visit, total EA-HOME and physical environment subscale (physical environment, learning materials, regulatory activities, and variety of experience) scores were obtained using the standardized procedure developed by Bradley et al. (2000) with the mother as the primary caregiver. The mother and father were also scored separately on the emotional quality subscales; modeling, fostering self-sufficiency, and acceptance and responsivity.

Pearson correlations were used to investigate the continuity of HOME scores. Total HOME scores at 6-months are significantly correlated with total HOME scores at 18-months and with total HOME scores at 14-years. Total HOME scores at 18-months also positively correlated with total HOME scores at 14-years. Continuity was found in the physical environment subscales from 6-months to 18-months to 14-years.

Assessment of the emotional quality subscales revealed continuity for mothers from 6- to 18- months on all three subscales but little continuity to 14-years. Fathers' continuity was demonstrated only in the involvement with child subscale from 6- to 18- months and from 6-month to 14-year acceptance subscale. When mothers' and fathers' HOME subscales were compared, mothers scored significantly higher on all emotional quality subscales than fathers.

In conclusion, the total HOME score showed continuity from 6-months to 18-months to 14-years. This continuity was primarily found due to the physical environment subscales. Although mothers scored higher than fathers on the emotional quality subscales, fathers showed more continuity from infancy to adolescence.

**Th3-05**

### Infant Mental Health in Malaysia: A Cultural Perspective

**Hasnah Toran**, Mohd. Hanafi Mohd. Yassin

*National University of Malaysia, Bandar Baru Bangi, Malaysia*

The ecological system and transactional developmental frameworks have led to the inclusion of family, broader community, and cultural context in understanding infant mental health issues. Culture influences every aspect of human development, including how child development is understood. In addition, adults' goals and expectation for young children's development, and the childrearing practices parents and caregivers use to promote, protect, or restore children's well-being are influenced by culture. These beliefs and practices include shared cultural assumptions about the causes and treatment of mental illnesses and mental health service utilization for young children.

Malaysia, a multiracial country with a population of 25.45 million, has three primary ethnic groups. The largest, making up 65.9% of the total population, is the Bumiputera, which literally means "sons of the soil," consisting of Malays, Ibans, Dayaks, Kadazan-Dusun and other native groups in the country. Other ethnic groups are the Chinese at 25.3% and Indians at 7.5%. The remaining 1.3% is composed of various additional ethnic groups. Each ethnic group has its own traditions, beliefs, and practices in terms of general and mental health care, resulting in different traditional concepts of healing.

Psychiatry was established in Malaysia during the period of British colonial power. Training in this field is still based on the western model of psychiatry. Several researchers on mental health in Malaysia argue that the western ethnocentric viewpoint of modern psychiatry fails to take into consideration the importance of ethnicity in interpreting mental health. The modern medical model of psychiatry does not confer meaning or significance to how people of diverse ethnicity view causality, illness, deviant behavior and treatment of mental health problems. This paper hopes to improve the understanding on infant mental health in Malaysia by discussing how infant mental health is perceived by the different ethnic groups in this country.

**Th3-06**

### A Functional Imaging Study of Development of the Parenting Brain in Adolescents

**Akio Nakai**[1] Ayako Sasaki[2] Hirotaka Kosaka[3] Ken-ichi Matsuki[4] Michiko Tanabe[2]

*1. Department of Pediatrics, Faculty of Medical Sciences, University of Fukui, Fukui, Japan; 2. Department of Maternity, Child Health Nursing, and Midwifery, Faculty of Medical Sciences, University of Fukui, Fukui, Japan; 3. Department of Neuropsychiatry, Faculty of Medical Sciences, University of Fukui, Fukui, Japan; 4. Department of Developmental Sciences, Faculty of Education and Regional Studies, University of Fukui, Fukui, Japan*

**Purposes:** To identify the development of the brain circuitry underlying parenting by experience with infants in adolescents.

**Methods:** Six males and 7 female adolescents (Experience group) experienced the program of first-hand learning about infants, for three months in a nursery school, and the Control group (9 males and 7 females) did not attend the program during this three months. Functional MRI was conducted, using 3 Tesla MRI (Signa Excite 3T; GE Medical Systems, USA), before and after program (Experience group) or simply 3 months later (Control group). We compared them with nine mothers. Subjects viewed and listened video clips of the unknown

infant's crying during scans. The functional MRI data was analyzed, using the statistical parametric mapping software (SPM5; Wellcome Department of Cognitive Neurology, London, UK) implemented in Matlab 7.1 (The MathWorks, Inc. Serborn, MA, USA). The study was approved by the Ethical Committee, and all subjects provided written informed consent.

**Results:** In comparison between mothers and adolescents before experience, mothers showed the significant activations in the brain lesions associated with mentalization, face processing, and emotional arousal. In Experience group, the program evoked changes of responses to infant's video in the orbitofrontal cortex (BA11), parahippocampal gyrus, and midbrain after experience. Controls showed no change between two fMRI scans with three-month interval. The Experience group showed the significant activations in the superior temporal sulcus, fusiform gyrus, temporoparietal junction, dorsolateral frontal cortex (BA9) and lingual gyrus, as compared with controls.

**Discussion:** Our preliminary data presented here suggest that even in adolescents, the continuous experience with infants develops the changes in the neural circuits, which are correlated to the mentalization, face processing, and emotional arousal, and there could be the experience-dependant aspect of human parenting. It is suggested that the accumulation of learning experience and the development of relationships with the infants, same as mothers do, are positively effective for the development of parenthood. Thus, the development of parenting brain in adolescents by experience and learning could be one of the social and the educational proposals to prevent child maltreatment and secure the next generations.

**Acknowledgements:** This study was supported, in part, by Grant-in-Aid for Scientific Research 17592240 from the JSPS.

**Th3-07**

## Media Use in Infant/Toddler Child Care Settings: Differences Across Arrangements and Family-Income, and Culture

**Eva Shivers**[1] Claire Nugent[2] Maureen Ryan[2] Lauren Shuck[2] Rachel Barr[2]

*1. Indigo Cultural Center, Institute for Child Development and Social Change, Phoenix, USA; 2. Georgetown University, Washington, USA*

Despite the large numbers of infants and toddlers in out-of-home child care settings, research on media exposure patterns typically does not consider the role of child care or the patterns of media use among families of color living in poverty (Anand & Krosnick, 2005; Christakis, Garrison & Zimmerman, 2007; ECCRN NICHD, 2001; Shivers & Barr, 2007). In this study we examined how media is used in different child care settings across diverse socio-economic settings and ethnicities in children under 2 years of age.

Participants from Pittsburgh and Washington DC included an ethnically and economically diverse group of parents, infants (10 - 24 months; 60% low-income, African American), and their child care providers (n= 57 children home-based care; n = 52 in center-based care). Parents provided data about their media usage patterns at home and their children's language development. We then collected information about media usage in the home-and center-based child care settings these children attended.

Preliminary descriptive analyses indicate that the majority of child care providers in this study were intentional about their media use. There were also some major differences by child care type and family-income. Table 1 displays findings for differences in the amount of time children were exposed to foreground child-oriented media and background adult-oriented media; differences in the reasons providers gave for using media; and differences in providers' beliefs about the value of certain formats of media. We are currently in the process of analyzing data on families' media patterns and associations with child language development.

These findings indicate that center-based care - regardless of family-income - may provide a buffering effect against exposure to large amounts of TV and videos. Culture may also play a role in media exposure for children in home-based settings.

| | **Childcare type** | | | |
|---|---|---|---|---|
| | **Center care** | | **Home-based care** | |
| Family income | High | Low | High | Low |
| % with media rules | 85.7 | 85.7 | 85.7 | 57.5 |
| Amount and content of media | | | | |
| Child-oriented TV | 5 min | 4 min | 30 min | 2 hr 36 min |
| Child-oriented video | 7 min | 0 min | 30 min | 42 min |
| Adult-oriented TV | 0 min | 0 min | 60 min | 3 hr 30 min |
| Reasons for viewing | | | | |
| Entertainment | 14.3 | 28.6 | 37.5 | 82.0 |
| Education | 64.3 | 50.0 | 50.0 | 77.5 |
| Calming/Relaxing | 0.00 | 7.10 | 12.5 | 55.0 |
| Belief (strongly agree 1, 5 strongly disagree) | | | | |
| Has educational value | 2.00 | 2.07 | 3.69 | 1.80 |
| Has entertainment value | 2.00 | 2.00 | 3.87 | 2.05 |
| Can keep occupied | 4.43 | 4.43 | 3.00 | 2.53 |

**Th3-08**

## Infants' Cognitive and Motor Development in Child Care since Their First Year of Life

**Nathalie Bigras**, Lise Lemay, Mélissa Tremblay

*Université du Québec à Montréal, Montreal, Canada*

**Background and Goals:** Previous works have suggested that children who experience Child Care Services in their first year of life present better cognitive scores at later ages than children who stay at home with their parents. Three variables seem to be important in the comprehension of these

**Results:** quality, quantity and type of day care (Vandell, 2004; Belsky, 2006). The effects of this process on cognition and motor functions, however, have been largely unexplored in Canadian and Quebec Daycare services. This study follows cognitive and motor development of one hundred and fifteen infants who have been exposed to three types of Child Care experiences in their first year of life.

**Method:** Infants were recruited when aged between five and twelve months. One hundred and fifty-two infants were distributed in three unequal groups according to type of daycare (1. center daycare: n = 47; 2. family daycare: n = 33; 3. stay at home with parents: n = 73). Infants were evaluated at home on mental (MDI) and motor (PDI) scales with the Bayley Scale of infant Development (BSID-II, 1993) between five and twelve months, as a baseline, and at the ages of fifteen and eighteen months.

**Results:** Multivariate analysis of variance with repeated measures revealed that MDI and PDI scores for all groups increased between the first year of life and the age of fifteen months, but decreased between the ages of fifteen and eighteen months. Results also indicated global differences between the three groups. At all instances of evaluations,

infants' MDI and PDI scores from daycare centres present higher scores than the others. The group of children at home with their parents shows the lowest global scores on both MDI and PDI.

**Conclusion:** These results support the importance of examining cumulative experience to understand the development of children that experienced day care in their first year of life. Further measures at 24 and 36 months would help to understand these results. Furthermore, the group of children staying at home with their parents present the lower scores at all times. Selection effect must be considered as an explanation for these results. The fact that infants from all groups show differences in the first instance of measure could be explained by the parents' choices regarding type of child care which are linked to their attitude and family stimulation context at home.

**Th3-09**

### Longitudinal Associations of Maternal Beliefs, Parenting Style, and Child Cognitive and Social-Emotional Outcomes: A Mediation Model

**C. Françoise Acra**, Keng-yen Huang

*NYU Child Study Center, New York, USA*

Maternal cognitions play an important role in parenting and child development. Among the different dimensions of maternal cognition, only a limited number of studies have documented the processes underlining the links between maternal beliefs and child development (Goodnow, 1988; Sigel, 1992). Guided by a cognitive-behavioral perspective, this study investigates how two dimensions of maternal beliefs-Progressive Beliefs (defined as democratic attitudes favoring self-directed child behavior) and Traditional Beliefs (defined as authoritarian attitudes that child behavior should follow adult directives) - predict subsequent parenting practices and child cognitive and social-emotional development. A mediation model is tested, hypothesizing that mothers who hold progressive beliefs are more likely to create an environment more appropriate for child development and/or to interact with their child in more sensitive ways, which in turn will support social and cognitive development.

This study used data from the NICHD Study of Early Child Care (SECC). Data were collected on 1,364 families with full-term healthy newborns, at 10 locations across the US and at multiple assessment points. This study utilizes data from 3 assessment points (ages 1, 24, and 36 months). Maternal beliefs were measured at 1-month using maternal reports on the Modernity Scale (Schaefer & Edgerton, 1985). Parenting behaviors such as maternal sensitivity and cognitive stimulation were measured at 24 months using objective observation measures developed by NICHD-SECCYD study. Child cognitive (school readiness, language competence) and social-emotional outcomes (problem behaviors, prosocial behaviors, self-control) were measured at 36 months using the BBCS School Readiness Scale (Bracken, 1984), the Reynell Language Proficiency Battery (Reynell, 1990), maternal reports on the Child Behavior Checklist (Achenbach, 1992) and Adaptive Social Behavior Inventory (Hogan et al., 1992), and an observational paradigm of self-control (Schneider-Rosen & Gross, 1990).

Preliminary regression analyses show that early maternal traditional beliefs predict low maternal sensitivity and cognitive stimulation at 24 months. Also, higher maternal sensitivity and cognitive stimulation predict better child outcome at 36 months (controlling for maternal beliefs), indicated by better school readiness, language, self-control, and prosocial behaviors, and lower problem behaviors. Conversely, progressive beliefs do not predict maternal sensitivity and cognitive stimulation, but predict better 36-month child language and prosocial behaviors. We will perform SEM analyses to explore these associations and further evaluate the potential mediation links between maternal beliefs and child outcomes. Implications of these findings will be discussed in terms of social policy and approaches to preventive interventions aiming to improve child outcome through parent training.

**Th3-10**

### Measuring Family-Centred Service For Infants with Developmental Risks: Parent Perception of Service Provider Behaviour

**Heather Boyd**[1] Peter Rosenbaum[2] Debra Cameron[3] Harry Shannon[4] Seanne Wilkins[5]

*1. McMaster University, Hamilton, Canada; 2. Department of Pediatrics, CanChild Centre for Childhood Disability Research, McMaster University, Hamilton, Canada; 3. Faculty of Medicine, Department of Occupational Science and Occupational Therapy, University of Toronto, Toronto, Canada; 4. Department of Clinical Epidemiology & Biostatistics, McMaster University, Hamilton, Canada; 5. Faculty of Health Sciences, School of Rehabilitation Science, McMaster University, Hamilton, Canada*

**Background:** Family-centred service (FCS) is a service delivery paradigm that has been shown to have positive impacts on family outcomes [1, 2]. Family-centredness emphasizes processes by which care is provided to families to improve outcomes and is fundamental to the principles and core values of Infant Development Programs (IDPs) [3]. These processes include provision of information to families, and decision-making power for parents [4]. By working with parents, IDPs promote the development of infants and young children who are at risk of developmental problems for biological, psychosocial, or environmental reasons [3]. Despite the popularity of FCS, no studies have validated measures of family-centredness in IDPs in Canada. From an ecological perspective, how service is provided has implications on the early environment of the at-risk infant. Furthermore, evidence-based service evaluation tools can impact both policy and practice of programs for families and infants at-risk. Measuring family-centredness from the parents' perspective is important for understanding and improving service delivery for infants and their families.

**Research Question:** Is the "Measure of Processes of Care" (MPOC-20) questionnaire a reliable and valid tool for measuring parent perceptions of family-centred behaviours in Infant Development Programs?

**Methods:** A random sample of more than 150 families receiving services from 12 IDPs across Ontario will complete the MPOC-20 [5](a previously developed measure of family-centred behaviour) by mail, as well as a standard satisfaction questionnaire and a parenting stress measure. Internal consistency, inter-rater reliability, and test-retest reliability will be evaluated. Construct validity will be established through positive correlation of MPOC-20 scale scores to parent satisfaction and negative correlation to parenting stress. Family, child and program characteristics will be evaluated.

**Results:** Programs and family characteristics will be described. MPOC-20's reliability and validity will be reported. Implications for program evaluation and outcome measurement will be discussed.

Future Implications: Future research includes studying the impact of specific service delivery models on family-centred behaviours towards families of infants at risk.

**References:**

1 King, G., King, S., Rosenbaum, P., & Goffin, R. (1999). Family-centered caregiving and well-being of parents of children with disabilities: Linking process with outcome. Journal of Pediatric Psychology, 24(1), 41-53.

2 Law, M., Hanna, S., King, G., Hurley, P., King, S., Kertoy, M., & Rosenbaum, P. (2003). Factors affecting family-centred service delivery

for children with disabilities. Child: Care, Health & Development, 29(5), 357-366.
3 Nugent, J. (Ed.) (2006). Maintaining Excellence: Best Practices for Infant Development Programs. Manual and Program Self Evaluation Tool (2nd ed.). Mississauga, ON Ontario Association for Infant Development.
4 Rosenbaum, P., King, S., Law, M., King, G., & Evans, J. (1998). Family-centred services: A conceptual framework and research review. Physical & Occupational Therapy in Pediatrics, 18(1), 1-20.
5 King, S., King, G., & Rosenbaum, P. (2004). Evaluating health service delivery to children with chronic conditions and their families: development of a refined Measure of Processes of Care (MPOC-20) Child Health Care, 33(1), 35-57.

**Th3-11**

## Behaviors at 15 and 18 Months for Infant who Experience Childcare Services since Their First Year of Life

**Lise Lemay**, Nathalie Bigras, Mélissa Tremblay

*Université du Québec à Montréal, Montreal, Canada*

**Background and Aims:** Previous studies have found relationships between childcare services, initiated within the first year of life, and the child's behaviour at later ages (De Schipper, Tavecchio, Van Ijzendoorn, & Van Zeijl, 2004; NICHD Early Child Care Research Network, 2006). Specifically, this relation seems to be mediated by several variables, such as the type of care experienced by the child (Hickman, 2006; NICHD Early Child Care Research Network, 1998, 2004; Pierrehumbert, Ramstein, Karmaniola, Miljkovitch, & Halfon, 2002; Vandell, 2004). Yet, few studies have investigated the effects of Canadian's and Quebecker's childcare services on this outcome. Accordingly, the aim of the current longitudinal study is to investigate the effects of exposure to three different types of childcare, since the first year of life, on the infant's behaviour.

**Methods:** Participants ($N$ = 149) were recruited between the ages of 5 and 12 months. They have then been distributed in three unequal groups according to the type of childcare they were experiencing (1. daycare center: $n$ = 47; 2. family daycare: $n$ = 33; 3. parental care: $n$ = 69). Children were evaluated at three different times with the *Behavioral Rating Scale* (BRS) of the *Bayley Scale of Infant Development* (BSID-II, 1993) in their home environment. The participants were first evaluated at 5 and 12 months, as a baseline, and, afterward, at 15 and 18 months.

**Results:** Multivariate analysis of variance with repeated measures revealed that the only significant result is a global difference between the daycare center and the parental care groups ($F_{2, 146} = 3.89$, $p \leq .05$). Overall, children attending daycare center obtains significant higher total scores on the BRS compare to those who receive mostly parental care.

**Conclusion:** The group receiving parental care shows the lower score at the three times of measurement. Therefore, selection effects should be considered as an explanation of these findings. Thus, the differences at the first measurement could be resulting form the parent's attitude, or else, toward childcare services that have led them to choose a certain type of care instead of another. Since results were mostly statistically not significant, they highlight the importance of examining more variables of the daycare experience to have a better understanding of its effects on children's behaviour. As suggested by previous studies, futures works should consider the quantity and quality of childcare as some possible explanation of the relation.

**Th3-12**

## Using Parent Empowerment in Parenting Program For a Young Child with Autism

**Shie Jung-jiun**, Wang Tien-Miau

*National Taiwan Normal University, Taipei, Taiwan*

**Background and Aims:** Recently, the model of incorporating the concept of empowerment in parenting program has been discussed in the literature. As compared to clinician-oriented model, the empowerment model has been viewed as more effective for facilitating positive affect and engagement in children with autism (Brookman-Frazee, 1997). However, few studies have deeply described how professionals can do to empower parents and what the outcomes of children with autism will be. This qualitative study was designed to explore these questions in a parenting program.

**Methods:** Due to the low-functioning characteristics of the child with autism and his powerlessness mother who despately needed professional assistance, the two-year-old child and his mother were recruited through an early intervention research grant at NTNU in Taiwan. The mother-child dyad received one-on-one services designed by researchers once every week. Parent was treated as a partner by researchers. For the purpose of facilitating the child's development, different strategies were developed by researchers to increase mother's competence in parent-child interaction, parenting knowledge and skills, and emotional coping capacities. The data were collected within 9 months through participation, observation, researchers' reflection, interviews including parents and any other participants involved in the study.

**Results:** Two themes were emerged. (1). From powerlessness to empowered in parenting, the parent experienced different strategies designed by researchers including parent involvement, information and emotional support, positive feedback, self-awareness of the strategies, and self-determination of child's goals. (2). When the parent gradually gained sense of control over her child's development, and capable of interacting with her child, the development of the child was also strengthened holistically.

**Conclusions:** The study supports that development of young children with disabilities is linked to parent's functioning. Professionals should place a important role in facilitating parent's capacities and sense of control in parenting skills.

**Th3-13**

## "Educational Toys": Do Parents Believe the Hype?

**Wilkey Wong**[1] Kelly Fisher[2] Ximena Uribe-Zarain[3] Weiyi Ma[1] Roberta Golinkoff[1] Kathy Hirsh-Pasek[2]

*1. University of Delaware, School of Education, Newark, USA; 2. Temple University, Philadelphia, USA; 3. University of Delaware, Newark, USA*

**Background:** As the popular press advocate the criticality of the first three years of life in children's development, toy manufacturers follow suit by marketing new lines of "educational toys" for infants and toddlers. Manufacturers make direct and indirect educational and developmental claims through advertising copy on product packaging. Nevertheless, the Kaiser Family Foundation report found no published studies on cognitive outcomes of such toys. In addition, research exploring specific experiences needed for early brain growth and development is also still unclear (Hirsh-Pasek & Bruer, 2007). Even so, when asked about using educational toys at home, parents

recited benefits parallel to marketing claims (Garrison & Christakis, 2005). Given the apparent influence of popular press and toy marketing on parent perceptions of toy benefits, the current study examines whether the types of claims printed on product packaging influence parents' hypothetical purchasing decisions.

**Method:** Survey respondents (134 parents with children 6 - 36 mo) were instructed to imagine they were going to purchase a toy for their child. Respondents rated 25 claims commonly found on product packages on a 5-point Likert scale (1 = this statement would influence my toy purchase NOT AT ALL, 5 = this statement would influence my toy purchase A LOT).

**Results:** Exploratory factor analysis of data revealed four developmental categories that influence hypothetical purchasing decisions: brain growth, social-emotional, sensory/fine motor, and gross motor skills. Next, ratings were averaged across items, where category means were significantly different ($p < .05$) from a target M=2 indicating not positively influencing. Fine motor claims were most influential (M = 3.83), followed by brain stimulation (M = 3.41), social-emotional development (M = 3.30) and gross motor claims (M= 3.26).

**Conclusions:** Parents found claims about physiological development more influential on purchasing while social-emotional claims were given less credence. The implications of this research are twofold. First, parents are influenced by marketing claims when purchasing toys, which in turn, influences the types of experience children will have early in their lives. Second, given toys promoting physiological development appeared more, such toys may be a dominant form of experience for the young infant/child. Thus, toy-purchasing patterns based on marketing ploys may ultimately restrict children's early experiences and may influence later development ('educational toys' may be more structured and less socially-interactive in nature, Fisher et al., 2007). This suggests purchasing decisions based on marketing has inherent implications for children's lives beyond the purchase of these toys.

**Th3-14**

## Shaken Baby Syndrome Measurement Needs Focus: Discipline, Soothing, and Potential For Injury Awareness

**Beth Russell**

*Worcester State College, Worcester, USA*

**Introduction:** Shaken Baby Syndrome (SBS) affects over 1200 children in the United States each year. In response to this incidence rate and the high fatality rate that occurs when children younger than 2 years of age are violently shaken (25% to 40%), several states are considering state-wide legislation mandating hospitals provide SBS prevention efforts for all new parents. The literature on SBS perpetrators indicates that they shook the infants in their care in an attempt to soothe an otherwise inconsolable cry, to teach the child that crying is unacceptable, or without knowing that shaking could harm the child. Indeed, evidence is mounting to support crying as the only consistent precursor to the violent shaking of an infant (see Barr, Trent, & Cross, 2006 for details). The most common program adopted thus far (designed originally by Dr. Mark Dias) does not measure the underlying soothing or discipline attitudes relevant to SBS, but instead focuses on parents' retention of the risks shaking poses. This poster describes an effort to design a reliable shorter measure of these three caregiver attitudes (Appropriate soothing practices, appropriate discipline practices, and knowledge of the potential for harm to the child) compared to the longer original version (Russell & Britner, 2006).

**Methods:** Over 360 participants (mean age = 21 years, 90 = males, 190 = caregivers for children) completed the Shaken Baby Syndrome Awareness Assessment - short version. This survey includes 36 six-point likert scale items, 12 items for each of the three scales.

**Results:** Preliminary alpha analysis on each scale suggests that this revised measure is reliable, as even the lowest of the three (alpha = 0.70) meets commonly accepted rules of thumb for acceptability. In addition to these internal consistency measures, confirmatory factor analysis results will also be presented, based on the a priori understanding of the item set.

**Discussion:** Preventionists working to reduce SBS incidence can enhance their services to all parents by engaging participants in conversations on responding to inconsolable crying. The measure presented here provides a framework for those conversations, useful to a wide range of program design. **Conclusion:** The short version of the SBS Awareness Assessment meets standards of acceptability and is ready for wider use in intervention settings.

**Th3-15**

## Examining Fetal Education, Taekyo: Teaching Invisible Baby in the Womb

**Eun Young Nahm**

*Seoul Women's University, Seoul, Korea*

In Korea, there is old practice, called Taekyo, for pregnant women and fetus in their womb. The concept of Taekyo, or fetal education, originated from the Hwanjae Naekyung, the Classic text of Traditional Chinese Medicine. Korean Taekyo has developed own ways of practicing. The theory of Taekyo is that the mother's mood, thought, speech and behaviors are as important as her physical health and nutrition in determining the character, health, and intelligence of the future child(Lee, 1801). According to 2005 annual report of Korea's National Statistical Office, South Korea was the lowest number of lifetime births per woman in the world. This old practice has become popular again with Korean mothers anxious to give their only child the best possible start in modern society. Research indicates that the Korean women who practice Taekyo believed that it would make their children smarter and healthier(Cho, 1987; Kim, 1995; Kim, 2000). However, it is not clear which factors influenced these practices of modern Korean women. The goal of this study is to examine the level of Taekyo practiced by pregnant women and factors influencing Taekyo behaviors, and eventually to provide practical database for the intervention program to help pregnant women and their families. Eighty four pregnant women in their trimester were recruited from Seoul area, in Korea. All target women were married, living with their husbands. First, they were interviewed about their general opinions of Taekyo and their own experiences of Taekyo practices. Second, the Taekyo behavior Scale(Kim, 2000) was examined. These ratings are likely to reflect preconceptions of Taekyo as well as actual Taekyo practices. The Index presented in two categories: 1) how often the pregnant women do something encouraged or prohibited for fetus, and 2) factors that might influence Taekyo practice in terms of belief in the effects of Taekyo, acceptance of pregnancy, physical and emotional condition, family support, stress, self- esteem. The Cronbach's alpha scores ranged from .66 to .97. Results revealed that the level of Taekyo practiced by pregnant women were positively correlated with the level of husband support($r = .28$, $p < .05$), social support($r = .25$, $p < .05$), acceptance of pregnancy($r = .28$, $p < .05$), self-esteem($r = .36$, $p < .05$), and planed pregnancy($r = -.32$, $p < .01$). Possible factors and mechanisms that might influence Taekyo practice and relationship between mother and fetus in modern Korean society will be discussed.

## *Emotional Development*

**Th3-16**

### Correlates of Maternal Representations of and Responses to Infant Distress: Maternal Attachment and Symptoms in Mother and Infant

**Susan Woodhouse**[1] Kristina Boldebuck[2] Sarah Halcrow[2] Jude Cassidy[2]

*1. Pennsylvania State University, State College, USA; 2. University of Maryland, College Park, USA*

Although both maternal representations of infants and sensitivity have been linked to maternal attachment as measured by the Adult Attachment Interview (AAI), little research has focused specifically on representations of and responses to infant distress or has examined associations with parental romantic attachment. In the present study we examine links between representations of and responses to infant distress to maternal attachment (AAI and romantic), as well as to maternal symptoms and later child symptoms.

Participants were 220 mothers and their irritable infants. At one month, mothers completed measures of representations of distress (MRID), romantic attachment (ECR), and maternal global symptomatology (BSI). Maternal responses to distress were coded from lab tasks completed at 4.5 months using a newly-developed measure. Mothers also completed the AAI, ECR, MRID, and BSI. At 24 months, mothers completed the Child Behavior Checklist (CBCL).

In terms of behaviors, maternal responses to infant crying were related to maternal romantic attachment and maternal symptoms, but not AAI. Dyadic regulation was inversely related to both attachment anxiety and avoidance. Secure base provision in response to cries, was inversely related to attachment anxiety. Ignoring of cries was positively related to avoidance. Mothers who were more symptomatic tended to ignore crying and have lower dyadic regulation scores during crying. Mothers who were more symptomatic tended to provide less secure base across crying episodes.

Results showed that representations were linked to both AAI and romantic attachment. Further, negative representations of the infant were associated with maternal symptomatology. Representations of the infant as asking for/appreciating care were related to lower maternal symptomatology. Representations of the infant as critical and willful were linked to infant internalizing problems at 24 months; critical representations at newborn were also related to externalizing symptoms. Representations of the infant as appreciating/asking for care were inversely related to later internalizing problems.

**Th3-17**

### Parental Positive Emotions and Responsiveness: Influences on the Relationship between Approach/Inhibition and Behavioral Adjustment

**Cynthia Stifter**, Elizabeth Cipriano, Jessica Dollar

*Pennsylvania State University, University Park, USA*

Research on parents' responses to children's emotions has typically neglected parental expression of positive emotions. Kochanska demonstrated that shared positive affect is particularly important for fearless children as it encourages compliance and the development of conscience. Parental sensitivity has been shown to lessen negative emotionality. However, research on behavioral inhibition suggests that parental sensitivity may, in fact, encourage ongoing fearfulness in inhibited children. In the present study we examine the concepts of shared positive affect and parental sensitivity and whether they moderate temperament, specifically approach/inhibition (A/I), to predict behavioral adjustment.

Families (N = 150) were recruited at birth. At 12 months, several interaction tasks and observer assessments of infants' temperament were used to create a composite approach construct. Parental overall positive affect and shared positive affect were drawn from two 12-month parent/child interactions and a 24-month structured play. Parental responsiveness (sensitivity-intrusiveness) was assessed from a 12-month free play. Child compliance (committed and noncompliance) was measured at 24 months with a clean-up task. Problem behaviors were rated by both parents.

Results revealed main and interaction effects. More sensitive and less intrusive fathers had children who were less compliant and more noncompliant. For mothers, committed compliance was dependent upon temperament. High approach infants whose mothers used fewer positive expressions were more likely to be compliant while greater committed compliance was found with inhibited children of highly positive mothers. This effect for inhibition was similar when mothers shared positive affect at high levels. For problem behaviors, a main effect was found for mothers' shared positive affect: high levels were related to lower ratings of internalizing. When fathers expressed high levels of positive affect their inhibited children were less likely to have internalizing behaviors. These data suggest that during the first year of life, inhibited children may benefit most from parents' positive responses.

**Th3-18**

### Maternal Representations and Toddlers' Regulation of Negative and Positive Emotions

**Roni Nadam**, Ruth Feldman

*Bar-Ilan University, Ramat-Gan, Israel*

Between age 2-3 years, children's social-emotional development undergoes a major reorganization. The present study examined the role of mothers' mental representations and coping with parenting-related emotions and behaviors in the development of children's emotion regulation.

Participants included 69 child-mother dyads. Mothers' mental representation of the child and parenting process was assessed with the Parent Development Interview (PDI, Aber et al., 1985). Interviews were coded for three dimensions of maternal representations: level of mother's preoccupation with emotions; the degree to which each of the following emotions appeared: anger, joy, guilt, competence, dependence, and the endorsement of self needs; and the mother's ability to regulate emotions during mother-child interactions and to achieve a balanced perspective of the relationship. Child emotion regulation skills, delay of gratification, and symbolic play were assessed in several interactive contexts and emotion-eliciting procedures that were micro-coded for regulatory behavior and maternal facilitation of emotion regulation.

Results showed that children of mothers with more regulated representations demonstrated higher regulatory capacities across a broad range of skills, including better delay of gratification and higher levels of symbolic play. Few differences in maternal and child behavior were related to the level of preoccupation. Similar findings emerged for very low and very high levels of preoccupation with representations of maternal anger and guilt, suggesting that when mothers are unable to regulate emotions regarding the child and the parenting role the child's regulatory capacities are compromised.

Maternal representations had a greater impact on child capacity to regulate negative emotions. Similarly, maternal representations had a greater impact on mother-present situations than situations when the child was required to self-regulate. Few associations emerged between maternal behavior and representations, suggesting that the effect of maternal representation on child emotion regulation is mediated not only by her immediate behavior but by her general style.

**Th3-19**

### The Dyadic Quality during the Still-Face: Associations with Maternal Attachment and Sensitivity and Infant's Attachment Organization

**Gabrielle Coppola**, **Tiziana Aureli**, Annalisa Grazia, Maria Concetta Garito

*Department of Biomedical Sciences, Chieti, Italy*

Previous studies have found associations between the infant's early affect and regulation during the sill-face paradigm (Tronick et al., 1978) and attachment relationships at 12 months (e.g., Diener et al., 2002; Kogan & Carter, 1996). Moreover, mother's sensitivity has been shown to be associated with both infant's and mother's behaviour during the still-face situation (e.g., Baumgart-Rieker et al., 1998). Lastly, although it has been demonstrated that mother's state of mind with respect to attachment is the main antecedent of maternal sensitivity and infant's attachment (van IJzendoorn, 1995), no study has investigated the role played by this variable in that situation.

This study was aimed at investigating the associations between attachment -related variables and the quality of the interaction during the still-face. In particular, we wanted to verify if mother's sensitivity and attachment organization predict the dyadic quality of the interaction before and after the still-face phase and if this quality predicts infant's attachment. Dyadic exchanges besides the individual behaviors were the main focus of the analysis. As we know, infant's attachment patterns are thought to be dyadic regulatory strategies (Sroufe, 1995) and, recently, maternal sensitivity was also reconceptualized as a dyadic construct (Biringen et al., 2000).

The sample included 25 dyads. All dyads went to the lab three times: at 3 months of infant's age, for administering the Adult Attachment Interview (Main et al., 1985) and for a videotaped session of 12-minute mother-infant interaction; at 4 months, for the still-face procedure and at 16 months, for the Strange Situation Procedure (Ainsworth et al., 1978).

Maternal sensitivity was assessed during the 3 months interaction using the Emotional Availability Scales (Biringen et al., 2000). Infants' and mothers' behaviours in still face procedure were coded using the Infant and Caregiver Engagement Phases (Tronick et al., 2005). According to that system, the dyadic quality of the interaction was assessed through the proportion of matches and mismatches between the mother's and infant's simultaneous affective displays (positive, negative, neutral)

Preliminary results showed that the distribution of Adult Attachment Interview and Strange Situation categories were as in normative samples (van IJzendoorn, Bakermans-Kranenburg, 1996; van IJzendoorn & Goldberg, 1992). Moreover, we found that both moternal sensitivity and maternal secure attachment were significantly associated with the proportion of affective matches in still-face situation. Implications for the importance of dyadic measures in analyzing relationships between early emotion regulation and affective variables will be discussed.

**Th3-20**

### Who's on First? Order Effects on Male and Female Infants' Socioemotional Behavior during Mother-Infant and Father-Infant Interaction at 3 Months

**Marjorie Beeghly**[1,2] Karen Olson[2] Edward Tronick[1,3] M. Katherine Weinberg[4]

*1. Harvard Medical School, Children's Hospital, Boston; 2. Wayne State University, Detroit, USA; 3. University of Massachusetts, Boston, USA; 4. Jewish Child and Family Services, Boston, USA*

**Background and Aims:** Prior research has documented that 6-month-old boys exhibit both more negative and more positive engagement than girls during social interaction with their mothers, whereas girls display more neutral object engagement. The goal of the current analysis was to extend this research by evaluating gender differences in the socioemotional behavior of male and female infants with their mothers and fathers at 3 months of age. Differences in mothers' versus fathers' interactive behavior and effects of the order with which each parent interacted with the infant (mother first, father first) were also examined.

**Method:** Participants included 103 mother-father-infant triads (58% with male infants) from a larger longitudinal study. To minimize differences in parental caregiving experience, all mothers and fathers were first-time parents. At the 3-month lab visit, mother-infant and father-infant dyads were videotaped during face-to-face social interaction for 3 minutes each. The order of interaction of mother versus father was counterbalanced. In order to prevent parental "copy-cat" effects, parents were prevented from watching each other's interactions with the infant. Infant, maternal, and paternal behavior was scored micro-analytically from videotapes by trained, reliable coders masked to the objectives of the study using the Infant-Caregiver Engagement Phases (ICEP) coding system. Four dependent variables were evaluated for each interactive partner: the proportion of time in social positive engagement (looks and smiles at partner), neutral social engagement (looks at partner with neutral facial expression), object engagement (looks at object), and negative engagement (negative facial expression or negative vocalization). The data were analyzed using 3-way [gender (boy, girl) X parent (mother, father) X order (mother first, father first)] ANOVAs.

**Results:** Order effects proved important. Infants exhibited more positive social engagement with their mothers than their fathers, particularly when the father had interacted with the infant first, $F(1, 91) = 3.95$, $p = 0.49$. Similarly, male infants exhibited more negative engagement with mother and father, if the father had interacted with them first, $F(1, 91) = 5.61$, $p = 0.02$. In contrast, girls exhibited more neutral social engagement than boys, especially when the father interacted with them first, $F(1, 91) = 4.41$, $p = 0.38$. Infants spent proportionately more time engaged with objects when interacting with their father than with their mother, $F(1, 91) = 4.41$, $p = 0.038$). Mothers exhibited significantly more positive engagement with their infants than fathers, $F(1, 89) = 17.76$, $p = 0.0001$, whereas fathers exhibited significantly more neutral social engagement than mothers, $F(1, 89) = 32.29$, $p = 0.0001$.

**Conclusion:** Results partially replicate and extend to 3 months previous findings regarding gender and parental differences in older infants' socioemotional behavior during parent-infant interaction. Mothers had more positive interactions with their infants than fathers. Significant order effects on infant behavior suggest that inexperienced first-time fathers can disrupt their infant's later positive engagement with the mother, when they interact with the infant before the mother does.

**Th3-21**

## Psychological Preparation for Motherhood: Prediction to Postpartum Mental Health and Infant Attachment Security

**Megan Beers**, Jennifer Ablow
*University of Oregon, Eugene, USA*

The transition to motherhood is, for many women, a profound and exciting time. However, along with the joy that can accompany this life change comes a great deal of vulnerability. During the prenatal and postpartum periods, women are at increased risk for a variety of mental health problems that result directly from motherhood (e.g. depression, anxiety; O'Hara & Swain, 1996). These difficulties place women at-risk for developing non-optimal relationships with their infants, which could have implications for their children's mental health for many years to come (Greenberg, 1999). Despite the documented risks associated with this transition, the factors that predict its quality have received strikingly little research attention. In particular, very little research has been conducted on the process that women go through psychologically to prepare themselves for motherhood. This gap, both theoretical and empirical, limits our capacity to develop scientifically-informed methods of intervention for women during the prenatal and early postpartum periods. The current study seeks to examine whether psychological preparation for motherhood is predictive of postpartum outcomes in first-time mothers and their infants. The sample comprises 100 at-risk women recruited during their third trimester of pregnancy with their first child. Women were first assessed during their third trimester of pregnancy, at which point they completed interview and self-report measures of psychological preparation for motherhood. Dyads were then seen at 5 months and 16 months postpartum, during which maternal mental health (5 and 16 months) and infant attachment security (16 months) were assessed. Interviews are being coded for psychological preparation using a coding system developed for this project. Self-report psychological preparation data suggests that women who reported the most unrealistic prenatal representations of themselves as mothers (either positive or negative) reported higher levels of depressive symptomatology at 5 months postpartum. Subsequent analysis of interview data will examine whether interview measures of psychological preparation for motherhood are predictive of postpartum symptomatology and whether interview and self-report measures of psychological preparation are predictive of subsequent infant attachment security. This project will aid in the understanding of a life transition that millions of women progress through each year and, in particular, may promote positive child development by contributing to uncovering the etiology of maladaptive adjustment during the transition to motherhood.

**Th3-22**

## The Interplay of Distress, Emotion Regulation Strategies, and Attachment Security

**Rebecca Brooker**[1] Kristin Buss[1] Elizabeth Kiel[2] Lauren Bailey[3]
*1. Department of Psychology, The Pennsylvania State University, University Park, USA; 2. Department of Psychological Sciences, University of Missouri - Columbia, Columbia, USA; 3. University of Missouri-Columbia, Columbia, USA*

Past studies have used Ainsworth's Strange Situation procedure to examine the development of distress-regulating behaviors (e.g., Mangelsdorf et al., 1995) but have not examined possible influences of attachment classification and context (i.e., mother-present, stranger-present, child-alone). Studies of heritability show that main effects associated with infant-mother attachment are transmitted largely through the rearing environment (Roisman & Fraley, 2006). Mothers influence the way infants learn to regulate (Grolnick et al., 1998) and attachment may be an active mechanism in this process. This study examines that possibility. We hypothesize that differences in context, attachment, and distress will contribute to individual differences in the use of regulatory behaviors.

These relationships are examined in a sample of 18-20-month old infants. The sample includes 100 infants (50% girls) observed during Ainsworth's Strange Situation procedure. Video of the visits was used to code infants' fear, sadness, anger, and use of various putative regulatory strategies (e.g., fidgeting, leave-taking, distraction, etc.) during the Separation 2 (child-alone) and Reunion 2 (mother-present) episodes.

Preliminary analyses include data from roughly half of the sample and reveal that in the child-alone condition, increases in distress predict increases only in leave-taking behaviors ($r$ =0.604, $p$ <0.01) across attachment classes. When examined separately by attachment classification, differences emerge in type of affect displayed and regulatory behaviors used. Insecure-ambivalent (C) infants use greater proportions of leave-taking behaviors than insecure-avoidant (A) or securely-attached (B) infants ($M$=0.33, 0.11, and 0.13 respectively). C infants also show more anger ($M$=0.67, 0.12, and 0.07) than A and B infants. B infants, in contrast, show more fear ($M$=0.36) than A ($M$=0.15) and C ($M$=0.05) infants, but do not show the highest proportions of crying.

In the mother-present condition, comparisons of means suggest that C infants remain more distressed than A and B infants even with their mother is present. When C infants are compared to A and B infants, they show greater proportions of crying ($M$=0.66, 0.34, and 0.05 respectively), sadness ($M$=0.85, 0.12, and 0.12), and anger ($M$=0.20, 0.02, and 0.03), and smaller proportions of time spent engaged in play ($M$=0.24, 0.70, and 0.67). Findings from the two episodes suggest that infants differing in attachment security have unique emotional responses to distressing situations, employ different regulatory behaviors, and are differentially successful in decreasing distress despite having similar resources.

Additional analyses with the full sample will and include a stranger-present condition, add supplemental behaviors from attachment coding, and examine possible influences of gender.

**Th3-23**

## Infants' Attention to Emotional Expressions: Evidence For Universal Biases and Individual Differences

**Frances Chen**, Susan Johnson
*Stanford University, Stanford, USA*

Research has shown that facial expressions of emotion influence attentional processes in healthy adults. In general, spatial attention is more strongly captured and held by negative than neutral expressions (cf., Dolan, 2002.) Population-specific effects have also been found. Depressed individuals are biased toward sad faces (Gotlib et al., 2004); anxious individuals toward angry faces (Fox el al., 2002). The current study investigated (1) whether, in general, emotional expressions exert similar influences in infancy, and (2) whether, because of its relationship to later psychopathology, attachment status predicts individual differences in these processes.

We tested 32 13-month-olds in an Emotion Attention task and Ainsworth's (1978) Strange Situation. For the Emotion Attention task,

five pictures of a single Caucasian woman producing neutral, fearful, angry, sad, and happy faces were chosen from the MacArthur Face Inventory. Each face appeared in the center of a screen in randomized order. 1000 ms after the infant fixated the face, it was replaced by a small star-shaped target to the far left or right. Frame-by-frame coding was used to measure how long (in ms) it took the infant to shift attention away from the central fixation after the target's appearance (i.e. launch an eye movement.)

Based on the Strange Situation, infants were classified as secure (n=15), insecure-avoidant (n=8), or insecure-resistant (n=9). Infants' behavior was also coded for degree of disorganization based on Main and Solomon's 9-point scale (1990).

A repeated-measures ANOVA was run with expression and target side as within-subject variables and attachment security and disorganization as between-subject variables. Several effects were found. Infants disengaged more slowly from some expressions than others ($F=6.54$, $p<.001$). Both fear and anger took significantly longer for infants to disengage from compared to neutral ($p<.001$ and $p<.05$ by simple contrast tests.) Infants were also slower to disengage from the faces when the target appeared in the left visual field ($F=6.43$, $p<.02$), suggesting a right hemisphere emotion processing bias. There was also an interaction between expression and disorganization ($F=2.82$, $p<.03$). Specifically, the more disorganized behaviors the infants showed in the Strange Situation, the more quickly they disengaged from fear faces. There was no effect of the traditional secure vs. insecure attachment classifications.

To our knowledge, these results provide the first direct evidence that (1) the influence of facial expressions on spatial attention is present in infancy, and that (2) attachment disorganization is related to infants' processing of facial expressions.

**Th3-24**

## Does Similarity Between Mothers' and Fathers' Emotionality Relate to Toddlers' Observed Emotional Reactivity?

**Benjamin Deweese**, Kristin Buss

*The Pennsylvania State University Department of Psychology, University Park, USA*

As one of the earliest mechanisms of socialization, parents offer a foundation for emotional development (Eisenberg, 2002). When parents present a negative, coercive, or unpredictable emotional environment, children are susceptible to becoming highly emotionally reactive (Sheffield Morris, 2007). Although family context impacts children's emotional development, the mechanisms through which this takes place are less clear (Darling & Steinberg, 1993). Examining the role of parent characteristics such as emotionality may be useful. Maternal depression and anxiety have been associated with children's negative emotionality. However, little is known about father's influences on children's emotionality (Lorraine, 2006). With this in mind, the current study will examine whether the similarities and differences between mothers' and fathers' emotionality impact children's behaviors in emotionally challenging tasks.

At twenty-four months of age, children and parents attended a laboratory visit and parents were asked to complete questionnaires. The PANAS (Watson, et al., 1988) assessing positive/negative affectivity and BIS/BAS (Carver & White, 1994) assessing behavioral inhibition/activation systems, were used to index the emotionality of both parents (n=111). We combined the two measures, in the following way, because they were moderately correlated (BIS/NA and BAS/PA). From this, four discrete composites of parental personality were created for both positive and negative emotionality: (Group 1) Mom High and Dad High; (Group 2) Mom High, Dad Low/Average; (Group 3) Dad High, Mom Low/Average; (Group 4) Mom Low/Average and Dad Low/Average. Four primary toddler behaviors were scored during laboratory episodes designed to be novel and mildly fear eliciting (e.g.; risk room): distress, positive affect, shyness, and boldness.

Initial analyses revealed that the strongest predictor of toddler distress was elevated parental BIS/NA. Comparisons across four parent groups indicated that the mismatch of elevated father negativity and low/average mother negativity (Group 3) related to shyness in risk room, $F(3,107)=2.85$, $p<.05$. This result was replicated across four of seven episodes. Analysis of gender also revealed a significant interaction. Girls displayed more shyness when only fathers were high in BIS/NA (Group 3), whereas boys showed greater shyness when both parents were rated as high (Group 1). Parent positive affect was not associated with toddlers' behavioral reactivity, suggesting negative emotionality as the more salient source of influence upon toddlers' emotional reactivity in the lab. Discussion will probe these results, seeking to further isolate the parental characteristics that shape toddlers' behavior. In addition, we will examine longitudinal predictions from parent emotionality and toddler behavior to outcomes in kindergarten.

**Th3-25**

## Trajectories of Behavioral Strategy Use with Mothers and Fathers Across Infancy

**Naomi Ekas**, Shannon Zentall, Diane Lickenbrock, Lauren Bohn, Julia Braungart-Rieker

*University of Notre Dame, Notre Dame, USA*

Between 3 and 7 to 9 months, infants begin to develop cognitive skills necessary for complex regulatory strategies. For example, during a Still-Face Paradigm, older infants were generally more likely to turn their attention away from the mother's unresponsive face (Gianino & Tronick, 1988). There is limited research, however, that investigates different patterns of emotional regulation trajectories over time and why infants may differ in those trajectories.. Therefore, the current study investigates possible predictors and outcomes as they relate to trajectory patterns. The study also extends previous work by examining emotion regulation trajectories when infants are with mothers and fathers.

This study follows 135 families when infants were 3, 5, 7, and 20 months of age. During the first three visits, each parent participated separately (order counterbalanced) in the Still-Face Paradigm with their infant, which involves three structured 90-s episodes: play, still-face (no interaction), play resume. During the final visit, each parent participated separately in the Parent-Ignore-Toddler-Situation, which also consisted of a similar sequence of episodes.. Infant and toddler affect was coded. Behavioral strategies from three domains of functioning were coded: visual, motor, and verbal, (20 month only). In addition, parents completed the Infant Behavior Questionnaire- Revised during the first three visits.

A group-based method for analyzing developmental trajectories was performed for each parent and for each behavioral strategy (Nagin, 2005). For the behavioral strategy of looking at the parent we found three distinct groups. Specifically, group one (inconsistent) infants spent little time looking at the parent at three months, increased at five months and then decreased again at seven months (9.8% with mothers; 8.5% with fathers). In contrast, group two (moderate decreasing) infants displayed moderate levels of looking at the parent at three months and then subsequently decreased (55.3% with

mothers; 44.8% with fathers). Finally, group 3 (high decreasing) infants displayed high levels of looking at the parent at three months and sharply decreased at five and seven months (34.9% with mothers; 46.7% with fathers). When investigating how the distinct trajectory groups might predict later regulatory strategy use, we found that infants in group two displayed higher levels of distraction strategies at 20 months with mothers. With fathers, however, infants in group one displayed higher levels of distraction at 20 months. Further analyses will be conducted with a variety of different behavioral strategies, as well as multiple outcomes and predictors of trajectory group membership, such as affect and temperament.

**Th3-26**

### Emotional Contagion and Individual Differences in Cardiac Autonomic Regulation in 9-Month-Old Infants

**Elena Geangu**[1] Renata Heilman[2] **Oana Benga**[2] Andrei Miu[2]

*1. Romanian Academy of Science, Babes-Bolyai University, Cluj-Napoca, Romania; 2. Babes-Bolyai University, Department of Psychology/Program of Cognitive Neuroscience, Cluj-Napoca, Romania*

Empathy is assumed to be the result of three major components: affective sharing, self-other awareness, and emotional regulation. Emotional contagion or affective sharing is considered a specific component of empathy, such that the perception of an emotional experience in another triggers similar emotional reactions in oneself. Perfect matching between the observed emotion and one's own emotional reaction is counterproductive in terms of prosocial behavior and nonadaptive for the self. Therefore, down-regulation by means of emotional regulation strategies is essential for the differentiation between pure emotional contagion and empathic-like reactions. The first signs of affective sharing are recorded early in the first year of life, when infants cry in reaction to the sound of another infant's cry. We have shown previously how 3- and 6-month-old infants' emotion regulation abilities are related to the down-regulation of affective sharing as indexed by contagious crying. The pattern of results was less clear though for the 9-month-olds group. The present study investigated whether non-invasive cardiovascular measures of vagal tonus predict the magnitude of contagious crying in 9-month-old infants.

Twenty 9-month-old infants were included in this study. The behavioral procedure consisted of a baseline and a test phase. After a 120 seconds baseline, in the absence of any auditory stimulation, the participants were presented for the test phase with the sound of another infant pain cry, with a duration between 120-300 seconds. During both baseline and test phase, infants vocal reactions of distress (i.e., percent of time crying, intensity of cry, and latency to cry), emotional facial expressions (i.e., anger and sadness), and electrocardiogram were recorded. Heart rate, as well as the low and high frequency components of heart rate variability were calculated from baseline and test recordings.

We report and discuss our findings on the relationship between baseline vagal tonus, vagal tonus change and contagious crying in 9-month old infants and their implications for empathy development. We will emphasize the contribution of the present results for the validation of contagious crying as an early precursor of empathy.

**Th3-27**

### Do Mothers and Fathers Provide Different Socialization Experiences For the Regulation of Positive Affect in Infancy?

**Rachel Hutt**[1] Ginger Moore[1] Anneliese Bass[1] Jeffrey Cohen[2]

*1. The Pennsylvania State University, University Park, USA; 2. University of Pittsburgh, Pittsburgh, USA*

Parental attunement to infants' affective cues is a vital component of parent-infant interaction that supports infant emotion regulation. Affect attunement is a mechanism through which mothers and fathers may differentially socialize infants' development of emotion regulation skills (ER), yet these differences have not been studied directly. Research suggests that mothers show more positive affect than fathers, that fathers spend more time in physical play, and that infants respond more positively to play initiated by fathers. Father-infant interactions are less cyclical and have higher levels of positive arousal with peaks of high intensity, whereas infants' arousal with mothers is centered on low and medium cyclical states (Feldman, 2003). This work highlights the unique role fathers may play in the socialization of infants' positive ER. The current study examines differences between mothers and fathers in the socialization of infant positive ER by observing parents' affect attunement in a game of peek-a-boo in comparison to infants ER in peek-a-boo and the Still-Face Paradigm (SFP). Parents' ability to provide sensitive attunement may be reflected in infants' need and ability to regulate emotions, both in the peek-a-boo game and other contexts.

Mothers and fathers ($n$ = 130) were observed in peek-a-boo interactions and in the SFP with their 6-month-old infants. The ability of parents to maintain positive engagement with infants was rated on a 5-point scale for each round of peek-a-boo. Infants' affect and gaze were coded for each second of peek-a-boo and SFP. SFP coding is complete with peek-a-boo coding in progress. Thirteen families with complete mother-infant and father-infant data are included in these analyses.

Preliminary findings suggest that mothers have higher levels of affect attunement with infants than fathers. Higher levels of fathers' affect attunement during peek-a-boo was negatively related to infant gaze aversion ($r$ = -.736, $p$ < .01), suggesting that infants of fathers with high attunement do not need to regulate as often. Further analyses with the entire sample will examine parents' affect attunement and infant ER in contexts designed to elicit both positive (i.e., peek-a-boo and normal play in the SFP) and negative affect (i.e., reunion episode of the SFP). In addition, relations among affect attunement, other parenting measures (e.g., sensitivity and flexibility), and contextual factors (e.g., parent depressive symptoms and parenting stress) will be examined for parental differences. These initial analyses suggest that there are differences between mothers and fathers in the socialization of positive ER in infancy.

**Th3-28**

### Infant Temperament as Mediator of Postpartum Depression on Attachment

**Sandra Jolley**[1] Alyson Shapiro[2] Ursula Krentz[3] Susan Spieker[1]

*1. University of Washington, Family and Child Nursing, Seattle, USA; 2. Arizona State University, School of Social and Family Dynamics, Tempe, USA; 3. Seattle Pacific University, Seattle, USA*

**Purpose:** The purpose was to examine the influence of early postpartum depression (PPD) on observed temperament and infant

attachment behavior in an otherwise low risk sample. PPD affects at least 15-20% of new mothers and their infants tend to be fussier, more avoidant, and make fewer positive facial expressions and vocalizations. Most research with early PPD has focused on PPD assessment at 6 weeks or later. Little is known about the impact of earlier and possibly transient PPD or blues at 3 weeks postpartum, or how the timing of PPD affects the mother-infant relationship and infant development.

**Methods:** Sixteen nondepressed mothers recruited during pregnancy, were followed dyadically through the infants first year of life. PPD was assessed at 3, 6, and 12 weeks, and 6 and 12 months postpartum using the Postpartum Depression Screening Scale (PDSS). Infant temperament, conducted during laboratory visits when infants were 6 months old was measured by the Laboratory Temperament Assessment Battery (Lab-TAB; Goldsmith and Rothbart, 1985). When the infants were 12 months old the Ainsworth Strange Situation was conducted to examine attachment behavior.

**Results:** PPD at 3-weeks-postpartum significantly predicted aspects of observed infant temperament at 6 months of age including infant negative vocalization, sad affect, and a lack of struggling to get the toys placed behind a barrier. These aspects of observed infant temperament, in turn, significantly predicted infant attachment behavior in the Strange Situation including: a tendency not to seek and maintain contact with one's mother during the reunion episodes, a lack of expressed distress during the separation episodes, and a lack of resistant behaviors. These behaviors may reflect a pattern of passivity (or lack of active engagement or coping), which would be consistent with previously reported depression like symptoms in infants of depressed mothers, suggesting that temperament may be a mediator through which early post-partum depression impacts attachment behavior almost a year later when infants are 12-months-old. Significant links between early post-partum depression and attachment classification were not evident.

**Discussion:** Findings linking early PPD with infant temperament at 6 months, and infant temperament with later strange situation behavior suggest, that infant temperament may be a mediator through which early postpartum depression impacts infant attachment behavior. Additionally, this evidence supports the effect of early nurture influences of the mother on infant development. This longitudinal relationship indicating an impact of early PPD highlights the importance of prevention, early detection and early intervention.

**Th3-29**

### Stop Crying! Origins of Mothers' Beliefs and Goals About Crying

**Esther Leerkes**, Stephanie Parade, Regan Burney

*The University of North Carolina at Greensboro, Greensboro, USA*

Parenting beliefs and goals reflect what parents hope to achieve through their interaction with their children and are believed to guide parenting behavior (Sigel & McGillicuddy-De Lisi, 2002). Parents who have more child-centered than parent-centered goals engage in more adaptive parenting behaviors (Dix, 1991; Hastings & Grusec, 1998; Kuczynski, 1984). The purpose of this study was to identify the familial and personal origins of mothers' beliefs and goals about infant crying. We hypothesized that: 1) mothers whose own emotional needs were not met in childhood would have more negative and self-focused beliefs and goals about crying than other mothers, unless the following buffers were present: positive intervening relationships, adult attachment security, or a partner with positive, infant-oriented beliefs and goals about crying; and 2) mothers prone to depression, anger, and avoidant coping styles would also have more negative and self-focused beliefs and goals about crying than other mothers.

Primiparous mothers (n = 101) completed measures of depression, trait anger, coping styles, childhood parenting history, and adult attachment security prenatally. Mothers were interviewed about their beliefs and goals about infant crying during the prenatal period. The presence or absence of 10 mother-oriented beliefs/goals (e.g., wants crying to stop because it bothers her) and 8 infant-oriented beliefs/goals (e.g., wants to respond in a way that promotes trust and security) were coded and then summed. At 6 months postpartum, mothers and partners completed the Infant Crying Questionnaire in which they rated how much they agreed with statements about crying and how and why they respond to crying. This yielded the following dimensions: crying is a nuisance/minimize emotions (10 items, α = .74), fear of spoiling (8 items, α = .74), parent esteem (3 items; α=.72); attachment/ comfort (9 items; α = .80); crying as communication (3 items; α= .72); and positive adjustment (8 items; α = .73).

Consistent with prediction, mothers prone to depression, anger, and avoidant coping styles had more self-focused goals, were more likely to view crying as a nuisance that should be minimized, and were afraid that their responses to crying might cause their infants to become spoiled. Mothers whose own emotional needs were not met in childhood were less likely to have infant-oriented goals, view crying as a form of communication, or believe that their responses to crying could promote attachment or other positive child outcomes, *but only if the predicted buffers were absent*.

**Th3-30**

### The Effects of Self-Produced Locomotor Experience on the Expression of Affect in Infants

**Brian Meyer**[1,2] Joseph Campos[1]

*1. Department of Psychology, University of California, Berkeley Berkeley, USA; 2. Department of Psychology, Luther College, Berkeley, USA*

Recent approaches to the nature-nurture issue in human and animal development have emphasized what Gottlieb (2007) calls an "epigenetic perspective." In terms of behavioral development, this perspective suggests that certain developmental acquisitions create experiences that bring about new psychological skills that either would not have come about, or would have come about much later in development, in the absence of the prior developmental acquisition. The present study focused on infant crawling as one such developmental acquisition, one predicted to influence the perception of self-movement, an important aspect of the development of self, as well as the child's emotional reactions. The perception of self-movement was tested using a "moving room" that manipulated optic flow in both the visual periphery and the frontal visual field. Such optic flow creates a sense of self-movement if detected and processed properly by the infant-a sense that is incongruent with the lack of objective movement by the infant. Therefore, the perception of self-movement in the moving room, being both unexpected and at odds with somatosensory and vestibular information specifying no movement, creates an affective reaction, which we indexed using Izard's MAX technique and global judgments of emotion and of distress. Previous studies have shown that, in terms of postural sway, locomotor infants respond significantly more to peripheral optic flow than do prelocomotors, but both respond similarly to global optic flow conditions. However, if locomotor infants truly are more sensitive to the peripheral flow than prelocomotors, the affective reaction of locomotor infants to global optic flow

should be stronger or greater in frequency than that of prelocomotors even though both are responding similarly in postural sway.

To explore the role of locomotor experience, 44 eight- to nine-month-old infants (15 prelocomotor and 29 locomotor) were tested in a modified moving room design. Several measures were taken: a) postural sway indexed by the cross-correlation of room movement and infant postural shifts, b) emotion (indexed by selected MAX facial movements), c) global judgments of the expression of any emotion (positive or negative), and d) global judgments of negative affect. Two hypotheses were tested. One, in moving room conditions approximating global optic flow, prelocomotors and locomotors should both respond significantly to the optic flow in postural sway. Two, locomotor infants should display significantly greater frequencies of affect than prelocomotors. Analysis of postural compensation and of the frequency of affective expressions supported these hypotheses. Future studies need to explore emotional reactions with more sensitive indicators (e.g., autonomic reactions), and also to more directly identify the causes of the differences found between the locomotor and prelocomotor groups.

**Th3-31**

### Mother's Perception of Infant Emotion: Focus on Their Own Emotion

**Tomoko Obara**[1] Natsumi Ueshima[2]

*1. Aichi Konan Collage, Nagoya, Japan; 2. Nagoya University, Nagoya-city, Japan*

**Background and Aims:** We examined what impact mother's own emotional state had on their perception of infant's emotion and their use of broader context. Previous research has suggested that the fluency of mother-infant interaction largely depends on mothers' ability to accurately assess their child's emotional expression (Kay, 1997). Recently, it is suggested that one's cognition and emotion are reciprocity (Endo, 2002).

Mothers' emotion might have impact on perception of infants' emotion. However, the relationship between mother's emotion and their perception of infant's emotion has not been studied empirically. The specific information mothers might use when interpreting infant's emotion also has not been studied in relation to their emotion.

In response to this, we developed tools to measure a mother's perception of infant emotion and examined the context with which mothers may use to interpret infant emotion. We also examined how mother's own emotional state effected on their interpretation of infant's emotion and their use of the context.

Development of stimuli: Eight mothers of infants 0 to 3 years of age were shown short video clips, each 15 seconds long. They were then asked to rate the strength of the infant's emotional expression on a 6-point scale, as well as the infant's emotional state (pleasant or unpleasant) on a 3-point scale. Half of the video clips included infants without their mothers and the other half included interactions with mothers present. We then used the average scale scores from this stage of our study to determine the order in which we would show the video clips to the next group of studies.

**Method:** Eight mothers of infants 0 to 1 year of age were also shown the video clips and were asked their own emotional state on a 3-point scale and infants' emotion. They were also asked the context which mother used to assess infant's emotion.

**Results:** Results indicated that mothers perceive infant emotion not only via infant facial, behavioral, or vocal expressions, but also from the context of the environment. About mother's emotion, those of emotional state was unpleasant used the context differently to interpret infant's emotion from those of that was pleasant.

**Discussion:** This is the 1st time such variables have been studied empirically in Japan. We are currently collecting more data for the present study. Our study might have implications for clinical samples, such as mothers who have negative emotion on their infants.

**Th3-32**

### Do Infant Child Characteristics Predict Emotion Regulation Strategy Understanding at 36 Months?

**Caroline Pemberton, Pamela Cole**

*The Pennsylvania State University, State College, USA*

Understanding effective emotion regulation (ER) strategies is an important aspect of socio-emotional competence (Denham, 1998; Saarni, 1999). Kopp (1982; 1989) emphasized that child intellectual and language skills contribute to developing self-regulation, yet few studies test this assertion in contrast to tests of the role of temperament. We test the role of early intellectual and language status, and temperament, in predicting later understanding of ER strategies. Between 18 and 36 months, there are major developmental changes in ER, cognition, and language. The ability of a child to integrate cognitive and language skills into the service of self-regulation may depend on parenting, especially during a period of increasing autonomy and socialization pressure (Belsky, Woodworth, & Crnic, 1996; Crockenberg, 1985). We will test a model that parenting factors mediate the relation between child intellectual and language skills and ER strategy understanding.

In this submission, we report preliminary findings as we process the remaining data that will be available in two months. In a sample of 115 children, we tested the degree to which child gender, intellectual status (Bayley MDI), language status (MacArthur CDI Vocabulary Comprehension and Production), and temperament (TBAQ-R Negative Emotionality, Effortful Control, and Extraversion/Surgency) at 18 months predict 36-month-olds' accurate recognition of ER strategies (using a new puppet procedure), controlling for 36 month intellectual status (WPPSI-III Full IQ) and grammatical understanding (CELF); temperament was strongly related across age and thus not entered at 36 months. Because no aspect of toddler temperament contributed, it was removed from the model. A significant model, Adj $R^2 = .21$, $F(6, 108) = 4.67$, $p < .0001$, revealed that intellectual status at 18 months ($\beta = .25$, $t = 2.14$, $p < .05$) and gender ($\beta = -.24$, $t = -2.66$, $p < .01$) account for variance in 36 month strategy recognition accuracy, after accounting for concurrent intellectual ($\beta = .17$, $t = 1.63$, *ns*) and language status ($\beta = .13$, $t = 1.26$, *ns*). The interaction of gender and intellectual status was not significant. Girls, and children with lower intellectual abilities, recognize fewer effective ER strategies at 36 months. The full model will add parental socialization of ER strategies.

These preliminary results indicate direct effects of early cognitive abilities and gender on early understanding of ER strategies, an important finding given that early strategy understanding is related to better behavioral self-regulation (Cole et al, in press).

Th3-33

## Temperamental Frustration and Inhibitory Control, and Parental Responses to Temperament Displays, in Relation to Toddler Behavior Problems

**Samuel Putnam**, Nicole Borunda
*Dept. of Psychology, Bowdoin College, Brunswick, USA*

Although the contention that aspects of effortful control should moderate the harmful effects of negative emotionality has been labeled a "core emotion-regulation prediction" (Belsky et al., 2001), only a handful of studies have empirically investigated such trait-by-trait interactions in relation to early indices of maladjustment (Rothbart & Bates, 2006). Furthermore, general aspects of parenting (e.g., sensitivity, power assertion) have been shown to play additive, mediating, and moderating roles in the connection between temperament and subsequent behavior (Putnam et al., 2002), but few studies have examined more specific parental responses to temperament-relevant behaviors (e.g., Eisenberg et al., 1999). These studies have largely focused on externalizing difficulties or social competence in older children, whereas less research has been conducted on toddlers or concerned internalizing-type behaviors. The current study addresses these shortcomings, examining interactions between temperamental frustration, inhibitory control, and parental responses to temperament displays in relation to internalizing and externalizing behaviors of 76 toddlers.

Observational data for frustration and inhibitory control were coded from videotapes of child restriction to a car seat and a resistance to temptation paradigm, respectively, at 30 months. At this time, parents completed scales assessing these traits, as well as a questionnaire regarding their typical responses to toddlers' displays of negative affect and effortful control. At 36 months, parents completed the CBCL.

Consistent with expectations, regression analysis suggested that high frustration and low inhibitory control explained non-overlapping variance in externalizing. Although a marginal negative correlation was obtained between inhibitory control and internalizing, only high frustration predicted unique variance. Inhibitory control did not moderate frustration in relation to behavior problems.

Parental reactions to temperament displays did not mediate links between temperament and frustration, but instead complemented temperament in additive and multiplicative fashions. Parents who reacted to their toddlers' effortful control attempts with supportive responses such as suggesting strategies and expressing pleasure with successful attempts appeared to contribute to their children's externalizing difficulties. In addition, inspection of a significant interaction term suggested that these parental reactions exacerbated the negative relation between inhibitory control and externalizing. Supportive reactions to effortful control bids were also associated with high levels of internalizing, whereas more directive and punitive parental reactions to effortful control were associated with lower internalizing. These findings conceptually replicate and extend those of Bates et al. (1998), who reported stronger associations between children's resistant temperament and externalizing when parents restrained and scolded their children for failing to demonstrate appropriate self-control.

Th3-34

## Mothers' Response to Infant Social Looks Predicts Emotion Recognition at 4 Years

**Jihyun Sung**, Hui-chin Hsu
*Dept. of Child and Family Development, University of Georgia, Athens, USA*

Infants learn and gather information in the context of social-affective relationships. From birth, infants demonstrate a preference to human face and speech. They also seek emotional or other social clues to guide their actions. Mothers provide verbal and nonverbal feedbacks to their infants' social looks. Through social referencing, infants figure out how others feel and behave with respect to the many new events encountered everyday situations. Therefore, the quantity and quality of maternal response to their infant's social looking may enhance sensitivity to and sophistication for emotion recognition. Thus, this study investigated the developmental links between mothers' response to infant social looks and children's subsequent development in emotional recognition.

Fifty-one 12-month-old infants and their mothers participated in a larger longitudinal study. At 12 months, mothers were asked to teach their infants several developmentally challenging tasks. Infant gaze toward their mother during interaction was coded from videos. Mothers' facial and verbal response to infants' social looks was also coded separately. Based on the Facial Action Coding System (Ekman & Friesen, 1978), mothers' positive facial responses were first identified and then further classified as simple (i.e., upturned mouth corn), Duchenne (i.e., upturned mouth corner with raised cheek), duplay (i.e., upturned mouth corner with raised cheek and dropped jaw), or play smile (i.e., upturned mouth corner with dropped jaw). Mothers' verbal response was classified as affect-focused, activity-focused, or negative. At 48 months, children participated in an emotion recognition test. The Diagnostic Analysis of Non-Verbal Accuracy (DANVA, Nowicki & Duke, 1994) was administered. The test items and scores were grouped into a high and a low intensity category for four facial expressions including happiness, sadness, anger, and fear.

Results indicated that infants whose mothers responded to their social looks with dynamic changes and complicated configurations (involving mouth, cheek, and/or jaw simultaneously) in their smiles performed better at recognizing high-intensity emotions at 4 years, particularly the emotion of happy. Moreover, frequent affect- and activity-focused verbal response by mothers also predicted better performance at recognizing high-intensity emotions subsequently. Surprisingly, mothers' negative and mismatched verbal response predicted better performance at recognizing low-intensity emotions. Finally, frequent multimodal (involving both verbal and nonverbal actions) maternal response predicted better performance at recognizing high-intensity emotions at 4 years rather than unimodal (verbal or nonverbal actions) maternal response.

These results suggest that social attention may provide an opportunity for infants to explore and percept mothers' emotional displays. Frequent dynamic and complex positive facial response by mothers to infant social attention may facilitate infants' sensitivity to emotions. Positivity and richness in maternal facial and verbal response to infant social looks may have long-term impacts on emotional development during preschool years.

**Th3-35**

### Mother's Perception of Infant Emotion: Focus on Infant and /Or Broader Context

**Natsumi Ueshima**[1] Tomoko Obara[2]

*1. Nagoya University, Nagoya, Japan; 2. Aichi Konan Collage, Nagoya, Japan*

**Background and Aims:** We examined what mothers use to assess an infant's emotion: infant behavior and/or broader context. Previous research has suggested that the fluency of the mother-infant interaction largely depends on mothers' ability to accurately assess their child's emotional expression (Kay, 1997). Infant's emotions have largely been the focus of research (Souce&Emde, 1982). Tronic & Brazelton (1980) posited that mothers perceive infant emotion not only from facial expressions but also from the context of the situation.

In response to this, we developed tools to measure a mother's perception of infant emotion, and examined the environmental context with which mothers may use to interpret infant emotion. We also examined how a mother's interpretation of infant emotion affected their behavior toward the infant.

**Development of stimuli:** Initially, eight mothers of infants 0 to 3 years of age were shown short video clips, each 15 seconds long. They were then asked to rate the strength of the infant's emotional expression on a 6-point scale, as well as the infant's emotional state (pleasant or unpleasant) on a 3-point scale. Half of the video clips included infants without their mothers and the other half included interactions with mothers present. We then used the average scale scores from this stage of our study to determine the order in which we would show the video clips to the next group of studies.

**Method:** Eight mothers of infants 0 to 1 year of age were shown the video clips and were asked infant's emotion and what they would do in such situation. They were also asked the context which mother used to assess infant's emotion and in selecting responses.

**Results:** Results indicated that mothers perceive infant emotion not only via infant facial, behavioral, or vocal expressions, but also from the context of the environment. Interestingly, we also found that, in addition to their assessment of the infant's emotion and environmental context, mothers also appeared to use their own emotional state to determine how they would respond to their infant.

**Discussion:** This is the 1st time such variables have been studied empirically in Japan. We are currently collecting more data for the present study. Our study might have implications for clinical samples, such as children with autism.

## *Social Development*

**Th3-36**

### The Measurement of Maternal Affect Attunement: Development of a Reliable Coding Scheme

**Karen Bartling**, Franziska Kopp, Ulman Lindenberger

*Max Planck Institute for Human Development, Berlin, Germany*

**Background and Aims:** The social exchange between mothers and their young infants contain highly complex interaction patterns. Affectively contingent action outcomes during turn-taking episodes promote infants' sense of control and agency, which are fundamental for social, emotional and cognitive development. Dating back to Stern's (1983), the concept of maternal affect attunement (MAA) has attracted much theoretical interest in the developmental literature but efforts at empirical validation have been scarce. Thus, the aim of this study was to develop a coding scheme for assessing the degree of MAA, and to examine its reliability.

**Methods:** The study included forty seven-months-old infants with their mothers. Mother-infant dyads were observed twice within ten days. Mother-child interactions were recorded during face-to-face play situations. Four raters coded three subscales of MAA, Maintaining Attention, Redirecting Attention, and Warm Sensitivity.

**Results:** For all three subscales, within-session inter-rater reliabilities were high, with kappas ranging from .87 to .94. From session to session, mean level stabilities were high, and relative stabilities (e.g., test-retest reliabilities) were statistically reliable, again for all three subscales. Furthermore, high scores on Warm Sensitivity were associated with high scores on Maintaining Attention (r = .29), and high scores on Warm Sensitivity were associated with low scores on Redirecting Attention (r = -.29). A final MAA score can be computed and used for follow-up analyses.

**Conclusion:** The proposed coding scheme of the Maternal Affect Attunement (MAA) subscales has satisfactory psychometric properties in seven-months-old infants.

**Th3-37**

### Contingency and Affective Mirroring in Fijian and Canadian Mother-infant Dyads

**Tanya Broesch**[1] **James Broesch**[1] Joseph Henrich[2] Ann Bigelow[3] Philippe Rochat[1]

*1. Emory University, Atlanta, USA; 2. University of British Columbia, Vancouver, Canada; 3. Saint Francis Xavier University, Antigonish, Canada*

**Background and Aims:** Previous studies assumed that maternal affect mirroring and contingent responding of the mother to her infant are prevalent determinants of social emotional development in infancy (Bigelow, 2003; Gergely and Watson, 1996). However, this is based on the observations of Western, typically urban mother-infant dyads, despite ethnographic reports and observational studies across diverse cultural settings indicating variation both in the modalities of maternal expression, and the maternal beliefs about infant cognition (Bornstein et al., 2002). We examined the validity of such assertions in the context of a small-scale, rural Melanesian society in the Fiji Islands. We assessed the magnitude and modality of contingent responses and affect mirroring by the maternal caregiver during face-to-face episodes with their infants (aged between 6 and 12 months). The Fijian dyads were compared to age-matched Canadian dyads.

**Methods:** We videotaped 15 mother-infant dyads during 3 minute episodes of interaction on Totoya Island, Fiji and compared this to 15 dyads in Canada. Contingency was captured by the timing of the mothers' response (within 1 second) and affect mirroring was captured by the mothers' facial and vocal exaggerated imitation of the infant's emotional expression. In addition we administered a survey on maternal attitudes and beliefs regarding infant cognition to 24 Fijian mothers and compared that with findings by Bornstein and co-authors, 2002.

**Results:** Video analysis indicates significant differences in the Fijian and Canadian mothers' responses. The amount of contingent responses were comparable in both groups, however, the modality differed as a function of culture with Canadians responding with more facial displays and Fijians responding with more tactile responses. We examined the magnitude and duration of vocal responses and found markedly more exaggeration of affect vocal responses by Canadian

mothers compared to Fijian mothers. We found no evidence for facial and vocal affect mirroring in the Fijian mothers however we did find evidence for a more generalized imitation of affect as indicated by measures of tactile responses.

**Conclusion:** The Social Biofeedback theory of parental affect mirroring proposed by Gergely and Watson (1996) needs to be revised in the context of other, non Western cultures. An extension of the Contingency theory put forth by Bigelow is proposed to encompass other modalities including touch, postural placing, support, and holding of the infant. It appears that early face-to-face exchanges as a paradigm for the study of early social and emotional development, is highly dependent on culture.

**Th3-38**

### Mimicry Increases Prosocial Behavior in 18-Month-Olds

Johanna Uebel, **Malinda Carpenter**, Michael Tomasello

*Dept. of Developmental and Comparative Psychology, Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany*

**Background and Aims:** Studies with adults have shown that being mimicked promotes a range of prosocial behaviors toward the mimicker, from increased liking to bigger tips for waitresses (Chartrand & Bargh, 1999; van Baaren, Holland, Steenaert, & van Knippenberg, 2003). Van Baaren, Holland, Kawakami, and van Knippenberg (2004) have shown in addition that being mimicked makes adults behave more prosocially not just to the person who mimicked them but also to other people who had nothing to do with the mimicking. We adapted the study of van Baaren et al. (2004) to test whether these effects of mimicry on prosocial behavior are also found in infancy.

**Method:** Eighteen-month-olds (n=24 in each study) were tested in one of two conditions: Mimicry and No Mimicry. In an initial 6-minute play period, the experimenter (E) played with infants in one of two ways. In the Mimicry condition, she copied everything the infant did and said. In the No Mimicry condition, in response to infants' actions E performed *different* actions, but with equal proximity, contingency, and friendliness as in the Mimicry condition. Following the play period, two test situations were presented in which E (Study 1) or a different adult (Study 2) needed help: i) the adult 'accidentally' dropped the objects she was carrying and ii) the adult then had difficulty opening a cabinet. We coded infants' helping behavior (i.e., picking up the objects and opening the cabinet for the adult).

**Results:** In Study 1, we found that in both tasks infants helped E significantly more quickly and spontaneously when she had mimicked them (mean latencies: 9.92 sec. for picking up, 23.75 sec. for opening the cabinet) than when she had not (mean latencies: 33.92 and 40.92 sec., respectively; Mann-Whitney U's=30.0 and 36.0, p's <.04). In Study 2, however, unlike the adults in the van Baaren et al. (2004) study, infants helped the other adult equally in both conditions, with mean latencies in both conditions very similar to those found in the No Mimicry condition of Study 1.

**Conclusion:** The basic effect of mimicry on prosocial behavior is thus also seen in 18-month-old infants. However, in contrast to adults, it appears as though in infants the effect is confined to direct interactions with the mimicker. Results are discussed in terms of evolutionary advantages of helping others who are perceived to be similar to oneself.

**Th3-39**

### The Development of 3rd Party Gaze Following in 12 and 18 Month Old Infants

**Stephanie Collins**, Cherie Collicott, Chris Moore

*Department of Psychology, Dalhousie University, Halifax, Canada*

**Background and Aims:** By 12 months, infants are able to follow the gaze of an individual with whom they are directly interacting (Corkum & Moore, 1998). Recent research shows that by 18 months, infants are capable of learning novel words in observational (or 'third party') contexts (Floor & Akhtar, 2006). These results suggest that by 18 months infants monitor their social environment for information, regardless of whether they are directly interacting with others. The current study examined third party gaze following in 12- and 18-month-olds. It was hypothesized that 18-month-olds would follow gaze in a third party setting whereas 12-month-olds would not.

**Methods:** Fifteen 12-month-olds and 15 18-month-olds were tested. During each session, the experimenter and parent sat facing each other while the infant was seated beside the parent in a high chair. Two toys were placed on either side of the room and during the trials would light up and rotate. The parent and experimenter then engaged in a conversation, creating a 'third party' context for the infant. Approximately every 30 seconds the experimenter said "OK", and turned her head to the right or left with the parent following suit. Each of eight trials lasted a total of 7 seconds. For the last 4 seconds of each trial the toy being looked at would be activated.

**Results:** Infant looks to the matched and mismatched sides were coded during the first three seconds of each trial, during which the toy was not active. A mixed two-way ANOVA was conducted on the match-mismatch difference scores with the results indicating that there was a main effect of age $F(1, 25) = 14.185$, $p < 0.001$, such that 18-months followed gaze (M=4.14, SD=2.87) but the 12-month-olds did not (M=0.71, SD=2.93). Infants at both ages looked towards the experimenter equally and the younger infants looked to the mother more than the older infants $F(1, 25) = 6.018$, $p< 0.05$. For 18-month-olds only there was a significant correlation between gaze-following and number of looks to the experimenter $r(11) = 0.565$, $p< 0.05$.

**Conclusions:** The results from the present study indicate that 18-month-old infants follow gaze in third party contexts whereas 12-month-old infants do not. These results suggest that 18-month-old infants are able to determine the focus of attention of interacting adults, even without explicit direction from those adults.

**Th3-40**

### Mother-Child and Father-Child Attachment Relationship and Triadic Interaction

Julia Mendonça[1] **Louise Cossette**[2] F. Strayer[3] France Gravel[2]

*1. Guararema, Brazil; 2. Montréal, Canada; 3. Bordeaux, France*

For the young child, the family is the most important social context. It is within the family that the child learns the basic social and communicative skills which will be the base of his/her future social adaptation. Family therapists from a systemic orientation highlight the importance of studying the child in the family context. However, attachment research has, traditionally, focused on dyadic relationships.

The main objective of this study was to investigate mother-child and father-child interaction behaviors in a triadic social context as a function of the quality of their attachment relationship. The main hy-

pothesis of our work was that the quality of both parents attachment relationship with their child would be related to their triadic patterns of interaction.

Forty-two families participated in this study. The quality of mothers' and fathers' attachment relationship with their child was evaluated using a French version of the Attachment Q. sort (Waters & Deane, 1985) when the children were two years of age. When the children were, on average, 32 months of age they were observed in a free play interaction with both parents. The videotapes were coded using a taxonomy of interactional dyadic behaviors including the social partners physical proximity, visual and body orientation, and dyadic involvement.

The attachment representations of both parents were combined and four groups were created: secure with mother and father, secure with mother and insecure with father, insecure with mother and secure with father and insecure with mother and father. Analyses of variance revealed distinct patterns of family interaction for these groups. Overall, in the majority of the families, mother-child dyads formed the "main unit" of the ongoing social interaction while the fathers were more distant from them. The triadic context in which both parents and the child are present seems to reinforce the traditional parenting roles: the mothers as the primary caregivers while the fathers play a secondary role. However, in families in which both parents report having a secure attachment relationship with their child, fathers seemed to be integrated into that "main unit", creating a truly triadic pattern of interaction and suggesting a more harmonious style of family communication.

These results show how attachment relationships within the family system are related to family communication. From a family system perspective, the family unit has to be included in attachment research. New methodological tools are needed to further study the multiplicity of relationships within families.

**Th3-41**

### Can Infants Resist a Mouse in a House? Another Look at Infants' Abilities to Copy Action Goals

Malissa Durham, **Erin Cannon**, Amanda Woodward

*University of Maryland, College Park, USA*

Carpenter, Call, & Tomasello (2005) found 18-month olds imitated action differentially, depending on context. When infants observed an experimenter hop or slide a toy mouse into one of two houses, they subsequently placed the mouse directly into the house, ignoring the details of the action. When infants observed the same action on a mat without houses, they were more likely to imitate that action. The authors concluded in the former condition, the house was viewed as the demonstrator's goal, whereas in the latter condition, the action itself was viewed as goal. We explored a different interpretation. First, we replicated the original study with 18-month-olds. Then, we asked whether infants would continue to copy action goals when faced with an available alternative.

Twenty-four 18-month-olds participated in each study. Study 1 replicated the Carpenter et al. (2005) procedure. In Study 2 the demonstrator hopped or slid the mouse on one type of mat, with a house on one side and nothing on the other (side of house was counterbalanced across trials). Demonstrated actions ended with either the mouse in the house, or away from the house. Dependent measures were proportion of trials the action and endpoint location matched the demonstration.

Study 1 confirmed the findings of Carpenter et al. (2005). Infants were more likely to copy the endpoint location in House trials (M = .43) than in No House trials (M = .13), $t(23) = 3.33$, $p < .01$. In contrast, infants were more likely to copy the action in No House trials (M = .52) than in House trials (M = .26), $t(23) = 4.61$, $p < .001$.

In Study 2, infants were significantly more likely to copy endpoint location in House trials (M = .70) than in No House trials (M = .10), $t(23) = 6.44$, $p < .001$. However, unlike Study 1, infants were not more likely to copy the action in No House trials (M = .32) than in House trials (M = .29), $t(23) = 4.61$, $p > .05$.

Our findings suggest that while it is possible for infants to infer an action as a goal in and of itself (Study 1), this type of goal attribution may only occur in the context of an impoverished environment. Given the presence of an interesting distracter (Study 2), the infants easily dismissed the demonstrator's goal in favor of their desire to put the mouse in the house.

**Th3-42**

### Relations among Aspects of Infant Temperament and Toddlers' Shyness

**Natalie Eggum**, Nancy Eisenberg, Tracy Spinrad

*Arizona State University, Tempe, USA*

**Background:** Behavioral inhibition (BI), which is related to shyness, has been positively related to reactivity (high motor activity/negative affect) and negatively related to smiling and activity level (e.g., Calkins & Fox, 1992).

This study was conducted to assess relations of shyness (18 and 30 months) to other aspects of temperament (6 and 12 months) in a normative sample. Previously conducted work often has been conducted using an extreme-group approach. We expected shyness to be negatively related to duration of orienting, soothability, falling reactivity, approach, and smiling, and to positively relate to distress to limitations, fear, and sadness.

**Methods:** The sample was comprised of 273, 199, 250, and 226 infants at 6, 12, 18, and 30 months.

At 6 and 12 months of age, mothers rated infants' temperament (R-IBQ; Gartstein & Rothbart, 2001). At 18 and 30 months of age, mothers and caregivers rated toddlers' shyness (ECBQ; Putnam et al., 2006), and fathers rated toddlers' inhibition to novelty (ITSEA; Carter et al., 2003).

**Results and Conclusion:** Obtained relations were in expected directions. A sex difference was obtained in which smiling/laugher was negatively related to shyness, but only for girls (see Table 1). It is possible that certain aspects of temperament elicit and interact with parental behaviors, which, in turn, foster the development of shyness.

Tables:

Table 1. Relations among Infant Temperament and Toddlerhood Shyness

| | 18 M Shy | 18 C Shy | 18 D Inhib | 30 M Shy | 30 C Shy | 30 D Inhib |
|---|---|---|---|---|---|---|
| 6 M Distress to Limitations | .15* | .17+ | .01 | .07 | -.01 | -.06 |
| 6 M Duration of Orienting | -.15* | -.09 | -.04 | -.13+ | -.08 | .05 |
| 6 M Smiling/ Laughter | B .01 / G -.24* | B -.06 / G -.16 | B -.09 / G -.12 | B .00 / G -.18+ | B .17 / G -.03 | B -.12 / G -.31* |
| 6 M Soothability | -.12+ | -.01 | -.12 | -.02 | .13 | -.11 |
| 6 M Falling Reactivity | -.03 | -.04 | -.05 | .06 | -.01 | .11 |
| 6 M Sadness | .15* | .13 | .03 | .12 | .00 | .03 |
| 6 M Approach | -.09 | -.10 | .01 | -.09 | .09 | -.10 |
| 6 M Fear | .10 | .13 | .06 | .18* | .07 | .03 |
| 12 M Distress to Limitations | .18* | .12 | .01 | .03 | -.02 | -.03 |
| 12 M Duration of Orienting | -.12 | -.04 | -.03 | -.09 | -.11 | .08 |
| 12 M Smiling/ Laughter | B .00 / G -.37** | B .01 / G .07 | B .05 / G -.20 | B .06 / G -.26* | B -.03 / G .01 | B -.14 / G -.30* |
| 12 M Soothability | -.18* | -.13 | -.08 | -.15+ | .07 | -.07 |
| 12 M Falling Reactivity | -.18* | -.21* | -.03 | -.07 | -.01 | .06 |
| 12 M Sadness | .17* | .22* | -.01 | .13+ | .14 | .05 |
| 12 M Approach | -.16* | -.17+ | -.03 | -.12 | -.03 | -.05 |
| 12 M Fear | .46** | .19+ | .37** | .43** | .07 | .07 |
| | | | | | | |

+p < .10, *p < .05, **p < .01

M = Mother-reported, C = Caregiver-reported, F = Father-reported, Shy = Shyness, Inhib = Inhibition to Novelty, B = Boy, G = Girl

N = 46-209

**References:**


Calkins, S. D., & Fox, N. A. (1992). The relations among infant temperament, security of attachment, and behavioral inhibition at twenty-four months. Child Development, 63, 1456-1472.

Carter, A. S., Briggs-Gowan, M. J., Jones, S. M., & Little, T. D. (2003). The Infant-Toddler Social and Emotional Assessment (ITSEA): Factor structure, reliability, and validity. Journal of Abnormal Child Psychology, 31, 495-514.

Gartstein, M. A., & Rothbart, M. K. (2003). Studying infant temperament via the Revised Infant Behavior Questionnaire. Infant Behavior & Development, 26, 64-86.

Putnam, S. P., Gartstein, M. A., & Rothbart, M. K. (2006). Measurement of fine-grained aspects of toddler temperament: The Early Childhood Behavior Questionnaire. Infant Behavior & Development, 29, 386-401.


**Th3-43**

## How Does Parents' Attribution of Intentionality Relate to Infants' Emerging Social Interaction Skills?


**Hannah Eisenbeis**, Claudia Thoermer, Susanne Kristen, Beate Sodian

*Department Psychology Ludwig-Maximilians-University, Munich, Germany*


The emergence of social interaction skills in infants such as the ability to coordinate one's attention with a social partner occurs at around 9 months of age. This ability has been interpreted as the infant's beginning understanding of the social partner as an intentional agent. However, so far very few studies have examined the relation of parent perception of infant intentionality and infants' precocious social interaction skills.

In an ongoing longitudinal study, N=86 infants were tested at two measurement points, t1 and t2. The mean age was 7 months (M=210 days) for t1 and 9 months (M=269 days) for t2. Infants at both measurement points were tested for joint attention competencies, first by a female experimenter assessing a gaze and point following task (following the protocol of the Early Social Communication Scale, Mundy, 2003) and secondly, by a 10-minute parent-child play period (Bakeman & Adamson,1984). In addition, parents rated infants' intentionality with the Infant Intentionality Questionnaire at t1 (IIQ, Feldman & Reznick, 1996). At t2, parents were asked to complete a questionnaire on prelinguistic communication (ELFRA, Grimm & Doil, 2006, German Version of the MacArthur Communicative Development Inventories (CDI)).

Our results reveal a relation between parent perception of infant intentionality and both measures of social interaction skills at t1: the IIQ ratings correlated moderately with gaze following in the attention following task as well as with infants' person-oriented behaviour during the parent-child interaction at t1. However, we found no relation between parent perception at t1 with attention following and behaviour during parent-child interaction at t2. Yet, parent perception of intentionality at t1 did predict early indicators of communicative gestures as assessed by the ELFRA at t2. Also, ELRA scores correlated with parent-child interaction at both measurement points.

Our findings indicate that parents' attribution of intentionality relates to parents' perception of early communicative behaviors in infants, and to the early emergence of social interaction skills in infants. However, the data do not yet allow an assessment of the predictive value of this relation. More longitudinal data on joint attention behaviour at older ages will be examined in order to determine how parents' perception of infant intentionality relates to infants' developing social interaction skills.

**References:**


Bakeman, R. & Adamson, L.B. (1984). Coordinating Attention to People and Objects in Mother-Infant and Peer-Infant Interaction. Child Development, Vol. 55, 4, 1278-1289.

Feldman, R., & Reznick, J.S. (1996). Maternal perception of infant intetnionality at 4 and 8 months. Infant Behavior and Development, 19, 483-496.

Grimm, H., & Doil, H. (2006). ELFRA, Elternfrageboegen fuer die Frueherkennung von Risikokindern, 2. Auflage. Göttingen: Hogrefe.

Mundy, P., Hogan, A., & Doehring, P. (2003). A manual for the abridged Early Social Communication Scales (ESCS). Coral Gables, Fl, USA: University of Miami.

**Th3-44**

## Prosocial Behavior: a Mediator of the Relationship Between Language Delay and Problem Behavior For High-Risk Toddlers

**Ann-marie Faria**, Christine Hughes, Marygrace Kaiser
*University of Miami, Coral Gables, USA*

The relationship between language and behavior was explored in a primarily African-American sample of toddlers living in poverty and enrolled in an intervention program for prenatal exposure to cocaine (PEC). PEC places infants at risk for language delay (Bandstra, et al., 2002). Many studies confirm that children with language delay engage in more problematic behaviors (Beitchman et al., 2001; Horwitz, et al., 2003; Kaiser, et al., 2001). However, the presence of prosocial behavior may steer children away from problem behaviors such as aggression or violence (Dionne, Tremblay, Boivin, Laplante, & Perusse, 2003). Using mediation regression analyses, the protective role of socially competent behavior on the relationship between language delay and problem behavior was explored in this high-risk sample.

The sample was primarily African-American (70%) and included 310 children enrolled in an intervention program for PEC. The Child Behavior Checklist (CBCL/2-3; Achenbach, 1992) was used to measure problem behavior at age three, the Adaptive Social Behavior Inventory (ASBI; Hogan, Scott, & Bauer, 1992) was used to measure prosocial behavior at age three, and the Reynell Developmental Language Scale (RDLS; Reynell & Gruber, 1990) was used to measure language ability at age three. Following Baron and Kenny's 1986 mediation procedure, four regression equations were calculated. All analyses controlled for gender effects.

The first regression determined that language delay predicted more problem behavior ($F(2, 309)=4.84$, $p<.01$, $\beta=-.16$,$p<.01$). The second found that better language ability predicted more prosocial behavior ($F(2, 309)=6.47$, $p<.01$, $\beta=0.20$,$p<.01$). The third found that higher prosocial behavior predicted lower problem behavior ($F(2, 309)=21.25$, $p<.01$, $\beta=-.34$, $p<.01$). Finally, when prosocial behavior was added to the original regression, language delay no longer predicted more problem behavior ($F(2, 309)=15.23$, $p<.01$, $\beta_{Language}= -.09$, $p=.09$). Rather, prosocial behavior acted as a mediator in the relationship between language delay and problem behavior ($\beta_{Prosocial}= -.32$, $p<.01$).

This complete mediation model supports the hypothesis that prosocial behavior acts as a protective factor for high-risk children. In a language delayed sample, engaging in more prosocial behaviors lead to a decrease in problem behaviors in toddlers. This study highlights the importance of teaching social skills to young children. Although language delay does predict higher levels of problem behavior, if children learn socially adaptive skills such as sharing and cooperation, these behaviors can steer children away from negative outcomes such as aggression and destructiveness and may have implications for later school success.

**Th3-45**

## The Development of Emotional Expression Discrimination in Infants: Evidence from Infant Scan Patterns

**Megan Fitzgerald**[1] Nim Tottenham[2] Juliet Davidow[2] Tara Gilhooly[2] Dima Amso[2]
*1. Weill Cornell Graduate School of Medical Sciences, New York, USA; 2. Sackler Institute of Developmental Psychobiology, New York, USA*

The ability to discriminate emotional expressions in others' faces is a key component of normal social interaction. A first step in this process is the ability to discern *perceptual* differences between faces and to generalize the encoded emotion across individuals. We used a combination habituation/eye tracking design with a group of 4-9 month-old infants to better understand what information infants use to successfully make this discrimination. Specifically, we examined how individual differences in information gathering, via shifts of eye gaze, support the ability to discriminate between open-mouthed happy and fearful female models. Infants were seated in a parent's lap approximately 104 cm from a 50 cm stimulus-presentation monitor. Eye movements were recorded with a remote-optics corneal reflection eye tracker (Applied Science Laboratories model R6). Each infant's point of gaze was calibrated prior to test. Infants were presented with two alternating models posing the same expression (either happy or fearful) during infant-controlled habituation. Emotional expression during habituation was counterbalanced across subjects. We presented three types of test trials: a familiar model with the novel expression, a novel model with the novel expression, and a novel model with the familiar expression. The strength of using multiple models during test is that it allows us to consider the nature of the discrimination infants make, be it specific to the individual posing the expression or to the expression independent of the model. We calculated an emotional preference score for infants that successfully habituated by comparing look times during the test phase to the novel emotion relative to the familiar, both modeled by a novel individual. Preference for the novel emotion will therefore only be obtained if infants both encoded the perceptual features characteristic of a particular emotion during habituation and generalized that information to a novel model. We examined the relationship between emotional preference at test and scan patterns gathered from eyetrack data during habituation. Data showed that infants whose preference indicated emotional discrimination were more likely to have scanned between the eye and the mouth during habituation. Infants who did not provide evidence of emotion discrimination tended to fixate *either* the eyes or the mouth during habituation. These data suggest that certain online-information gathering supports both face expression discrimination in infancy and generalization of the encoded information across individuals.

**Th3-46**

## "Mommy, Where Are You?" Maternal Responsiveness at Night and Toddlers' Security of Attachment

Megan Blair[1] Meret Keller[2] **Wendy Goldberg**[2]
*1. University of California, Irvine Medical Center, Orange, USA; 2. University of California, Irvine, USA*

Infants often do not have the capability to soothe themselves to sleep at bedtime, or back to sleep during the night, and may require the parent's presence, a bottle, or other external sleep aid in order resettle (Sadeh and Anders, 1993). This exchange can be disruptive to the parents' sleep and can prompt parents to look to professionals for suggestions on how to deal with their child's "sleeping problem"(Middlemiss, 2004). An interesting "disconnect" in developmental psychology and pediatrics concerns the apparent discrepancy between advice to provide sensitive, responsive care to an infant during the day, which is supported by research and theory (Ainsworth, 1978), and the recommendation of some sleep experts to let a young child cry it out and self-soothe at night.

This study examined the associations between mothers' means of responding to their toddlers' night waking and the security of toddler-mother attachment. Participants to date have been 90 toddlers, aged 17-19 months, and their mothers. Families were mostly Caucasian

(48%) or Hispanic (39%) and middle- class. Mothers were recruited during pregnancy as part of a larger study. The attachment status of each child was assessed using the Ainsworth Strange Situation Procedure (Ainsworth et al., 1978). Information about children's sleep behaviors and parental nighttime responses was obtained using a maternal sleep survey, which had been validated with taped recordings of toddlers' nighttime wakings. Daytime sensitive parenting was coded from laboratory-based observations of mothers and toddlers during play.

Based on analysis of the first 31 children (17 male), use of formal "sleep intervention" methods was not common (26% reported using a formal sleep training method) and it was not significantly associated with security of attachment. However, mothers of securely attached toddlers were more physically responsive to their children during the night than were mothers of insecurely attached infants ($p < .05$). These results indicate that nighttime parenting behaviors may play an important role in the development of secure attachments. Additional analyses will repeat the preliminary analyses with the full sample of 90 toddlers and will investigate both daytime sensitive parenting and nighttime parental behaviors in relation to the security of attachment.

**Th3-47**

## Young Children Understand the Obligations of Joint Commitments: Leave-Taking Behavior in Joint Activities

**Maria Graefenhain**[1,2] Tanya Behne[1,3] Malinda Carpenter[1] Michael Tomasello[1]

*1. Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany; 2. University of Leipzig, Germany, Leipzig, Germany; 3. University of Manchester, UK, Manchester, UK*

**Background and Aims:** When two people have decided to take a walk together, it would be very strange for one person to just walk off in another direction without having first taken leave of the other person. This is because joint activities engender joint commitments and obligations with which partners have to conform (Gilbert, 1990). Recent research from our lab suggests that 3-year-olds understand that joint commitments can be created by an explicit invitation to play together. Yet whether children understand that partners should then finish their joint activity together has never been studied. The current study thus investigated leave-taking behavior in young children's joint activities.

**Method:** Three- and 4-year-old children participated in the study (n=30 at each age). They were assigned to one of two conditions: In the Commitment condition, the child (C) was encouraged to invite the experimenter (E) to play a game and E then emphasized that they were now going to play this game together. In the No Commitment condition, E instead joined into the game once it was already being played. In both conditions, E then played in parallel to C. After 30 seconds, an assistant began playing another attractive game off to the side and gradually tried to make C leave the 'old' game to play this new game. We assessed children's behavior when leaving the 'old' game, expecting to find more leave-taking behavior in the Commitment than in the No Commitment condition.

**Results:** A three-way univariate ANOVA on mean percentage of games in which children verbally or nonverbally communicated to E that they were going to stop playing the old game revealed a main effect of condition, $F(1, 48)=5.26$, $p<.05$; that is, children in the Commitment condition communicated their leaving more frequently (M=31%) than children in the No Commitment condition (M=16%). A main effect of gender indicated that girls (M=32%) communicated to E more often than boys (M=14%), $F(1, 48)=8.46$, $p<.01$. No effect of age and no interactions were found.

**Conclusion:** When leaving the game they were currently playing, children communicated their leaving to E more frequently when they had been engaged in a joint commitment with her than when they had not. This study thus contributes to previous findings suggesting that children around the age of 3 years start to understand the normative consequences that joint commitments entail (Kalish, Weissman, & Bernstein, 2000; Rakoczy, Warneken, & Tomasello, in press).

**Th3-48**

## Affect Attunement during Early Mother-Infant Interaction: How Specific Intensities Predict the Stability of Infant's Coordinated Joint Attention Skills

**Lisa Greenwald, Pamela Rollins**

*School of Behavioral and Brain Sciences, University of Texas at Dallas, Dallas, USA*

**Background:** Coordinated joint attention (CJA) represents intersubjectivity and drives language development (Carpenter et al., 1998; Tomasello & Todd, 1983). Many theorists have proposed a predictive relationship between emotion sharing/affect attunement and CJA (Adamson & Russell, 1999; Hobson, 1993; Rochat & Striano, 1999; Stern, 1985, 1995, 1999; Tomasello et al., 2005; Trevarthen, 1993). This study examines the putative nature of this relationship: Does the intensity of early caregiver-infant affect attunement, before the emergence of CJA, predict the stability of CJA skills later?

**Methods:** Fifteen mothers-infant dyads participated in object-mediated free-play at 6, 9, and 12 months of age. Mother-infant interaction was captured utilizing split-screen video. Data was microanalytically coded for affect attunement at 6 and 9 months and CJA at 9 and 12 months. Affect attunement was measured utilizing affect-intensity matching (neutral, low-, moderate-, and high-positive intensity) occurring within a 2-second window during mutual-engagement time (ME-time). The percent of ME-time dyads demonstrated low- and moderate-intensity affect matching were the primary predictor measures. The primary outcome measure was the mean length of CJA episodes at 12 months, representing the stability of CJA skills. CJA was measured utilizing a well-replicated coding scheme (Adamson, et al., 2004; Bakeman & Adamson, 1984; Carpenter et al., 1998).

**Results:** Multiple regression indicated that low-intensity affect matching at 6 months positively predicted, and moderate-intensity affect matching at 9 months negatively predicted CJA at 12 months ($R^2 = .604$, $p < .05$). On average, dyads with frequent low-intensity matching at 6 months and infrequent moderate-intensity matching at 9 months had longer CJA episodes later. Further, frequent low-intensity matching and infrequent moderate matching at 9 months predicted longer CJA episodes on average ($R^2 = .625$, $p = .003$). A combined quantitative and qualitative analysis indicated that infants with poorer CJA skills at 12 months exhibited, on average, more moderate-intensity affect matching at 9 months, intensity mismatching, and gaps in ME-time.

**Conclusion:** Findings both support and extend the long-standing theory regarding a predictive relationship between affect attunement and intersubjectivity. Findings suggest that shared, pleasurable, low-intensity emotional states support social-cognitive development before and during the emergence of CJA; whereas moderate-intensity affect attunement may do the opposite. The authors theorize that the purpose of affect attunement shifts from understanding others' emotions to understanding others' attentions during object-mediated mutual engagement between 6 and 9 months of age, and that the

modulation of optimal emotional states create greater processing capacities for infants to learn intersubjectivity.

**Th3-49**

### Infants' Ability to Learn and Remember Object-Affect Pairings Using Direction of Gaze

Laurie Hamer, Sarah Johnson, **Ross Flom**
*Brigham Young University, Provo, USA*

From 9-months of age infants are sensitive to the direction of another's gaze. Between 12- and 14-months of age infants can use another's direction of gaze and an adult's affective expression in learning about various objects and events. What is not well understand, however, is whether, and for how long, infants can remember various object-affect pairings. In the current experiment we examined infants' sensitivity to an adult's direction of gaze and infants' memory for object-affect pairings.

Sixty-four infants at 12- and 16-months of age participated and were habituated two events. In the first event infants viewed a female actress looking toward or away from an object while facially and vocally conveying a positive affective expression. In the second event infants viewed the same actress looking at or away from a different object while conveying a negative affective expression. For the test trials the object-affect pairing was reversed. Following the two test trials infants received four refamiliarization trials. After a 5-minute or 1-month delay infants' preferential looking to the positive or negative object-affect pairing was assessed.

Results indicate that following habituation infants at all both ages perceived the change in the object-affect pairings when the actress was looking toward the object ($t(31) = 4.1$, $p < .01$, $t(31) = 6.5$, $p < .01$, for 12- and 16-month-olds respectively) but not when the actress was looking away from the object. Both 12- and 16-month-olds showed a significant preference for positive object-affect pairing following a 5-minute delay ($t(31) = 2.7$ $p < .05$, $t(31) = 3.2$, $p < .01$ respectively) whereas only the 16-month-olds showed a preference for the positive object-affect pairing following a 1-month delay ($t(31) = 2.4$, $p < .05$).

The results of this study demonstrate that by 12-months of age infants are able to use another's direction of gaze in learning object-affect pairings. These results provide limited evidence regarding 12-month-olds' memory for object-affect pairings. By 16-months, however, infants are able to remember an object-affect pairing following either a 5-minute or 1-month delay. Results will be discussed in terms of infants' ability to perceive and remember the behavior of others, the emergence of social referencing, and infants' understanding of others' intentions.

**Th3-50**

### Toddler-Mother Attachment Security: Maternal and Child Correlates Across Interactive Contexts

**Ashley Holland**, Nancy McElwain, Maria Wong
*University of Illinois at Urbana-Champaign, Champaign, USA*

**Introduction:** Previous research has examined the correlates of the child-mother attachment relationship during infancy (Thompson, 1998), the preschool years (Greenberg, Cicchetti, & Cummings, 1990), and middle childhood (Kerns & Richardson, 2005). Little is known, however, about correlates of toddler-mother attachment security. Given that the toddler years are characterized by increases in child negativity, autonomy-seeking, and child-mother conflict (Kopp, 1989), it is important to investigate the child and maternal correlates of attachment security during this developmental period. This study aimed to assess how toddler-mother attachment security was associated with maternal and child affect and behaviors across contexts that varied in stress levels.

**Method:** Mothers and their two-year-old children ($N = 128$, 66 girls) participated in a 90-minute visit to the laboratory playroom which included a series of interactive sessions, including a 17-minute modified Strange Situation procedure (Cassidy & Marvin, 1992), a 15-minute free play (FP, low stress) session, a 7-minute snack (SK, moderate stress), and a 2-minute Disappointing Situation (DS, high stress), in which the child received an attractive but empty gift box. Attachment security was assessed from the Strange Situation using a 9-point security scale. Mother and child affect, maternal sensitivity, and child support-seeking and assertiveness were each rated during 30-sec intervals from the FP and SK. Maternal sensitivity and child support-seeking and assertiveness were coded during 10-sec intervals of the DS.

**Results:** Correlational analyses revealed that greater toddler-mother attachment security was associated with ((a) less mother and child negative affect in FP and SK (range: $r = -.18$, $p < .05$ to $r = -.42$, $p < .01$), (b) more maternal positive affect in FP ($r = .21$, $p < .05$) and SK ($r = .17$, $p < .10$), (c) more maternal sensitivity in SK ($r = .23$, $p < .05$) and DS ($r = .24$, $p < .01$), and (d) more child support seeking in SK ($r = .26$, $p < .01$) and DS ($r = .18$, $p < .05$). Additionally, associations with maternal FP sensitivity, child FP support-seeking, child positive affect, and child assertiveness were non-significant.

**Discussion:** The results suggest that the mother-toddler attachment relationship may be important for the co-regulation of negative emotions, even in low stress contexts. That is, for toddlers who were more securely attached, both mothers and toddlers displayed less negative affect during free play and snack. In contrast, maternal sensitivity and child support-seeking may relate to attachment security only in contexts that pose moderate to high stress (snack and disappointing situation). Importantly, child positive affect and assertiveness were not associated with security, suggesting that these behaviors may be distinct from the attachment behavioral system. These results begin to demonstrate the importance of how attachment security during toddlerhood may be associated with specific mother and child behaviors across contexts.

**Th3-51**

### Mothers' Attention Regulation in Infancy: Correlates and Outcomes

**Hui-chin Hsu**, Leo White, **Jihyun Sung**, **Marina Klimenko**
*University of Georgia, Athens, USA*

Mothers scaffold their infants' visual attention. Individual differences in maternal attention regulation have been found to be associated with child development during the first years of life. For example, frequent following by mothers is related to advanced play and language development in toddlers (e.g., Bornstein & Temis-LeMonda, 1990). However, little is known about whether and how infant and maternal characteristics contribute to individual differences in maternal attention regulation and whether later behavioral adjustment and problems in children are related to maternal attention regulation styles in infancy. Thus, the present study was designed to examine (1) infant temperament and maternal affect as the correlates and (2) toddler behavior problems as the outcomes of maternal attention regulation in infancy.

Fifty-five first-born infants and their mothers participated in a larger longitudinal study. At 12 months, mothers and their infants were observed during floor play for about 3 minutes. Mothers' actions in guiding infant attention were coded second by second from videos, which were classified as direct (i.e., guide infant's attention when unengaged), maintain (i.e., follow infant's attentional focus), redirect (divert infant's attentional focus), or monitor (i.e., observe infant quietly). Mothers also filled out two questionnaires: (1) Infant Behavior Questionnaire assessing infant temperamental characteristics; and (2) Positive Affect and Negative Affect Scale assessing maternal positive and negative affective states. At 30 months, mothers filled out the Infant-Toddler Social and Emotional Assessment reporting internalizing and externalizing behavior problems in their toddlers.

Based on the frequency of mothers' actions in directing, maintaining, redirecting, and monitoring infant attentional focus and/or activities, cluster analysis was performed to discern their preferential patterns. Four groups of mothers were classified: Direct (n=15; frequent directing), Maintain (n=17, frequent following), Redirect (n=8; frequent redirecting), and Monitor (n=15; frequent monitoring). One-way MANOVAs were then conducted to compare differences in infant temperament and maternal affect among the four groups of mothers. Results revealed that infants of mothers adopting the Redirect and Monitor patterns were more easily distressed than infants of mothers exhibiting the Direct and Maintain pattern. No group differences were found in maternal positive and negative affect. Furthermore, one-way MANOVA was used to examine group differences in toddlers' behavior problems. Results indicated that mothers in the Redirect group had toddlers scored the highest in internalizing problem, whereas mothers in the Monitor group had toddlers scored the lowest. No group differences were found in toddlers' externalizing behavior problem.

Taken together, it appears infant temperamental characteristics, but not maternal affective states, contribute to individual differences in maternal attention regulation. Also, maternal attention regulation in infancy links to later internalizing, but not externalizing, behavior problem in toddlerhood. The underlying processes through which maternal attention regulation exerts its impact on developmental psychopathology will need to be further explored.

**Th3-52**

## The Roles of Prior Intentions and Object Affordances in 2-Year-Olds' Use of Context Information to Imitate a Complex Tool Use

**Chi-tai Huang**, Guan-jay Huang, Mei-jun Tsai, Hsiao-hua Chen, Mei-yu Lin

*Department of Human Development, Tzu Chi University, Hualien, Taiwan*

**Backgrounds and Aims:** A growing consensus suggests that imitation during childhood depends on inferences about intentions. It has been shown that prior intentions such as failed attempts, action outcomes and context cues enable preschoolers to efficiently imitate tool use (Carpenter, Call & Tomasello, 2002). However, a range of nonimitative social learning processes discussed in the comparative literature provides a significant challenge for the intentional account. The present study aimed at delineating the role of emulation learning in children's use of context information in a prior situation as used in Carpenter et al.

**Methods:** The apparatus comprised a prior task and a target task. The prior task was a box having two covers that could be removed by sliding a bolt on the edge or by pulling out the cover horizontally. The target task was a birdhouse having two doors that could be opened by lifting the door up or by pulling out a pin on the outside. Two-year-olds (n = 60) were randomly assigned to one of five conditions. Children in three Prior conditions watched the adult interact with the box before the demonstration of the birdhouse: they first saw the adult remove the covers (Prior Full Demo), or display the end state after removing each cover (the action was occluded by a screen; Prior End State), or manipulate the key parts of the box with irrelevant actions (Prior Irrelevant Action). Children in two Non Prior conditions saw the demonstration of the birdhouse (Non Prior Full Demo) or were given the birdhouse without demonstration (Non Prior Baseline).

**Results:** Children opened the birdhouse more often in the Prior Full Model and Prior End State conditions than in the other conditions. No difference was found between the two conditions. Solution was at intermediate level in the Non Prior Full Model and Prior Irrelevant Acts conditions and each outperformed that in the Baseline. Considering whether children copied the sequence of acts they actually observed, only the Prior Full Demo group faithfully copied the sequence.

**Conclusions:** This study replicated the study of Carpenter et al. (2002) and extended their paradigm by introducing context information coming from different sources. The results showed that while end-state and action information induce subsequent solutions equally efficiently, children tend to engage in emulation based on observation of end states. Intention reading and emulation of affordances thus appear to have differential roles in children's use of context information in a prior situation.

**Th3-53**

## Influences of Biological Risk at Birth and Temperament on Development at Toddler and Preschool Ages

Hua-fang Liao[1] **Ai-wen Hwang**[1] Wei-tsuen Soong[2] Kuo-su Tsou[3]

*1. School and Graduate Institute of Physical Therapy, College of Medicine, National Taiwan University, Taipei, Taiwan; 2. Department of Psychology, National Taiwan University Hospital, Taipei, Taiwan; 3. Department of Child Psychology, Taipei Municipal Women's and Child's Hospital, Taipei, Taiwan*

**Background and Aims:** The developmental effects on toddlers and preschoolers of biological risk factor at birth together with temperament are not well known. This study examined a sample consisting of typically developing children and biologically at-risk children at the toddler age, and once again at the preschool age, to investigate the effects of Neonatal Medical Index (NMI) and temperament type on various developmental domains.

**Methods:** 110 (53%) full-term children and 98 (47%) preterm children were followed at the toddler age (18-36 months), and at preschool age (51-71 months) in a longitudinal study. The NMI classification was determined from the chart as a value ranging from I to V to present the severity of neonatal medical risk. Other family background factors, such as social economic status (SES), parental ages and educational levels were also collected as possible confounders for outcomes. Parental reports on the Chinese Toddler Temperament Scale (CTTS) at the toddler age were collected and the temperament type (easy, intermediate, and difficult) of each child was assigned. The child outcomes were measured using the Comprehensive Developmental Inventory for Infants and Toddlers (CDIIT) at toddler and preschool ages. The developmental quotients (DQs) of two domains (perceptual-motor and social-adaptive) for toddlers, and of three domains (cognitive-language, motor, and social-adaptive) for preschoolers, was calculated using age norms. ANCOVA was conducted to analyze the predictability of NMI classification, temperament type, and family background.

**Results:** There was no significant interaction between NMI and temperament on DQs for all domains at both ages. At toddler age, higher

NMI (higher biological risk) had significant adverse effects on the perceptual-motor DQ [F(3, 207)=6.79, P<.001] and social-adaptive DQ [F(3, 207)=7.27, P<.001], while easy temperament type had positive effects only on the social-adaptive DQ [F(2, 207)=3.90, P<.05]. For preschoolers, the NMI could predict only the cognitive-language DQ [F(3, 118)=3.20, P<.05], and temperament did not predict any DQs.

**Conclusion:** There was no interaction between the effects of biological risk and temperament on DQs. The adverse effects of biological risk on the cognitive-language DQ seemed to be sustained till the preschool age, and on the motor DQ, existed only at the toddler age. Temperament could affect the social-adaptive DQ at the toddler age, but not at the preschool age. Further studies are needed to clarify other potential factors for predicting child developmental outcomes, such as environmental factors.

**Th3-54**

## The Functions of Maternal Touch during a Face-To-Face Still-Face Procedure: Influence of Maternal Regulatory Behaviors during the Transition Periods

**Amelie Jean**, Robin Moszkowski, Nadine Girouard, Dale Stack

*Concordia University, Centre for Research in Human Development, Montreal, Canada*

Touch plays an essential role in mother-infant interchange; however investigations have focused primarily on the role of distal modalities of communication, such as affect and gaze while neglecting the indispensable contributions of maternal touch. The present study was designed to investigate maternal touch, specifically its functions, during a Still-Face (SF) procedure between mothers and their 5-month-old fullterm infants. As in most SF studies, there were brief intervals between each period. One important focus of the present study was to investigate these "Transition" periods that are considered to be an integral component of the SF procedure.

The objectives were to document how: (1) maternal functions of touch varied across both Normal periods, (2) infants' affect influenced maternal touch, (3) infants' reaction to the SF influenced maternal behaviors during the subsequent Transition period, and (4) maternal behaviors during the Transition period following the SF influenced the amount of nurturing touch during the Reunion Normal period. Forty mother-infant dyads participated in a SF procedure which consisted of three 2-minute interaction periods: Normal, SF, and Reunion Normal periods, which were separated by two Transition periods lasting approximately 30 seconds. All interactions were coded for infants' affect. The functions of maternal touch were coded during both Normal periods while maternal regulatory behaviours were coded during the Transition periods.

Findings indicated that across periods, mothers used consistently high amounts of overall touch (M = 81.15%). In addition, mothers adapted the functions of touch they used across period, and according to infants' affect. Specifically, mothers used more attention-getting function of touch during the first Normal period and more nurturing function of touch during the Reunion Normal period. Mothers used more nurturing function of touch when their infants were fretting whereas they used more playful function of touch to get their infants to smile. Moreover, findings revealed that infants' reaction to the SF influenced the amount of maternal regulatory behaviors provided in the subsequent Transition period. Specifically, when infants were fretting, mothers tended to use more regulatory behaviors. In return, these regulatory behaviors influenced the overall amount of nurturing touch mothers provided in the Reunion period.

Together, these results highlight mothers' abilities to sensitively adjust the function of their touch according to their infants' affect, while at the same time underscoring the importance of touch as a channel of communication. In addition, results underscore the importance of the Transition periods in the SF procedure.

**Th3-55**

## Mothers' Knowledge about Infant Milestones in Relation to the Age of their Own Infants

Nichole Elliott, **Katherine Karraker**

*West Virginia University, Morgantown, USA*

Mothers' knowledge about infant developmental milestones is frequently proposed as an important facilitator of effective parenting behavior. Adolescent mothers and mothers with less previous experience with infants have previously been found to have less accurate milestone knowledge than other mothers. However, studies have not assessed mothers' knowledge of developmental milestones in relation to the current age of their own infants. Parenting knowledge may be cumulative, or may be comprised of information relevant to infants' current and upcoming milestones.

Participants in the current study were 115 primiparous mothers, 61 with 4-month-olds and 54 with 10-month-olds. Mothers were primarily Caucasian, with a mean age of 29.5 years, and an average educational level of college completion. Mothers returned completed questionnaires by mail or completed questionnaires online.

Mothers indicated the age at which they thought 48 milestones (4 questions for each month from 1 through 12, presented in random order) typically are acquired. Answers were considered correct if mothers guessed within a month of the correct age, based on Bayley (1993).

The number of correct answers was calculated for each 2-month interval (1-2, 3-4, 5-6, 7-8, 9-10, and 11-12 months). A repeated-measures ANOVA was conducted with milestone age category as the within-subjects variable and mothers' own infant's age as the between-subjects factor. There was a significant multivariate interaction between milestone age category and own infant age as well as a main effect of milestone age category. Mothers answered more questions correctly about milestones that occur near the current age of their own child. Follow-up t-tests revealed that mothers of 4-month-olds were more likely to correctly answer questions about 1- and 2-month olds' milestones and about 3- and 4- month olds' milestones than were mothers of 10-month-olds. Mothers of 10-month-olds were more likely to correctly answer questions about 7- and 8-month-olds' milestones and about 9- and 10-month-olds' milestones than were mothers of 4-month-olds. There were no significant differences in mothers' answers for 5- and 6-month-olds' milestones or 11- and 12-month-olds' milestones.

These results illustrate that mothers are most knowledgeable about milestones that their infants have recently acquired or are in the process of acquiring. Most mothers tend to forget the details of earlier milestones, and they don't learn about future milestones very far in advance. However, mothers who are knowledgeable about impending changes in their infants should be better able to predict their infant's behavior and provide them with a facilitative environment.

**Th3-56**

## Effect of Familiar information on Reading Interaction between Toddler and Teacher

**Minhwa Kim**

*Hanbuk University, Seoul, Korea*

**Background and Aims:** Book reading becomes one of the most important things in early experiences. Most of early book readings are sharing with adults. Shared reading interaction can be clearly classified than other interactions because it is a triadic interaction mediated by the book. Thus, traits of book provoke different reading interactions. The book treats on familiar information with readers can promote substantial interactions between them. This study aimed to exam the effect of the book on reading interaction between toddler and teacher in the daycare center.

**Methods:** The materials are 4 picture books, in which matched two books include different items but treat equally on the same subjects. First subject is about animals; second subject is about vegetables. One series of books were originally published in France and translated to Korean. In French picture books there were unfamiliar items, for example, a badger, a peacock, an asparagus and a beet, with Korean. The other series were published in Korea and they have more familiar items with Korean than French books. Ten reading groups participated in the study. Each group composed of 3 toddlers (M=27.8 months, Range=24-30 months, N=30: 16 boys and 14 girls) and their one teacher in the daycare center. Reading interactions of each reading group were videotaped and scored in the coding system of initiating and responsiveness.

**KeyResults:** Toddlers showed more initiating and responsiveness on the familiar vegetable items than unfamiliar items (initiating: $t=2.34$, $df=29$, $p<.05$; responsiveness: $t=2.65$, $df=29$, $p<.05$). Instead, both their interaction behaviors are indifferent on the animals. Teachers showed more responsiveness on the familiar vegetable items ($t=2.19$, $df=29$, $p<.05$). But, other interaction behaviors of teachers on both subjects are indifferent according to familiarity of items. Rather, teachers interacted initiatively on the subject of animals than on the vegetables, regardless of item familiarity ($t=5.94$, $df=29$, $p<.001$).

**Conclusions:** These results suggest that familiar information of the book could encourage abundant initiating and active responsiveness of toddlers'reading interactions, not the same as teachers'. However, effects of familiar information are different within the subjects. Toddlers could directly connect various vegetables to their well treated behavior, eating, but it comes under the influence of well known items. Through the discussions, we could think about the traits of the book which make enjoyable reading interactions in early period.

**Th3-57**

## The Interactions with a Trained Tutor Improve the Synchrony of Interactions with Other Persons in Institutional 1-3 Month Old Infants

**Elena Kruchenkova**

*Moscow State University, Fac. of Biology, Moscow, Russia*

Study conducted at "Dom Rebenka" (an institution for infants without parents) where four 1-3 month infants were chosen to interact with trained tutors (skills training program The Keys to Caregiving ) and four with untrained tutors (control). Both trained and untrained tutors were college students with similar backgrounds. Every session of interactions lasted for one hour and included face-to-face interactions and playtime. For every new session the tutor was selected randomly. As a result each tutor has given (and each infant has received) 10 to 12 sessions, and every tutor interacted with every infant from one to seven times (mean =3.4).

After interaction with a trained tutor infants displayed a marked increase in interactive behaviors. Also adult-infant synchrony in the interactions with known adults (institutional caregivers) were significant higher in this group.

**Th3-58**

## The Developmental Change in Infants' Responses to Peek-A-Boo Game

**Misa Kuroki**[1] Aya Kutsuki[1] Sonoko Egami[2] Tamiko Ogura[3] Shoji Itakura[4]

*1. Japanese Science and Technology Agency, Kyoto City, Japan; 2. Hokkaido University of Education, Hokkaido City, Japan; 3. Kobe University, Kobe City, Japan; 4. Kyoto University, Kyoto City, Japan*

**Introduction:** Peek-a-boo game is a well-known game which used to play with infants. The game is constructed from two phases. In the first phase, player hides his or her face with hands, and in the second phase, removes those hands and show his or her face again (reappearance phase). The first phase can be called "anticipatory phase" because the situation sets infants' expectation on reappearance of player's face. To form clear expectation of reappearance of player's face despite the absence of face appearance, infants were thought to need understanding of object permanence. Because if they didn't understand the permanence of hidden face, they couldn't believe that the face would come back in their view after a few seconds. Then, when infants could be able to join peek-a-boo game with their partner? Piaget (1937) suggested that infants be able to practice seeking of hidden object from 5- to 7-month old. In this period, infants show a sprouting of permanence understanding, but they couldn't search for absent objects systematically (Piaget, 1937; Kleeman, 1967). Moreover, Piaget(1937) suggested that infants show significant progress in their permanence understanding after 8-month old. This study examined the developmental change of infants' response to peek-a-boo game in 5-, 7- and 9-month olds.

**Methods:** 32 infants were longitudinally videotaped while participating a peek-a-boo game with experimenter in 5-, 7-and 9-month old. Infants' gaze direction toward expromenter and facial expression during peek-a-boo game were coded. Infants' positive expression and looking at experimenter were compared in anticipatory phase and in reappearance phase of peek-a-boo game.

**Results and Discussions:** Infants' looking time toward experimenter and time of positive expression were entered into a 3 (age: 5, 7, 9) × 2 (phase: anticipatory, reappearance) ANOVA. Only 9-month-olds tend to increase looking at experimenter at anticipatory phase than reappearance phase ($F(1, 25) = 3.80$, $p < .10$), although they showed more positive expression at reappearance phase than at anticipatory phase in all month-age ($F(1, 25) = 42.54$, $p < .01$). These results indicate that 9-month-olds might have clear expectation for reappearance of players face. These findings were consisted to previous studies which showed that abilities of permanence understanding and forming expectation develop from 8- to 9-month-old.

**Th3-59**

### Socialization Strategies used by Parents with their Toddlers

**Julie Laurin**, Audrey Savard, Véronique Rouvès, Mireille Joussemet
*Université de Montréal, Montréal, Canada*

The present study explores how parents help toddlers do important yet less enjoyable things , and refrain from doing forbidden things ("dos" and "don'ts"; Kochanska & Aksan, 1995). The main goal was to examine what socialization strategies parents tend to use with their toddlers, how efficient they report them to be, and how child and parent characteristics relate to those strategies.

**Method:** The study took place in playgrounds in Montreal (Quebec), during the summer. The participating parent could engage in the study (about 20 minutes) as one of the two experimenters watched and played with his/her child.

Participants (N=73) were French-speaking mainly middle-class parents of toddlers. Parental age ranged from 25 to 45 yo (M = 33 years; SD = 5) and toddlers were 9 to 45 months of age (M = 24 months; SD = 8).

**Measures:** A list of 23 strategies was presented. Parents rated how frequently each are used with their toddler (scale : 0 to 5), and how efficient these seemed to be, (scale : 1 to 3). Next, parents completed a "negative emotionality" subscale (Bates et al., 1987) assessing the child's temperament (e.g. mood, reactivity). After giving socio-demographic information, parents also described how tired, stressed, and discouraged they felt (scale:1 to 10), and rated how much support they receive.

**Preliminary Results:** Frequency and Efficacy Ratings.

Praising toddlers and making tasks fun were the most frequently used, and rated as highly efficient. Choice and distraction were also rated as highly efficacious, although not used frequently. Conversely, saying "no" was frequently used, despite being rated as ineffective. Finally, giving up was used the least and had the lowest efficacy rating.

Child and Parent Characteristics.

Neither toddler's sex nor temperament was associated with strategy use. Parents of more difficult toddlers saw rationales and distractions as less effective. Parents with older children used more time-out, choice, reparation, alternatives and praise.

Mothers use more time-out and praise than fathers. Older parents give up more often and insist less often than younger parents. In bigger families, parents suggest alternatives and thank their toddler less frequently.

Parental stress is negatively associated with the use of distraction and fun, while support received is positively associated with using distraction. Finally, discouraged parents report saying "no" more often.

**Discussion:** Together, these finding shed further light on the strategies used by parents in the emergence of socialization, and suggest that some factors (e.g.stress) prevent parents from using strategies they perceive as effective with their toddlers.

**Th3-60**

### Supporting Toddlers' Need for Autonomy in the Context of Socialization

Audrey Savard, **Julie Laurin**, Véronique Rouvès, Mireille Joussemet
*Université de Montréal, Montréal, Canada*

Socialization is a central task in toddlerhood and it can be a challenging task for parents, as toddlers also need to assert themselves. According to Self-determination theory (Deci & Ryan, 1980, 1985, 1991, 2000), supporting the need for autonomy is essential in promoting healthy internalization. The main goal of the present study is to examine whether an autonomy-supportive approach affects the type of strategies used, with a population of toddlers.

**Method:** The study took place in playgrounds in Montreal (Quebec), during the summer. The participating parent could engage in the study (about 20 minutes) as one of the two experimenters watched and played with his/her child. Participants (N=73) were French-speaking parents of toddlers. The sample was mainly middle-class. Parental age ranged from 25 to 45 yo (M = 33 years; SD = 5) and toddlers were 9 to 45 months of age (M = 24 months; SD = 8).

**Measures:** A list of 23 strategies was presented. Parents rated how frequently they used each of them (scale: 0 to 5) and how efficacious these strategies seemed to be (scale: 1 to 3). Next, parents completed a French version of the Problems in School questionnaire (Deci, Schwartz et al., 1981). Vignettes represent various responses to situations while scores reflect autonomy-supportive and more controlling options. Finally, participants completed some basic socio-demographic information.

**Preliminary Results:**

Frequency Ratings.

Correlational analyses revealed that an autonomy-supportive orientation was associated with more "protective" strategies. The global score was positively related with preventing the child physically from doing forbidden things. In addition, the autonomy-supportive subscale was positively associated with making the forbidden activity impossible (e.g. hide object, blocking access). Surprisingly, higher scores on the autonomy-support subscale was negatively associated with giving the child a rationale).

Efficacy Ratings.

Correlational analyses revealed that an autonomy-supportive orientation was associated with believing that offering choice is efficacious, while giving up is not. Parents who prefer highly controlling options see offering rationales and warning the child as ineffective. Finally, parents who prefer moderately controlling options reported that time-out was ineffective while offering alternatives were found to be effective.

**Discussion:** While autonomy-supportive behaviors are often described as offering choice, rationale and empathy, it seems that parents who value this approach do not necessarily use these strategies more often with their toddlers. Using a developmental perspective sheds further light on autonomy-support and the form it takes with toddlers. It seems that this "child-centered" approach leads parents to make age-appropriate demands (protection).

**Th3-61**

### Parental Responsiveness and Sensory Stimulation during Play with Infants

**Nicole McCray**
*University of Montana, Missoula, USA*

The period from birth to three years of age is characterized by rapid development in emotional, social, cognitive, and physical domains. Positive play interactions with responsive partners promote development within these domains and enhance the growing bond between parent and child (Landy, 2002; Tamis-LeMonda, Katz, & Bornstein, 2002). While the responsibility for initiating these interactions falls initially to the parent, toddlers begin to take a more active role and contribute significantly to the direction and maintenance of play as their physical and cognitive capacities increase (Power, 2000). Thus,

when analyzing parent-infant interactions it is important to consider the interaction between the environmental contexts provided by the parent and the unique characteristics of the child. Use of such a Transactional Approach (Sameroff, 1975) allows a better understanding of the ways in which parents and infants reciprocally respond to one another and influence each other's behavior. When structuring play interactions, parents must consider the child's sensory preferences in order to optimize the play interaction for both partners. Each child varies in the way his/her nervous system receives, interprets, and responds to sensory input. If caregivers understand the meaning of their child's behavior and are successful at constructing daily routines that match their child's sensory needs, children are free to enjoy the interaction without becoming over or under aroused (Dunn, 2004). This study examined the role of sensory stimulation in toy play interactions between young children (9-18 months) and their caregivers. Specifically, video-recorded free play interactions were analyzed to determine specific infant behaviors associated with the level of sensory stimulation provided by the play environment and the amount of stimulation provided by play partners. Parents and infants were observed in a laboratory equipped with a variety of toys selected to provide high and low levels of sensory stimulation to each sensory modality. Parental responsiveness to infants' observed sensory preferences in play was also examined. Overall parental responsiveness in play interactions, as assessed by an existing scale, was correlated highly with parental responsiveness to children's sensory needs as assessed by the coding system created for this study, suggesting that responsiveness to infant sensory preferences might be a component of overall responsiveness. Significant correlations were also found between specific parent and infant behaviors, supporting the Transactional Model (Sameroff, 1975). Limitations, implications, and suggestions for future research are discussed.

**Th3-62**

### Infant Social Referencing Predicts Preschool Self-Regulation

**Berit Olsen**, Betty Repacholi

*University of Washington, Seattle, USA*

**Background and Aims:** In a novel social referencing study, Repacholi and Meltzoff (2007) demonstrated that 18-month-olds can use indirect emotional information to regulate their imitative behavior. Although many infants responded appropriately, some failed to regulate their actions. It was predicted that these individual differences might be related to self-regulation abilities during the preschool period. Thus, a longitudinal follow-up was conducted with children from Repacholi and Meltzoff's original sample.

**Methods:** At 18 months, children saw an Experimenter demonstrate an action on an object. A stranger subsequently entered the room, watched the Experimenter, and then expressed Anger toward her for having performed the action. Infants were then given 20s to play with the object. The stranger was silent and neutral during this time. Two further trials were administered, each involving a different action and object but otherwise following an identical procedure. An imitation score was calculated for each child based on the number of trials in which they reproduced the modeled action.

A battery of tasks (compliance, inhibitory control, emotion-understanding, theory of mind, empathy, verbal IQ) were administered to these children at 3.5 years of age. Prior to testing, parents completed questionnaires about their child's self-regulation abilities. To date, 20 children have been tested at both time points. The estimated final sample size is 40.

**Results:** Data collection and analyses will be complete by February, 2008. Preliminary analyses indicated that infant imitation scores were correlated with two sub-scales from a compliance questionnaire (safety, $r$=-.52, $p$=.02; protection, $r$=-.52, $p$=.04). Preschoolers who were less able to comply with parental guidelines for safety and the protection of personal property, had higher imitation scores in infancy. Preschoolers' internalized conduct scores (separate questionnaire) were also correlated with infant imitation, $r$=-.73, $p$<.001. Children who imitated the modeled actions at 18 months of age were less likely to demonstrate compliance in the absence of parental monitoring when they were preschoolers. Finally, the correlation between infant imitation and preschoolers' latency to touch a forbidden toy (a lab-based compliance task) approached significance, $r$=-.34, $p$=.07, one-tailed. Preschoolers who quickly touched the toy were less likely to have regulated their imitative behavior in infancy.

**Conclusion:** The data suggest that infants who fail to regulate their behavior in response to another person's emotional signals are at risk for difficulties in the preschool period with the internal regulation of their conduct. These findings have implications for the early identification and prevention of childhood conduct problems.

**Th3-63**

### Attachment Quality at 12-16 Months and Collaborative Symbolic Abilities at 3 Years of Age

**Ana Osorio**[1] Carla Martins[1] Elizabeth Meins[2] Eva Martins[3]

*1. Instituto de Educação e Psicologia - Universidade do Minho, Braga, Portugal; 2. Department of Psychology - University of Durham, Durham, UK; 3. Instituto Superior da Maia, Porto, Portugal*

**Background and Aims:** This poster focuses on the impact of the quality of children's early relationships on their later socio-cognitive development. Previous empirical findings have highlighted an important relationship between various socio-cognitive development milestones and attachment quality (e.g., Fonagy, Redfern and Charman, 1997; Meins et al., 1998, 2002; Symons & Lark, 2000). For example, children assessed as securely attached showed not only improved collaborative symbolic competences (age 3) as well as better performance on theory of mind tasks (age 4) (Meins et al., 1998, 2002).

**Methods:** 34 children and their parents recruited at kindergartens from Oporto metropolitan area have been participating in this longitudinal study. The Strange Situation (SS) procedure (Ainsworth & Wittig, 1969) was used to assess mother-infant quality of attachment. Because both parents were included in the study, testing was counterbalanced. Therefore, half the children were filmed at the SS with their mother at 12 months (and at 16 months with their father) and the other half at 16 months with their mother (and at 16 months with their father). Collaborative symbolic play was assessed using the task devised by Meins and colleagues (1998) in which children were presented with pairs of one representational toy (e.g., car or doll) and one non-representational object (e.g., a toilet roll inner tube, a piece of aluminium foil). The presentation order for the pairs was randomized. The symbolic play task is currently under coding using Meins and colleagues' (1998) adaptation of Lewis and Boucher (1988) criteria.

**Results:** Regarding attachment security, of the 34 children, 25 (14 girls and 11 boys) were found to be securely attached to their mothers, as the remaining 9 (2 girls and 7 boys) were classified as insecurely attached to their mothers.

Collaborative symbolic play is still under analysis.

**Possible Conclusions:** Although this study is still underway, we expect that the securely attached children will present higher competence in the collaborative symbolic play task than the children in the insecure group. The secure group children are also expected to be more willing to engage in collaborative symbolic play with the experimenter. This possible connection may be explained by the higher tendency of secure children's mothers to acknowledge and understand children's mental states, improving the child's own and other's mental state understanding.

**Th3-64**

## Executive Function and Belief-Desire Psychology in Young Children

**Hannes Rakoczy**

*Max-Planck-Institute for Evolutionary Anthropology, Leipzig, Germany*

A much debated question in theory of mind research has been how understanding subjective beliefs and desires develop in relation to each other. The symmetry position holds that understanding truly subjective beliefs and desires develop in parallel around 4 years when children acquire a notion of subjective perspective (e.g., Moore et al., 1995; Perner et al., 2005). The asymmetry position holds that children understand subjective desires earlier than subjective beliefs (e.g., Wellman, 1990). The crucial test case for subjective belief understanding is the false belief task; the crucial test case for subjective desire understanding are tasks of ascribing mutually incompatible desires in two persons. Empirically, the findings so far have been mixed (e.g., Moore et al. (1995) for the symmetry view; Rakoczy et al. (2007) for the asymmetry view).

The present study therefore tested 3- and 4-year-olds with an improved design on subjective belief and desire understanding tasks. In two experiments (n=134) children were more proficient at ascribing subjective, mutually incompatible desires and desire-dependent emotions to two persons than they were at ascribing analogous subjective false beliefs - providing the clearest evidence to date for the asymmetry position.

One explanation for this asymmetry might lie in the specific involvement of executive function (EF) in understanding attitudes that aim to represent true states of affairs (beliefs) and thus have truth as their default which has to be suppressed in the case of false beliefs. Such a possibility is suggested, for example, by recent findings that EF correlated specifically with the false belief task, but not with structurally analogous tasks that do not involve belief ascription (Sabbagh et al., 2006).

To test for this possibility, performance on tasks requiring the ascription of beliefs and desires was also investigated in relation to executive function. Experiment 1 (n=80) showed, replicating previous findings, that EF was correlated with false belief ascription. However, EF was also correlated with performance on tasks requiring subjective desire understanding. Experiment 2 (n=54) replicated these results, and showed that the correlations hold even if controlling for age, vocabulary and working memory. This is the first study to show that EF is not only involved in false belief ascription, but in other forms of theory of mind reasoning as well. Executive function seems thus not be specifically involved in tasks requiring belief ascription and suppression of truth as default, but in tasks requiring the coordination of subjective and mutually incompatible perspectives generally.

**Th3-65**

## The Effects of Shared Book Reading on Mother-Child Interaction

**Ayumi Sato**, Ichiro Uchiyama

*Department of Psychology, Doshisha University, Kyoto, Japan*

**Background and Aims:** Some researchers have suggested that repeated book reading between mothers and children enhances the quality of mother-child interaction like attachment (e.g., Bower, 1974). However, empirical studies for the effects of shared book reading from infancy to childhood on mother-child interaction have not often been conducted so far. Therefore, in this study, we examined the effects of shared book reading by observing the behavior of mothers and children in free-play situations before and after repeated book reading.

**Methods:** Participants were 19 pairs of 9-month-old infants and their mothers. They were randomly assigned either to (1) the shared book reading condition ($N$=11) in which mothers were asked to share books every day and given picture-books regularly from the experimenter, or (2) the control group ($N$=8) in which mothers were given no instruction. The experiments were conducted when these children were 9, 12 and 30 months old. In the laboratory, they were instructed to play together with six toys; a plastic boat, a stuffed monkey, a puzzle, wooden blocks, a shape-sorting cube, and a drawing board, and their behavior in the free play session was observed during ten minutes. The behavior of them was coded; *mother's praise*, *child's reaction* included *smile* and *looking at mother* (refer to Stipek, Recchia, & McClintic, 1992). Moreover, mother's praise and child's reaction were coded only when they occurred within 3 seconds of children producing some discernible outcomes with toys, which were *not* defined by mothers *but* by children.

**Results:** In this study, mainly two results were led. The first result is that mother's praise and child's smile in the shared book reading group occurred simultaneously and more frequently than those in the control group when children were 12 and 30 months old ($F$(2, 32)=4.04, $p$<.01). The second one is that children in the shared book reading group smiled and looked at their mothers simultaneously and more frequently than those in the control group when children were 30 months old ($U$=10.50, $p$<.01).

**Conclusions:** The first result suggests that mothers in the shared book reading group attuned their praise to children's social signals. The second result suggests that these children tend to share emotions with mothers. Therefore, it seems that shared book reading enhances mother-child interaction, that is, mothers' attunement to their child and children's cognitive ability to share their emotions with other persons.

**Th3-66**

## Cooperative and Social Referencing Behaviors with Strangers from Different Racial Groups in 18-Month-Olds

**Mariah Schug**[1] Tricia Striano[2]

*1. Max Planck Institute for Human Cognitive Brain Science, New York, USA; 2. Hunter College and Max Planck Institute for Human Cognitive Brain Science, New York, USA*

Several recent studies suggest that infants attend differentially to pictures of faces of individuals from their own and other racial groups. What is unknown, is how this tendency may affect live interactions and predict overt behaviors. The current study examined these issues by using a series of behavioral paradigms. Additionally, as two of

these paradigms were designed to elicit cooperative behaviors, we expanded on a growing body of literature showing that in early childhood there is a tendency to behave cooperatively with strangers.

In the present study, 27 18-month-olds, who had had little exposure to racial diversity, interacted with pairs of experimenters. One member of each pair was from the infant's racial ingroup (Caucasian) and one was from a racial outgroup (African American, Nigerian or Indian). Six experimenters participated and were counterbalanced to form 9 pairs. The study consisted of 5 parts. First there was a 5 minute free-play session, followed by two games designed to elicit cooperative behaviors, one game intended to elicit social referencing, and finally a second 5 minute free-play.

Results showed that infants looked significantly longer to experimenters from a racial outgroup in the first free-play. The infants participated successfully in the 3 games following the first free-play, thus establishing new cooperative and social referencing paradigms for use with 18-month-olds. Interestingly, there was no difference in how the infants interacted with the ingroup and outgroup experimenters while playing these games. Finally, there were no significant differences in the infants' behavior with the two experimenters in the second free-play. Thus, the infants responded differently to the ingroup and outgroup experimenters early in the study, but this differential response was extinguished after minimal exposure.

These findings suggest that at 18 months, infants are interested in strangers from different racial groups if given the opportunity to interact with them in a positive environment. Remarkably, this increased interest disappears after just a short period of interaction. Further, our results show that 18-month-olds are willing to cooperate with, and socially refer to, strangers from their own or another racial group. These results have important implications for future research in which experimenters and infants may come from different racial groups, as well as research intended to examine cooperative behaviors in early childhood.

**Th3-67**

### Do Infants Treat Hands Like Faces or Like Objects?

**Virginia Slaughter**, Philippa Neary
*University of Queensland, Brisbane, Australia*

It is well established that infants' spontaneous responses to humans differ from their responses to nonhuman objects. From an early age, infants address social behaviours, such as smiling and vocalising, to other humans whereas they tend to reach toward nonhuman objects (Legerstee, 2005). The studies that have established this effect have used faces or upper torsos as the key human stimulus, so we do not know if infants' differential treatment of humans depends on the presence of a face, or if other parts of the human body also trigger social behaviours in infants.

There are reasons to suppose that human hands may also engender social responding in infants. For instance hands, like faces, are often a focus of social and communicative exchanges, in adult-adult and infant-adult interaction alike (e.g., waving, pointing, teasing games).

The current study sought to explore young infants' spontaneous responses to human hands. Twenty 4-month-olds and 20 6-month-olds were exposed to the following five stimuli in randomised order: (a) a female human face wearing a neutral expression, (b) a mannequin face with a neutral expression, (c) a pair of female human hands in a relaxed posture, (d) mannequin hands in the same relaxed posture, and (e) a colourful stacking ring toy. These stimuli were presented through small openings in a black panel so that only the specific body part (or toy) appeared for 30 seconds at the eye height of the infant who sat 40 cm away in a high chair. Infants' spontaneous responses to each stimulus were coded from videotape.

Statistically significant findings from a series of repeated measures ANOVAs (all p's <.05) indicated that infants' responses to hands were distinct. At both ages infants tended to look up and visually scan the space above the hands. This was observed in both the human and mannequin hands conditions, though infants looked up more frequently and for longer in the human hands condition. Infants did not scan above the faces or the toy. Infants smiled and vocalised toward the faces but not to the hands or the toy; responses to the mannequin and human faces were similar. Thus infants' responses to hands differ from the social responses typically addressed to faces, but it also appears that by 4 months, when infants see human hands, they look up to find the face.

**Th3-68**

### Socialization in Progress: Discordant Interactions in Families with Two Year Olds

**Linda Sperry**, Douglas Sperry, Melissa Hamill
*Indiana State University, Terre Haute, USA*

**Background and Aims:** Maratsos (2007) framed two kinds of theoretical parent-child interactions: a Piagetian "self-motivated seeker after knowledge and cognitive development" who uses adults only when necessary and a Vygotskyan receiver of "information from helpful adults who try to give information that will be useful" (p. 123). Maratsos observed that real parent-child interactions may well occupy a middle ground.

The present program of research examines real parent-child interaction, specifically, parent-child interaction where one party says, in effect, "No, this interaction cannot proceed as it is." In this study, discordant interaction that is initiated by family members is the focus. For example, parents may want their children to pick up their toys, avoid hurting themselves, talk for the researcher, or understand that what they have said is wrong. If the child protests in any way, the interchange is coded as discordant.

**Methods:** Two year olds from 12 families from a low-income African-American community in the rural Black Belt region of the Deep South were videotaped in their homes once every 2 months between 24 and 42 months of age. Approximately six 30-minute transcripts per child served as the corpus for this study. An inductive analysis of types and frequencies of "discordance" was performed.

**Results:** Sixteen categories of discordance were reliably identified across an initial sampling of 2500 family member utterances, ranging from prohibitions, denials, threats and corrections to urges and promises. The utterances were drawn from the 35th to the 40th minute of every two-hour observation for each child. In this random sampling of family interaction, the prevalence of discordant interaction is very high. On average, 47% of family member utterances directed to 2 year olds resulted in discordant interaction. The percentage was slightly higher for girls (55%) than for boys (38%). All 16 categories occurred fairly often. Linguistic form, type of family member (child or adult or parent), age of child, and linkage into episodes have been coded which will permit more subtle description.

**Conclusion:** Given the high prevalence of discordance, this type of speech event is surely influential in the socialization of young children. For these poor, rural African-American 2 year olds, neither the

Piagetian "self-motivated seeker after knowledge" nor the Vygotskyan "receiver of useful information from helpful adults" was the dominant model of parent-child interaction in their families. This description will permit a nuanced view of socialization and co-regulation processes.

**Th3-69**

### Mother-Infant Contingent Responsiveness in Families by Adoption and Birth

**Joan Suwalsky**, Linda Cote, Marc Bornstein, Charlene Hendricks, O. Haynes

*National Institute of Child Health & Human Development, Bethesda, USA*

**Introduction:** The possible role of family dynamics in the etiology of adjustment difficulties of adopted children is not well understood. Suwalsky, Hendricks, and Bornstein (2006) reported group similarities and differences in patterns of mother-infant socioemotional interaction in dyads by adoption and birth. Contingency analyses contribute important additional information about the nature of interaction that has not been reported previously for adoptive samples.

**Method:** Thirty-seven adoptive and 37 birth families with a firstborn 5-month-old infant (21 males and 16 females in each group) comprised the sample. Adoptions were by non-relatives in very early infancy (M < 90 days old). Families were matched in terms of maternal age, education, SES, and hours of employment. Mothers and infants were videorecorded in naturalistic interaction for 50 min at home. Onsets/offsets of two infant (look at mother; nondistress vocalization) and three maternal behaviors (solicit infant attention; social play; speech to infant) were recorded to the nearest .1s, allowing for sequential analysis. All behaviors met and surpassed acceptable levels of interrater reliability. Infant and maternal behaviors were paired to create 6 sequential dependent variables.

**Results:** One sample t-tests indicated that vocal-attention interactions were significantly contingent for both family groups whether mothers or infants initiated these behaviors, and infant-initiated vocal interactions were also significantly contingent for both family groups. Six 2 (Family) x 2 (Gender) x 2 (Initiator) MANOVAs were performed, one for each pair of DVs, followed by Bonferroni-adjusted t-tests ($p < .05$). Some differences in mother-infant interactions based on family type and infant gender were observed. Mother social play-infant nondistress vocalization interactions were more contingent for birth dyads than for adoptive dyads. Vocal interactions were more contingent for birth dyads than for adoptive dyads when the infant was a girl, while the reverse was true when the baby was a boy.

**Conclusions:** These dyadic analyses contribute new information to the study of adoptive family dynamics, supporting earlier findings that adoptive and birth mothers interact with their young infants in ways that are both similar and unique. Subtle differences in early interaction patterns may persist as children grow older. Examination of adoptive family dynamics may assist in understanding the increased vulnerability of some adopted children to adjustment difficulties in middle childhood and adolescence.

**Th3-70**

### Mothers' Mental State Talk Scaffolds Children's Mental State Language and Emotion Understanding From 15 - 54 Months

**Mele Taumoepeau**, Ted Ruffman

*Otago University, Dunedin, New Zealand, Dunedin, New Zealand*

**Background and Aims:** Although there are several studies demonstrating a relation between children's developing social understanding and maternal mental state input, it is still unclear the exact mechanism underlying this relation. In order to better understanding how maternal input relates to mental state understanding, this study longitudinally examined the predictive nature of mother mental state talk at 15, 24, 33 and 54 months and children's later mental state language and emotion understanding at 24, 33 and 54 months.

**Methods:** At all four time points the mothers (N=74) described pictures to their children and their talk was coded for mental and non-mental state language at four time points: 15, 24, 33 and 54 months. In addition, at all four time points, children's mental and non-mental state vocabulary levels were obtained via parental report. At Times 2, 3 and 4 the children were administered an emotion-situation and a body emotion task. The mothers' ability to interpret emotion faces was also assessed.

**Key Results:** Results from the first three time points suggest a developmental pattern in the way in which mothers talk about mental states with their young children. Partial correlational analyzes demonstrated that mothers' references to the *child's desires* at 15 months uniquely predicted children's mental state language and emotion situation task performance at 24 months. At 24 months, maternal references to her *own thoughts and knowledge* predicted children's mental state language and emotion task performance at 33 months. The final analyzes show that at 33 months, only mothers' references to *others' thoughts and knowledge*, and not any other mental state talk, related to children's mental state language and emotion understanding at 54 months, accounting for 5 out of 7 criterion variables. All partial correlation analyzes were conducted accounting for potentially confounding variables such as SES, mothers' own emotion understanding and child language and emotion understanding.

**Conclusions:** It is proposed that Vygotsky's zone of proximal development provides a framework within which maternal talk about specific mental states scaffolds the development of children's later social understanding. We suggest that such scaffolding follows a triadic framework such that mothers initially focus on the child's mental states, then her own mental states before focusing more on others' mental states. In this way, the incremental exposure to children's own and others' mental states starting in infancy, makes tractable a seemingly intractable problem of how to learn about the social world.

**Th3-71**

### Interpretation Accuracy of Infant Facial Expressions and Maternal Depression as Predictors of Maternal Sensitivity

**Catherine Tenedios**, Erica Musser, Jennifer Ablow

*Department of Psychology, University of Oregon, Eugene, USA*

For optimal development, infants rely on their caregivers to accurately interpret their emotional cues and to respond to these cues in a prompt and sensitive way (Ainsworth, 1973; Raval, Goldberg, Atkinson, Benoit, Myhal, Poulton, & Zwiers, 2001). Previous research has demonstrated that mothers vary in their ability to recognize and interpret infant expressions of emotion. Specifically, maternal depression, alexithymia, and a past history of trauma have been shown to compromise a mother's ability to interpret infants' expressions of emotion (Zahn-Waxler, & Wagner, 1993; Tenedios, Ablow, & Freyd, 2007; Knezevic, & Jovancevic, 2003). Although research has begun to elucidate the relation between maternal symptomatology and the accuracy with which mothers interpret infant facial expression, the relation between a mothers' ability to interpret infant expressions of emotion and maternal sensitivity has been largely unexplored. One study (Broth et al., 2004) found that among non-depressed mothers

only, accuracy in identifying infants' negative emotions was related to enhanced mother-infant interaction. As the literature is limited in this area, the current study attempts to elucidate the relation among women's depressive symptomatology, their ability as mothers to interpret infant emotion expressions, and maternal sensitivity.

Participants were 95 first-time mothers. During their third trimester of pregnancy, women's ability to interpret infant facial expression was measured (using the IFEEL picture system), as were depressive symptoms, using the CES-D, alexithymia symptoms, using the Toronto Alexithymia Scale, and history of trauma. At five-months postpartum, mothers and their infants completed the Still Face procedure, which was coded for maternal sensitivity using the Global Rating Scales of Mother-Infant Interaction.

Preliminary analyses support our prediction that women with prenatal depression were subsequently less sensitive with their infants. However, this association appears moderated such that women with the highest levels of depressive symptomatology who also scored low (bottom quartile) in their ability to accurately identify infant facial expressions, were among the least sensitive during mother-infant interactions. Additional analyses are underway to examine the potential added effects of women's alexithymia and history of trauma.

Our discussion will consider the possibility that depressed mothers have difficulty interpreting infants' emotions, which may compromise their capacity to interact sensitively with their infant.

**Th3-72**

### Dyadic and Triadic Social Interaction and Action Understanding in the First Year of Life

**Claudia Thoermer**, Hannah Eisenbeis, Susanne Kristen, Beate Sodian

*University of Munich, Munich, Germany*

**Background and Aims:** Early dyadic and triadic interactions skills as well as skills of action understanding, as assessed by looking-time paradigms, are discussed as instantiations of early understanding of intentionality. However, very few studies to date look how these different social-cognitive capacities relate to each other in development.

**Method:** N = 86 infants were studied in an ongoing longituditnal study at 7 and 9 months of age. At both ages infants participated in a modified still-face paradigm with two different still-face periods: a "classical"still face during which the experimenter ignored the infant, and an "alternating gaze" (Striano & Stahl, 2005) phase, during which the experimenter alternated her gaze between the child and a target object, a 10-minute parent-child toy play interaction, and a structured test of attention following. At 7 months children were presented with a goal-encoding habituation task and at 9 months infants with a looking-time task requiring encoding of action roles in a give-and-take interaction. To control for information processing capacities infants also participated in a looking time task assessing pattern recognition

**Results:** Moderate correlations between still-face reactions and triadic interaction skills were found. In particular, a decrease in smiling and an increase in communicative bids in the "ignore" condition were significantly positively correlated with the proportion of time spent in supported joint attention in mother-child play at both ages, and an increase in communicative bids in the alternating condition was negatively related to point-following.

For tasks of action understanding, the rate of habituation to the goal-encoding scene predicted test trial differentiation in the agent-role-encoding task, as well as attention following two months later, even if information processing capacities were partialled out. However, no direct relations between early dyadic competencies and skills of action understanding at either age were found.

Clonclusion: This pattern of results points to the role of interaction experience for the development of early dyadic competencies, but does not support very generous interpretations as indicating intentional understanding at this early age. In contrast, results do support the assumption of continuity in early action understanding. While no direct link between dyadic interaction and action understanding was found at this early age, both appear to be related to triadic interaction skills.

References

Striano, T. & Stahl, D. (2005). Sensitivity to triadic attention in early infancy. *Developmental Science, 8,* 333-334.

**Th3-73**

### Whom to Help, Whom Not to Help: Mediators of Prosocial Behavior in Early Childhood

**Amrisha Vaish**, Malinda Carpenter, Michael Tomasello

*Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany*

Young children behave prosocially by helping, comforting, and sharing with others. An open question is whether this tendency is modulated by children's moral evaluation of the other. To assess this possibility, we examine children's prosocial behavior toward a victim and a perpetrator.

Study 1 assessed the relation between children's sympathy for and subsequent sharing with a victim. Previous research on sympathy has mostly involved presenting young children with a distressed person and evaluating children's subsequent affect and prosocial behavior (Eisenberg & Miller, 1987; Zahn-Waxler et al., 1992). However, since the victims in those studies demonstrated an emotional response, it is unclear whether children can only sympathize by emotion reading (emotional route) or can also do so by evaluating the victim's situation (cognitive route). We showed 18- and 24-month-olds an adult (the perpetrator) either harming another adult (the victim) by, for instance, destroying her possessions (Harm condition), or doing something similar that did not harm her (Neutral condition). The victim expressed no emotions in either condition. Nevertheless, in the Harm condition, more children showed sympathy ($p=.016$) and children showed more subsequent prosocial behavior ($p=.047$) toward the victim, and children's degree of sympathy correlated with their prosocial behavior, $r(22)=.39$, $p=.032$. Thus, young children's cognitive sympathy is related to their subsequent prosocial behavior.

In a second, ongoing study, we are examining children's evaluation of and subsequent prosocial behavior toward the perpetrator. Specifically, after 24-month-olds witness either the Harm or Neutral condition (as in Study 1), they must decide whether to help the perpetrator or a familiar but neutral person (i.e., not the victim but a third adult). We predict that in Harm, children will help the perpetrator less than the neutral person, whereas in Neutral, they will help both adults equally. This would indicate that young children evaluate morally relevant behavior even from a third-party perspective (i.e., when they are uninvolved in and unaffected by the perpetrator's actions) and that their prosocial behavior is mediated by such evaluations. If this prediction does not hold, we will assess this ability in older children.

Thus, during the second year, children's prosociality toward a victim is mediated by cognitive sympathy for the victim, and children's prosociality toward a perpetrator might be mediated by their moral evaluation of the perpetrator. This work pertains to the broader issue

of how we determine whom to help and affiliate with, and whom to not help and not affiliate with.

**Th3-74**

### The Role of Rewards and Parental Control on Helping in Young Children

**Felix Warneken**, Michael Tomasello

*Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany*

Prosocial behaviors emerge early in ontogeny. Specifically, studies have shown that children begin to help others in the second year of life (Rheingold, 1986; Warneken & Tomasello, 2006). The fact that children often do so spontaneously in the absence of rewards allows for the possibility that young children have an intrinsic motivation to help others. However, the role of external incentives such as rewards and parental authority have not systematically been studied in children this young. In social-psychological research with older children and adults, it has been established that if people are intrinsically motivated to perform a certain activity, external incentives such as material rewards or social control are either superfluous or even undermine their intrinsic motivation (Deci, 1971; Lepper, 1981). It is not known if similar effects occur in young children's prosocial behaviors.

Therefore, in experiment 1, we investigated the role of rewards on subsequent helping. The helping situation was one in which an experimenter was unsuccessfully reaching for various objects and the child could help by picking it up for her. For a treatment-phase, 20-month-old children (N = 36) were randomly assigned to one of three between-subject conditions, varying in how the experimenter responded to the helping act (Material Reward; Praise; Neutral). During the subsequent test-phase, all children had the opportunity to help repeatedly, without being rewarded or praised. Results showed that the children from the Praise and the Neutral condition helped equally often (M = 88 and M = 81 percent of trials, respectively). However, children from the Reward condition helped significantly less (M = 53; Fs (1,22) > 4.5, ps < .05). This indicates that children have an intrinsic motivation for helping which can be undermined by external rewards.

In experiment 2 (in progress), we study a different external incentive: the social control through parents. Employing the same treatment-test-design, we assign children to one of three treatment-conditions: The mother either (1) observes passively, (2) encourages the child to help, or (3) is absent. During the test-phase in the mother's absence, we then test for children's helping over 9 consecutive trials. This design will enable us to determine whether external social control has a similarly undermining effect on children's helping as have material rewards.

Taken together, these two studies will help to better understand the motivation of children's helping in relation to external material and social incentives as it emerges in the second year of life.

**Th3-75**

### Infant Sleep Quality, Parenting, and Infant Developmental Outcomes. Maternal Separation Anxiety as a Regulator of Infants' Sleep

**Anat Scher**

*University of Haifa, Haifa, Israel*

**Background:** The regulation of infants' sleep is determined not only by biological factors but by relational aspects too. This study focused on maternal separation anxiety (MSA) and examined its association with infant sleep-wake regulation at 10 months of age.

**Method:** In a community sample comprising 52 infants and their mothers, infant sleep was measured objectively with an activity monitor, as well as through questionnaires. The mothers reported on their own separation anxiety and on their perceptions of their infants separation anxiety as well as fussiness.

**Results:** The main finding was that mothers' own separation anxiety was significantly associated with the number of infant nightwaking episodes, as measured with the actigraph (r=.35, p<.01), but not associated with the nightwaking index, which was based on maternal reports. Infant fussiness predicted 14% (B = -.28, p<.05) and MSA contributed additional 9% (B = -.29, p<.05) to the explained variance of the infants' sleep efficiency scores. Importantly, a partial correlation indicated that the association between maternal separation anxiety and more fragmented infant sleep remained significant after controlling for fussiness (r =.33, p<.05). It was also found that maternal separation anxiety was linked to reported settling to sleep routines and to nightime parenting. Mothers who were actively involved in comforting the child to sleep reported higher separation anxiety compared to the mothers of the "autonomous" settlers.

**Conclusions:** The finding that even when controlling for a child's fussy temperament, maternal separation anxiety predicted infant nightwaking, lends further support to the premise that maternal mental states with regard to infant sleep (in this case, mothers' separation anxiety) serve as modulators of child's sleep. Consistent with the transactional perspective, the current research documented an interplay between maternal separation anxiety and specific aspects of the child's sleep-wake transitions, as measured both subjectively and objectively.

**Th3-76**

### Infant Sleep Quality, Parenting, and Infant Developmental Outcomes. Sleep in Preterm and Low Birth Weight Infants: Maternal Perceptions and Developmental Outcomes

Amy Schwichtenberg[1] **Julie Poehlmann**[2]

*1. Waisman Center, University of Wisconsin, Madison, USA; 2. University of Wisconsin, Madison, USA*

**Background and Aims:** Sleep is a necessary part of development that has the potential to influence the development of regulatory competencies and behavioral problems in young children. However, the mechanisms through which sleep influences development are largely unknown. Psychological research suggests that parental perceptions of children's sleep may be better predictors of children's developmental outcomes than their actual sleep behaviors. The present study tests this assumption via two models in a sample of infants at risk for developmental delays and regulatory difficulties.

**Methods:** A subsample of 66 infants born preterm or low birthweight were followed from hospital discharge to 24 months (corrected for gestational age). At hospital discharge, family demographic information and the infant's medical history were collected. At 4 and 9 months post-term, infant sleep behaviors were assessed via sleep logs and maternal sleep perceptions were assessed in a semi-structured interview. At 24 months post-term, toddlers attended a laboratory visit which included Kochanska's effortful control paradigm, the Stanford-Binet 5th edition, and the Child Behavior Checklist.

**Results:** The two models were tested using a regression approach to path analysis. In all analyses infant prematurity, family sociodemo-

graphic factors, and toddler Stanford Binet scores were included as controls. In the first model, infant sleep behaviors (sleep logs) predicted toddler delay of gratification and effortful attention. In the second model, maternal perceptions of infant sleep predicted children's internalizing behavior problems and suppressing-initiating activity to signal.

**Conclusion:** Infant sleep behaviors were associated with toddler regulation tasks requiring more independent functioning (i.e., delay of gratification and effortful attention), whereas maternal perceptions of sleep were associated with a regulation task that required more co-regulation (suppressing-initiating activity to signal). These findings illustrate that both infant sleep behaviors and parental perceptions of infant sleep may be predictive of toddler outcomes, depending on the skill assessed.

**Th3-77**

### Infant Sleep Quality, Parenting, and Infant Developmental Outcomes. Maternal Adaptation to Infant Sleep, Infant's Sleep Quality, and Behavior Problems in the Second Year

**Douglas Teti**, Molly Countermine, Gail Mayer
*The Pennsylvania State University, University Park, USA*

**Background and Aims:** Although sleep disruption among preschool-aged and older children is predictive of children's cognitive and behavior problems (O'Brien & Gozal, 2004), very little is known about these linkages in infancy. In addition, information about whether early developmental outcomes can be predicted by how well parents adapt to children's sleep patterns, and what factors might predict such adaptation, is non-existent. The present study examines maternal adaptation to infant sleep, and infant sleep quality, as predictors of infant behavior problems.

**Methods:** Participants were 45 socioeconomically diverse, predominantly White families with infants ranging in age from 1 to 24 months of age (Project SIESTA) in central Pennsylvania. Mothers completed daily infant sleep diaries (for seven consecutive days) and questionnaires that tapped, among many things, parents' satisfaction with a) their infants' sleeping location, b) infants' ability to settle to sleep at bedtimes, and c) the frequency of their infants' night waking. Five items from these domains were composited and used as an assessment of maternal adaptation to infant sleep behavior (Cronbach's alpha = .76). Mothers also completed measures of generalized depression and anxiety. Actigraph recordings of mothers' sleep-wake activity and digital video recordings of infant-parent interactions during one night of sleep were also recorded. Mothers of second-year infants completed the Brief Infant and Toddler Social and Emotional Assessment (BITSEA), a measure of infant behavior problems and competencies (Briggs-Gowan et al., 2004).

**Results:** Poorer maternal adaptation was associated with frequency of infant night waking (from sleep diary data; r =.47, p =.002), and several measures of maternal sleep quality derived from actigraph recordings. Importantly, poorer maternal adaptation was also associated with fathers' criticism of mothers concerning infant sleep behavior (r = .45, p=.002), and with mothers' reports of overall depressive symptoms (r = .51, p = .001). Multiple regression analysis revealed that frequency of infant night waking, fathers' criticism of mothers about infant sleep, and mothers' overall depressive symptoms, each contributed significant and unique variance to quality of mothers' adaptation to infant sleep problems. Finally, infants' behavior problems on the BITSEA were not associated with infant sleep behavior, but were significantly associated with quality of mothers' adaptation to infant sleep behavior (r = .54, p = .015).

**Conclusions:** Mothers' adaptation to infant sleep patterns is complexly determined and may be a critical predictor of sleep-linked infant developmental outcomes, and perhaps as important as quality of infant sleep. Additional work on the complex linkages between infant sleep, parenting, and developmental outcomes in early childhood would be of great value to the field.

## *Attention, Memory and Learning*

**Th4-01**

### A New Procedure to Examine the Role of Intersensory Integration in an Operant Learning Task in 3- and 5-Month-Old Infants

Kelly Armstrong, Kimberly Kraebel
*Dept. of Psychology, SUNY Cortland, Cortland, USA*

Intersensory integration continues to be a topic of interest among infant researchers (Bahrick & Lickliter, 2004; Schweinle & Wilcox, 2004), particularly in terms of how intersensory integration influences learning. Most procedures have examined the influence of intersensory integration using habituation procedures; few have used more complex procedures, such as operant learning. The goal of the current study was to determine if Rovee-Collier's conjugate mobile procedure (Rovee & Rovee, 1969) could be modified to examine the role of amodal information in a complex learning task using 3- and 5-month-old infants. Specifically, we wanted to ask whether infants given congruent amodal information would show facilitated operant learning over those given incongruent information. Manipulation of the amodal information (in this case, shape) would come from the sight of the mobile and an object being held during acquisition. Before this hypothesis could be tested, however, several procedural details needed to be worked out. First, although haptic exploration has been studied previously in infants (Bushnell & Boudreau, 1991), it has not been examined in the presence of learning an operant response. Could infants hold onto an object for a sufficient period of time during a 15 min operant training session? Would it be necessary to prevent movement of the object to the infant's eyes or mouth (to prohibit visual and/or oral exploration of the held object)? And if so, what would be the best method to do so? In addition, studies using older infants (5-6 months) in the operant learning task place the infants in a sling chair. To overcome potential problems in using different procedures for the two age groups, the current study tested the use of a U-shaped infant support pillow that allows older infants to lie in a reclining position similar to younger infants. Preliminary data revealed that both age groups could hold onto the objects significantly above the 90 s need to detect shape information haptically (Streri, 1987) and that the padded arm shield allowed for infants to process information only haptically. The presence of the shield did not inhibit kick rates. This study shows the successful implementation of a modification of the operant learning task to allow for the study of intersensory integration in young infants.

**Th4-02**

## Individual Differences in Short-term Memory: The Role of Language Development and Verbal Encoding

**Annie Cardell**, Katherine Morasch, Martha Bell

*Virginia Polytechnic Institute and State University, Blacksburg, USA*

**Background and Aims:** Several behavioral and brain imaging studies have linked memory to verbal ability. However, few studies have specifically investigated the degree to which language ability might enhance strategies of memory encoding and retrieval. It may be that as children become more proficient language-users, their ability to verbally encode information enhances their ability to store and retrieve this information. This is difficult to examine behaviorally because overt behavior is not necessarily an accurate indicator of underlying cognitive processes. However, left frontal-temporal connections are implicated in the verbal encoding process, and EEG coherence can serve as a measure of the strength and number of such connections. This study used both behavioral data and EEG coherence to investigate the extent to which verbal encoding strategies account for individual differences in short-term memory (STM) performance in 3-year-olds. It was predicted that children who performed better on the STM task would also have better language ability. It was also predicted that children with better performance on the short-term memory task would have greater left frontal-temporal (F7-T3) EEG coherence during the task than children who performed less well, indicating that they are using more verbal encoding strategies.

**Methods:** Participants in the current study were 44 3-year-old children. STM was assessed using a variation of the Corsi-Milner test of recognition memory. Children were shown a series of cards, each depicting a simple monochromatic line drawing of an everyday object (which can be easily associated with a verbal label). After certain trials, a question card depicting two images (one of which was previously presented) was shown, and the child was asked to point to the picture that had been shown before. EEG was measured both at baseline and during the STM task. The Peabody Picture Vocabulary Test-III was administered to assess receptive vocabulary.

**KeyResults:** Children in the high STM group (M=51.52) had higher PPVT-III scores than children in the low STM group (M=41.37), indicating that those with better STM also had better language ability. Children in the high STM group also had significantly greater left frontal-temporal coherence (F7-T3) than those in the low STM group both at baseline and during the STM task, implying the use of more verbal encoding strategies.

**Conclusions:** These results suggest that language and memory are intertwined and provide some evidence that the development of language and the use of verbal encoding strategies may enhance short-term memory in young children.

**Th4-03**

## Within-Session Variability in Infants' Looking Time Habituation

**Rick Gilmore**, **Adam Christensen**

*Penn State University, University Park, USA*

Looking time habituation dominates studies of visual perception and cognition in infants and yet remains poorly understood. Inspired, in part, by psychophysical approaches, we analyzed individual patterns of habituation using regression techniques (Thomas & Gilmore, 04). The goal was to determine whether individual infants show consistent patterns of habituation within a single session. One group (n=57) viewed patterns of optic flow depicting motion of the viewpoint 45 deg to the left or right of center. A second group (n=73) viewed movie clips of two different infant faces. Each infant viewed 7 trials of one display (familiar), followed by 7 trials of a different (novel) display. Linear and nonlinear functions were fit to looking time data for each infant and goodness of fit assessed by the Bayesian Information Criterion (BIC). On average, younger (3-4 month-old) infants looked longer than older (5-6 mo-old) ones, $F(1,126)=8.99$, $p=.003$, faces elicited longer looking, $F(1,126)=8.52$, $p=.004$, and the familiar display drew longer looks than the novel one, $F(1,126)=9.17$, $p=.003$. Nevertheless, infant looking time patterns differed across the two phases. Fewer than 1/5 infants habituated to both the familiar and novel displays according to the standard 50% decrement from baseline criterion. Moreover, for 57/130 infants, a flat line through the mean provided the best fit to the observed looking time data in both phases of the experiment. When looking times declined, a 3-parameter exponential function provided the best fit. The results suggest that few infants show systematic look time patterns to both familiar and novel displays within the same experimental session. While average looking times across infants may show statistically detectable trends, individual data do so inconsistently.

**Th4-04**

## What Habituates in Infant Habituation? A Psychophysiological Analysis

**John Colombo**[1] Jill Shaddy[1] Otilia Blaga[1] Christa Anderson[1] Kathleen Kannass[2] Linzi Gibson[1]

*1. The University of Kansas, Lawrence, USA; 2. Loyola University of Chicago, Chicago, USA*

The visual habituation technique has long been used as a tool for assaying infant cognitive function. However, relatively little attention has been paid to the processes that underlie it. In this presentation, we draw from a database of behavioral and psychophysiological data to elucidate these processes. Data were drawn from infants at 4, 6, and 8 months of age. Habituation was attained using an infant-controlled protocol (50% decrement criterion) to static, chromatic slides of faces. Interobserver reliability for coding of looks was high (+.99). In addition to behavioral data, HR was collected and digitized during the session and synchronized with looking and stimulus events. Analyses yielded four major conclusions.

1. HR-Defined Phases of Attention (from Richards & Casey, 1992). At all ages, the proportion of time spent in Attention Termination declined significantly across habituation ($p<.001$). This suggests that infants more readily disengage attention toward the end of habituation than at the start.

2. "Startle" Response. Comparison of HR during pre-stimulus baseline (interstimulus interval) with the latency period (period after presentation of the stimulus but prior to the onset of looking) shows a reliably increase ($p<.01$) at all ages, implying the presence of a "startle" response to the appearance of the stimulus. This response habituated rapidly. There is no change in trials 2-4, and afterwards, HR actually decreases from prestimulus to latency. The presence of this response has not been previously documented in the literature.

3. Decelerations During Looking. As expected, HR showed a sustained decelerative response during looking. Interestingly, however, a mixed-model beat-by-beat analysis indicated that the shape of deceleration did not change over the course of habituation. That is, the extent and form of HR decelerations on criterion trials were the same as on the first trial of the session. This finding implies that significant stimulus processing occurs throughout habituation, even during criterion looks.

4. HR Across Trials. Finally, infants' HR reliably increased across trials ($p<.001$). Given that this sample is specifically culled to represent sessions in which there was no fussiness or crying, we are inclined to interpret this change as a more tonic response that reflects decreased load in information processing across the sessions. These systematic mean HR changes across trials may provide a new measure of changes in information processing during habituation.

**Th4-05**

### Domain-Dependent Refinement of Attention to Relations

**Colin Dawson**, Louann Gerken
*University of Arizona, Tucson, USA*

One of the biggest challenges for learners is separating relevant from irrelevant sources of information in the environment. Biology undoubtedly plays an important part in constraining learning mechanisms, whether via the perceptual apparatus themselves or through innate cognitive biases. However, the role of prior experience in refining learning mechanisms may be larger than has often been hypothesized. A series of experiments with infants suggests that, as they gain experience with different input domains, they learn to emphasize cues that have proved reliable in the past, and de-emphasize those that have been noisy or unreliable. Critically, a cue that is reliable in one domain may not be reliable in another. Infants' differential performance between domains reflects this discrepancy.

4-month-olds and 7.5-month-olds were familiarized with sequences of musical chords that either all fit an AAB pattern, or all fit an ABA pattern. When tested on novel chord sequences adhering to the two patterns, 4-month-olds, but not 7.5-month-olds, listened longer to phrases with the novel pattern. In another experiment, 7.5-month-olds were familiarized with melodies, in several keys, that either all ended on a I chord or all ended on a V chord. When tested on novel melodies in novel keys, the infants preferred melodies that adhered to the opposite pattern. Taken together with previous findings that 7.5-month-olds learn AAB/ABA generalizations over syllable sequences, these results suggest that, as infants gain experience with music, they learn to ignore position-sensitive repetitions of single chords, but attend to the tonal structure of the music. A survey of children's songs confirms that nearly all phrases end on either a I or a V chord, but the occurrence of repeated notes in three-note windows at the ends of phrases is not significantly more frequent than would be expected by chance.

In light of these findings, it appears that the reliability of various relational cues in particular contexts can sway infants' prior expectations upon encountering a new set of input in a familiar context. Here, a generalization depending on a relation that is not reliably found in a corpus of children's songs is learned by infants that are presumably more musically naïve, but is not learned by more experienced infants. On the other hand, a generalization depending on an extremely prevalent relation is learned by the older group of infants. These results suggest that strong, innate, domain-specific constraints may play a smaller role in guiding learning than previously thought.

**Th4-06**

### Vigilance in Infant Attention: Individual Differences

**Kaya de Barbaro**, Andrea Chiba, Gedeon Deak
*University of California, San Diego, USA*

**Background and Aims:** Previous work in animals and adults suggests that attentional and visual strategies can vary as a function of the certainty of an environment. In a relatively certain environment, animals can focus on a central task; with increased uncertainty (i.e. under states which lead to acute stress) animals may adopt broader, or vigilant, attentional states characterized by short fixations and short response latencies (Aston Jones, Rajkowski, et al., 1999). Notably, the same response characteristics have been characterized in the developmental literature as indices of stable information processing traits in human infants (Frick, Columbo, et al., 1999). To address stress-reactive vigilance effects on visual information processing, infants experienced a mild stressor, the "Still Face" (Tronick, Als, et al., 1978) prior to a social situation that tested vigilance.

**Methods:** 15 6-7 month olds' performance on a 'Loud Peripheral Events game' was compared following either a Still Face episode or a non-stressful control period. Six monitors placed around the infant turned on, one per trial (i.e., "target"), to play a short musical video clip. Fine-grained video analyses were used to assess several previously verified measures of vigilance, including response latency to target, duration of non-target fixations, and increased target fixation.

**Results:** Still face ("stress") and control ("no stress") conditions did not significantly differ. However, the three measures showed bi-modal distributions, and many infants' scores patterned as either "High Vigilantâ" (above the median on all three) or "Low Vigilant/Baseline" (below the median on all three), more than would be expected by chance. Additional analysis showed that these profiles predicted individual infants' interest in stimuli over time, as well as some unpredicted measures such as looks to non-target locations (e.g., floor). Infants in the Low Vigilance group showed initially high but fast-declining interest in the videos as measured by number of targets fixated and time spent looking to videos, and overall higher looking time at non-target locations during target presentation ($P<.1$). By contrast, High Vigilance infants maintained initial levels of video interest and looked less often to non-target locations. All differences except that noted are significant at $P<.05$.

**Conclusion:** Infantsâ¤™ vigilant attentional states could not be attributed to stress-related processes or responsivity to uncertainty. However, results were consistent with animal-model effects of stress-induced vigilance. Specifically, lack of habituation in vigilant infants is characteristic of stressed states in which animals cannot modulate attention but are locked into a state of high readiness. These findings are suggestive of additional dimensions of modulation in developmental models of information processing. Ongoing longitudinal investigations will provide further information.

**Th4-07**

### Predicting When Babies First Point

**Warren Eaton**, Debra Lall
*University of Manitoba, Winnipeg, Canada*

Recruiting the attention of an adult by pointing to share an interesting event is an important communicative achievement for typically developing infants, whereas its absence predicts later childhood psycho-

pathology. However, much of what we know about individual differences in joint attentional behavior is based on parent questionnaires or infant behaviors observed during brief parent-child encounters in cross-sectional designs. Here, we approach individual differences in joint attention from a longitudinal rate-of-development perspective. We predict, from variation in other developmental correlates, the age at which an infant first points. Infant gender is the only predictor to emerge with consistency from previous studies.

**Method and Analysis**. We collected longitudinal daily parental diary recordings of multiple developmental milestones for 519 infants who were healthy at birth. Of these, 330 had daily parent observations on a joint attention item, "Baby points or reaches to make you notice something", as well as complete data on the following predictor variables that have been found to be developmentally potent in other studies: gender, gestational age, delivery type, maternal alcohol and cigarette consumption during pregnancy, mother age, birth order, birth weight, ponderal index, maternal education, and family income. From parents' daily observations we calculated the age in weeks when an infant first pointed. Age of first point was the criterion variable in a survival analysis with the other variables as predictors. Survival analysis is ideal for predicting when events will occur because information from dropouts is included (i.e., the information that a baby was not pointing at the point of attrition is used).

**Results**. Two of the eleven predictors were significantly related to age of pointing onset, gender ($\chi^2$=6.98, p<.01) and mother education ($\chi^2$=4.04, p<.05). Girls started pointing at 40.2 weeks, whereas boys lagged by 5 weeks at 45.2 weeks. Mother education was represented as a 5-category classification and ranged from high school to graduate work. Mother education was linearly and negatively related to pointing onset; infants of the most educated pointed for the first time at 48.9 weeks, compared to 41.8 weeks for infants of the least educated.

**Conclusions**. Our gender finding corroborates other reports, and a 5-week difference at 10 months of age is non-trivial. The negative relation between mother education and pointing onset, was a surprise and may be explained by Rodrigue's (2006) finding that mothers with lower education use more gestures than their more educated counterparts.

**Th4-08**

### Assessing the Influence of Amodal Cues (i.e. Shape) in a Tactile Habituation Task in 3-Month-Old Human Infants

Nicole Granger, Kimberly Kraebel

*Dept. of Psychology, SUNY Cortland, Cortland, USA*

This study investigated the role of amodal information in a simple learning task in 3-month-old human infants. Amodal information refers to information that is redundant across separate sensory modalities. For example, shape is an amodal dimension because it can be processed both haptically (i.e. through the sense of touch) and visually (i.e. through the sense of sight). The current study asked whether the presence of amodal shape information would influence simple habituation processes in human infants. Using an infant-controlled tactile habituation task, half the infants held, in one hand, a simple object (a cylinder) while the other half held the cylinder while visually processing cylinders hanging from a toy mobile. Preliminary results show that infants who received congruent amodal shape information habituated faster in comparison to infants who received no amodal shape information. It is predicted that infants who receive incongruent shape information will show inhibited performance. These results suggest that, in addition to being able to detect amodal cues (Bahrick, 1983; Lewkowicz, 1994; Spelke, 1981), infants also use such cues to facilitate learning. These results are in agreement with Bahrick and Lickliter's (2004) Intersensory Redundancy Hypothesis which predicts facilitated learning in a multimodal context for young infants.

**Th4-09**

### Specific Event Schemas for the Acquisition of Japanese Topic Particle Wa

**Tomoya Hashimoto**[1] Shigeaki Amano[2]

*1. Osaka City University, Kyoto, Japan; 2. NTT Communication Science Laboratories, NTT Corporation, Kyoto, Japan*

**Background and Aims:** Japanese language marks the topic of a sentence using topic particle *wa* (*Watashi wa bengoshi da.* [I TOPIC lawyer COPULA-PRES.; '(As for me,) I am a lawyer.']). Japanese-speaking children start producing *wa* around two years of age (e.g., Watamaki & Nishino, 1997), although adults learning Japanese often have difficulty mastering it. Recently, much research has found that the majority of young children's early language is organized around some specific event schemas (e.g., Tomasello, 1992). However, little is known about the kinds of discourse situations in which young children use *wa*. We therefore hypothesized that topic particle *wa* is acquired through specific event schemas and examined it.

**Methods:** The analyses were performed on longitudinal data (Amano et al., 2002). The participant was one girl. The speech of the child was recorded at home during interactions with her parents between the ages of 18 and 36 months. The utterances containing *wa* were exclusively divided into three groups in terms of their functions: ASKING FOR LABELING (*Kore wa nani?* [This TOPIC what?; 'What is this?']), ASKING FOR DESCRIPTION (*Wanwan wa nani shiteru?* [Doggie TOPIC what do-PROG?; 'What is the doggie doing?']), and DESCRIPTION (*Kore wa wanwan.* [Kore TOPIC doggie.; 'This is a doggie.']).

**Results:** At 18 months, no utterances containing *wa* were produced. This finding corresponds with previous studies. At 24 months, utterances functioning as ASKING FOR LABELING showed the highest proportion (85%). Furthermore, demonstrative pronoun *kore* previously co-occurred with *wa* in all of these utterances. After 24 months of age, the proportion of utterances functioning as DESCRIBING sharply increased (63% at 30 months and 50% at 36 months), and the proportion of utterances functioning as ASKING FOR DESCRIPTION was higher than that of ASKING FOR LABELING (22% and 15% at 30 months and 36% and 14% at 36 months, respectively). Furthermore, in contrast to the strong connection between *wa* and *kore* at 24 months, various words co-occurred with *wa* at 30 and 36 months.

**Conclusion:** The results support the hypothesis that *wa* is acquired through specific event schemas. Utterances containing *wa* were produced mainly in a specific event schema at each month of age. Furthermore, the dominant event schemas changed from ASKING FOR LABELING to DESCRIBING between 24 and 30 months. The role of ostensive situations and the degree of collocation in the acquisition of *wa* will be discussed.

**Th4-10**

### The Development of Episodic Memory in Infants - Longitudinal Evidence

**Thorsten Kolling**, Claudia Goertz, Stefanie Frahsek, Monika Knopf

*Johann Wolfgang Goethe University, Frankfurt/Main, Germany*

In infancy, declarative memory performance is assessed with the deferred imitation task. Experimental studies demonstrated that infants

from 6-months of age onwards imitate experimenter-performed actions after delays. Furthermore, it was shown that with increasing age, infants learn faster, and retain more target actions over longer retention intervals. However, what still remains unclear is which memory system (semantic vs. episodic) is tapped by deferred imitation tasks. Theoretically, several theories claim that episodic memory co-emerges with the development of the categorical self, namely at the age of approximately 18 months. Up to now, empirical tests of these theoretical approaches are still rare. In a cross-sectional study, it was demonstrated that a context change influenced declarative memory performance dependent on self-development (Prudhomme, 2005). However, longitudinal approaches investigating the theoretical link between memory and self-development are still missing.

The present four-wave (12-, 18-, 24- and 36-month-old infants) longitudinal study analyzed deferred imitation tasks in line with self-recognition tasks. For the assessment of deferred imitation, standardized, reliable tests (Frankfurt Imitation Tests) were used. Mirror self-recognition was assessed with hat, toy, rouge and name task (Bertenthal & Fischer, 1978) and the temporarily extended self tasks by Povinelli (1995). Furthermore, development (language, motor, cognitive, social, emotional) was additionally assessed with a German developmental test.

Growth analyses yielded that imitation scores increased with age. Stability analyses indicated that rank-order stability for the deferred imitation tasks was low at the beginning of the study and increased with age. Moderate stabilities were found for self-development tasks. Group-based analyses showed that the dynamics of deferred imitation performance were moderated by the dynamics of self-development. The results are discussed both in relation to theories of the development of episodic memory and representational theories of the mind.

**Th4-11**

### The Influence of Joint Attention on Memory Processes in Infants

**Franziska Kopp**

*Max Planck Institute for Human Development, Berlin, Germany*

**Background and Aims:** Interactive processes play a major role in infants' learning about the world. It is known that object processing is facilitated in 9-month-old infants when they are engaged in a joint attention interaction including the object compared to a non-joint attention condition (Striano et al., 2006). Moreover, infants as young as 4 months use social cues in object processing as was previously shown using event-related brain potentials (Reid et al., 2004). The aim of this study was to test whether the effect of joint attention is still present in long-term memory.

**Methods:** EEG of 4-month-old (n=20) and 9-month-old (n=20) infants was recorded during a recognition paradigm. Infants were familiarized with two pictures of toys presented on a screen. This familiarisation procedure was varied between two conditions: In the joint attention condition the experimenter alternated gaze between infant and object while expressing short vocalizations and positive affect. In the non-joint attention condition the experimenter looked constantly to the toy and not to the infant while vocalizations were presented via loudspeakers. The procedure was applied until infants had reached a cumulative looking time of 20 s per object. EEG was recorded in the test phase where familiar items were presented with novel items in random order. This test phase was repeated after one week to test for long-term memory effects. Event-related potentials were calculated for familiar and novel items.

**Results:** Event-related potentials showed a novelty effect both in the immediate test phase and after one week. Furthermore, 9-month-old infants were able to follow the experimenter's gaze in the joint attention condition. Differential effects were found for 4-month-olds and 9-month-olds between familiar and novel items for immediate recognition and recognition after one week and for joint attention and non-joint attention conditions.

**Conclusion:** Interaction between infant and an adult in a joint attention vs. non-joint attention context affects processing of items in immediate and long-term memory.

**Th4-12**

### The Differential Influence of Ostensive Communicative Context on Observational Learning in Human Infants and Domesticated Dogs: a Comparative Study

**Krisztina Kupan**[1] Jozsef Topal[2] Katalin Egyed[2] Kata Kreko[2] Gyorgy Gergely[2]

*1. Department of Ethology, Eotvos University, Budapest, Hungary; 2. Institute for Psychological Research, Hungarian Academy of Sciences, Budapest, Hungary*

**Background:** Infants show special sensitivity to ostensive-communicative and referential cues (OCRCs) (Tomasello et al., 2005; Csibra & Gergely, 2006). According to 'natural pedagogy' theory (Gergely & Csibra, 2006) OCRCs trigger fast-learning of manifested new and relevant knowledge about referents even when the demonstrated actions are 'cognitively opaque' to the observational learner. Unlike most non-human species (including primates), dogs also show sensitivity to OCRCs (Miklosi et al., 2003). To compare the functional role of OCRCs in observational learning in humans vs. dogs we created a two-way object choice task in which 14-month-olds and dogs observed a human person retrieving hidden ball from one of two containers either in a Communicative(OCRC) or Non-communicative Demonstration-context. To examine the influence of the demonstrator's presence on observational learning, subjects searched for the object either in the presence of the demonstrator (Model-Present) or after she left the room (Model-Absent).

**Method:** Subjects first observed a demonstrator hiding a ball under one of two containers (the baited container was non-transparent, the empty container was transparent). Then the demonstrator - who could've simply lifted the baited container - retrieved the ball by lifting the empty container. (The containers were invisibly connected, so lifting the empty container resulted in the ball's release from the baited container.) During test subjects could retrieve the ball by choosing to manipulate either the baited or the empty container. In a two-by-two between-subject design we tested four groups of infants and dogs in two Demonstration (Communicative vs. Non-communicative) and Test conditions (Model Present vs. Model Absent).

**Results:** In the Model Present condition both infants and dogs re-enacted the demonstrated (but sub-optimal) means (searching first the empty container) more often in the Communicative(OCR) than in the Non-communicative Demonstration-context (Fischer's exact tests, dogs: N1=17 N2=14 $p<.001$; infants N1=14 N2=14 $p<.001$)

While infants showed the same differential pattern in the model's absence (C/MA vs. NC/MA: N1=14 N2=14 $p<.001$) dogs did not re-enact the demonstrated - but less efficient - action in either of the demonstration-contexts (C/MA vs. NC/MA: N1=14 N2=14, $p=.32$).

**Conclusions:** Both human infants and dogs showed differential learning from observed actions when those were accompanied by social-communicative cues. While these cues trigger imitative learning of even inefficient - cognitively opaque - means actions in both species, this effect is qualitatively different in humans vs. dogs. While humans show fast-learning and generalization over situational and

person-contexts of ostensively demonstrated actions, dogs's imitative responses seem to be local and transient being locked to the presence of the demonstrator.

**Th4-13**

### Influences on Infant Duration of Orienting in Low-Income Latinos

**Kathryn Lemery-Chalfant**[1] Kristy McDonald[1] Linda Luecken[1] Felipe Castro[1] Carlos Valiente[1] Rose Howe[2]

*1. Arizona State University, Tempe, USA; 2. Maricopa County Department of Public Health, Tempe, USA*

**Background and Aims:** Infancy is a particularly critical period for the development of attention. Across the first year of life infants begin to spend considerable amounts of time looking at and interacting with the world around them. Duration of orienting is defined as vocalizations, looking behavior, and/or interaction with an object for an extended period of time when no sudden change in stimulation has occurred. Behavior genetic studies have reported that duration of orienting in infancy is influenced by both genes and the shared environment. The larger literature confirms the notion that the acquisition of appropriate attention allocation is embedded in the social context and is supported by adult intervention. Parental involvement in infants' developing attention can vary by culture, with American caregivers frequency soothing by orienting their infants to external events (and stimulating to induce positive emotion) and Japanese caregivers frequently rocking and soothing by contact to perhaps direct attention toward internal events (Caudill & Frost, 1972). In the current study, we consider the predictive power of early maternal cultural processes, personality, and social support on infant duration of orienting.

**Methods:** Participants were very low income, predominantly Latina women residing in Arizona, USA (N=133; mean age=26.5). Bedside interviews were conducted at birth and follow-up phone interviews were conducted at five months and nine months postpartum. Cultural processes were measured at birth and included acculturation (with less acculturation representing a greater adherence to Mexican culture and greater acculturation representing a greater adherence to U.S. culture), ethnic pride, and traditionalism. Maternal personality was measured at infant age five months and included neuroticism, agreeableness, and self compassion. Maternal social support was measured at five months and was the average support across five domains ranging from informal kinship to professional support. Infant duration of orienting was measured at nine months. Significance was reported at $p < .05$.

**Results:** Low maternal acculturation ($r = -.30$) and high traditionalism ($r = .24$) predicted infant duration of orienting at nine months of age. Further, high maternal self compassion ($r = .25$) and low neuroticism ($r = -.20$) predicted duration of orienting, whereas the influence of agreeableness was nonsignificant. In addition, high maternal social support ($r = .22$) predicted infant duration of orienting.

**Conclusion:** Results support the role of cultural processes, maternal personality and social support in the development of duration of orienting in the first year of life. Implications for early intervention will be discussed.

**Th4-14**

### Background Music Interferes with Imitation from Televised and Live Demonstrations during Infancy

Rachel Barr[1] Katherine Salerno[1] Lauren Shuck[1] Emily Atkinson[1] Deborah Linebarger[2] **Nancy Miller**[3]

*1. Georgetown University, Washington, USA; 2. University of Pennsylvania, Philadelphia, USA; 3. Loyola University, Chicago, USA*

While infants are often exposed to television for up to 2 hours per day, little is known about how they translate what they see on television to the real world. In the current study, music was added to a brief video segment in order to examine its effects on deferred imitation. Transfer of information was indexed via deferred imitation of the target actions following a 24 hr delay. Six-, 12-, and 18-month-olds were randomly assigned to five groups; video music with music during the test, video music with no music during the test, live music with music during or baseline control. A 2(music; present during test vs. music not present during test) x 2(mode of presentation; live vs. video) design was used. Half the infants were shown the target actions on video and half saw a live demonstration. For all infants a music sound track was presented during the demonstration phase but only for half of the infants was the same music track played during the test phase. The control group participated in the test session without prior exposure to either a video or live demonstration of the target actions. Regardless of group, attention was high averaging between 81-94% of the demonstration. However, all experimental groups performed at baseline, except 18-month-olds tested in the live music with music during test condition. Infants in the current study also performed below significantly below those in similar studies where music was not added to the demonstration. We conclude that the music track creates additional cognitive load and inhibits information processing of the imitation task whether the demonstration is on video or a live demonstration. Music may impair an infant's ability to translate information from a two-dimensional to three-dimensional world even if the context remains the same and may even impair learning during typical live interactions.

**Th4-15**

### Both Maternal Sensitivity and Atypical Maternal Behavior Independently Predict Attachment Security and Disorganization in Adolescent Mother-Infant Relationships

**Greg Moran**[1] Lindsey Forbes[1] Elspeth Evans[1] George Tarabulsy[2] Sheri Madigan[3]

*1. The University of Western Ontario, London, Canada; 2. Universite Laval, Quebec, Canada; 3. Hospital for Sick Children, Toronto, Canada*

The assertion that the quality of the caregiver's response to infant distress is the primary determinant of the attachment relationship is the cornerstone of attachment theory (Bowlby, 1969/1982; Ainsworth, Blehar, Waters & Wall, 1978). During the first year of life most infants develop organized relationships but 15% of low-risk and as many as 80% of high-risk populations display a disorganized pattern, thought to reflect the breakdown or absence of an organized attachment strategy (Main & Solomon, 1986). Disorganized attachment is a major risk factor in the development of psychopathology and later coping difficulties (Carlson, 1998; van IJzendoorn, Schuengel & Bakermans-Kranenberg, 1999). Disorganized attachment is held to arise, not as a result of the variation in sensitivity held to determine organized relationships, but from substantially atypical and frightening maternal

behavior (Main & Hesse, 1990). Although research has confirmed these two pairs of predicted associations, there is some suggestion that maternal insensitivity may be associated with disorganized attachment, especially in some high-risk populations (van IJzendoorn et al., 1999; Bailey et al., 2007; Carlson, 1998). There are parallel suggestions that, contrary to current theory, atypical maternal behavior is associated with attachment security (Grienenburger et al., 2005; True et al., 2001). These patterns of findings call for an examination of all relevant factors in a single study.

The present analyses focus on 82 of 99 adolescent mother-infant dyads (45 girls). The Strange Situation Procedure (SSP, Ainsworth et al., 1978) was used to categorize the mother-infant relationships. Maternal sensitivity was assessed with the Maternal Behavior Q-set (MBQS, Pederson & Moran, 1995). The AMBIANCE coding scheme (Bronfman, Parsons & Lyons-Ruth, 1999) was used to describe atypical maternal behaviour. Maternal sensitivity was assessed in a 2-hour home visit conducted when infants were 12-months-old; the Strange Situation Procedure was conducted and the play session recorded at the university within a few weeks of this visit.

Hierarchical regression analyses revealed that, consistent with theory and previous research, we found associations between 1) maternal sensitivity and attachment security and 2) atypical maternal behavior and attachment disorganization. Contrary to current theoretical models, we also found that: 1) while maternal sensitivity at home significantly predicted attachment security, atypical maternal behavior in the laboratory significantly added to maternal sensitivity's prediction of attachment security and, 2) that consideration of maternal sensitivity at home enhanced the prediction of disorganization by atypical maternal behavior. These parallel findings raise a number of theoretical and methodological issues.

**Th4-16**

### Embodied Infant Attention

**Steven Robertson**, Sarah Johnson, Molly Ayzikovich
*Cornell University, Ithaca, USA*

**Background:** In recent years, considerable interest has emerged across diverse fields in embodied cognition, the notion that mental activity is intrinsically coupled to the physical properties and activity of the body. We have looked for early signs of coupling between mental and physical activity in the rapid fluctuations of visual attention and body movement that occur when infants are awake and alert, and have found robust connections that consolidate between the 1st and 3rd month. But does real time coupling between mental and physical activity early in development have any functional significance?

**Methods:** We examined the habituation of visual attention and response to change in two groups of 41 3-month-olds with different patterns of movement-attention coupling. In Suppressors, the typical decrease in body movement at the onset of looks persists into the looks. In Rebounders, the initial decrease is more transient and movement quickly returns above baseline. Infants were tested in both a Change condition (stimulus object rotated slightly back and forth when the habituation criterion was met) and a No Change condition (object remained stationary).

**Results:** Suppressors and Rebounders did not differ on any measure of habituation: number of looks, total looking time, average look duration, duration of the first two looks, the two peak looks, the two habituation looks; the changes between the first two looks, the two peak looks, and the two habituation looks; overall habituation rate (all p's > .05). However, Rebounders spent nearly twice as much time looking away during habituation: 27.0 ± 4.7 vs. 15.0 ± 1.3 s, p = .004. When the stimulus changed, Rebounders' looking increased nearly three times more than Suppressors: 33.3 ± 5.8 vs. 12.3 ± 4.4 s, p = .006.

**Conclusions:** Previous research with 3-month-olds indicates that bursts of body movement may make visual attention more interruptible. The present results suggest that Rebounders' rapid motor reactivation soon after gaze locks onto a target may facilitate more complete disengagement of attention after sufficient processing of the target has occurred, thus promoting more effective visual foraging and supporting a more differentiated response when change is detected. More generally, the results reveal initial conditions that are likely to bias the subsequent development of embodied cognition.

**Th4-17**

### Development of Cross-modal Statistical Learning

**Christopher Robinson**, Vladimir Sloutsky
*The Ohio State University, Columbus, USA*

The ability to detect the underlying statistical structure of the input appears to be in place early in development (Saffran, Aslin & Newport, 1996), and statistical learning occurs across stimuli and sensory modalities: Infants can detect the statistical information in sequences of syllables, musical notes, and geometric shapes (Fiser & Aslin, 2002; Kirkham, Slemmer, & Johnson, 2002; Saffran, Aslin & Newport, 1996; Saffran, Johnson, Aslin, & Newport, 1999). While many studies have examined statistical learning within the auditory modality and within the visual modality, there is surprisingly little research examining how sensory modalities interact in statistical learning tasks (e.g., does the presence of auditory input affect visual statistical learning?) and how cross-modal statistical learning changes throughout development.

In a series of experiments, infants and adults were presented with an auditory statistical learning task, a visual statistical learning task or a cross-modal statistical learning task. In the auditory task, participants were familiarized to an auditory sequence and tested on new and old auditory sequences. In the visual task, participants were familiarized to a visual sequence and tested on new and old visual sequences. In the cross-modal task, participants were familiarized to an AV sequence, and the auditory and visual sequences shared the same underlying statistics. After familiarization, participants were either tested on the visual sequences (presented unimodally) or on the auditory sequences (presented unimodally). Learning in the cross-modal conditions was compared to the respective unimodal baselines. Preliminary findings suggest that while cross-modal presentation can sometimes facilitate statistical learning in adults, it often hinders statistical learning in infants. The poster will discuss factors that facilitate and interfere with cross-modal statistical learning and will show how these effects change across development.

**References:**

Fiser, J., & Aslin, R. N. (2002). Statistical learning of new visual feature combinations by infants. Proceedings of the National Academy of Sciences, 99, 15822-15826.

Kirkham, N. Z., Slemmer, J. A., & Johnson, S. P. (2002). Visual statistical learning in infancy: Evidence of a domain general learning mechanism. Cognition, 83, B35-B42.

Saffran, J. R., Aslin, R. N., & Newport, E. L. (1996). Statistical learning by 8-month old infants. Science, 274, 1926-1928.

Saffran, J. R., Johnson, E. K., Aslin, R. N., & Newport, E. L. (1999). Statistical learning of tone sequences by adults and infants. Cognition, 70, 27-52.

**Th4-18**

## Parenting Across Cultures: Different Patterns but Similar Pathways

**Lori Roggman**[1] Gina Cook[2] Vonda Jump[2] Mark Innocenti[2] Katie Christiansen[1] Cora Price[2]

*1. Family, Consumer, & Human Development, Utah State University, Logan, USA; 2. Early Intervention Institute, Utah State University, Logan, USA*

Parenting occurs in multi-leveled contexts, including the familyÕs ethnic/cultural group, and the impact of parenting behavior on childrenÕs early development may be affected by that context. Our observational measure (PICCOLO; Parenting Interactions with Children: Checklist of Observations Linked to Outcomes) of interactive parenting behavior in 4 domainsÑaffection, responsiveness, encouragement, and teachingÑwas developed from 4,000+ observations of parent-child interaction and validated in a sample of 1200+ low-income families including European-Americans (EA, n = 490), African-Americans (AA, n = 440), and Latino-Americans (LA, n = 205) who participated in the Early Head Start Research and Evaluation project. We examined child outcomes (36m, pre-K) from each PICCOLO domain within each group; domain and item scores across groups, and patterns of factor loadings and age changes (14m, 24m, 36m) within groups.

All four PICCOLO domains predicted positive child outcomesÑvocabulary, cognitive skills, and social behaviorÑ within all groups but most consistently for children of EA and AA mothers. Domain scores differed across groups, with EA parents showing more affection, responsiveness, and encouragement but AA parents doing more teaching, and across specific behaviors within domains, such as AA parents responding more directly to childrenÕs emotional expressions. Within each group, domains each fit a single-factor structure, but factor loadings differed. For example, giving praise was a more important affectionate behavior for LA mothers, but staying physically close was more important for EA mothers. For responsiveness, following the childÕs lead was more important for LA mothers but paying attention to the childÕs actions and words was more important for EA parents. For encouragement, physical help was important for LA mothers but verbal encouragement was more important for EA mothers. For all groups, domain scores showed significant stability as children got older, but they were the most stable for LA mothers and changed the most for EA mothers; for AA and LA mothers, domain scores changed mostly between age 1 and 2 and then stayed comparatively stable.

These group differences suggest that the influence of culture is both subtle and complex. Much of the research literature on parenting is on EA middle-income samples. Our assumptions about the ÒrightÓ way to parent, derived from that literature, are both challenged by the present findings, as different ethnicities show somewhat different parenting patterns, and confirmed, in that parenting domains follow similar pathways to child outcomes for all groups.

**Th4-19**

## Infant Short-Term Memory for Non-Linguistic Sounds

**Shannon Ross-Sheehy**[1] Rochelle Newman[2]

*1. University of Iowa, Iowa City, USA; 2. University of Maryland, College Park, USA*

For decades, researchers have explored visual and auditory short-term memory (STM) development. However, few researchers have probed the relationship between visual and auditory STM, likely due in part to the logistical difficulties of testing STM cross-modally. To that end, we have developed a task based on previous visual work (Ross-Sheehy, 2005) that allows us to make more direct comparisons between infant visual and auditory STM development. We tested 10-month-old infants in an auditory change-detection task.

Using the head-turn-preference procedure, infants were presented with sets of sounds (synthesized instruments matched on pitch) that repeated until the infant oriented away from the speaker. On half the trials, sounds remained constant (piano/tuba, piano/tuba, piano/tuba, etc.) on half they changed (piano/tuba, piano/flute, trumpet/flute, etc.). In Experiment 1, the sounds were each 350-ms followed by a 500-ms delay, and were presented in sets of either 2 or 4 instruments. We predicted infants would orient longer to the changing than to the non-changing sound sets, but only if they could encode all of the tones in each set, remember it across the delay and compare it to the subsequently presented set. Results indicated that infants did orient preferentially to the changing streams, but only for set size 2: $t(15)=-4.99$, $p<.001$.

In Experiment 2, infants again heard changing and non-changing sound sets composed of either 2 or 4 instruments. However, overall set duration was equated across set size (2 instrument sets had 2 700-ms tones; 4 instrument sets had 4 350-ms tones). If the previous set size effect was driven by constraints on the number of "objects" in auditory STM, then infants in Exp 2 should detect the change for 2 instrument sets but not 4 instrument sets. If, however, the previous set size effect was driven by constraints on duration or stability of auditory STM, than equating durations across set size should reduce performance for 2 tone sets to chance. This is precisely what we found.

Thus, these studies demonstrate that: 1) this task appears to be an effective tool for measuring auditory STM in infants, 2) infants appear to have limits in the amount of auditory information they can represent in STM, and 3) these limits appear to be in duration rather than the number of "objects" per se. Future research will more closely examine the nature and development of these limitations, and possible implications for a capacity-limited domain general theory of STM.

**Th4-20**

## The Role of Ostensive-Communicative Referential Cueing in Inducing the A-Not-B Perseverative Search Error: a Comparative Study on Human Infants Dogs, and Wolves

**Jozsef Topal**[1] Julia Bognar[2] Gyorgy Gergely[1]

*1. Institute for Psychological Research Hungarian Academy of Sciences, Budapest, Hungary; 2. Department of Ethology Eotvos University, Budapest, Hungary*

8-12 month-olds commit a perseverative search error in Piagetian A-not-B tasks. Subjects first search correctly for an object repeatedly hidden in a container(CA) at location-A, but then perseveratively search at A even after the object is hidden at a new location(CB). Although the demonstrator's actions are typically accompanied by ostensive-communicative and referential cues (OCRs) , standard interpretations of the A-not-B error make no reference to the potential role of social-communicative cuing. Here we explore a new perspective offered by 'natural pedagogy' theory (Csibra & Gergely, 2006) according to which OCRs trigger a semantic-encoding bias in infants who expect the demonstrator to manifest new, relevant, and kind-generalizable information about the referent. We hypothesize that when observing the object being repeatedly hidden in CA, the OCR cueing-context triggers the interpretation that 'CA functions 'for' containing 'O'-type objects' or 'Location A is the place where 'O's can be usually found'. It is this semantic information that needs to be inhibited during B trials. It is predicted therefore that in a Non-communicative demonstration-

context the A-not-B error should be less likely to occur. . Dogs, unlike other non-human species including their ancestor the wolf, are also sensitive to human OCRs (Miklósi et al., 2006). Therefore, we predict that dogs (but not wolves) should similarly show context-dependency of the A-not-B error.

**Method:** Two groups of 10-month-olds (N=12-12) were tested in an A-not-B paradigm. In the social-communicative demonstration-context(SCD) the Experimenter used eye-contact, gaze-shifts, and addressing infants in motherese (OCRs) while repeatedly hiding an object under CA. In the Non-communicative demonstration-context(NCC) object-hiding was performed without OCRs as the Experimenter was acting hidden behind a curtain. After each of four A- and 3 B-trials infants were allowed to search for the object. A similar procedure was applied to dogs (N=24) and hand-reared wolves (N=10).

**Results:** Infants committed the A-not-B error more frequently in SCC than NCC demonstration-contexts (Mann-Whitney U, p=.0219). While dogs showed the same differential pattern (Wilcoxon test, p=.001), wolves exhibited no A-notB error in either conditions (Wilcoxon, p=.9). The results confirm the causal role of OCR cuing-context in inducing the A-not-B error both in humans and dogs (two species sensitive to social-communicative cues). This is confirmed by the lack of A-not-B error in human-rared wolves who don't develop sensitivity to OCRs. These findings are difficult to accommodate by traditional accounts of the A-not-B error in terms of inability to inhibit the prepotent A-response primed due to repeated executions.

**Th4-21**

### Effects of Feeding and Familiarity on Newborn Speech Recognition

**A. Valiante**[1,2] Ronald Barr[3] Philip Zelazo[4] Emmett Francoeur[5] Nicole Catherine[3] Simon Young[1]

*1. McGill University, Montreal, Canada ; 2. University of British Columbia, Vancouver, Canada; 3. Center for Community Child Health Research, University of British Columbia, Vancouver, Canada; 4. Concordia University, Montreal, Canada; 5. McGill University Health Center, Montreal, Canada*

**Background:** A feeding effect for enhancement of newborn short-term memory has been demonstrated for unfamiliar words spoken by a stranger. Early experiences with speech sounds before birth usually include exposure to recurrent words spoken by familiar voices. Newborns preferentially recognize familiar words when spoken by their mother versus a female stranger, implying memory for fetal auditory experiences. The aim of this study was to determine whether short-term recognition memory is enhanced when the speech sound is familiar and, if so, whether it can be further enhanced by feeding.

**Methods:** Memory was assessed before or after a routine milk feed using headturning to sound in a habituation-recovery paradigm. Forty-three infants aged 2-3 days were randomized to one of four groups: (i) prefeed with unfamiliar word (stranger speaking "beagle"), (ii) prefeed with familiar word (mother speaking "baby"), (iii) postfeed with unfamiliar word, and (iv) postfeed with familiar word. Infants initially turn towards a word presented randomly from either side and habituate with continued presentations, indicating learning. When presented again after 85s, turning towards the word sound indicates that it was forgotten, while not turning or turning away indicates that it was remembered. Infants must then turn toward a novel word to complete the test. The main outcome measure was percentage of turns toward the sound following the delay. Memory was assessed using 2(word) x 2(feed) ANOVA.

**Results:** Mean (SE) turns toward the sound after the delay were (i) 59.8±8.6, (ii) 26.7±5.2, (iii) 27.2±7.7, and (iv) 35.0±8.4. A 2(feed) x 2(word) ANOVA for memory revealed a significant interaction, [$F(1,39)=7.3$, $p<0.01$], but no main effect for word [$F(1,39)=2.8$, $p=0.10$], or feed condition [$F(1,39)=2.6$, $p=0.12$]. Post hoc bivariate comparisons indicated that the word baby was better remembered than beagle before a feed ($p<0.003$), however, memory for baby was not further enhanced by feeding ($p=0.41$). No difference was found for postfeed memory between baby and beagle ($p=0.50$). Consistent with previous reports on feeding enhancement of unfamiliar words, memory for beagle was better after feeding ($p<0.01$). **Conclusions:** Newborns are able to remember a familiar sound across an 85s delay before and after feeding. They cannot do so for an unfamiliar sound before a feed, but can after, confirming previous results. For this delay, feeding does not further enhance memory for a familiar word. Because of the infant's prenatal experience with speech sounds, familiarity may be as important an influence as feeding on short-term memory for words.

## *Cognitive Development*

**Th4-22**

### Children Attend to Part-Shapes and Part-Relations in Object Categorization

**Elaine Augustine**, Susan Jones

*Indiana University, Bloomington, USA*

Early word learning has been linked to changes in children's perception and representation of object shape. In particular, Smith (2003) has shown that young children who know more object names are better able than those who know fewer object names to recognize familiar objects from their global shape characteristics alone. Smith's test objects followed Biederman's proposal that objects are represented as sets of geometric volumes in particular relations to one another. However, Smith's data do not reveal whether children who were able to recognize the "shape caricatures" perceived these objects as similar to familiar objects in their part shapes, their part relations, or both. Here we ask which of these two aspects of shape similarity are used by young children to recognize shape caricatures of familiar objects.

Adults apparently use both part-shapes and part-relations in object recognition, but these two aspects of shape similarity are psychologically distinct (Arguin & Saumier, 2004). Research on infants demonstrates that attention to part-shapes plays an important role in object categorization (Haaf et al., 2003). There is no evidence on whether young children attend to and use information about the spatial relations among object parts. The present research examined the possibility that young children use part-relation as well as part-shape information to recognize objects. In addition we asked whether the ability to match on part-shape and/or part-relations is related to early language learning.

Children from 16- to 30- months of age were tested for (1) their ability to recognize common objects represented by 2-4 simple shapes in their proper relations ("Shape Caricature Recognition"); (2) for their ability to match objects on just their part shapes or just their part relations; and (3) for their ability to recognize realistic versions of the objects used in the shape caricature recognition task. In addition, parents reported productive vocabularies on the MacArthur Communicative Developmental Inventory (MCDI).

The results indicate that the ability to recognize objects from their abstract shapes alone is strongly dependent on the ability to attend both to the shapes of the object's parts and to the relations among them. For young children, as for adults, part-shapes and part-relations appear to contribute separately to object recognition. Finally, the results

show that attention to part-relations is closely related to the number of words in a child's vocabulary, suggesting that it develops with, and perhaps because of, early word learning.

**Th4-23**

### Infant and Mother Play in South Korea and the United States

Diane Putnick[1] Keumjoo Kwak[2] **Marc Bornstein**[1]

*1. NICHD, Bethesda, USA; 2. Seoul National University, Seoul, Korea*

**Background and Aims:** Play is a common childhood activity in (almost) all cultures, but at the same time play expresses concerns particular to each culture. In this sense, anthropologists have long noted that play provides an important context for cultural learning, and in many cultures, though not all, parents' efforts to enculturate young children involve play. The growth of play in early childhood follows some pervasive developmental processes. At the same time, specific structures associated with those general processes have proved to be modifiable with experience. The present study compared South Korean and U. S. American infants and their mothers on exploratory and symbolic play.

**Method:** Participants were 47 South Korean and 50 U.S. American mothers and their firstborn 20-month-olds, 52 boys and 45 girls. Korean mothers were restricted to South Korean background, and U.S. mothers to comparable women of European American heritage. One female researcher who was native of the country audio/videorecorded dyads in the home for two 10-min play sessions: a child solitary and a collaborative play session with mother. From those records, child and mother exploratory and symbolic play were coded in accordance with a mutually exclusive and exhaustive category system that included 4 levels of exploratory play, 4 levels of symbolic play, and a default (no play) category.

**Results:** In both cultures, individual variation in infants' collaborative exploratory and symbolic play was specifically associated with individual variation in mothers' demonstrations and solicitations of exploratory and symbolic play, respectively. Infants in both cultures engaged in more exploratory play while alone and more symbolic play while playing with their mothers. Between cultures, American infants engaged in more exploratory play, whereas Korean infants and mothers engaged in more symbolic play across play settings.

**Discussion and Conclusions:** During an early period of infants' mental and social growth, general developmental processes in play appear to be pervasive, but some cultural manifestations are also specific. The cultural differences revealed in this study suggest that South Korean and U.S. American infants and mothers tend to engage in modes of exploration and representation differently, but in ways consonant with their larger cultural childrearing goals; such cultural emphases help to shape the course of child development (Bornstein, 1991; Bradley, 2002; Kessen, 1979). At the same time, wherever they play together mothers scaffold their infants' play, and mothers and their infants are in tune with one another.

**Th4-24**

### Nine-Month-Olds' Discrimination of Ordinal Information

**Caitlin Brez**, Marc Tomlinson, Leslie Cohen

*The University of Texas at Austin, Austin, USA*

It has previously been shown that infants at 11 months of age, but not 9 months of age can discriminate ordinality when habituated to either ascending or descending displays (Brannon, 2002). However, transfer between the habituation stimuli and the test stimuli involved only a change in the number of objects; the objects themselves were held constant. In the current study, we show that 9-month-olds are capable of differentiating ascending from descending displays. Furthermore, we accomplished this by familiarizing 17 nine-month-old infants to nine fixed-length trials of an increasing or decreasing number of shapes that varied randomly in size and coverage and then testing them with novel objects of the same number but different shape. Nine-month-olds infants were able to discriminate the ordinality of the sequences in the test trials, $F(1,5) = 13.07$, $p = .04$. This finding is in contrast to Brannon's study in which she found that infants could not discriminate ordinality by 9 months of age. In the current study, infants looked longer at the familiar ordinality ($M = 10.3$ sec) than the novel ordinality ($M = 8.3$ sec). One reason for this preference for the familiar ordinality may be that infants did not have enough time to habituate during the familiarization trials. Another possibility is that the stimuli were too complex. Indeed, the size of the shapes and on-screen density varied randomly across trials which does increase the complexity of the stimuli. We are currently investigating some of these options with hopes that we can get 9-month-olds to habituate and reverse the looking pattern in the test trials. If these studies are complete in time for the conference, data will be included.

**Th4-25**

### Eighteen-Month-Olds Form a Spatial Category of Tight-Fit Relations: a Boost From Labels and Experience

**Jui Bhagwat**, **Marianella Casasola**, Anne Burke

*Cornell University, Ithaca, USA*

Providing labels for objects and events in an infant's environment heightens his or her attention to commonalities among different exemplars of a category and facilitates categorization of objects (e.g., Balaban & Waxman, 1997) and dynamic events (e.g., Casasola & Bhagwat, in press). We examined the influence of a label on 18-month-olds' categorization of a novel spatial relation that is not lexically encoded in English (i.e., tight-fit). We also explored the effect of previous experience with a specific label and with tight-fit relations on infants' categorization of tight-fit.

In Experiment 1, infants were habituated to four video-taped events, each depicting one object being placed in a tight-fit relation to a second object. One group of infants viewed the events in silence, a second group heard the English term 'tight' during habituation, and a third group heard a novel label ('toke') during habituation. Infants then were tested with exemplars of tight-fit, as well as exemplars of a novel relation (i.e., loose-fit), depicted by novel and familiar objects. Experiment 2 followed the same procedure, except that prior to habituation, an experimenter provided infants with direct experience with the tight-fit relation, by exposing them to objects that could be placed in a tight-fit relation with each other and using the term 'toke' to label the relation.

In Experiment 1, only those infants who were habituated with the term 'tight' formed an abstract category of the tight-fit relation, as indicated by an increase in looking time to test events with a novel loose-fit relation than to events with the familiar tight-fit relation, regardless of the familiarity or novelty of the objects. Infants in the silent condition and those who heard the novel label 'toke' during habituation in Experiment 1 did not form the category. In contrast, Experiment 2 showed that infants given direct experience with the tight-fit relation and the label 'toke' prior to habituation, and who then heard

the same label during habituation, did indeed form the category of 'tight-fit'.

The results indicate that a specific label can facilitate 18-month-old infants' ability to form an abstract categorical representation of tight-fit, but only if infants have had some experience with the label. This result was found to be true for the English term 'tight' (possibly a familiar label) as well as a novel label (toke) that was provided briefly just prior to habituation.

**Th4-26**

## Sensitivity to Physical and Psychological Constraints in Infants' Statistical Inference

**Stephanie Denison**, Fei Xu

*University of British Columbia, Vancouver, Canada*

Two studies explore how 11-month-old infants integrate intentional and physical constraints in a statistical inference task. Previously we asked whether 11-month-olds can reason about samples and populations using a violation-of-expectation looking-time procedure. Two conditions were included: 1) The random sampling condition: The experimenter closed her eyes and drew out, on alternating trials, 5 red balls or 5 five white balls from an opaque box. She then revealed the contents of the box-a population of mostly red balls. 2) The non-random sampling condition: The experimenter first conveyed a color preference, e.g., she likes white ones, by picking out the white balls from a set of both colours. The rest of the procedure was identical to condition 1, except that the experimenter looked inside the box while sampling. Results suggested that infants are sensitive to the sampling condition: they looked longer at the unexpected outcome according to either proportions or expressed preference in the corresponding conditions.

The current studies further investigate whether infants can integrate intentional information from the experimenter, as well as integrating physical constraints in the sampling procedure. In Study 1, twenty-four 10.5- to 11.5-month-olds were tested in a procedure identical to the non-random sampling condition above with a critical modification-the experimenter was blindfolded during test trials. If infants understand that a blindfolded experimenter would be unable to pull a sample out according to preference, they should revert back to expecting the sample should be representative of the population. Results confirmed this hypothesis- infants looked reliably longer at a sample of 5 white balls removed from a mostly red box ($F(1,22) = 5.177$, $p < .05$).

In the second study, we are investigating whether infants are able to integrate a physical constraint in a similar task. In this on-going study, we show the infants a box containing three kinds of balls: red, green, and white in a ratio of 8:2:1. In one condition, the green balls are of a different texture so they cannot be removed from the box (i.e., they are stuck); in another condition, none of the balls are stuck. The question of interest is whether infants can compute the probability of drawing the various proportions of balls in both conditions, taking into account a physical constraint.

Our results suggest that infants can integrate psychological constraints in making inferences from samples to populations; they may also be able to integrate physical constraints in the same task.

**Th4-27**

## Are Faces Necessary? 6- to 9-Month-Olds' Gaze Following of Humans and Objects

**Barbara D'Entremont**

*University of New Brunswick, Fredericton, Canada*

Johnson (2003; Johnson, Slaughter & Carey, 1998) found that 12-month-olds followed the "gaze" of an object if it displayed qualities of agency (e.g., contingency) even if it had no human-like attributes. Five-month-olds will attribute goals to human agents as well as non-human agents which display contingency or self-propelled motion (Luo & Baillargeon, 2005; Woodward, 1998). Therefore, infants younger than 12 months may also follow the gaze of non-human agents. This research tested that possibility.

**Method:** Following Johnson et al. (1998), 142 6- to 9- month-olds interacted with a human or a cone-shaped object. There were six conditions: Human-Contingent; Object-Face-Contingent; Object-NoFace-Contingent; Human-nonContingent; Object-Face-nonContingent; and Object-NoFace-nonContingent. The human winked and vocalized; the object flashed and beeped. In the contingent conditions, winking/vocalizing (flashing/beeping) was in response to infant movement and vocalizations. In the noncontingent conditions, winking/vocalizing (flashing/beeping) occurred at predetermined times. In the Object-Face conditions, the object had eyes, a nose and a mouth. During the interaction, the human/object stopped interacting four times to briefly orient towards one of two toys. The infants' gaze during these orienting trials was recorded as being in the same or opposite direction as the human/object. A difference score was calculated as the number of same-opposite responses.

**Results:** Difference scores were significantly greater than zero for the Human-Contingent ($m=1.00$, $se=.25$, $t(25)=4.03$, $p=.000$), Human-nonContingent ($m=.89$, $se=.24$, $t(26)=3.79$, $p=.001$), Object-Face-Contingent ($m=1.10$, $se=.31$, $t(28)=3.59$, $p=.001$) and Object-Face-non-Contingent ($m=.61$, $se=.29$, $t(27)=2.08$, $p=.05$) conditions. Neither the Object-NoFace-Contingent ($m=0.0$, $se=.31$) nor the Object-NoFace-nonContingent ($m=.40$, $se=.37$) condition was significantly greater than zero. The Human conditions were not significantly different from each other ($t(51)=.326$, $p=.75$). A 2(contingency) by 2(face/no face) ANOVA on the object conditions revealed a marginal effect of face ($F(1,83)=3.41$, $p=.06$). Infants tended to follow the direction of the object's orientation more often when the object had a face.

**Conclusions:** Infants as young as 6-9 months of age will follow the "gaze" of a contingently interacting non-human object, though presence of a face may be necessary. The discussion will focus on young infants' understanding of looking as intentional attention directed towards objects and on whether a human-specific mechanism is implicated in the ontogeny of gaze following.

**Th4-28**

### Does Olfaction Modulate Visual Behaviour and Learning in Newborns?

**Karine Durand**[1] Sébastien Doucet[1] Gaëlle Baudon[1] Alix Seigneuric[1] Jean-yves Baudouin[2] Robert Soussignan[3] Benoist Schaal[4]

*1. Centre Européen des Sciences du Goût UMR-CNRS 5170, Dijon, France; 2. SPMS, EA 3985, Université de Bourgogne, Dijon, France; 3. Centre Emotion UMR-CNRS 7593 - CHU Salpêtrière, Paris, France; 4. Centre Européen des Sciences du Goût, Dijon, France*

Human infants are reactive to odorants and in the same time highly adept at perceiving intersensory interactions. However, little is known on whether olfaction is involved in non-olfactory perceptual/cognitive processes. As odors can rapidly gain affective meaning, especially by association with nursing, they are in a good position to transfer their reinforcing value to other stimuli. Here, we present two experiments on early olfaction-vision interactions.

We first verified whether neonatal visual behavior was affected by different odor conditions. The infants (3-4 days) were positioned against their mother's breast in two 90-sec trials: a scentless condition (breast covered with a transparent film) and one of four odor conditions (breast odor: n=15; nipple odor: 15; areola odor: 13; milk odor: 12). It came out that the infants were more visually aroused when facing any of the odor conditions than when facing the scentless breast. Further, when exposed to an odor, the infants who had their eyes open evinced improved oral activity.

A second experiment used an intersensory pairing-preference paradigm. First, 3-day-olds were concurrently exposed for 60sec to an odor and an object. After that pairing, the odor was removed to start a 60-sec visual test between the odor-paired object and a novel object. Looking time to both objects was recorded and compared in 3 groups differing by the odor (breast odor, no odor, arbitrary odor). It came out that looking was longer to the object paired with the breast odor (n=7 infants) than to the object associated with no odor (n=7). This experiment is currently being replicated and completed with the arbitrary odor group.

These results indicate that odors are valid stimuli to investigate early skills for intersensory integration. In particular, odors acquired in contingence with the mother constitute a biologically-meaningful model system to analyse the developmental course of intersensory interactions.

**Th4-29**

### Processing of Action Goals in Infancy

**Jonathan Herberg**, **Maria Vazquez**, Megan Saylor, Dan Levin

*Vanderbilt University, Nashville, USA*

The ability to analyze continuous human action is a core achievement of early development. The skill lays the foundation for reasoning about the goals and intentions of others and may therefore be central to the development of a theory mind. One question concerns the origins of such skills. It is possible that infants' knowledge of events guides their attention to objects that are relevant for an interpretation of others' goals. If infants are familiar with a goal-directed action (e.g., reaching) they may selectively attend to the goal-object associated with the action. A prediction arising from this possibility is that they will be more likely to detect goal-relevant than goal-irrelevant changes inserted into human action sequences.

To investigate this prediction, 6- and 12-month-old infants were shown videos of a woman interacting with two objects (a yellow glass and a blue bowl). She made a goal-directed action (reaching that terminated in her grasping the object) toward one object (e.g., the glass) and a non-goal directed action (a back of the hand motion that terminated in her touching the object) toward the other (e.g., the bowl). Following familiarization to this event, they were presented with two kinds of test trials: goal change and non-goal change. During the goal change test trials a change was made to the object of the goal-directed action (e.g., the glass flipped upside down) and during the non-goal change test trial a change was made to the object of the non-goal directed action (e.g., the bowl flipped upside down).

The main question was whether infants looked longer at the goal-change than non-goal change trials. If they did this would indicate that they were more sensitive to the change in the goal-relevant objects. Infants at 12-months did so, while infants at 6-months looked equally long at the two kinds of test trials. This finding is consistent with the prediction that a knowledge-driven analysis will lead to greater attention to goal-relevant features of events. Follow-up studies in progress will investigate whether younger infants can succeed in detecting goal-changes for simpler action sequences, will test infants' detection of changes for a point rather than reach cue, and will examine whether infants who do not indicate a knowledge-based action analysis for a given cue (gaze) can be trained to do so by first being exposed to salient effects of the cue.

**Th4-30**

### Using Language Cues to Facilitate the Flexibility of Infant Memory Retrieval

**Jane Herbert**

*University of Sheffield, Sheffield, UK*

The relation between emerging language skills and children's memory abilities has been the focus of considerable attention (e.g., McGuigan and Salmon, 2004, Simcock & Hayne, 2002). Although the majority of previous research on this topic has focused on verbal children, even early-verbal infants can benefit when an adult provides event narration. For example, 24-month-old infants, but not 18-month-old infants, show improved memory flexibility in a deferred imitation task when the experimenter uses a nonsense verbal label during learning and at retrieval (Herbert & Hayne, 2000). Younger infants can also benefit when provided with simple, more familiar, narration: 18-month-old infants remember the original demonstration stimuli for longer if the stimulus and actions are described by the experimenter (Hayne & Herbert, 2004). The purpose of the present study was to examine whether simple verbal labels could facilitate the flexibility of memory retrieval earlier in infancy.

Twelve- and 15-month-old infants' (n=72) watched an experimenter demonstrate a sequence of actions and were given the opportunity to reproduce those actions after a 10-minute delay with a stimulus that differed in form. For half the infants in the demonstration conditions, the experimenter provided simple verbal labels for the event ("Look. A puppet. Off. Shake. On"). The remaining infants received only empty narration designed to maintain attention but not to describe the event.

In the absence of event narration, infants at both ages demonstrated some evidence of memory flexibility, performing significantly more target actions than their age-matched control groups. There were, however, age-related changes in the effect of verbal information on memory flexibility: verbal information facilitated performance at 15-months, but not 12-months. The number of target actions pro-

duced by individual infants was not correlated with parental reports of infant comprehension for the words used by the experimenter or overall language comprehension as measured with the Macarthur Communicative Development Inventory.

The present results indicate that simple language can facilitate the flexibility of memory in the 2nd year of life. While there is an age-related change in the ability to benefit from adult labelling, this effect does not appear to be solely dependent on infants' comprehension of the exact words used in the narration.

**Th4-31**

### Mental Rotation in Human Infants: a Sex Difference

**David Moore**[1] Scott Johnson[2]

*1. Pitzer College and Claremont Graduate University, Claremont, USA; 2. University of California at Los Angeles, Los Angeles, USA*

**Background and Aims:** Men typically outperform women in spatial ability tests (Voyer, et al., 1995). Such sex differences have also been detected in four-year-olds (Levine et al., 1999); in prepubescent populations, they are most often found on tasks requiring mental rotation (MR). MR tasks usually require participants to view 2D representations of a 3D object, and then recognize a novel representation of that object rotated in 3D space (Shepard & Cooper, 1982). Although some studies of infants have utilized rotating visual stimuli (e.g., Hespos & Rochat, 1997), there have been no publications reporting MR in infants. We used a visual preference method to explore MR in 5-month-olds.

**Methods:** Twenty male and 20 female 5-month-olds sat on a caregiver's lap while viewing videos of a simplified, colored Shepard-Metzler (1971) object revolving back and forth through 240° around the vertical axis. Twenty infants were habituated to this object and 20 to its mirror-image. When average fixation duration declined below a 50% habituation criterion, test trials began in which all infants saw-revolving back and forth through the previously unseen 120°-either the familiar habituation object or its mirror-image; three test trials presenting the familiar object alternated with three presenting its mirror-image (presentation order was counterbalanced). Observers measured infants' fixations on habituation and test trials. We hypothesized that infants would recognize the habituation object when seen from the new perspective. Because the habituation and familiar test trials presented entirely different views of the same object, recognizing it from the new perspective required MR of a mental representation of a stimulus (to compare it to a mental representation of the other stimulus).

**Results:** Females fixated the two test stimuli about equally. In contrast, males fixated the mirror-image test stimulus longer than the familiar test stimulus, both rotating through the novel angle [$t(19) = 4.07$, $p<0.001$]; 70% preferred the mirror-image test stimulus [$p<0.003$]. Males' novelty preferences were greater than females' [$t(38) = 2.07$, $p=0.045$]. Thus, males discriminated the habituation and mirror-image test objects, not the habituation and familiar test objects.

**Conclusion:** Males' preference for the mirror-image over the familiar test stimulus implies recognition that the latter represented the habituation object. This requires MR of a mental representation of either the habituation or familiar test object, or both. These data demonstrate MR in infancy, and reveal a sex difference also seen in adults. We will discuss endogenous and experiential factors contributing to MR development in infants.

**Th4-32**

### Not Just From A to B: How Eye Movements Change Our Understanding of the A-Not-B Task

**Johanna Muenke**[1] Natasha Kirkham[2]

*1. Stanford University, Stanford, USA; 2. Birkbeck, University of London, London, UK*

In the canonical A-not-B task, infants are judged on a binary measure of correct/incorrect reaching to the hiding location. Studies examining infants' first looks also use a binary correct/incorrect measure. To investigate the online decision making process, specifically during switch trials, this study tracked the eye movements of 9-month-olds throughout a four second search period which followed an object's disappearance from sight and a three second delay. Subjects included in the analysis were 22 9-month-olds who successfully searched at location A during A trials, which was defined as looking more towards location A than location B during the 4-sec search period. Visual search during the switch trial (the first hiding event at location B) was at chance levels, with 50% of the infants continuing to search at location A, and 50% searching more at location B. These data seem consistent with a working memory account in which mental representations of the old (A) and new (B) hiding locations cannot be held separately throughout the delay, leading to search performance at chance levels. The non-binary measure of searching behavior allows a more graded approach to understanding infants' searching behavior, and further analyses of visual search behavior promise to be informative about infants' online decision making process.

**Th4-33**

### Can 18-Month-Olds Overcome the Reality Bias in Theory of Mind Tasks? New Evidence from Eye-Tracking

**Annina Neumann**, Claudia Thoermer, Beate Sodian

*Ludwig-Maximilians-University, Dept. of Psychology, Developmental Psychology, Munich, Germany*

**Motivation:** The term reality bias refers to an inability to inhibit one's own knowledge when adopting somebody else's perspective. It has often been claimed to be one of the main reasons why young children fail epistemic tasks. Consequently, the methodological inhibition or facilitation of the reality bias has been a substantial aspect of Theory of Mind (ToM) tasks.

We present two eye-tracking experiments, investigating the reality bias of 18-month-olds in an implicit knowledge-ignorance and an implicit false-belief task. We analyzed whether infants would rely on their own perspective or on the actor's perspective when investigating possible object locations and the actor's actions.

**Methods:** In the knowledge-ignorance task (n=32) infants had to anticipate which of two boxes contained an object. Two contradicting pointing gestures served as clues, one coming from a person having visual access to the boxes' contents, the other one from a person without visual access. We compared infants' anticipatory fixation times on 1) the two boxes and 2) the two pointing hands.

In the false-belief task (n=39) infants had to anticipate in which of two boxes an actor, holding a false belief, would look for an object. To open the boxes, the actor had to grab through one of two corresponding doors. We compared infants' anticipatory fixation times on 1) the two boxes and 2) the two doors.

**Results:** In both tasks infants' fixation times on the boxes were congruent with their own perspective: In the knowledge-ignorance task they fixated significantly longer on the box which was closer to where they had seen the object enter the scene, and in the false-belief task they fixated significantly longer on the box they had last seen the object enter. However, in both tasks the fixation times relating to actions were congruent with the actor's perspective: In the knowledge-ignorance task infants fixated significantly longer on the knowledgeable person's hand, and in the false-belief task they fixated significantly longer on the door consistent with the actor's false belief.

**Conclusion:** Our findings indicate that infants predict another person's actions based on this person's knowledge or belief despite their tendency to focus on the true location of the object. Thus, there is evidence for both a reality bias and an ability to represent epistemic states. It appears that the success in ToM tasks depends on whether the focus of attention is turned on the object itself or towards the actions expected from the actor.

**Th4-35**

### Attributing False Beliefs About the Internal Properties of Objects: Evidence From 18.5-Month-Old Infants

**Rose Scott**[1] Hyun-joo Song[2] Renee Baillargeon[1] Alan Leslie[3]

*1. University of Illinois, Champaign, USA; 2. Yonsei University, Seoul, Korea; 3. Rutgers University, New Brunswick, USA*

Recent evidence suggests that infants in the second year of life attribute to others false beliefs about objects' location and identity; the present experiments examined whether 18.5-month-olds also attribute false beliefs about objects' internal properties. By this age, infants expect like objects to have like properties. If infants assume others share this expectation, they might attribute a false belief to an agent when two identical objects have dissimilar properties.

In Experiment 1, an experimenter sat at a window in the sidewall of an apparatus. On the floor were three closed cups: one red cup sat in front of the experimenter, and an identical red cup (same cup) and a green cup (different cup) sat in front of a closed window in the back wall. During the familiarization trial, the experimenter shook all three cups; her cup and the different cup made noise, but the same cup did not. During the test trial, another experimenter, called the agent, sat at the window in the back wall. The experimenter shook her cup and then asked the agent "Can you do it?" The agent grasped either the same or the different cup and paused until the trial ended. Infants looked reliably longer at the different- than at the same-cup event, suggesting that they expected the agent to grasp the same cup, presumably because they attributed to her a false belief about its internal properties.

Experiment 2 ruled out an alternative interpretation: perhaps infants realized that the agent was ignorant about which cup made noise, expected her to select the wrong cup, and were surprised when she selected the right cup instead. However, when both of the agent's cups were red, infants looked equally whether she selected the one that made noise or the one that did not.

Experiment 3 ruled out another alternative interpretation: perhaps infants realized that the agent was ignorant about which cup made noise, expected her to copy the experimenter by selecting the same cup, and hence were surprised when she selected the different cup. During familiarization, the agent was present when the experimenter demonstrated the cups' properties; after the agent left, the experimenter switched the contents of the agent's cups. Infants now expected the agent to select the different cup, which she falsely believed made noise.

These and control results together suggest that by 18.5 months, infants can attribute to others false beliefs about objects' internal properties.

**Th4-36**

### Understanding Relief and Achievement: Infants' Discrimination and Crossmodal Perception of Two Positive Affective Expressions

**Melanie Soderstrom**[1] Disa Sauter[2] James Morgan[1]

*1. Brown University, Providence, USA; 2. University of London, London, UK*

Studies of infants suggest that their ability to discriminate and associate positive (e.g. happy), negative (e.g. angry or sad) and neutral affective expressions in the visual and auditory domains emerges between 4 and 7 months of age (e.g. Walker, 1982, Flom & Bahrick, 2007). Research with adults suggests that "positive" affect can be divided into consistent subtypes of affect (Sauter and Scott, 2007). This study examines when infants become sensitive to this more subtle distinction between two positive affective expressions, relief and achievement.

We first demonstrated that infants are able to discriminate vocal expressions of relief and achievement, using infant-controlled habituation. Three-, six- and eight-month-old infants heard non-linguistic auditory-only vocal expressions from a speaker paired with a checkerboard visual stimulus on a television screen. After habituation to multiple tokens of either relief or achievement, infants were tested on a new token of the same affective expression, and a token of the novel expression. Six- and eight-month-olds showed significant dishabituation to the novel expression over new tokens of the familiar expression. Preliminary findings with three-month-olds (10 participants) do not show significant dishabituation. This suggests that by 6 months, infants discriminate the vocal expressions of relief and achievement.

We then examined when infants begin to attach these vocal expressions to visual expressions of the same emotion. In a preferential looking procedure, infants were shown videos of the two facial expressions, relief and achievement, demonstrated by a male actor. Infants heard the same auditory tokens used in the discrimination phase of the study. Based on previous research (e.g. Walker-Andrews, 1986), if infants associate the auditory and visual expressions, they should prefer to look for the video that matches the auditory stimulus. Infants as old as eight months showed no preference in their looking pattern. However, preliminary results from 12 11-month-olds do show a preference for the matching video.

These findings show that infants' ability to discriminate two positive affective expressions in the auditory domain emerges by 6 months of age. Infants' early understanding of vocal affect is therefore not limited to differentiating positive and negative affect, but includes differentiating two positive affective expressions. However, their ability to associate these auditory expressions with the appropriate facial expressions may be delayed. These findings provide support for the existence of these expressions as separate, distinguishable affective expressions for infants as well as adults. The early emergence of discrimination also provides tentative support for their universality.

**Th4-37**

### Beyond Action: Imitation of Strategies and Goals

**Ashley Pinkham**[1] **Vikram Jaswal**[1] Francys Subiaul[2] David Buttelmann[3] Gergely Csibra[4]

*1. University of Virginia, Charlottesville, USA; 2. George Washington University, Washington, USA; 3. Max Planck Institute, Leipzig, Germany; 4. Birkbeck, University of London, London, UK*

Although young children's imitation has long been a rich field of study, much of the research has focused on their ability to imitate particular actions rather than their ability to imitate strategies or goals (Subiaul et al., 2004). In contrast to motor imitation, "cognitive imitation" requires individuals to separate actions from goals and mentally represent those goals in the absence of external cues. This proposed symposium will examine how young children and non-human primates can imitate an "approach" to a problem even when that approach is not directly afforded by a model's actions.

The first presenter uses a rational imitation paradigm to show that infants and enculturated chimpanzees and orangutans can successfully infer whether a behavior is the result of a free or a forced choice. These species separated the model's actions from his goals, selectively reproducing the actions only when the model freely chose them. The second presenter will show that 18- and 36-month-olds will adopt the sorting strategy used by a model even though it is different from the one they would use spontaneously. Finally, the third presenter will describe data showing that typically-developing children, as well as autistic children and rhesus monkeys who do not show robust action imitation, imitate novel cognitive rules.

The presentations in this symposium will demonstrate that young children and non-human primates can separate the particular motor behaviors a model uses from the strategies responsible for those behaviors, and that they actively select which element(s) of a demonstration are relevant. This research has broad implications, suggesting that imitation is a route not just to the discovery and execution of new behaviors and sequences of behaviors, but also to new cognitive strategies. The discussant will touch on these points and situate these findings in the broader context of earlier imitation research.

**Th4-38**

### 18- and 36-Month-Olds Imitate Sorting Strategies

**Ashley Pinkham**[1] Rebecca Williamson[2] Vikram Jaswal[1] Andrew Meltzoff[2]

*1. University of Virginia, Charlottesville, USA; 2. University of Washington, Seattle, USA*

**Background and Aims:** Can infants and young children learn a strategy through imitation? Can they learn to approach a situation in a particular way through observation?

**Methods:** 18- and 36-month-olds were assigned to one of three conditions. In Sorting, children watched a model sort eight objects (e.g., 4 toy ducks and 4 bracelets) into two separate boxes by kind (18-month-olds) or by color (36-month-olds). In Handling, children watched the model pick up and examine all four objects of one kind or color and then all four objects of the other, but they never saw her sort the objects. In Control, children did not see the model sort or handle the objects. Children were then presented with the two boxes and the eight objects, and they were encouraged to "put them away." Of interest was whether children in the Sorting condition would be more likely than those in the other conditions to adopt the model's sorting strategy.

**Results:** 18-month-olds in the Sorting and Handling conditions were more likely to sort the objects by kind (35% of the time in each condition) than those in the Control condition (11%). Additionally, they were more likely to interact with all of the objects of one kind before interacting with those of the other kind (55%) than children in the Control condition (29%). 36-month-olds in the Sorting condition were more likely to sort by color (71%) than those in the Handling or Control conditions (38% and 54%).

**Conclusion:** Infants and young children adopted the sorting strategy demonstrated by an adult model, although they did not spontaneously sort by kind or color. This suggests that children not only learn actions but also strategies through imitation.

**Th4-39**

### Isolating Cognitive from Motor Imitation: Evidence from Monkeys and Children

Francys Subiaul

*George Washington University, Washington, USA*

Imitation is not one thing. Most scientists, for instance, distinguish between two super-ordinate concepts of imitation: (a) copying new responses and (b) copying familiar responses. But, while some researchers have recognized that there's a significant difference between motor and vocal imitation, few have explored 'cognitive' imitation, defined by Subiaul and colleagues (2004) as "a type of observational learning where a naïve student copies an expert's use of a rule." In a series of studies, the imitation of a serial rule was isolated from the imitation of specific motor responses using the simultaneous chaining paradigm (Terrace, 2005). In this paradigm, individuals respond to arbitrary pictures presented in a touch-sensitive screen in a specific order. From trial to trial pictures change spatial configuration, preventing respondents from using a specific motor or spatial rule. Here, data from the original studies on cognitive imitation in rhesus monkeys will be summarized along with recent data from human children and individuals with autism. In each of these studies, we demonstrated that populations that typically do poorly in motor imitation tasks (e.g., monkeys and children with autism) are capable of copy novel cognitive rules following observation. These studies highlight how the copying of cognitive (e.g., serial) rules can be experimentally isolated from the copying of motor rules or responses. Perhaps most importantly, these results shed light on potential developmental and evolutionary discontinuities in imitation performance.

**Th4-40**

### Jumping But Not Marching? the Relationship Between Vocabulary Knowledge and the Categorization of Intransitive Actions

**Lulu Song**[1] Roberta Golinkoff[1] Weiyi Ma[1] Rebecca Seston[2] Kathy Hirsh-Pasek[3]

*1. University of Delaware, Newark, USA; 2. Boston University, Boston, USA; 3. Temple University, Philadelphia, USA*

As verbs refer to categories of actions and events, a fundamental requirement for learning them is the formation of these categories. Perhaps verb learning is difficult (e.g., Gentner, 1982) because, given the wide variability in how actions are performed, extracting the invariant is challenging. We examined infants' categorical representations of intransitive actions and the relationship between forming these categories and language knowledge. We selected two actions, jumping and marching, because in English jump emerges earlier than

march in children's vocabulary (Fenson et al., 1994). Furthermore, not all languages have a word for march. Would infants then find it easier to form a category of jumping than marching?

Using the Preferential Looking Paradigm without language, infants (10-12; 13-15 months) were shown an actor jumping on one side of the screen and marching on the other. A salience trial assessed whether infants had a priori preferences for one action over the other (they did not). In familiarization trials, infants saw jumping (Jump/March Condition) or marching (March/Jump Condition) performed by 4 human actors. In the 12-second test trial, infants witnessed the same display seen in salience. If infants formed a category of action, they should increase looking time to the novel action at test compared to how much they watched it during the salience trial.

Two results emerged. First, infants who had bigger relational vocabularies (verbs and prepositions) based on parental report ¨C but not necessarily who were older, or who were reported to understand jump or march ¨C showed a reliable novelty preference (categorical response) in the Jump/March Condition, but not in the March/Jump Condition. Second, infants' novelty preference decreased through the test trial in the Jump/March Condition versus a staircase increase pattern in the March/Jump Condition. Both results suggest that infants found the jumping category easier to form than the marching category.

These results indicate that by 10 months of age, infants with stronger relational vocabularies can form nonlinguistic categories of intransitive actions such as jumping and are thus prepared to learn the names of such actions. It is unclear whether there is a causal relationship between children's relational vocabularies and their nonlinguistic category formation. The relatively late emergence of the ability to form action categories compared to an early emerging ability to form object categories (e.g., Eimas & Quinn, 1994) suggests another possible reason for why verbs are harder to learn compared to nouns.

**Th4-41**

### Understanding Exact Equality Between Quantities Through One-To-One Correspondence

Veronique Izard[1] **Arlette Streri**[2] Elizabeth Spelke[1]

*1. Harvard University, Cambridge, USA; 2. Laboratoire Psychologie de la Perception, Paris V University, CNRS, Paris, France*

**Introduction:** Infants possess two systems capable of representing numbers, both limited in their representational power: the first one represents numbers in an approximate fashion, and the second one conveys information about small numbers only. Conception of exact numbers is thought to develop either as children get exposed to the number words, or through their understanding of one-to-one correspondence.

**Method:** We studied whether children aged 32 to 36 months are able to use one-to-one correspondence cues to give judgments of exact equality. To begin, children were presented with a set of finger puppets, sitting on the branches of a tree (5 or 6 puppets on a tree with 6 branches). All the puppets disappeared in a box, and then reappeared. We report children's searching behaviour for a 6th puppet, after 5 puppets have been taken back to the branches. Additional conditions tested their performances when an event occurred while the puppets were in the box (addition, subtraction or replacement), or in the absence of one-to-one correspondence cues (large tree).

**Results:** Children used the one-to-one correspondence cues successfully when no transformation occurred (73% correct searching; Pearson chi-square against chance p=0.033), but failed in a control condition with a larger tree, where one-to-one correspondence cues were not available (accuracy 48%, p=0.73). When a transformation occurred, children failed whenever the initial sets of puppets and branch were modified (addition or subtraction of one puppet: 55% correct, p=0.55; addition or subtraction of one branch: 57% correct, p=0.45; replacement of one puppet by a different one: 55% correct, p=0.65). However; they succeeded when the transformation did not modify the identity of the items forming the set (one puppet going out of the box and then back in: 71% correct, p=0.050), or with small numbers (91% correct, p<0.001).

**Discussion:** These results show the limitations of understanding of one-to-one correspondence in young three year-olds: they know that the one-to-one correspondence between two sets is conserved as long as the items forming these sets stay identical, and that this correspondence is modified when one object is added or subtracted to either set, yet they do not know that one-to-one correspondence does not depend on the identity of the items forming the sets. This partial understanding of one-to-one correspondence could serve as a precursor to the development of exact number concepts. We are currently investigating 7-months-old infants' competences with one-to-one correspondence on an analogue task with looking times.

## *Motor and Sensorimotor*

**Th4-42**

### Understanding Others' Actions: Comparing Active Participation and Observational Experience

**Jessica Sommerville**

*University of Washington, Seattle, USA*

A classic question in developmental psychology concerns how infants and children acquire information about their physical and social worlds. Prior works suggests that infants learn both from acting on the world and through watching others act. Yet few studies have directly compared active and observational experience to determine whether each experience type confers unique benefits for infants' learning. Across a series of studies, we investigated the relative influence of active versus observational experience on infants' understanding of the goal-directed nature of a tool use event.

Infants either received active training and practice using a tool to retrieve an out-of reach toy (training condition, n = 17) or watched an actor use the tool to retrieve an out-of-reach toy (observation condition, n = 16). Infants subsequently took part in a habituation paradigm designed to investigate their encoding of the goal of the tool use sequence. After seeing an actor repeatedly use one of two tools to get a toy on habituation trials, only training infants looked longer at test events that featured a change in the object that the actor pursued than at test events that changed the tool that the actor acted on ($t(16) = 2.2$, $p < .02$). These findings indicate that active experience has a unique impact on infants' action understanding, enabling infants to recognize or identify the goal of simple actions and action sequences.

In everyday life, however, active and observational experiences seldom occur in isolation. Rather, these types of experience are often intertwined. Thus, in ongoing work we are investigating infants' learning in the context of joint activities in which the infant and an adult co-perform a tool use sequence. These findings will have important implications for the conditions under which infants learn to identify the goals behind other people's actions.

**Th4-43**

### Parent-Guided Action Facilitates Infants' Learning About Physical Events: a Cross-Cultural Study

**Su-hua Wang**
*University of California, Santa Cruz, USA*

Infants under 12 months typically fail to use height information in covering events (e.g., Wang et al., 2005). However, 9-month-olds learn to use height information after watching two or three pairs (but not one pair) of covering events (Wang & Baillargeon, in press; Wang & Kohne, in press). This study explores the effect of action experience when visual exposure is limited. It compares cross-culturally parental guidance on infants' manual exploration and the learning consequences.

Nine-month-olds and their parents were tested in Taiwan and the U.S. (16 dyads in each site). In a teaching session, the parents lowered a cover over an object to demonstrate covering events. Two covers were used; one was tall enough and the other too short to hide the entire object. The parents were instructed to use the covers alternately and allow the infants to act upon the stimuli. In a test session, the infants received a choice task testing whether they learned to use height information in covering events: a tall toy had been hidden under a cover, and the infants were forced to choose one of two covers in search of the hidden toy.

During the teaching session, the Taiwanese parents interrupted their infants' action more frequently than did their Euro-American counterparts, $t(15) = 4.41$, $p < .001$. During the test session, 7 out of 16 Taiwanese and 14 out of 16 Euro-American infants chose the correct cover; the cross-group difference was significant, $_{\varphi}2(1, N = 32) = 6.79$, $p < .01$. Control data indicated that Taiwanese infants succeeded in the task when their action was not interrupted.

The results suggest that uninterrupted action experience enhances infants' use of task-relevant information in physical events, even when provided visual exposure is insufficient. The cross-cultural differences will be discussed in terms of underlying beliefs and related practices.

**Th4-44**

### Baby See, Baby Do: Parents and Infants Playing with Sound

Tracy Smith, Teresa Wilcox
*Texas A&M University, College Station, USA*

There is evidence that infants use auditory information as the basis for individuating objects, but that infants are more sensitive to property-rich (intrinsically tied to objects' physical properties) than property-poor (arbitrary and contrived) sounds. Infants' earlier sensitivity to property-rich sounds may be explained, at least in part, by the kinds of sound experiences they have. The present research assessed this hypothesis.

Infants aged 6 and 12 months were tested in a two phase experiment. In Phase 1, an experimenter laid out six toys and allowed infants to play alone with the toys for four minutes. All six objects produced both types of sounds. For example, the toys could be shaken or banged on the table (property-rich) or acted upon in select ways to produce an electronic noise (property-poor). In Phase 2, the toys were set out again and parents were instructed to play their infant as they would home.

Two main findings emerged. First, during Phase 1, six-month-olds produced about an equal proportion of property-rich and property-poor sounds, $F(1,21)=0.65$, $p>.05$, whereas twelve-month-olds made significantly more property-poor than property-rich sounds, $F(1,21)=18.68$, $p<.001$. During Phase 2, the six-month-olds, $F(1,21)=11.41$, $p<.01$, and the twelve-month-olds, $F(1,21)=81.96$, $p<.001$, made significantly more property-poor than property-rich sounds. Second, the infants who demonstrated more coordinated patterns of interaction with their parents were more likely to produce property-poor sounds in Phase 2 as compared to Phase 1.

Together, these results suggest that (a) with age infants are more likely to produce property-poor sounds when interacting with objects and (b) the kinds of sounds parents produce when playing with their infant, and the quality of the infant-parent interaction, influences the sounds infants produce. These results provide insight into the types of sound experiences infants seek out on their own, and the role that parents play in guiding infants' sound experiences.

**Th4-45**

### Effects of Simulated Reaching Experience on Action and Perception

**Klaus Libertus**, Amy Needham
*Duke University, Durham, USA*

The transition into reaching brings about new opportunities to act on the environment. For the first time, infants don't have to wait for a caregiver to place objects into their hands for manual or oral exploration. Studies have shown that simulated reaching experience increases infants' engagement in objects (as measured by visual and oral contact) and leads to more sophisticated multimodal object exploration (Needham, Barrett, & Peterman, 2002). The present study explored the effects of reaching experience by following a group of pre-reaching infants (M = 82 days) as they were trained for 12 to 15 days using the simulated reaching paradigm. Reaching behavior and object engagement were measured repeatedly using a sequential 4-step assessment: toy beyond reach, toy far, toy close, toy placed in hand. Following the training period, eye-tracking was used to assess infants' visual exploration of faces, objects and action-sequences. Trained infants were compared to a group of age-matched infants (M = 99 days) and a group of 4-month-old infants (M = 142 days), neither of which received any training. Results showed that object engagement, manual contact and exploration increased gradually over the training period. Visual scanning differed significantly between the age-matched control group and the 4-month-old control group. Older infants showed more attention toward a static face and more switches between a face and an object during an action sequence (both Tukey, $p < 0.05$). Surprisingly, trained infants showed patterns that fell consistently between those two groups, suggesting a relation between acquired level of motor skill and visual exploration. It is possible that infants who have learned about their own ability to act on objects - either over the normal course of development or via artificial training -judge a situation according to the actions they could produce within this context.

**Th4-46**

### Infant Perception and Action: the Role of Functional Object Affordances

**Haiko Ballieux**, Denis Mareschal
*CBCD - Birkbeck College, London, UK*

In adults, actions evoked by familiar objects depend either on activation of semantic knowledge concerning an object's function, or directly on stored visual knowledge concerning the object (Hodges et al.,

2000). Little is known, however, about the acquirement and representation of functional object knowledge in early infancy. We investigated whether knowing an object's function (i.e. how to use it, and therefore where to grasp it) has a differential effect on infants' looking behaviour, compared to not knowing an object's function. The hypothesis is that top-down functional knowledge can change looking behaviour even in early infancy.

In the first part of our study we investigated whether knowing the function of an object changed to which part of the object 14-month-olds and adults looked longer. Specific areas of interests (AOIs) were defined and a distinction was made between physical AOIs (object parts that afford action) and functional AOIs (object parts that indicate the object's proper use). Eye-movements were recorded while infants and adults watched objects from 3 different categories: 1) objects familiar to both infants and adults, 2) objects familiar to adults but not to infants, and 3) objects unfamiliar to both infants and adults.

The infant results showed a clear and strong interaction between object familiarity and looking time. Infants looked much longer at functional AOIs than physical AOIs when looking at highly familiar objects ($F(1,7) = 9.03$, $p<.05$, $r = .75$), and much longer at physical AOIs than functional AOIs when looking at highly unfamiliar objects, $F(1,7) = 9.71$, $p<.05$, $r = .76$. A similar pattern of results emerged when the measurement was number of fixations. These results indicate that the more familiar an object is the more infants look at parts that indicate the function of the object, and confirm the main hypothesis that top-down semantic information can alter looking behaviour even in early infancy. The adult results show a slightly different pattern, especially concerning category 2 objects (familiar to adults but not to infants).

In the second part of the study (underway) the 14-month-olds handled some of the objects depicted in the eye-tracking test. The question was which part of the objects infants would grasp first, and whether this depended on whether they had any functional knowledge of that object. This was done in order to compare infants' looking and grasping behaviour, and to see whether there is a discrepancy between the two.

**Th4-47**

### A Longitudinal Study of the Role of Infants' Locomotor Expertise on the Development of Inhibition

**Sarah Berger**

*The College of Staten Island, Staten Island, USA*

Although several studies of the interaction between cognition and action have demonstrated that manipulating the motor demands of an experimental task can change cognitive performance, few have examined the effect of performing effortful motor behaviors on infants' ability to inhibit. If overall task difficulty, rather than specific motor demands or cognitive development alone, determines infants' ability to inhibit, then performance on a task would fluctuate as motor skills are mastered over time. The aim of this experiment was to track the development of infants' problem-solving skills in a changing locomotor context, specifically whether changes in infants' motor expertise influenced their ability to inhibit in locomotor A-not-B tasks.

Data collection is ongoing. Thus far, 4 infants have been tested longitudinally at the onset of 5 motor milestones. To control for practice, cross-sectional infants were tested once at matched sessions: 1st week independent crawling (n=1), 6-8 weeks crawling experience (n=3), 1st week independent walking (n=5), 6-8 weeks walking experience (n=5). Longitudinal infants had an additional session during the transition between crawling and walking.

At each session, infants navigated both low-demand (unobstructed paths) and high-demand (tunnels) V-shaped pathways, starting each trial at the point of the "V". Infants traveled to a caregiver who sat several feet away at the end of one arm of the "V". After several A trials, caregivers moved to the other arm of the "V" (B trial).

Infants' ability to inhibit taking the old path on the B trial fluctuated according to locomotor expertise and task difficulty. Infants were more likely to perseverate in a novice posture than an experienced posture and they perseverated more often in the tunnels than the direct path condition. Novice crawlers perseverated, but the same infants inhibited on the same task after several weeks of crawling experience and perseverated again when they began walking. Notably, at the 3rd longitudinal session (infants were new walkers, but still crawling) infants showed the opposite pattern: they perseverated in the direct path condition, where they were novice walkers, but inhibited in the tunnels condition, where they were simultaneously expert crawlers.

Preliminary results suggest that the dissociation between locomotor postures of infants' ability to inhibit stems from a cognition-action trade-off. Expending motor effort comes at the expense of an ability to inhibit compelling behaviors. The interaction between developmental domains has important implications for the fluidity of expertise and the nature of development.

**Th4-48**

### Using Real-Time Motion Capture to Measure Handedness in Infants

**Eliza Nelson**, George Konidaris, **Neil Berthier**

*University of Massachusetts Amherst, Amherst, USA*

**Background and Aims:** The development of hand preference in infancy has been widely studied but little is known about the development of hand performance or the proficiency of each hand. In this study, hand preference and hand performance were independently measured in 11-, 14-, and 17-month-old infants. Preference was measured from toy play and performance was assessed by two novel motor tests using a motion capture system. Motion capture has previously been used to explore differences in infant reaching, but to our knowledge, no one has used kinematic equipment to measure differences in infant hand proficiency. To date, two 11-month-olds, six 14-month-olds, and six 17-month-olds have provided reliable data for this study.

**Method:** Infants were tested once when they were 11-, 14-, or 17-months-old. The experiment consisted of three tasks. In the first task infants were presented with five toys during a free-play period. Each toy was presented individually at the infant's midline for 90 seconds. Unimanual manipulations were scored from videotape to calculate hand preference. The remaining tasks measured hand performance. The second task required the infant to fit a ball into the top opening of a toy and the third task required the infant to retrieve a Cheerio from a stationary plastic cup. During the performance tasks, infants used both the left and right hands on different trials and wore two infrared markers on each wrist to track their movements.

Data Analysis: A Handedness Index (HI) will be used to characterize unimanual hand preference for each infant. The HI is computed by subtracting the number of left unimanual responses from the number of right unimanual responses and dividing by the total number of unimanual responses. Hand preferences range from -1 to 1 with negative values interpreted as a left bias and positive values as a right bias. One-sample t-tests will be performed to determine whether

each group mean is significantly different from 0. Preliminary analysis indicates a right trend in the older age groups (means 0.32). Hand performance data from the fitting and Cheerio measures will be analyzed with Matlab. Kinematic variables of interest include the number of peaks, peak speed, average speed, movement duration, and path length. Movement straightness will also be calculated for the fitting task. Finally, hand preference will be regressed onto hand performance to evaluate the hypothesis that differences in hand proficiency predict hand choice. Results will be discussed in relation to handedness theory.

**Th4-49**

### Predictive Tracking of Social and Non-Social Stimuli

Ty Boyer, **Bennett Bertenthal**

*Indiana University, Bloomington, USA*

**Background and Aims:** Recent research from our lab shows that infants' predictive tracking of a briefly occluded moving object is sensitive to the manner by which it disappears and reappears. Five, 7-, and 9-month-old infants were shown a rolling ball that briefly disappeared via kinetic occlusion or implosion (rapidly shrinking to nothing). Predictive tracking increased with age, and infants were more likely to anticipate the reappearance of the ball following occlusion than implosion. In a related series of experiments, 5- , 7-, and 9-month-old infants were more likely to detect a featural change of a social object than of a non-social object. If predictive tracking depends on the representation of an object, then we would expect infants to show an advantage for predictively tracking social vs non-social objects. The purpose of the current experiment was to test this prediction by measuring predictive tracking of a briefly occluded social stimulus vs. a briefly occluded non-social stimulus.

**Methods:** A total of 10 5-month-old and 10 7-month-old infants were tested. Two different stimuli were used: (1) a multicolored ball, and (2) an animated cartoon-like figure of a woman. Both stimuli moved from left-to-right across the screen, and then reversed direction and returned to their starting location. An occluding screen was located in the middle of the objects' paths. The objects disappeared behind the occluder via kinetic occlusion or via implosion (and reappeared via occlusion or explosion). Trials were blocked by stimulus type (social or non-social) and manner of disappearance (occlusion or implosion). Visual tracking was measured with a TOBII eye tracking system.

**Results:** The principal dependent measure was the time difference between the reappearance of the object and the first fixation to the far side of the occluding surface. If the first fixation appeared within 200ms of the reappearance of the object, we scored the trial as predictive. Preliminary results reveal that predictive tracking increased as a function of age and was more frequent in the occlusion condition. In addition, predictive tracking was more frequent at both ages to the animated cartoon character than to the rolling ball.

**Conclusion:** These results support our hypothesis that infants are more proficient at predictively tracking a social than a non-social stimulus suggesting that the representation of social stimuli differs from the representation of non-social stimuli.

**Th4-50**

### Look Mom, No Hands! the Impact of Learning to Walk on Carrying Objects

**Melissa Clearfield**[1] **Emily Bushnell**[2] Katherine Baxter[1] Jordan Fitzgerald[1]

*1. Whitman College, Walla Walla, USA; 2. Tufts University and Whitman College, Boston, USA*

In human evolution, upright walking is linked to carrying behavior; a prime advantage of bipedal locomotion is that hands are free to transport objects. Likewise, in individual development, the increased capacity to transport objects may impact the transition from crawling to walking. For the first time, new walkers have hands free to carry things. However, carrying also poses a challenge to new walkers, as it demands attention, distorts posture, and precludes using hands for balance. To explore infants' response to this challenge, we investigated longitudinally infants' choice of locomotion and tendency to carry objects as they transitioned from crawling to walking.

Twelve infants were tested monthly from 9 to 14 months in a free play session on a checkerboard floor, with toys in diagonally opposite corners and the parent and experimenter in the other two corners. We analyzed the 3 sessions around the transition to independent walking: infants' last crawling session, and first and second walking sessions. Measures included time spent with toys and mother, and distances traveled crawling and walking, while carrying toys and not.

There were no differences across sessions in overall distance traveled while not carrying toys. However, while carrying toys, infants traveled significantly further in their first walk session (M=25.08 squares crossed) compared to the last crawl session (M=4.83), and also in their second walk session (M=81.42) compared to the first. The first walk session was the only session in which infants both crawled and walked substantial distances. Within this session, infants walked and crawled equivalent distances while not carrying toys, M = 200 squares and M = 151 squares respectively. However, when carrying toys, they walked much more than they crawled, M = 261 squares versus M = 34 squares. Interestingly, in this session infants also spent more time overall with their mothers and less with toys than in either the preceding last crawl session or the subsequent second walk session.

Thus, in development as in evolution, upright walking and carrying are tightly coupled. As infants learn to walk, they transport objects further and further, and even while in transition between crawling and walking, they choose to walk for carrying objects. Indeed, the desire to transport objects may be an important motivator to practice walking early on, when it is precarious. In future studies, we will explore this connection further, by manipulating both the locomotor task and characteristics of the to-be-carried objects.

**Th4-51**

### Action Tendencies Generalize from Feet to Hands: Kicking and Button-Pressing in an A-not-B Task

Joshua Goldberg[1] **Evelina Dineva**[2] Jing Feng[3] Gregor Schöner[4] Esther Thelen[5] John Spencer[2]

*1. Indiana University, Bloomington, USA; 2. University of Iowa, Iowa City, USA; 3. Shriners Hospital for Children-Portland, Portland, USA; 4. Ruhr-Universität-Bochum, Bochum, Germany; 5. deceased, Bloomington, Indiana*

**Background and Aims:** According to dynamical systems theory, perseverative and correct reaching in the A-not-B task reflect the development and stabilization of skilled reaching (Diedrich et al., 2000). We use a novel technology (Feng et al., 2007) to probe whether these signatures generalize to a different action type--kicking--and,

further, whether action planning tendencies measured in a kicking task generalize to a subsequent reaching task.

**Methods:** Six- or 9-months-old were seated in a chair that allowed free movement of the arms and legs. Two buttons were placed in front of each infant with the height adjusted so that she could press the buttons either with feet (Kicking) or hands (Reaching). On each trial, the experimenter pressed one of the buttons (generating sights/sounds) to cue the infant. After a three second delay, the buttons were moved close allowing free interaction, although only the cued button generated sights/sounds when pressed. After 6 trials on one side (A), the experimenter cued the other button (B) for two trials. One group was tested on just Kicking, one group was just tested on Reaching, and a third group was tested on Kicking followed by Reaching one week later.

**Results:** We compared the proportion of correct (cued side) first presses on A and B trials. In the Kicking condition, both 6- and 9-month-olds' first presses were roughly 60% correct for both the A and B trials. Thus, infants can follow a cue with kicking--a pattern that differs from past studies of reaching. However, prior experience with Kicking had a strong influence on Reaching performance. Six-month-olds who only participated in Reaching tended to be correct on both A and B trials, but 6-month-olds with prior Kicking experience were at chance on A and B trials in Reaching. Nine-month-olds showed the opposite pattern. Nine-month-olds who only participated in Reaching were at chance on both A and B-trials, but with Kicking experience, 9-month-olds were correct on A and B trials.

**Conclusion:** Behavioral history matters, but younger and older infants learned different things from Kicking. Previous research shows that before 7 months, infants' reaches are not stable enough to generate sufficient motor memory to perseverate (Clearfield et al., 2006). With Kicking experience, past memories began to influence 6-month-olds' responses and they performed at chance levels. Nine month olds, who are influenced by past memories, learn flexibility--how to overcome perseverative tendencies to follow a cue.

**Th4-52**

### Longitudinal Studies of Very Premature Infants: Reaching For Moving Objects

**Helena Grönqvist**

*Uppsala University, Department of Psychology, Uppsala, Sweden*

Very premature infants, born before 32 weeks gestational age are in greater risk to develop Periventricular Leucomalsia (PVL), i.e. lesions to the afferent pathways of the white matter. The damages can affect various perceptual and motor abilities, e.g. the ability to identify and interpret movements. These disabilities can lead to several problems in motor development, for instance in eye-hand tasks. In addition, the very premature infants are at greater risk for retinopathy of prematurity (ROP), which is a potentially blinding eye disorder.

In a longitudinal project in Uppsala county 100 infants born before week 32 are studied over a 4-year-period, both at Uppsala university hospital and at the Department of psychology. Among other things, cranial ultra sound is performed within the first week and the infants are screened for ROP after 5 weeks. Visuo-motor coordination is studied with various methods at 2, 4, 5, and 10 months corrected age. Motor skills are investigated at 8, 22, and 26 months corrected age. The general aim of the project is to find early diagnostic tools to recognize PVL and other possible perceptual problems.

von Hofsten (1980,1983) has shown that healthy full term infants can catch an object moving 30 cm/sec at 18 weeks of age, 8-month-olds can catch objects moving with 120 cm/sec. When the object moved horizontally in front of the infant the infant reached predicatively for object, that is they aimed for the point where the object should be caught not for the point where the object was at the beginning of the reach. The purpose of the present experiment was to investigate differences in reaching strategies and quality between the premature infants and a full term control group at 8 months (corrected age).

The participants were seated in front of a large vertical plane. They reached for an object (a small doll) that moved on a semicircular pendulum path on this plane. The trajectories of the target and the hands of the infant were sampled in a 3D space at 240 Hz using five ProReflex cameras (Qualisys).

Preliminary results show that the infants aimed their reach ahead of the moving target. The extremely premature infants (< 28 weeks) and those with ROP aimed less precisely for the upcoming target than he controls.

**Th4-53**

### Grasping Skill Improves with Crawling Experience: Converging Data from Typically-Developing Infants at Two Ages and Toddlers with Obstetrical Brachial Plexus Palsy

**Rosanne Kermoian**, Jereen Kwong, Terri Tsang, Christine McGettigan, Tien Dong

*Stanford University, Stanford, USA*

**Background and Aims:** Between 6-12 months of age grasping skill improves rapidly and becomes increasingly precise. Recent explanations suggest that development of primary motor cortex and grasping skill is use-dependent. One form of hand use that has been hypothesized to aid in the development of grasp is weighting the hand, such as when crawling.

**Methods:** The sample included 43 infants 9.5 (N=22,11 girls) and 10.5 (N=21,11 girls) months of age (±1 week). Children were grouped according to hands-and-knees crawling history as determined by maternal report (1) unable to crawl, (2) crawling but not 8ft or more on a regular basis, (3) crawling 1-5 weeks, and (4) crawling 6+ weeks. Grasp was assessed as infants lifted an alphabet cube from a tabletop and was scored blind to crawling history as unspecialized (grasps involving whole hand: palmar, radial palmar), some specialization (radial digital, inferior pincer), specialized (grasps involving rotation of the thumb into opposition and finger pads: palmar pincer, three-jaw chuck, pincer). The score used for analyses was the highest specialization score received (either right or left hand). There were no significant differences between the scores of boys and girls so data were combined for all analyses. To explore an association between neural maturation and everyday hand use for grasping skills in the absence of crawling, we assessed the three children (2 girls) 15-19 months of age with Obstetrical Brachial Plexus Palsy, a stretch injury occurring during the birth process affecting peripheral sensory and motor fibers of the hand/arm on one side of the body.

**Results:** A Chi-square analysis revealed a significant positive association between crawling and specialization of grasp, $\chi(10) = 28.18, p<.001$ (two-tailed). The relation between age (9.5 vs. 10.5) and grasp was not significant. No 6+ weeks crawler received an unspecialized score, no non-crawler received a specialized score. Similarly, none of the three toddlers with OBPP, received a specialized score for their uninvolved hand despite the fact that these children were 4.5-8.5

months older than the infants in the sample and were highly dependent on their uninvolved hand for grasping.

**Conclusions:** Although these data cannot establish causality, if primary motor cortex and corticospinal maturation is implicated in precision hand movements, these findings from typically-developing 9.5- and 10.5-months-old infants and toddlers with OBPP suggest that crawling or experiences associated with crawling (such as bearing weight on the hand or intense and repeated sensory input) may facilitate CNS maturation and hand skill development.

**Th4-54**

## Exploring Effects of Early Musical Experiences on the Infant's Physical and Motor Development during the First Year

**Izumi Kida**, Mayumi Adachi

*Dept. of Psychology, Hokkaido University, Sapporo, Japan*

In Japan, there is widespread belief among mothers and pregnant women that music listening during pregnancy facilitates the healthy development of fetus and its safe delivery. Some argue, however, that early exposure to music or any other "unnatural" form of exposure can be unsafe for fetuses and young infants. These contradictory claims not only lack scientific bases but also induce confusion among parents and care-giving specialists. It is about time to investigate whether music influences an infant's development one way or another.

The purpose of this study was to explore how pre- and post-natal musical experiences would influence the infant's physical and motor development during infancy. We recruited approximately 40 mothers with 3-month-old infants who were willing to participate in a two-year-long study. A half of the mothers--the "rhythm" group--were given a CD with three traditional songs (sung by a mother who did not participate in this study) and a brochure illustrating how to interact with an infant with these songs. The mothers of the "rhythm" group were asked to sing these songs as frequently a possible while touching and moving their child's body. The other half-the "control" group-were neither given a CD nor specific requests for musical interactions with their child.

By means of face-to-face interviews with each mother, we obtained information about what she had done during pregnancy, whether she believed in any effect of pre-natal exposure to music and other items on her child's development and/or her own pregnancy, how hard the delivery was, and the child's weights and heights at and after birth. As for the motor development, we gave each mother lists of typical motor skills (for the first year) and of typical play repertories (for the second year), asking her to keep records of the date on which she observed each skill for the first time. To keep up with the child's motor development, we made monthly telephone calls to each mother and made total of six home visits for interviews with the mother while videotaping the child.

In the present poster, we will focus on 16 pairs of the mother and the infant (including the "rhythm" group) who completed the first year of the study. We will report initial findings for effects of early musical experiences on the infant's physical and motor development during the first 12 months.

**Th4-55**

## One Child's Day: A Descriptive Case Study of Locomotor Experience in the First 18 Months of Life

**Eleni Mathioudakis**, Daryaneh Badaly, Karen Adolph

*New York University, New York, USA*

Rich descriptive data have proven invaluable in advancing developmental research. For example, Barker and Wright's (1951) serial observations of "One Boy's Day" provided the first empirical evidence about children's range of social skills and relationships. Roger Brown's (1973) analyses of Adam, Eve, and Sarah's everyday language changed the nature of research on language acquisition. Following in their footsteps, our goal was to obtain a detailed, serial account of one boy's everyday locomotor experience from birth to 18 months of age. Such a detailed report is important for documenting developmental changes in opportunities for learning.

Every month, we videotaped the infant for several consecutive hours (*M*=6.56, *SD*=.83) during a typical day. His caretaker was advised that the infant should engage in his usual activities. Here we report preliminary data from 4 months straddling the transition from crawling (8-12 months) to walking (14 months) in terms of how much time he spent in unrestrained activity (on the floor engaged in independent maintenance of balance and locomotion), restrained in a stationary position by his caregiver, in passive locomotion (carried in caregiver's arms, stroller, etc.), eating, napping, and dressing.

Table 1 shows that the percentage of time spent in the various activities was relatively constant from 8 to 14 months, despite the transition from crawling to walking. Approximately 55% of each session was occupied by activities that involved caregiver support for balance and locomotion (restrained activity, passive locomotion, eating, and dressing). Only 30% of the time did the infant independently maintain balance and locomote. Most experiences with passive locomotion (particularly long bouts) took place out-of-doors; most experiences with unrestrained balance and locomotion took place at home. Further analyses will quantify the number of crawling and walking steps, duration of locomotor bouts, and locations and distances in which they occurred. These descriptive data may provide vital information about opportunities for learning and may also help to constrain theorizing about experience-related changes that underlie the link between locomotion and psychological development.

| Age (Mos.) | Unrestrained | Restrained | Passive Locomotion | Eating | Napping | Dressing | Unknown | Total Time (Hrs.) |
|---|---|---|---|---|---|---|---|---|
| 8 | 30.38% | 21.51% | 13.97% | 13.29% | 13.89% | 4.19% | 2.78% | 6.88 |
| 10 | 32.70% | 15.27% | 16.39% | 14.36% | 13.97% | 3.84% | 3.47% | 7.13 |
| 12 | 28.37% | 14.28% | 7.86% | 15.98% | 27.36% | 1.94% | 4.20% | 6.90 |
| 14 | 30.44% | 18.80% | 19.25% | 9.65% | 14.60% | 2.40% | 4.86% | 5.32 |

**Th4-56**

### Quantifying Variability in Phase Portraits

John Polk[1] Jesse Spencer-Smith[2] Louis DiBerardino[3] Daniel Ellis[4] Matthew Downen[4] **Karl Rosengren**[5]

*1. Department of Anthropology, University of Illinois, Urbana-Champaign, USA; 2. Dept of Psychology, University of Illinois, Urbana-Champaign, USA; 3. Dept of MSE, University of Illinois, Urbana-Champaign, USA; 4. Dept of Kinesiology, University of Illinois, Urbana-Champaign, USA; 5. University of Illinois, Urbana-Champaign, USA*

Most healthy children begin to walk at around one year of life. During the second year of life substantial changes in infants' gait patterns occur as stride length increases and the gait becomes more stable (Clark, Truly, & Phillips, 1993). Phase portraits have been instrumental in demonstrating this pattern of increased gait stability through development (Clark & Phillips, 1993; Clark, Truly, & Phillips, 1993). However, the manner in which phase portraits have been used in the past to examine developmental changes has not involved techniques to effectively quantify changes over time

This study presents new methods for quantifying differences in the phase diagrams that characterize cyclic patterns of limb segmental movement and velocity during gait. Phase portraits provide dynamic representations of a particular segment's movement, and typically are bivariate plots of angular displacement on angular velocity. The key assumption of our approach is that similar movement patterns should result in similar trajectories, as well as consistent location of the trajectories in phase space. Thus, the similarity of trajectory shape and location across multiple gait cycles can be used as measures of gait stability. We describe new Fourier- and shape-based methods for quantifying variation in phase-portraits, and re-analyze previously-published ontogenetic and adult data (Clark and Phillips 1993). The new methods that we use are specifically aimed at evaluating gait complexity and variability. More specifically, we use (i) elliptical Fourier analyses (ii) movement of the area centroid of sequential gait cycles, and (iii) variation in the radius of phase portraits to quantify gait complexity and variation.

Our results provide preliminary evidence for the efficacy of using more quantitative approaches to the analysis of phase portraits in order to describe stability and change in gait patterns. Specifically, the use of elliptical Fourier analysis in conjunction with analysis of the radius CV, and centroid drift enables us to quantitatively examine changes in gait over the first year of walking and compare these patterns with adult gait. These techniques indicate considerable inter- and intra-individual variation in the pattern of development across the first year of walking, but after six months of walking some gait patterns stabilize.

**Th4-57**

### 3D Object Completion Develops with Infants' Visual-Manual Exploration

**Kasey Soska**[1] Karen Adolph[1] Scott Johnson[2]

*1. New York University, New York, USA; 2. University of California, Los Angeles, Los Angeles, USA*

How do infants learn to perceive objects as complete in 3D space when they can only see the objects from a single vantage point? 3D object completion abilities emerge around 6 months of age (Soska & Johnson, 2006). Six months also marks the advent of independent sitting and coordinated visual-manual object exploration. Independent sitting frees the hands and helps infants to control gaze while manipulating objects. Coordinating hands and eyes while exploring thus provides information about objects' properties from visual, tactile, and proprioceptive systems simultaneously. The present study examines how postural development and manual exploration are related to 3D object completion in infants between 5 and 7 months (N = 28).

Infants were habituated to a computer-generated 3D object rotating back and forth through 15˚, so that only two faces of the object were visible. At test, infants viewed a solid, complete object and a hollow, incomplete object that rotated 360º. The proportion of looking to the novel, incomplete object display served as the measure of 3D object completion. In the same session, we obtained measures of infants' sitting experience from parents' reports, and behavioral measures of coordinated visual-manual object exploration in a structured play session (latency to grasp, dropping, rotating, running the fingers along the edges, and transferring toys between hands).

Age at testing and basic reaching/holding skills were not reliably associated with 3D object completion. In contrast, measures of independent sitting experience and visual-manual exploratory skills were associated with performance in the visual habituation task. Infants who showed stronger novelty preferences had more sitting experience ($r(27) = .49$, $p<.01$) and displayed more rotations ($r(27) = .45$, $p<.05$), fingerings ($r(27) = .38$, $p<.05$), and transfers ($r(27)=.53$, $p<.01$) while looking. These results are framed within a perception-action approach, where infants' multimodal exploration and nascent object knowledge are coupled in developmental time.

**Th4-58**

### Nonlinear Analysis of Sitting Postural Sway Indicates Developmental Delay in Infants

**Nicholas Stergiou**[1,2] Joan Deffeyes[1] Regina Harbourne[3] Stacey DeJong[3] Anastatia Kyvelidou[1] Wayne Stuberg[3]

*1. HPER Biomechanics Laboratory, University of Nebraska at Omaha,Omaha, USA; 2. Department of Environmental, Agricultural and Occupational Health Sciences, College of Public Health, University of Nebraska Medical Center, Omaha, USA; 3. Munroe Meyer Institute, University of Nebraska Medical Center, Omaha, USA*

Upright sitting is one of the first developmental motor milestones achieved by infants, and sitting postural sway provides a window into the developing motor control system. However, sitting postural sway has not been carefully examined in the past and thus the optimal measures for infant development have not been identified. We have collected sitting postural sway data from two groups of infants, one with typical development (n=35) and one with delayed development (n=27). Data was collected at two time points, once when the infants could just maintain sitting for about ten seconds (novice sitting), and once three to four months later (experienced sitting). Paired t-tests showed an increase in postural sway in the side-to-side direction (i.e. range of the sway path), and a decrease in complexity in the forward-backward direction (i.e. Lyapunov exponent, a measure of consistency in the sway path trajectories), with development for infants having typical development. No significant differences were seen with development for the infants with delayed development. Independent t-tests showed that the Lyapunov exponent was the only measure of postural sway used in the study that showed significant differences between the postural sway of infants with typical versus delayed development, and that the difference was only significant for novice sitting. The postural sway of typically developing infants had a higher Lyapunov exponent, indicating higher complexity for the healthy condition compared to the pathologic condition.

**Th4-59**

### Development of Cerebral Oxygenation Preceding a Reaching Movement

**Rieko Takaya**[1] Akira Midorikawa[2]

*1. Faculty of Human Development and Culture, Fukushima University, Fukushima, Japan; 2. Department of psychology, Chuo University, Tokyo, Japan*

**Background and Aims:** The pre-reaching activities of infants change with age during the first 5 months of life. The amount of pre-reaching decreases at around 2 months of age, and infants cannot reach for an object successfully until 5 months (Hofsten, 1984). While infants cannot reach for objects, they do not seem to lose interest in them. In this study, in order to explore the development of the nervous system as a background for the reaching movement, we investigate the relationship between the development of the reaching movement and cerebral development using a near infrared spectroscopy (NIRS).

**Methods:** Ten infants from 1 to 6 months old were longitudinally examined. The infants sat on a baby chair and were presented with a stimulus in front of them while cerebral blood oxygenation changes were measured using the multi-channel NIRS. The session was composed of three trials containing a one minute stimulus phase following a one minute rest phase. The measurement device was a 22 multi-channel NIRS that was mounted on the infants' foreheads. Significant changes of the oxygenation corresponding to the stimulus were considered as an index. The stages of reaching movement were classified into three types: (I) Absence of a movement, (II) Lifting the arm in the direction around the target, (III) Reaching the target. In this study we were interested in the relation between the pattern of cerebral blood oxygenation and the stage of reaching movement.

**Results:** Reaching movements did not appear until the age of 4 months in any infant; stage II occurred around 4 months, and stage III began to appear around 5 months. The development of cerebral blood oxygenation had an inverted V shape and peaked in four-month-olds. Although the appearance of reaching movements (stage III) occurred in five-month-olds, the peaks of the development of oxygenation change occurred in four-month-olds; the appearance of reaching movements fell behind the peaks of the development of oxygenation change.

**Conclusion:** The development of oxygenation change did not directly reflect the reaching movement; however, it did correspond to the immature reaching movement. These results might reflect the frontal region's role in the course of learning reaching

**Th4-60**

### Sensorimotor Experience and Effects on Look and Touch Behavior in Pre-Reaching Infants

**Joshua Williams, Daniela Corbetta**

*The University of Tennessee, Knoxville, Knoxville, USA*

Early experience has been shown to have an effect on infant development. Needham, Barrett, & Peterman (2002), for example, have shown that providing pre-reaching infants experience with Velcro mittens simulating grasping increased their interest in and exploration of objects. This study attempts to determine what aspect of this particular experience drives an increase in object-directed activity. For instance, is it the simulation of grasping provided by the stickiness of the mittens, or is it simply the increased salience of the hand from wearing the mittens that drives this increase?

Thirty pre-reaching infants aged 2 months 3 weeks were followed for 16 consecutive days. Each infant was randomly assigned to one of 3 groups: velcro mitten (grasping simulation), non-velcro mitten (no grasping simulation), or control (no mitten). On Day 1, all infants came to the laboratory for a baseline assessment. Infants wore no mittens and their arm movements in the presence of a toy were recorded using kinematics. From Days 2 to 15, the velcro group and non-velcro group were tested in their homes without kinematics. On Day 16, all infants were brought back to the laboratory to reassess movement kinematics without mittens. All lab and home sessions followed the same procedure: infants were supported in an infant seat with a waist-high table placed in front of them. The experimenter, facing the infant, placed a toy in front of the child at midline within reaching distance for a duration of one minute. We coded the number of touches when looking or not looking at the toy and the changes in overall hand-toy distance between Days 1 and 16.

Preliminary results on over half of the total infants indicate that all groups did improve on their ability to look at and touch the objects from the first to final day, however, only the non-velcro group showed a significant and sustained increase in looking and touching over time. These results suggest that the stickiness of the mittens simulating grasping may not be the most important part of the experience. Rather, the salience of the hands, or the fact that the toy in the non-velcro condition could be touched and explored repeatedly may have contributed to maintaining greater interest in the task and triggering more successful attempts.

## *Perceptual Development*

**Th4-61**

### Tempo Discrimination in Infants: The Roles of Intersensory Redundancy, Task Difficulty, and Expertise

**Lorraine Bahrick**, Robert Lickliter, Mariana Vaillant-Molina, Irina Castellanos

*Florida International University, Miami, USA*

**Background and Aims:** Prior research has provided support for the Intersensory Redundancy Hypothesis (IRH, Bahrick & Lickliter, 2000, 2002, 2004), which proposes that in early development information presented redundantly and synchronously across two or more sensory modalities is highly salient and facilitates perceptual learning of amodal properties (tempo, rhythm, intensity) to a greater extent than the same information presented to one sense modality. Further, with increased experience infants discriminate amodal properties in both multimodal and unimodal stimulation. The present study tested a new extension of this developmental prediction of the IRH: that redundant stimulation across two or more sensory modalities continues to facilitate perceptual learning of amodal properties across development and that this is most evident when tasks are difficult in relation to the capabilities of the perceiver. As an initial test of this prediction, we assessed discrimination of tempo contrasts of differing difficulty in bimodal vs. unimodal stimulation in 5-month-old infants.

**Methods:** Stimuli and data from a prior study of tempo discrimination in 5-month-olds (Bahrick & Lickliter, 2004) served as the low difficulty condition (110 vs. 240 bpm), and tempo contrasts of moderate (160 vs. 200 bpm) and high difficulty (160 vs. 185 bpm) were created for the present study. As in our prior study, infants were habituated with a video of a toy hammer tapping at one of two tempos (faster vs slower, counterbalanced) and their visual recovery to the novel tempo served as an index of discrimination. Infants were randomly assigned to

modality (bimodal, audiovisual vs. unimodal visual) and difficulty level conditions (moderate vs. high).

**Results:** Infants discriminated the low and moderate difficulty tempo contrasts in the bimodal audiovisual ($t(15) \cong 4.27$, $p < .01$; $t(11) \cong 3.08$, $p < .05$, respectively) and unimodal visual ($t(15) \cong 3.04$, $p < .01$; $t(11) \cong 2.17$, $p \cong .05$) conditions. However, infants discriminated the high difficulty tempo contrasts only in the bimodal audiovisual condition ($t(11) \cong 2.24$, $p < .05$)

**Conclusions:** These findings extend the developmental hypothesis of the IRH to older infants and indicate that as task difficulty increases, discrimination of tempo is facilitated in bimodal, redundant, stimulation as compared with unimodal stimulation. Thus, in more difficult tasks older infants revert to patterns of facilitation characteristic of younger infants. Taken together, these findings suggest intersensory facilitation is a function of task difficulty in relation to the expertise of the perceiver, and thus may be evident across the lifespan.

**Th4-62**

### Visual-Only Spoken Word Discrimination in Infants

**Tonya Bergeson**, Ashley Williams

*Indiana University School of Medicine, Indianapolis, USA*

**Background and Aims:** The ability to integrate auditory information with visual information is important for speech perception and spoken language development. Studies have shown that infants as young as 2 months of age can integrate the auditory and visual information contained in steady-state vowels (Kuhl & Meltzoff, 1982; Patterson & Werker, 2003). In a recent study using the preferential looking paradigm, we found that 7.5- and 10.5-month-old infants were also able to match audiovisual (AV) information when presented with the words "back" and "judge," but 5.5- and 13.5-month-old infants did not exhibit such audiovisual integration skills. The present study investigated infants' ability to visually discriminate the spoken words "back" and "judge."

**Methods:** Using a visual-habituation procedure, we tested 14 infants from three age groups: 5.5 months (n = 6), 7.5 months (n = 2), and 10.5 months (n = 6). During the habituation phase, infants were presented with a visual display of a woman articulating a word ("back" or "judge"). Once infants reached the habituation criterion, the test phase was presented using an oddball paradigm. The first two test trials consisted of an old and a novel trial, followed by three sets of four trials, three of which were old and one of which was novel.

**Results:** A repeated measures ANOVA using test type (old vs. novel) as the within-subjects repeated measure and age group (5.5, 7.5, and 10.5 months) as the between-subjects factor revealed no main effects, but a marginally significant interaction between test type and age group, $F(2,11) = 3.303$, $p = 0.075$. Post-hoc paired t-tests comparing looking time to novel and old trials for the 5.5- and 7.5-month-old infants showed that the looking time differences across the two test types were not significant (5.5 months: $t = -0.958$, $p = 0.191$; 7.5 months: $t = -6.977$, $p = 0.45$). However, the 10.5-month-old infants tended to look longer at the novel than the old trials ($t = 1.778$, $p = 0.068$).

**Conclusion:** The younger infants were not able to visually discriminate the words "back" and "judge," whereas the 10.5-month-olds did discriminate these words. The present results may help to explain why the 5.5-month-old infants did not exhibit audiovisual integration in the previous study. Perhaps the use of more visually distinct words would reveal an ability to match auditory and visual articulation cues in words in infants across a wider age range.

**Th4-63**

### The Relation between Configural and Holistic Face Processing in Infancy

**Ramesh Bhatt**, Angela Hayden, Ashley Kangas

*University of Kentucky, Lexington, USA*

**Background and Aims:** Although several types of relational information have been identified as being involved in face processing, not much is known about how they are related to each other. In the current study, we explored the relations between configural and holistic processing in infancy. Configural (second-order relational) information refers to fine spatial relations among features. Holistic processing refers to the fact that faces are processed as holistic Gestalts.

In Hayden et al. (2007), 5-month-olds discriminated between intact faces and configurally distorted faces (in which distances between the eyes and between the nose and the mouth were altered). Did infants detect these changes based only on local information around the features or did configural processing take place in the context of the whole face, i.e., holistically (Bartlett et al., 2003)? We examined this issue in the current study.

**Method and Results:** Using a movement enhanced discrimination procedure (Hayden et al., 2007), we examined 5-month-olds' discrimination between intact and configurally distorted faces. In the whole face condition, the normal faces were unaltered photographs while the only changes in the distorted faces involved the spacing of features. In the split face condition, the top and bottom halves of both the normal and distorted faces were displaced (a manipulation known to affect adults' holistic processing; Young et al., 1987). This manipulation left the relevant configural information (distances between eyes and between the nose and mouth) intact.

Infants discriminated configural distortions in the whole face (preference score = 54.25, $t(23) = 2.04$, $p < .05$, compared to chance) but not in the split face condition (preference score = 50.29, n.s.). Moreover, the score was significantly greater in the whole face than in the split face condition, $t(46) = 1.81$, $p < .05$. Thus, configural processing was affected by the fractioning of faces of the sort that affects holistic processing in adults.

In Experiment 2, infants detected normal faces from first-order distorted faces (i.e., with features completely scrambled) even with split faces (novelty preference score = 54.31, $t(15) = 2.02$, $p < .05$). Thus, the displacement of the top-bottom face portions specifically affected configural but not first-order relational information processing in this study.

**Conclusion:** The results indicate that configural (second-order relational) processing in infancy is not localized but takes place in the context of holistic face Gestalts. However, not all kinds of relational information processing are dependent upon the processing of faces as holistic Gestalts.

**Th4-64**

### Infant Word Recognition is Stress-Full

**Heather Bortfeld**[1] James Morgan[2]

*1. Texas A&M University, College Station, USA; 2. Brown University, Providence, USA*

In a series of studies, we examined how mothers naturally stress words across multiple mentions in speech to their infants and how this marking influences infants' recognition of words in fluent speech. We first collected samples of mothers' infant-directed speech using a technique that induced multiple repetitions of target words. Acoustic analyses revealed that mothers systematically alternated between emphatic and nonemphatic stress when talking to their infants. Using the headturn preference procedure, we then tested 7.5-month-old infants on their ability to detect familiarized bisyllabic words in fluent speech. Stress of target words (emphatic and nonemphatic) was systematically varied across familiarization and recognition phases of four experiments. Results indicated that, although infants generally prefer listening to words produced with emphatic stress, recognition was enhanced when the degree of emphatic stress at familiarization matched the degree of emphatic stress at recognition.

**Th4-65**

### Ethnic Familiarity Does Not Affect 6- and 10-Month-Olds' Processing of Novel Faces

**Tanya Broesch**, **Erin Robbins**, Philippe Rochat

*Emory University, Atlanta, USA*

**Background and Aims:** Previous studies have documented a shift in the ability to discriminate faces as a function of early exposure, indicating that there may be emerging face categories in the first months (de Haan, Belsky, Reid, Volein, & Johnson, 2004; Slater et al., 2000). In particular, Pascalis, de Haan, & Nelson (2002) report a change between 6- and 10-months, in infants' ability to perceptually discriminate among monkey faces. We further investigated the mechanism underlying this development by recording 6- and 10-month-olds' visual exploration of novel adult human faces that were either ethnically familiar or unfamiliar (black or white individuals) using a non-invasive (Tobii) eye tracking device.

**Methods:** Twenty-seven infants were tested using a Visual Paired Comparison (VPC) procedure modeled after Pascalis and co-authors (2002). We used a within subjects design and presented infants with two blocked conditions of faces from either same- or other- ethnic faces. Infants were familiarized to a face, followed by preferential looking test trials in which the Familiar was paired with a Novel face. In order to determine visual discrimination, we recorded and analyzed infants' visual exploration of Novel and Familiar faces either from same- and other- ethnic faces.

**Results:** We analyzed total gaze duration to Novel and Familiar faces during test trials, as a function of whether it matched or did not match the infant's ethnicity. Confirming past studies, 6-month-olds displayed visual discrimination with preferential looking for Familiar faces regardless of matching or non matching ethnicity (black or white). In contrast, 10-month-olds did not show any signs of discrimination in any of the conditions. Consistent with previous developmental studies, 10-month-olds gaze distribution becomes more evenly distributed across regions of the face, compared to gaze patterns of 6 month-olds.

**Conclusions:** These findings confirm that there is a general developmental shift in face processing between 6- and 10-months that is independent of ethnic familiarity. More studies are needed to understand the potential effect of exposure and familiarity on face processing and social perception in the first year of life. We interpret these findings as indicating a potential shift in what constitutes a familiar face, with familiarity becoming restricted to primary caretakers in the life of the infant by 10-months of age.

**Th4-66**

### Attentional Mechanisms Involved in the Selection of an Illusory and a Non Illusory Figure

**Hermann Bulf**, **Eloisa Valenza**

*Dipt. di Psicologia dello Sviluppo, Università degli Studi di Padova, Padova, Italy*

Our perception of coherent unified objects depends crucially on how attention is allocated to bind together and integrate objects' features in correct combinations. The study of illusory perception in infancy is a useful tool to investigate the emergence of objects processing abilities. Traditional studies suggest that illusory contours perception emerge between 5 and 7 months (Bertenthal, Campos & Haith, 1980; Otsuka & Yamaguchi, 2003). However, these studies have used paradigms (i.e. visual preference/habituation) that did not allow to disentangle the role of perceptual and attentional processes involved in the perception of illusory contours.

The present study was aimed at investigating the role of figural binding and selective attention involved in the selection of a Kanizsa figure. To this end, 6-month-old infants and adults were tested in a illusory (Kanizsa triangle among distractor pacmen) or non illusory condition (a real triangle included in the same pacmen's pattern). Saccade directions and latencies (ms) were measured using an eye-tracker system. Six-month-old infants showed a visual preference for illusory Kanizsa figure when a preferential looking paradigm was used (Experiment 1). Conversely, when a paradigm more akin to those used with adults was employed (i.e. visual search), infants did not show the same pattern of results obtained with adults. Indeed, adults selected both the Kanizsa and the real figures automatically and without a serial search of the target, (Experiment 2), whereas 6-month-old infants showed a pop-out effect only for the real figure, but not for the illusory figure (Experiment 3). Overall, this outcome demonstrate that, although 6-month-old infants are able to perceive a Kanizsa figure, their ability to extract information from the environment when they are asked to select the illusory figure is affected by the attentional processes involved in the task.

**Th4-67**

### Face Perception in Three-Month-Old Infants: an Eye-Movement Study

**Irene Leo**, **Elisa Di Giorgio**, Francesca Simion

*DPSS-Università di Padova, Padova, Italy*

**Background and Aims:** Previous studies showed that 3-month-old infants prefer an upright real face to an upside-down one (Macchi Cassia et al., 2006; Turati et al., 2005), corroborating previous evidence obtained with schematic face-like stimuli (e.g., Haaf, 1974; Johnson et al., 1992). Studies of infants' scanning suggest that four-month-old infants spend more time exploring internal features, when they are habituated with an upright face (Gallay et al., 2006) and that, around 3-months of age, among all of the facial features, the eyes appear to be of

particular importance in face perception (Haith et al., 1977; Hainline, 1978) independently from their location in the face (Maurer, 1985). However, it is not clear which of the properties embedded in a face attract infant's attention: the position of the eyes, their orientation or the eyes properly located in the natural arrangement in the face. In order to investigate this issue three variables have been manipulated: the position (Experiment 1) and the orientation (Experiment 2) of the eyes and the natural arrangement of a face (Experiment 3).

**Method:** Three experiments were carried out using a corneal reflection system (i.e., eye-tracker). Forty infants, 3 months of age, were tested using the preferential looking. Eye movements were recorded as infants observed the photographs of an upright face with misoriented eyes along with an inverted face with the eyes correctly oriented but located in the lower part (Experiment 1), two upright faces in which one presented with misoriented eyes (Experiment 2), and two upright faces in which one scrambled but with the eyes correctly oriented and in the right position (Experiment 3).

**KeyResults:** Results indicated that the eyes are not preferred per se, because either when the eyes are in the correct position but misoriented or when the eyes are correctly oriented but misplaced and located in the lower part of a face, they lose part of their salience and failed to attract infants' gaze (Exp.1). On the contrary, the eyes play an important role in inducing face preference only when they are located in their natural arrangement within the upright face (Exp. 2 and 3).

**Conclusions:** Overall, these results show that the 3-month-old's gaze seems to be attracted by the interrelation between the arrangement of the inner features and by the position and orientation of the single facial features. This suggests that the infants' preferential response becomes more specific to the face category.

**Th4-68**

## Stimulus Contingency and the Malleability of Species-Typical Auditory Preferences

**Christopher Harshaw**[1] Isaac Tourgeman[2] Robert Lickliter[1]

*1. Florida International University, Miami, USA; 2. Nova Southeastern University, Fort-Lauderdale, USA*

**Background and Aims:** A growing body of research attests to the importance of social interaction and contingency during early development. Goldstein, King and West (2003), for example, demonstrated that infants produce more sophisticated vocalizations when their mothers respond to their babbling in a contingent manner. The acquisition of filial preference (i.e. imprinting), in contrast, has traditionally been characterized as a special type of learning that occurs largely independent of social interaction or contingency. We recently demonstrated, however, that brief contingent exposure to a bobwhite quail maternal call significantly enhanced the acquisition of preferences in bobwhite chicks compared to noncontingent exposure (Harshaw & Lickliter, 2007). In the current study we explored whether contingent exposure to a species-atypical maternal call could significantly alter the normally robust species-typical auditory preferences of newly hatched bobwhite neonates.

**Methods:** Day-old bobwhite chicks received either 5-, 8- or 10-min contingent (CON) or yoked, noncontingent (NOC) exposure to a bobwhite (BW) or a Japanese quail (JQ) maternal call. Additional groups of chicks were given either no exposure (controls) or else CON exposure to the JQ call on a variable-ratio schedule. All subjects were tested in simultaneous choice tests between the bobwhite and Japanese maternal calls one day later at 48-hrs of age.

**Results:** Naïve chicks displayed a strong preference for the BW call ($\chi^2$ = 17.29, p < .000) that was no longer present in chicks provided 5-min CON exposure to the JQ call ($\chi^2$ = .84, p = .658). Chicks given NOC exposure showed no shift in their species-typical preference for the BW call (Z = -.25, p = .805). In contrast, chicks provided with intermittent CON exposure to the JQ call (on a VR2 schedule) reversed their typical preference and displayed a significant preference for the species-atypical JQ call ($\chi^2$ = 7.75, p = .021).

**Conclusion:** A key feature in the developmental system of many precocial avian species is the presence of social interaction and contingency. Our results demonstrate that social contingencies may provide a powerful mechanism influencing the malleability of species-typical auditory preferences during early development. This finding extends Gottlieb's (1991) demonstration that the social contact provided by conspecifics can increase the malleability of species-specific preferences and suggests a possible pathway to developmental novelty and evolutionary change.

**Th4-69**

## Infants' Sensitivity to Configural Information in Human Male and Monkey Faces

Angela Hayden, Ramesh Bhatt, Nicole Zieber

*University of Kentucky, Lexington, USA*

**Background and Aims:** Adults' face processing expertise comes from their ability to process information not only about the features of a face (e.g., eyes) but also about the configural spatial relations among them (e.g., the distance between the eyes). Some researchers have argued that the development of face processing expertise primarily involves the development of configural (or second-order relational) information processing (Diamond & Carey, 1994).

Recently, we reported that 5- and 7-month-old infants are sensitive to configural information in female faces (Hayden et al., 2007). However, some researchers have argued that children as old as 4 years of age are not sensitive to configural information (Mondloch et al., 2006). Given this uncertainty about the development of configural processing, we sought to obtain convergent evidence of our findings and extend them to new kinds of faces.

**Method:** We examined whether 6- to 7-month-olds are sensitive to configural information in human male and in rhesus monkey faces. Using the movement-enhanced discrimination procedure used in our previous study, we examined whether infants would discriminate between an undistorted face photograph and a distorted photograph that differed from it in terms of configural information. The distorted versions of the male human faces and monkey faces were generated by changing the distance between eyes and between the nose and the mouth by the same proportions as was done with the female faces in our prior study.

**Results:** Infants discriminated between the undistorted and the distorted human male (novelty preference score: 54.15, SE = 1.72, t(15) = 2.47, p < .05, compared to chance) and monkey faces (53.25, SE = 1.72, t(15) = 1.89 p < .05). Thus, they exhibited evidence of sensitivity to configural changes in human male and monkey faces.

**Conclusion:** The results extend our findings of sensitivity to configural (second-order relational) information in female faces to male faces and to a different species. Some prior studies indicate that infants process female faces differently than male faces. However, the current results suggest that infants' processing of configural information does not differ in male versus female faces. Moreover, the fact that configural

changes in monkey faces were also discriminated by infants indicates that, at least at 6 to 7 months of age, infants' face processing expertise extends not only to male faces but also to faces of other species.

**Th4-70**

### Parts, Cavities, and the Development of Object Representation in Infancy

Angela Hayden, Ramesh Bhatt
*University of Kentucky, Lexington, USA*

**Background and Aims:** Part perception is fundamental to a number of critical visual functions such as figure-ground assignment, visual search, and allocation of attention (Singh & Hoffman, 2001). However, virtually nothing is known about the development of part perception.

In the current study, we examined whether infants process the shape of parts more than the shape of cavities. If parts play a key role in object representation, then the visual system should give more priority to parts than to other object attributes. Prior research on adults supports this contention. For instance, adults are quicker to process the location of parts than the location of cavities (Bertamini, 2001).

**Method and Results:** In Experiment 1, using an infant control habituation procedure, infants were habituated to an image of an object that had a (circular, rectangular or triangular) part on one side and a different shaped (rectangular, triangular or circular) cavity on the other. Then, infants were tested for their preference between the part shape versus the cavity shape. We reasoned that infants would exhibit a novelty preference for the cavity shape if they had preferentially processed the part shape during habituation.

Five-month-olds exhibited a preference for the cavity shape (preference score = 59.09, $t(11) = 2.65$, $p < .05$, compared to chance) but 3-month-olds did not (novelty score = 48.98, n.s.). Moreover, the 5-month-olds' score was significantly higher than that of the 3-month-olds, $t(22) = 1.88$, $p < .04$. Thus, 5-month-olds, but not 3-month-olds, exhibited evidence of differential processing of parts over cavities.

In Experiment 2, we ensured that older infants' differential processing in Experiment 1 was specific to parts rather than to any external contour subset. We habituated infants to the same stimuli as those used in Experiment 1 but tested them for their preference between the cavity shapes versus non-part shapes composed of arbitrary subsets of the external contour. Infants failed to exhibit a preference (novelty preference score = 47.99, n.s.), thereby indicating that 5-month-olds' performance in Experiment 1 was specific to parts.

**Conclusion:** Five-month-olds, but not 3-month-olds, processed parts more than cavities in this study. These results reveal that, at least by 5 months of age, infants are able to selectively process contour changes that signal parts. However, the fact that 3-month-olds failed to exhibit evidence of part representation suggests that part processing is not innately specified, in the sense of being available from birth.

**Th4-71**

### Gender Differences in Older Infants' Auditory-Visual Integration of Speech Using the Mcgurk Effect

**Cassandra Hockman**[1] Jessica Versele[1] Robin Panneton[2]
*1. Department of Psychology, Virginia Tech, Blacksburg, USA; 2. Virginia Tech, Blacksburg, USA*

Although speech perception during infancy has often been examined in conditions that concentrate only on auditory processing, it is clear that most infants learn about language in a multimodal context. In particular, infants interact with speakers who convey language information in their faces and voices. But to what extent are infants actively processing visual speech information? Infants match information across faces and voices, learn about specific face+voice relations, and are influenced by the dynamic integration that is specifically related to articulatory gestures that can be both seen and heard. The latter has been documented in a few studies employing the McGurk Effect. In such studies, infants are given displays of adult speakers who are producing one phoneme visually (e.g., /ga/) but another vocally (e.g., /ba/). In adults and children, such AV mismatches typically produce blended phoneme percepts (e.g., /da/ or /tha/; however, some cultural differences exist). Although previous McGurk studies with infants suggest that they too perceive a blend, the results are not robust. Infants appear to perceive the blend under some conditions but not others, and there have been reports of inconsistent gender effects. The ambiguity in this line of research may stem, in part, from the inclusion of fairly young infants (4 - 5 month olds) and the lack of infant directed (ID) styles of speaking.

The purpose of this study was to examine visual speech processing in 7-8 month old infants (an age when attention to dynamic faces is increasing) with female ID McGurk movies. All infants were habituated to an ID auditory /ba/ - visual /ga/ (AbaVga) McGurk movie. After habituation, infants were tested with three kinds of trials: AgaVga (novel), AbaVba (novel), and AbaVga (familiar). In testing, infants received more familiar than novel trials (3:1) to increase the saliency of the novel events (a total of 14 test trials). If infants perceive a blended percept during habituation, then attention on novel trials should increase. In a preliminary analysis of 18 infants (11 females), females show significantly higher attention on both types of novel test trials (compared to attention on the familiar trials), but males only show recovery on the VgaAga trials (i.e., there was no difference in their attention on AbaVba compared to familiar trials). This pattern of results partially replicates an earlier finding by Desjardins & Werker (2004), and suggests that female, but not male, infants actively integrate AV speech information.

**Th4-72**

### Exploring the Emergence of Intersubjectivity in an Avian Neonate: The Development of Gaze Following Behavior

**Mark Jaime**, Robert Lickliter
*Florida International University, Miami, USA*

**Background and Aims:** The ability to follow gaze provides key information about the goals and intentions of others. However, little is known about the development of this ability in non-human animals, especially during early development. We explored bobwhite quail neonates' ability to track human gaze by assessing their avoidance behavior in an open arena in the days following hatching.

**Methods:** Chicks received a 5 min simultaneous choice test between two identical bobwhite maternal calls broadcast from opposing sides of a circular arena in one of three conditions: (1) a Control condition, in which no human gazer was present, (2) a Gaze Follow condition, in which a live human gazer was positioned between the two approach areas. When chicks approached a pre-designated approach area, the gazer ongoingly directed his/her gaze toward that approach area, and (3) an Intersubjective condition, which consisted of two parts. In the observation component, chicks were placed in a semi-circular cage directly underneath the position of the gazer. The cage contained a barrier that prevented the chick from seeing the human gazer directly above them. However, chicks were allowed to observe a conspecific

while it received the same Gaze Follow procedure as described in Condition 2. The test component began after the observation session was completed. The conspecific chick and human gazer were removed from the test arena and the observer chick received a 5 min choice test between the two identical bobwhite maternal calls. Chicks from each condition were tested once at 24, 48, or 72 hr after hatching.

**Results:** As expected, control chicks showed no preference for either approach area at any age tested, indicating no naïve side bias in the test arena. Chicks in both the Gaze Follow condition and the Inter-subjective condition showed a significant preference for the approach area that received no human gaze at both 48 and 72 hr, but not at 24 hr following hatching.

**Conclusions:** These results indicate the rapid emergence of gaze following behavior in bobwhite quail neonates. Chicks avoided approaching a maternal call that received human gaze by 48 hr of age. Our results raise the interesting question as to whether and to what extent precocial avian neonates can attribute intentional states to others by means of gaze information. Current research is focused on determining the experiential factors that could contribute to this rapid emergence of gaze following and the possible precursors to inter-subjectivity.

**Th4-73**

### Recognition of the Profile Pose of the Mother's Face By 9 Week Old Infants: Evidence For the Emergence of a Broader Facial Representation

**Fatma Zohra Sai**

*Al ain, UAE*

Previous evidence shows that 4 week old infants look longer at the 3/4 profile pose of the mother's face, but fail to recognize the profile pose of the same face (Sai & Bushnell, 1988; Sai,1990a) and only 12 week old infants demonstrate preference for the profile pose of their mother's face (Sai,1990a). The purpose of the present study was to find out the earliest age for the emergence of a representation of the mother's face that includes the different perspectives of that face. We tested the ability of 8 week and 9 week old infants to recognize the face of their mother's shown in full face, three quarter profile and profile poses. Nine week old infants showed evidence of recognizing the mother's face and thus having a representation of the mother's face. Only few of the 8 week olds have started showing preference for the profile pose of their mother's face, and the results were not significant. These findings are clear evidence that around 9 weeks, infants develop a broader representation of their mother's face that is not orientation specific.

**Th4-74**

### Processing of Face Identity and Emotional Expression in 8-Month-Old Infants

**Gudrun Schwarzer**, Bianca Jovanovic

*University of Giessen, Department of Psychology, Giessen, Germany*

While previous work has shown that infants discriminate among a number of different facial identities and different facial expressions of emotion (see de Haan, 2003 for an overview), the relationship between the processing of facial identity and emotional facial expression in infants has not yet been explored. Recent studies suggest that the face processing system in adults includes independent functional subsystems for face identity and emotion processing, and also interactions between these subsystems (e.g., Schweinberger & Sokoup, 1998). The present study investigated to what extent facial identity and emotional expression are processed independently or interactively in infants.

8-month-old infants were randomly exposed to two conditions and looking times were recorded. In condition 1, infants were habituated to two facial identities (face A and face B). Face A expressed a positive emotion and face B expressed a negative emotion (or vice versa). At test, a familiar face (A or B), a composite face, and a new face were presented. Face identity and emotional expression were recombined in the composite faces, i.e. face A was presented with the expression of face B or vice versa. In condition 2, infants were shown the faces of the habituation and test phase in an inverted orientation because it is known that this will disrupt interactive processing. If infants are processing identity and emotional expression of the faces A and B interactively, then we would expect them to look longer at the composite faces in the upright than in the inverted condition. An analysis of variance of the results revealed this to be the case: Infants looked significantly longer at the composite face in the upright than in the inverted condition.

We conclude therefore that information on face identity and emotional expression are processed interactively in infants. The extent to which these interactions parallel those reported for the adult face processing system, will be discussed.

**Th4-75**

### Infants Prefer Culturally Familiar Music

**Gaye Soley**[1] Erin Hannon[2]

*1. Dept. of Psychology, Harvard University, Cambridge, USA; 2. Dept. of Psychology, University of Nevada, Las Vegas, Las Vegas, USA*

**Background and Aims:** Newborns and very young infants tend to prefer familiar structures such as their native language, own-race faces, and their own mother's voice, face, and smells. Music is a ubiquitous, culture-specific stimulus that is typically heard and recognized prior to birth, yet it is currently unknown whether or not infants prefer genres or styles of music on the basis of cultural familiarity. *Meter* is one aspect of music that varies cross-culturally: Western music has temporally regular rhythms and underlying beats whereas music of Eastern Europe and the Middle East (i.e., Bulgaria, Macedonia, Turkey) can have both regular and irregular structures. We examined whether infants of varying cultural background would exhibit culture-specific preferences for music on the basis of meter, in parallel with preferences observed in other domains.

**Method:** We created sets of melodies having three types of meter but otherwise maximally similar in pitch structure and tempo. *Western* meters contained regular rhythms and even beats, *Balkan* meters contained irregular rhythms typical of Bulgarian and Turkish music, and *Alien* meters contained irregular rhythms uncommon to any known cultures. American and Turkish infants (N=101, mean age=6.1 months) were individually presented with alternating pairs of two rhythm types (i.e. Western and Balkan, Western and Alien, or Balkan and Alien). Identical, non-rhythmic portions of a film accompanied all auditory stimuli. Trial durations were infant-controlled and could last up to 60 s each. Looking times were coded on-line and verified by later frame-by-frame coding offline.

**Results:** Two-tailed, paired t-tests on looking times (s) revealed that American infants preferred listening to melodies with Western meter over either Balkan or Alien meters ($p<.05$, $p<.01$). They showed no preference when presented with two unfamiliar meters (Balkan and Alien) ($p>.10$). By contrast, Turkish infants exhibited no preference

when presented with the Western and Balkan pairing ($p$>.50), whereas they showed robust preferences for either Western or Balkan over Alien ($p$<.01, $p$<.05).

**Conclusion:** These results indicate that North-American infants preferred a culturally familiar meter (Western) over two unfamiliar meters, whereas Turkish infants, who are 'musically bilingual' (i.e., equally familiar with both regular and irregular meters), preferred either familiar meter (Balkan or Western) over an unfamiliar meter (Alien). These results closely parallel prior findings of native language preferences in monolingual and bilingual infants, and they provide the first evidence to date that young infants exhibit musical preferences on the basis of cultural familiarity.

**Th4-76**

### Differential Processing of Newborn and Adult Faces in 6-Month-Old Infants: Evidence From ERPs

**Alissa Westerlund**[1] Katherine Hung[1] Charles Nelson[2]

*1. Children's Hospital Boston, Boston, USA; 2. Harvard Medical School, Children's Hospital Boston, Boston, USA*

Experience with faces plays an important role in the development of face discrimination and recognition abilities. One major category of visual face perception is gender. Studies of gender perception indicate that infants show a processing advantage and preference for female faces that is likely due to greater experience with female faces (Ramsey-Rennels & Langlois, 2006). In support of this view, Quinn et al. (2002) observed that 3- and 4-month-old infants whose mother was their primary caregiver tended to prefer female faces to male faces, whereas infants with a male primary caregiver showed a preference for male faces. A second category of visual face perception is race. Bar-Haim and colleagues (2006) reported that racial environment influences face preferences in 3-month-olds. Specifically, infants living in a homogeneous own-race environment show a preference for own-race faces, whereas infants who experience significant cross-race exposure do not exhibit an own-race face preference at three months. Collectively, these studies illustrate the important mediating role that experience plays on two categories of visual face perception - gender and race. The goal of the present study was to examine whether the effects of experience extend to a third category of face perception - specifically, age.

Six-month-old infants were presented with randomly alternating pictures of black-and-white upright adult and newborn faces while event-related potentials (ERPs) were recorded from 63 scalp locations using a Geodesic Sensor Net. Artifact-free data were obtained from 18 infants (8 female). Analysis of the P400, an ERP component that responds differentially to various aspects of faces, revealed significantly larger average amplitude to the adult faces compared to the newborn faces (main effect of FACE AGE, $F(1,17) = 5.25$, $p = .035$). Analysis of the NC, a component related to obligatory attention or stimulus salience, indicated that the adult faces elicited significantly larger average amplitude than the newborn faces (main effect of FACE AGE, $F(1,17) = 4.99$, $p = .039$). These results will be discussed in the context of the developmental literature on the role of early experience in the specialization of face processing in the first year of life.

## *Psychopathology and Developmental Delay*

**Th4-77**

### The Validity and Modifiability of Mother Reported and Observed Infant Distress to Novelty in relation to Mother and Father Reported Social Fear at 2 1/2 Years

**Susan Crockenberg**[1] Esther Leerkes[2]

*1. University of Vermont, Burlington, USA; 2. University of North Carolina, Greensboro, USA*

In this study, we: 1) test the validity of mother-report and observational measures of infant distress to novelty by comparing their prediction to mother and father reported social fear; 2) test the modifiability of infant temperament in relation to later social fear by sensitive maternal behavior; and 3) test the discriminate validity of social fear in relation to anxiety. We reasoned that: significant positive associations between early and later temperament reported by mothers and fathers would indicate predictive validity, eliminating source variance; interactions between infant temperament and maternal sensitivity would indicate that temperamental continuity is conditional; and significant associations between infant temperament and social fear controlling for child anxiety would indicate that they are distinct constructs.

**Methods:** Participants were 65 low-risk mothers and children (46 fathers). Mothers completed the Marital Conflict Questionnaire prenatally, yielding a measure of avoidance, and the Infant Behavior Questionnaire at 5 months, yielding a measure of reported infant distress to novelty, separated into fear of strangers/animals and fear of objects/noises. At 6 months, infants and mothers were observed in a laboratory designed to elicit infant distress to novel toys, yielding independent measures of infant distress to novelty and maternal sensitivity. At 2 1/2 years, parents completed the Toddler Behavior Assessment Questionnaire, yielding measures of social fear and social desirability; mothers completed the Child Behavior Checklist, yielding a measure of child anxiety.

**Results:** Using hierarchical multiple regression, and controlling for social desirability and maternal avoidance, reported distress to strangers positively predicted mother- and father-reported social fear. Additionally, maternal behavior moderated this effect: easily distressed infants with highly sensitive mothers exhibited more social fear at 2 than comparable infants with less sensitive mothers. Effects were independent of child anxiety. Observed distress to novelty negatively predicted social fear.

**Discussion:** That mother-reported distress to strangers (but not objects) predicts social fear reported by both mothers and fathers supports the validity and specificity of maternal report measures of infant temperament. That is does so independently of child anxiety supports the distinctiveness of these constructs during the toddler period (Putnam, Ellis, & Rothbart, 2001). Evidence that maternal sensitivity moderates the link between infant temperament and social fear is consistent with previous findings that less sensitive mothers may reduce the degree to which initially reactive infants exhibit social fear in childhood (Arcus, 2001; Park, Belsky, Putnam, & Crnic, 1997). Explanations of the negative association of observed distress with social fear are considered.

## Poster Presentations, March 28 2008

### *Attention, Memory and Learning*

**Fr1-01**

#### Use of Geometry for Spatial Orientation in Toddlers: Does it only Apply to Symmetric Arrays?

**Adina Lew**, Bryony Antcliff, Caroline Murphy, Gavin Bremner
*Lancaster University, Lancaster, UK*

**Purpose:** A recent proposal, termed the geometric module hypothesis, suggests that we orientate by maintaining dynamic, egocentric (centred on self) representations of our position with respect to one, or few, single landmarks. If we become disoriented, we only use the large-scale geometry of the environment to regain our sense of orientation (Wang & Spelke, 2002; 2003). Proponents of the geometric module argue that as natural environments are asymmetric they provide unambiguous spatial information even without specific landmarks. Paradoxically however, the evidence cited to support the hypothesis is based on systematic errors in symmetrical environments. The purpose of the 3 experiments reported below was to investigate whether toddlers (18 months - 3 years) were able to find a toy they have seen hidden prior to inertial disorientation in asymmetric arrays or enclosures.

**Methods:** In experiment 1, toddlers had to find a hidden toy following inertial disorientation with a rectangular array of landmarks with 4 identical hiding boxes placed between landmarks, with the asymmetric condition being an irregular quadrilateral arrangement of landmarks. In experiment 2, there was an isosceles triangle array condition and an irregular triangle condition. In experiment 3, there was a rectangular enclosure condition, with 4 hiding bins at the middle of each wall, and an irregular quadrilateral enclosure condition.

**Results:** Toddlers performed at above chance levels in all symmetrical conditions (rectangular array, isosceles triangle array rectangular enclosure), replicating previous research, but did not perform above chance levels in any of the asymmetric conditions.

**Conclusions:** The clear message from the programme of work is that toddlers are sensitive to geometry in simple, symmetric shapes, but lose this sensitivity in more complex, asymmetric arrays. A process of simplification may occur when we remember landmark subsets, whereby we abstract memorable and simple configurations from the array available to guide orientation and search.

**Fr1-02**

#### Location Representation in Young Children: is There an Advantage For Composite Cues?

**Stella Lourenco**, Dede Addy
*Emory Univeristy, Atlanta, USA*

**Purpose:** Young children use the shape of an enclosed space, after being disoriented, to locate an object hidden at one of the corners (Hermer & Spelke, 1996); in a rectangle, they search at the geometrically appropriate corners (e.g., long wall to the left of short wall). Recently, Huttenlocher and Lourenco (in press) suggested that the privileged status of geometry may rest on more general relative or scale-like properties. These properties can be composite in nature - i.e., consisting of more than one dimension (e.g., "length" involves area and perimeter). In the present study, we examined the influence of composite cues on disorientation tasks.

**Methods:** Children (18 - 24 months) were tested in a square-shaped space. On each trial, an object was hidden in one of the containers (positioned at each corner); after the hiding, children were disoriented and allowed to search for the object. In Experiment 1, the corners were distinguishable in terms of an isolated scale-like property - luminance (e.g., dark grey wall to the left of light grey wall), or angular orientation (e.g., lines in one orientation to the left of lines in another orientation). In Experiment 2, there were composite cues - namely, luminance and angular orientation (e.g., dark grey of one orientation to the left of light grey of another orientation).

**Results:** In both experiments, children performed above chance (50%), indicating that they could use these scale-like cues to determine location. Importantly, however, children performed significantly better in Exp. 2 (composite cues) than Exp. 1 - 70% vs. 59%, respectively.

**Conclusions:** Consistent with previous work, these results indicate that children use scale-like properties to determine location following disorientation. In addition, there seems to be an advantage when the properties are composite in nature; children perform at a higher level, much as in previous studies with rectangular spaces.

**Fr1-03**

#### Session-Spacing Effects over the First 2 Years of Life

**Vivian Hsu**
*Rutgers, The State University of New Jersey, Piscataway, USA*

The time window (TW) construct accounts for numerous phenomena that entail the integration of information from two temporally disparate events. A TW is a limited period within which successive events can be integrated and is defined by the forgetting function of the first event. It opens when an event is encoded and shuts when its memory cannot be retrieved. A second event that occurs before the TW shuts will be integrated with the first one; otherwise, it will be treated as unique. A prior study with 3-month-olds documented that the TW construct applied to session-spacing effects. Because older infants trained for 2 consecutive days forget after increasingly longer delays (31/2 months by 18 months of age), the TW becomes correspondingly wider. Whether older infants could integrate two training sessions spaced by very long delays seemed doubtful. The present study was designed to determine whether the TW construct predicts session-spacing effects at older ages.

In three experiments, infants learned to move a miniature train around a circular track by lever pressing. Experiment 1 determined the forgetting functions of independent groups of 6-, 9-, 12-, 15-, and 18-month-olds after a single training session (the "TW"). All ages forgot twice as fast after one session as after two consecutive sessions. Experiment 2 assessed the retention benefit of administering session 2 either just inside or just outside the session-1 TW that had been determined for each age in Experiment 1. We predicted that session 2 would be integrated with session 1 only when session 2 occurred inside the session-1 TW. This prediction was confirmed. All ages remembered the task longer than in Experiment 1 when session 2 occurred inside the TW; when it occurred outside the TW, it was treated like another first session. Experiment 3 assessed the predictive validity of the TW construct using a reactivation paradigm. Because reactivation requires two training sessions, we predicted the forgotten training memory would be reactivated only if sessions 1 and 2 were integrated. Infants

were trained as in Experiment 2, given a reactivation 1 week after forgetting, and tested 24 hr later. As predicted by the TW construct, the memory was reactivated only when session 2 had occurred inside the TW.

These findings confirm that the TW construct applies to session-spacing effects throughout the infancy period. We conclude that the timing of successive events determines whether early experiences accumulate and affect later behavior.

**Fr1-04**

### Individuation by Color Facilitates Visual Short-Term Memory for Location in 12-Month-Old Infants

**Karinna Hurley**, Lisa Oakes, Shannon Ross-Sheehy, Steven Luck
*University of California, Davis, USA*

**Background and Aims:** Visual short-term memory (VSTM) capacity for object color develops over the first year of life (Ross-Sheehy et al., 2003). Less is known about infants' VSTM for object location. Seven-month-olds can bind color to location (Oakes et al., 2006), suggesting that some aspect of location is encoded. However, we do not know whether infants encode the locations of individual objects. Remembering each object's location may depend on individuating the objects. Although infants younger than 12 months can use spatiotemporal cues to individuate, we do not know whether they remember the locations of the objects they individuate. Providing redundant cues to individuate objects - i.e., color and location - may help infants encode location in VSTM. The present investigation tested infants' VSTM for location in arrays of objects that can be individuated by color and in arrays of objects that can be individuated only by location.

**Methods:** We used a change-preference task (Oakes et al., 2006; Ross-Sheehy et al. 2003). Infants sat in front of two computer monitors on which stimulus streams were presented. Streams were arrays of 1 to 3 circles that appeared for 500 ms, disappeared for 300 ms, and then reappeared (this cycle repeated for 20 s). On each of 6 trials, infants saw a changing stream on one side (the location of one of the circles changed each time the array reappeared) and a non-changing stream on the other side (the location of the circles remained the same when the array reappeared). In Experiment 1 the circles were different colors; thus infants could individuate them using color and/or location. In Experiment 2, the circles were the same color within each trial; thus infants could only use location to individuate objects.

**Results:** When the objects within a given array were different colors, 12-month-old infants detected a change in location when there were 1, 2, or 3 items in each array. The proportion of time they looked at the changing stream was significantly greater than chance (.50). When the objects were the same color, 12-month-old infants detected a change in the location only when the arrays contained a single object.

**Conclusion:** Presenting arrays in which each object was a different color facilitated 12-month-olds' memory for location. Apparently, when infants can individuate objects using color they can encode the locations of multiple objects in VSTM. Therefore, by 12 months, individuation by color facilitates VSTM for location.

**Fr1-05**

### The Effects of Event Familiarity and Individual Differences on Infant Distractibility

**Kathleen Kannass**, Nancy Miller, Adana Celik
*Loyola University Chicago, Chicago, USA*

**Background and Aims:** Research on distractibility has revealed that how infants distribute their attention is influenced by a complex interaction of endogenous (i.e., internal) and exogenous(i.e., external) factors. The present project investigated how the novelty or familiarity of a distracting event and individual differences in looking patterns may affect distractibility.

**Methods:** All sessions consisted of familiarization and distractibility phases. Thirty-two 10-month-olds participated in a familiar (same events presented in both phases) or novel (different events presented) distractor condition. During familiarization, a bi-modal event was presented during six 20-second trials; duration of looking was recorded. Next, the distractibility phase consisted of three 3-minute trials; here, the infant explored a target toy and distracting events were presented on a monitor. The distracting event remained on the monitor for 5 seconds after the infant fixated it. Distraction latencies (the amount of time it took infants to turn from the toy to the monitor) and the duration of looking to the distractor monitor (when it was on and off, coding in progress) were recorded.

**Results and Conclusion:** We did a median split on looking during familiarization. A 2 (Condition: Familiar or Novel) x 2 (Familiarization Looking: High or Low Looking) x 2 (Trials: First and Last) ANOVA on distraction latencies revealed that infants were more distractible in trial 1 than 3, $F(1, 28) = 40.63$, $p < .01$, and infants who exhibited more looking during familiarization were more distractible, $F(1, 28) = 4.54$, $p < .05$.

A 2 (Distraction Looking: Monitor On and Off) x 2 (Condition) x 2 (Familiarization Looking) ANOVA on looking to the distractor monitor revealed a main effect of Distraction Looking, $F(1, 18) = 37.96$, $p < .01$, a marginal effect of Condition, with infants in the novel condition looking more at the distractor monitor $F(1, 18) = 3.17$, $p = .09$, a main effect of Familiarization Looking, $F(1, 18) = 16.18$, $p < .01$, and a significant Distraction Looking by Condition by Familiarization Looking interaction $F(1, 18) = 6.40$, $p < .05$. For infants in the familiar distractor condition, when the distracting event was on, there were group differences (infants in the high looking familiarization group looked at the distracting event more); when the distracting event was off, there were no differences. In the novel distractor condition, infants exhibited similar looking in across groups. Therefore, individual differences and the familiarity of the distracting event influenced infants' attention.

**Fr1-06**

### Some Effects of Recurring Auditory Experience in the 28- to 34-Week-Old Preterm Infant

**Charlene Krueger**, Glen Sizemore
*University of Florida, Gainesville, USA*

This study describes the influence of recurring auditory experience on the preterm infant during a transitional time-period in neurobehavioral development (28-34 weeks). A convenience sample of 38 low-risk preterm infants was randomly assigned to one of two groups: Group One heard a CD recording of their mothers reciting a nursery

rhyme from 28 to 34 weeks, Group Two from 32 to 34 weeks. Heart rate was recorded weekly while a recording of the rhyme, read by an unfamiliar female, was played. Recordings were evaluated for detection of a heart rate deceleration (1-5 beat decrease) within the first 5-s of playing the rhyme. Group 1 and 2 infants did not consistently respond with a heart rate acceleration or deceleration from 28-to-32 weeks of age. At 33 weeks, a nonparametric sign test did not reveal significant differences however the majority of Group 1 infants responded with a heart rate deceleration (n=11; 7=heart rate deceleration; 4=no deceleration), while Group 2 responded inconsistently. By 34 weeks of age, Group 1 infants responded significantly with a heart rate deceleration (n=9; 8=heart rate deceleration; 1=no deceleration; p = .0195) and Group 2 approached significance (n=7; 6=heart rate deceleration; 1=no deceleration; p = .0625). The findings demonstrate that responding in the preterm infant can be influenced by earlier experiences and that this effect is potentially influenced by maturity of the developing auditory and autonomic nervous system.

**Fr1-07**

### Encouraging Cognitive Development: The Role of Maternal Mind-mindedness in Language Acquisition of Infants

**Cynthia LaMorticella**[1] Jennifer Ablow[2] Dare Baldwin[2]

*1. University of Oregon, Elmira, USA; 2. University of Oregon, Eugene, USA*

**Background and Aims:** Research has demonstrated that maternal mind-mindedness (the inclination of a mother to treat her child as an individual with a mind) assessed at 6 months of age, is predictive of attachment security at 12 months (Meins et al. 2001) and theory of mind performance at 45 and 48 months (Meins et al. 2002). The relationship between maternal mind-mindedness and subsequent language development has yet to be established, yet this association may play an important mediating role in other aspects of socio-emotional development. Our study attempts to discover if mothers who are more likely to engage in mind-related behavior, will encourage more and possibly earlier language acquisition in their child.

**Methods:** 95 first time mothers were videotaped during a 5-minute free play session with their 5-6 month-old infant. Their comments were transcribed word for word and then coded as mind related, other comments demonstrating mind-mindedness, or not mind-related. Mind related comments refer to vocalizations in which the mother comments on her infant's mental states such as desires and preferences, cognitions, emotions, epistemic states, or talking on the infant's behalf. Other comments demonstrating mind-mindedness include imitation and encouragement of autonomy. The Bayley Scales of Infant Development was administered as a measure of cognitive development. The same mothers and infants were brought back in to the lab when infants were 16-18 months old. At this time the Bayley was administered again as well as the MacArthur Short Form Vocabulary Checklist: Level 1. This is a maternal report instrument which asks the mother to report whether or not her baby can understand and/or speak a list of 90 words.

**Results:** Preliminary analyses of the data suggest that the infants whose mothers used more mind-related comments in speaking to them at 5-6 months old understand more language, have a greater vocabulary, and have higher Bayley scores at 16-18 months than the infants whose mothers use fewer mind-minded comments. Important is the fact that these associations hold even after controlling for quantity of maternal speech.

**Conclusion:** These results suggest that mothers who comment on their infant's mental states encourage language development in their child. Implications for mind-mindedness in promoting infant cognitive development will be discussed.

**Fr1-08**

### Sequence Learning in 4 Month-Old Infants: Do Infants Represent Ordinal Information?

**David Lewkowicz**, Iris Berent

*Florida Atlantic University, Boca Raton, USA*

**Background and Aims:** Sequence learning is a fundamental perceptual/cognitive skill. Although there is ample evidence that young infants can learn sequences, it is currently unknown how they represent sequential information: Do they only track statistical relations of specific sequence elements (e.g., AB, BC) or can they encode abstract ordinal position information (e.g., that B occupies the second or third position in a sequence)? To examine this question, the current study investigated two questions: (1) can 4-month-old infants learn ordinal invariance when statistical sequential relations are controlled, and (2) can 4-month-old infants learn statistical sequential relations when ordinal information is controlled?

**Methods:** Using duration of visual fixation as a measure of attention, we conducted three experiments in which we habituated different groups of 4-month-old infants (N = 33, 24, and 33 in each experiment, respectively) to three different sequences consisting of the same four moving/sounding objects. Across the habituation sequences, three of the objects occurred in different ordinal positions whereas one, the target, occurred in an invariant ordinal position (e.g., ABCD, CBDA). To determine what type of information infants learned (ordinal or statistical), in Experiments 1 & 2 we administered test trials in which we examined responsiveness to changes in the target's ordinal position either accompanied by statistical information or not. In Experiment 3 we investigated responsiveness to the target's position either when only statistical information was changed or when only ordinal information was changed.

**Results:** Experiments 1 & 2 showed that infants detected changes in the target's position when such changes disrupted the statistical co-occurrence of sequence elements but that they did not detect such changes when statistical information was absent. Experiment 3 confirmed that infants only learned statistical relations because here infants responded to statistical information changes but not to ordinal information changes.

**Conclusion:** The current study explored how infants encode sequential information. Findings showed for the first time that 4-month-olds infants do not encode the ordinal position of a particular sequence element. In addition, and consistent with previous studies, the current study found that infants successfully encoded sequential information by tracking the statistical co-occurrence of specific elements. It is up to future research to determine how and when infants learn to extract abstract positional information.

**Fr1-09**

### Further Evidence that Young Infants Cannot Store Multiple Objects in Visual Short-Term Memory

**Lisa Oakes**, **Ian Messenger**, Shannon Ross-Sheehy, Steven Luck

*University of California, Davis, USA*

**Background:** Change-detection tasks reveal that 6-month-olds represent only one object in VSTM (Ross-Sheehy et al., 2003) and can-

not bind color to location (Oakes et al., 2006). Seven-month-olds, in contrast, can bind color and location. In these tasks, an array of objects appears and disappears repeatedly during a trial. Therefore, detecting changes in arrays of multiple objects may depend on binding. That is, comparing objects across appearances of the array requires knowing which object in one array should be compared with which object in the subsequent array. Because 6-month-old infants cannot bind color to location, they may compare an object from a given location in one array with an object from a different location in the next array. This leads to a striking prediction: for six-month-old infants, all multi-object arrays should appear to change-even when none of the objects actually change. In contrast, because 7-month-old infants can bind color to location, only changing arrays will appear to change.

**Methods:** We tested 6- and 7-month-olds in a change-detection task (Oakes et al., 2006; Ross-Sheehy et al. 2003). Infants sat in front of two computer monitors on which stimulus streams were presented. In each stream an array of 3 different colored squares appeared for 500 ms, disappeared for 300 ms, and then reappeared in the same locations (this cycle repeated for 20 s). On each of 6 trials, infants saw a changing stream on one monitor (the color of every square changed on each reappearance) and a non-changing stream on the other monitor. Thus, detecting the change seems trivially easy because the colors of all objects changed on each cycle in the changing stream.

**Results:** Six-month-olds looked equivalently at the two streams; they found the changing and non-changing streams equally interesting. Seven-month-olds, in contrast, preferred the change; the proportion of time they looked at the changing streams was significantly greater than chance (.50).

**Conclusion:** Like the ability to bind color and location in 3-item arrays, the ability to detect changes in the colors of multiple objects appears to develop between 6 and 8 months. Without binding, infants cannot keep track of particular objects; as a result, each object appears to have changed at each reappearance even in non-changing streams and changing and non-changing streams are equivalently interesting. Binding, therefore, appears to be a critical aspect of detecting changes in multi-object arrays.

**Fr1-10**

### Video Comprehensibility and Attention in Very Young Children

**Tiffany Pempek**[1] Heather Kirkorian[2] Michael Stevens[3] Anne Lund[4] John Richards[3] Daniel Anderson[2]

*1. Georgetown University, Washington, USA; 2. University of Massachusetts, Amherst, USA; 3. University of South Carolina, Columbia, USA; 4. Curious Pictures, New York, USA*

Videos produced for infants and toddlers are often promoted as beneficial for cognitive development. There is currently no empirical evidence to support this claim. In order for children to extract an educational message, they must first comprehend the content. Prior research using Sesame Street demonstrated that children 24 months and older look more at normal segments of the program than at sequential or linguistic distortions, suggesting that they make discriminations based on whether or not they comprehend the program. The goal of this experiment was to identify the youngest age for which this distinction holds.

Participants included 102 children between 6 and 24 months. Infants were shown 10 minutes each of normal and distorted Teletubbies, with order of presentation counterbalanced. Half saw a linguistic distortion (reversed audio track for each utterance) while the other half viewed a sequential distortion (constituent shots edited into a random sequence). Attention was measured with overt looks at the screen and sustained decelerations of heart rate.

For the first 10-minute segment, look lengths increased with age for normal video but remained constant for distorted video such that only 18- and 24-month-olds showed evidence of comprehensibility discrimination. Although look lengths for all individuals were lognormally distributed, there were differences in the parameters of these distributions; group differences were due to particularly long looks by the older viewers to comprehensible video. Heart rate deceleration increased with age and was greater for relatively long looks (>10 seconds) than short ones. In particular, heart rate deceleration during long looks was greater during normal than distorted video only for the older age groups. Older children watching normal video showed deeper levels of engagement than did younger children. However, patterns of attention to sequential or linguistically distorted video were similar across ages.

In the second 10-minute segment, there was no effect of comprehensibility, possibly because experience with incomprehensible content during the first segment suppressed cognitive processing of subsequent comprehensible material. No differences were found between sequential and linguistic distortions.

These findings extend earlier work by demonstrating developmental change in the effect of video comprehensibility on look length and attentional engagement. Together with research indicating that infants learn more from real-life demonstrations than from equivalent video presentations, these findings suggest that the cognitive mechanisms necessary to extract meaning from edited video containing dialogue and narration may not be present until the second year of life.

**Fr1-11**

### Linking Individual Differences in Looking Behavior To Learning and Recognition

**Sammy Perone**[1] John Spencer[2]

*1. University of Iowa, North Liberty, USA; 2. University of Iowa, Iowa City, USA*

There has recently been a strong interest in individual differences in looking behavior and recognition. However, there is yet to be a formal account of how looking behavior is linked to real-time neural states and development. In addition, tracking what infants actually learn by looking is complicated by the high-dimensional stimuli used in the literature. To address these limitations, we present a joint theoretical and empirical initiative.

We present an autonomous neural network that forms a memory for the metric details of objects as it stochastically looks among them. Memory formation in the network has an inhibitory effect on fixation to remembered objects. Thus, one behavioral signature of memory is disengaging fixation and looking away. One prediction is that as infants form a memory, looking back and forth between objects increases in frequency.

We tested this prediction using a stimulus set consisting of six metric steps along color and aspect-ratio dimensions. We familiarized infants with a pair of identical objects on 6 10 s trials. On two tests, we gauged the precision with which infants remember objects. On a one step test, infants were presented with the familiar object paired with an object that was novel on one dimension by one metric step. On a three step test, the familiar object was paired with an object that was novel by three metric steps.

Novelty preferences at test were examined for one group of infants who showed more looking back and forth between objects toward the end of familiarization and another group of infants who did not. Only infants who increased their looking back and forth over familiarization showed a significant novelty preference on the three step test. Interestingly, these same infants also showed a significant familiarity preference on the one step test.

Model simulations showed an identical pattern. Simulations that increased their looking back and forth over familiarization had a stronger long-term memory representation for the familiar object and, therefore, looked away from familiar objects and toward novel objects during the three step test. By contrast, on the one step test, these simulations showed a familiarity preference. Critically, differences in looking in the model emerged stochastically, suggesting that individual differences in learning emerge during the course of familiarization. To examine the implications of these results, we are tracking developments in looking behavior and probing the role of task conditions on looking and memory formation in term and preterm infants.

**Fr1-12**

### Infant Sustained Attention Affects Brain Areas Controlling Covert Orienting

**John Richards**

*University of South Carolina, Columbia, USA*

Infants show covert orienting in a "spatial cueing" procedure, including facilitation and inhibition of return of RT, and enhancement of the P1 component of the ERP to target onset for the validly cued trials (P1 validity effect). The current study examined these effects under conditions of attention and inattention.

Infants of 14 or 20 weeks of age were tested in a spatial cueing procedure. A central stimulus was presented until the infant fixated it, a cue was presented in the periphery for 300 ms, and then a "target" was presented on the same side as the cue ("valid"), on the opposite side of the cue ("invalid"), or a target was presented without a prior cue ("neutral"), and at short- or long- stimulus onset asychrony. Heart rate was recorded continuously and heart rate slowing and the return of heart rate to a prestimulus level were used to define periods of attentiveness and inattentiveness. ERP averages were computed around the time of the target onset and immediately preceding the saccade towards the target. Cortical source analysis was used to identify the location and activation of the places in the cortex responsible for generating the P1 validity effect.

ERP analyses showed an enhanced P1 on valid trials over invalid and neutral trials. This P1 component was enhanced if the infant was attentive, and primarily on short SOA trials. The enhanced P1 was larger for short SOAs, suggesting this was spatially-cued orienting rather than endogenous attention. Dipole current sources were located in the extrastriate occipital cortex and fusiform gyrus. The sources had larger activity when the infant was attentive than when inattentive.

**Fr1-13**

### Infant-Directed Behavior Modulates Social Preferences in 5-Month-Old Infants

**Adena Schachner**[1] Erin Hannon[2]

*1. Dept. of Psychology, Harvard University, Cambridge, USA; 2. Dept. of Psychology, University of Nevada Las Vegas, Las Vegas, USA*

**Background and Aims:** Within the first months of life, infants prefer certain individuals over others based on properties like race, gender, and even prior behaviors like the language that individuals have previously spoken (e.g. Kinzler, Dupoux & Spelke, 2007). However, these preferences can often be explained by the familiarity of the property or behavior: for example, most infants have more frequently seen their own race and heard their native language. The extent to which young infants encode dimensions other than familiarity in behavior has been largely unexplored. When speaking to infants, adults in all cultures modify their speech to have a higher pitch, greater pitch variability, slower speed, and longer pauses (Fernald, 1992). Critically, both infant-directed and adult-directed speech are familiar to infants. The current experiment examined the effects of infant- vs. adult-directed modes of speech on infants' subsequent preferences for individuals.

**Methods:** Twenty infants (mean age= 5 months) participated in both the infant-directed and adult-directed speech conditions. In both conditions, infants viewed a 60-s fixed-length familiarization video consisting of a person speaking, followed by two silent, 20-s visual preference tests. The key manipulation was the manner of speech (infant- or adult-directed) used during familiarization. During post-familiarization preference tests, infants were presented with two photos side-by-side: a still, smiling photo of the person they had seen during familiarization and a similar photo of a novel person they had not seen before. Order of familiarization condition, person order, and location of familiar face during test were counterbalanced.

**Results:** Familiarity preference scores were derived by dividing the amount of time spent looking at the familiar face by the total looking time on each trial. Two planned t-tests on the familiarity preference scores revealed that in the infant-directed speech condition, infants showed a significant preference for the familiar face (preference score=.5691, p=.027). In contrast, in the adult-directed speech condition, infants showed a significant preference for the novel face (preference score=.4472, p=.049).

**Conclusion:** These results suggest that young infants' social preferences can be generated not only by familiarity, but by behavior that has been appropriately modified for the emotional, communicative, and perceptual needs of the infant. Infants thus encode the appropriateness of vocal behavior and use that information to guide subsequent preference for individual social partners, an ability that may serve as an important foundation for social reasoning.

**Fr1-14**

### Repetition Suppression of Induced Gamma Activity Predicts Behavioral Responses to Novelty in 6-Month-Old Infants

**Kelly Snyder**[1] Andreas Keil[2]

*1. Department of Psychology, University of Denver, Denver, USA; 2. Department of Psychology and NIMH Center for the Study of Emotion & Attention, University of Florida, Gainesville, USA*

Habituation is defined as a decline in responding to a repeated stimulus, and can be inferred to reflect learning about the properties of the

repeated stimulus when followed by increased orienting to a novel stimulus (i.e., novelty detection). The aim of the present study was to examine infant brain activity during habituation, and how this activity relates to (or predicts) behavioral responses to novelty. Specifically, we recorded EEG from 6-month old infants while they attended to repeated presentations of either a single face or a single object (stimulus condition assigned at random). Infants were then tested for their memory of the repeated stimulus using a conventional looking time measure. We examined whether changes in induced alpha, beta, and gamma activity during habituation predicted behavioral responses to novelty at test. To examine possible changes in stimulus-induced EEG activity, we compared baseline-corrected EEG responses during the initial (i.e., First Block) and final (i.e., Last Block) stages of habituation. Induced gamma activity decreased across blocks in the face condition, paired $t(25) = 2.98$, $p < .01$, but showed no evidence of change in the toy condition, paired $t(28) = -0.83$, $p > .4$. In addition, change in gamma power over the posterior region was negatively correlated with novelty scores at test in the face condition, $r(18) = -0.49$, $p = .04$, but not in the toy condition, $r(21) = -0.07$, $p = .76$. The negative correlation between change in gamma and novelty scores in the face condition indicates that repetition suppression of induced gamma activity during habituation to a face was associated with enhanced orienting toward a novel face, suggesting that gamma activity may play a role in encoding featural information about faces in infants. In contrast, repetition-related changes in induced alpha and beta activity were unrelated to behavioral responses to novelty at test.

**Fr1-15**

### The Development of Visual Working Memory: Bridging the Theoretical and Empirical Gap Between Infancy and Five Years

**John Spencer**, Vanessa Simmering, Sammy Perone, Shannon Ross-Sheehy
*University of Iowa, Iowa City, USA*

Previous work investigating the development of visual working memory in infancy has used a task adapted from work with adults (Ross et al., 2003). Infants are presented with two screens with multiple objects (e.g., colored squares) on each screen. Both screens turn on and off rapidly, requiring the use of working memory to track the contents of each screen. One screen presents a changing array while the other does not. Ten-month-olds (but not 6.5-month-olds) show a preference to look at the changing screen when the array consists of 1-4 items. Thus, by 10 months, infants appear able to hold multiples items in VWM. Research with children using tasks more directly analogous to adult VWM tasks paints a different picture. According to Riggs et al. (2006), 5-year-olds (the youngest age assessed) have a VWM capacity of 1.5 items.

The goal of the present report was to bridge both the empirical gap between infancy and 5 years as well as a critical gap in theory. In particular, it is not clear precisely what these different tasks are measuring, particularly given that the infant task uses a looking measure while the child task requires an explicit same/different response.

To bridge these gaps, we present a new dynamic field theory that captures both infants' performance in the infant VWM task as well as children's performance in the standard task. Simulations of the infant task highlight that this task primarily assesses the initial formation of working memories for the non-changing side. When there is enough support to form a memory for items on this side, fixation is released, and the model shows a novelty preference. By contrast, the child task assesses children's ability to hold multiple items in VWM during a short delay and explicitly compare these representations to items in the test array. Critically, we show that quite fragile VWM representations are sufficient to support the release from fixation in the infant task, while more robust representations are required to support comparison and the generation of same/different responses in the child task.

We then bridge the empirical gap in the literature by assessing the performance of children at intermediate ages--3.5-year-olds, 4.4-year-olds, and 5-year-olds--on both tasks directly. Results are consistent with predictions of the model: children's looking performance in the infant VWM task points toward a larger estimate of capacity than the more adult-like VWM task.

**Fr1-16**

### A Longitudinal Study Assessing the Development of Attention, Inhibition, Working Memory and Temperament from Infancy to 7 Years

**Wendy Troob**, John Spencer, Lisa Oakes
*University of Iowa, Iowa City, USA*

This study assessed the development of attention, inhibitory control, working memory, and temperament from infancy to 7 years. Twenty six of one hundred children that initially participated in the study at 7 and 9 months were subsequently evaluated at 18 and 24 months, 2.5 years, and 7 years of age. We focus here on relations between measures of performance at 7 and 9 months and 7 years.

At 7 and 9 months, children were assessed using a single object familiarization task, a multiple object free play task with no distracters, a distractibility task, the Rothbart temperament scale. At 7 years, visual-spatial attention and memory were assessed using a dual task where children both remembered a target location for a 10 s delay and made a color discrimination during the delay interval that required a shift of attention. In addition, children participated in an hour-long free-play distraction task. Pictures were projected at random intervals in conjunction with a tone to assess distractibility, number of looks at toys, look/play episode lengths, and attentional inertia in a play context. Children also were given two vocabulary assessments at 7 years, the Peabody Picture Vocabulary Test (PPVT-III) and the Expressive Vocabulary Test (EVT), an inhibitory battery, a Go/No-Go computer game to assess inhibitory control, and a Stroop task to assess inhibitory control. Finally, parents filled out two temperament questionnaires and two ADHD assessment questionnaires.

Overall, looking measures from several of the tasks used at 7 and 9 months were predictive of performance at 7 years across several tasks. In particular, number and duration of looks at 7 and 9 months predicted number of looks and look length in the freeplay distraction task at 7 years. Additionally, looking performance at 7 and 9 months was related to attentional and inhibitory measures at 7 years as measured by two ADHD questionnaires as well as performance in the Stroop and Go-No-Go tasks. Finally, looking performance at 7 and 9 months was related to whether children's memory performance was modulated when they had to shift their focus of attention to a color discrimination task. Measures of temperament at 7 and 9 months showed weaker correlations with behavioral and temperamental measures at 7 years, though fear, soothability, and happiness at 7 and 9 months did correlate with some behavioral measures at 7 years.

**Fr1-17**

## Can Young Infants Understand When Another's Attentional Gaze is Directed Towards the Same Object That They Are Looking At? Preliminary Study

**Hiromi Tsuji**

*Osaka Shoin Women's University, Kashiba, Japan*

**Background of the Study:** Gaze following behaviour is an indication of an infant's ability to orient their attention to another person's gaze. Orientating one's attention to another's is very important because this is one of the foundations of joint attention, which begins to emerge in infants at the age of 9 months. Tomasello (e.g.1995; 1999) argues that joint attention is represented by a behaviour in which infants look at both the person and the object to which the person's line of gaze is directed. Despite young infants' early sensitivity to people's eye gaze and their gaze following behaviours, the extent to which such gaze following behaviour represents their understanding of another's attentional behaviour is not clear. This paper addresses the understanding that young infants have of another person's direction of gaze in the context of the development of joint attention. It is hypothesized that if infants have an explicit understanding of another's line of gaze towards the same object as they are looking at, then they would prefer to look at that person rather than a person who has a simple direct gaze at them.

**Method:** Twenty infants with a mean age of 10 months were studied using a preferential looking paradigm. This paradigm comprised two schematic faces, in which one of the faces looked at the infant and the other face looked either towards or away from the object to which the infants were initially introduced. A video recording of the infant's gaze direction was assessed frame by frame. Total number of frames (a frame duration is 33.3 milliseconds) for which the infants looked at either of the two schematic faces was counted.

**Results:** The results indicated that infants preferred to look at the faces that either looked at them or looked at the object of common interest. The infants looked less at the face with eyes averted from both themselves and the object. This result suggests that these young infants have started to participate in joint attentional episodes.

**Summary:** The young infants showed a preference to look at a face that is either looking at them or at an object of common interest, rather than at a face with an averted gaze. However, this study did not show that infants had a preference to look at a person who gazed at the same object as them, rather than at a person looking directly at them. This preliminary study can be refined to discover at what age infants start to express an understanding of another person's attention.

**Fr1-18**

## Newborn Habituation and Retention of the Glabella Reflex: No Evidence of a Feeding Effect

**A. Valiante**[1,2] Ronald Barr[3] Shuvo Ghosh[4] Emmett Francoeur[4] Philip Zelazo[5] Maeve Francoeur[4] Simon Young[1]

*1. McGill University, Montreal, Canada; 2. University of British Columbia, Vancouver, Canada; 3. Center for Community Child Health Research, University of British Columbia, Vancouver, Canada; 4. McGill University Health Center, Montreal, Canada; 5. Concordia University, Montreal, Canada*

**Background:** Nutritional influences on newborn habituation and memory for sensorimotor reflexes have not been investigated. The glabella reflex is a polysynaptic brainstem blink reflex elicited by pressure on the glabella. Changes in blink reflex response with repeated stimulation reflect changes in sensorimotor processing. The aims of this study were to determine whether newborns display habituation and retention of the glabella reflex after a feed and, if so, to compare pre- and postprandial habituation and retention.

**Methods:** Newborns were tested at 2-to-3 days of age. The blink reflex was elicited by tapping the infant's glabella with the index finger at a frequency of one tap every 3 seconds over two 15-tap sessions separated by a delay (range: 4s-25s). Blinking was defined as "eye (s) open before and closed after tap". Sixty-two infants were tested postfeed, randomized to 1 of 4 delays [4s(n=16), 8s(n=15), 18s(n=15), 25s(n=16)]. An additional thirty-four infants were tested prefeed, randomized to 1 of 2 delays [8s(n=17) and 18s(n=17)]. Two measures were assessed: (i) initial pattern of habituation, determined by dividing Session 1 into 3 equal blocks of 5 trials and recording percent blinking for each block; (ii) retention of habituation defined as the change in mean blink response in session 2 relative to session 1.

**Results:** Postprandial habituation was observed for all delay groups [$F(2,116)=14.5$, $p<001$], with infants blinking less in Blocks 2 and 3 relative to Block 1 (both: $p<0.001$). After the delay, the 4s delay group produced fewer blinks than the 25s group, indicating postprandial retention [Oneway ANCOVA on postdelay response using predelay response as covariate and delay group as the independent variable: [$F(1,57)=33.3$, $p<0.001$; post hoc: $p<0.001$]. Mean (SE) postprandial blink response in session 2 were, respectively, [4s(37.8±5.0), 8s(52.1±4.5), 18s(51.4±5.7), 25s(65.8±3.7)]. When the prefeed values were compared with the postfeed values from the same delay conditions [8s and 18s], there were no significant differences on measures of habituation and retention. Mean (SE) preprandial blink response in session 2 were, respectively, [8s(48.2±4.5), 18s(50.6±5.8)].

**Conclusion:** Newborns display rapid learning of the glabella reflex and retention over short intervals after a feed, affirming the utility of the blink reflex as a tool for measuring sensorineural information processing in newborns. Habituation of the glabella reflex is thought to be mediated by central dopaminergic pathways. Feeding does not appear to influence newborn learning and retention of the blink reflex within this sensory-motor system.

**Fr1-19**

## Developmental Changes in IOR From 3 to 6 Months of Age

**Krisztina Varga**, Janet Frick, Leah Kapa, Melissa Dengler

*University of Georgia, Athens, USA*

Previous research suggests that inhibition of return (IOR), or the tendency to inhibit attention to a previously cued location, begins to emerge between birth and 3-months of age, is observed inconsistently in 4-month-olds, and is stable by 6-months of age (Richards, 2000). At brief (<200ms) stimulus-onset-asynchronies (SOAs), facilitation to the cued side is typically observed, while at longer (>300ms) SOAs, inhibition is usually observed. However, little information exists on the developmental emergence of IOR, or the transition from facilitation to inhibition within individual infants. Thus, we studied IOR in 3-, 4.5-, and 6-month-olds (between-subjects), using both a 300ms and 600ms SOA (within-subjects), to examine these questions.

A flashing bulls-eye attracted infants' attention and remained in the center of the screen while a cue appeared in the periphery for 100ms. Following the cue, the bulls-eye remained on for another 200 or 500ms, after which it turned off and a target appeared in the periphery until the infant made an eye movement. Some cues were valid (target on same side) and some were invalid (target on opposite side). Only trials in which infants made direct eye movements toward the

target were analyzed. Cueing effects were examined by subtracting the mean reaction time (RT) of the invalid trials from the mean RT of the valid trials. Negative numbers indicate facilitation and positive numbers indicate inhibition.

When comparing cueing effects to zero, 3-month-olds showed neither facilitation nor inhibition. Four-month-olds showed facilitation at 300ms (M =-384, p<.01), but showed no effect at 600ms (M=32, p=.66). Six-month-olds showed marginal (p<.10) effects in both conditions, suggesting a trend toward inhibition at both 300ms (M=261, p=.09), and 600ms (M=274, p=.09). Further examination of the 300ms condition indicated that the cueing effects of 4.5-month-olds were significantly different from 6-month-olds (p=.002).

The results show development of IOR between 3- and 6-month-olds. Three-month-olds did not show an effect at either SOA. Four-month-olds showed facilitation at the 300ms SOA, but no evidence of IOR at 600ms. Six-month-olds showed marginal evidence of IOR at both SOAs. Of note is the difference between 4.5- and 6-month-olds at the 300ms SOA, which is on the borderline between eliciting facilitation and inhibition. The two groups clearly showed effects in opposite directions, further supporting previous findings that IOR develops between 4 and 6 months of age.

## *Cognitive Development*

**Fr1-20**

### Inferring the Presence of Hidden Objects From Manual Actions

Victoria Southgate, **Mark Johnson**, **Tamsin Osborne**, **Gergely Csibra**

*Birkbeck University of London, School of Psychology, Centre for Brain and Cognitive Development, London, UK*

Recent studies have shown that infants can distinguish intentional and accidental manual actions (Woodward, 1999, Behne et al., 2005) and do not readily attribute a goal to an unfamiliar "back-of-hand" object-directed action (Woodward, 1999). Various monkey species also display an ability to selectively interpret different manual actions, inferring the presence of a goal object only when the action was apparently intentional, but not when it was incidental (Woods et al., 2007; Lyons et al., 2006). In the current study, we asked whether human infants too can use their abilities to interpret certain manual actions in order to infer the presence of a hidden object. Nine-month-old infants watched two test events, in which a human hand disappeared behind an opaque screen. In one event (grasping hand), the hand was in a grasping position as it reached behind the screen, whereas in the other event (flat hand) the hand disappeared behind the screen in a flat back-of-hand position. In both cases, the occluder moved aside to reveal that no object was present behind the screen. Results show that infants look longer at the outcome (no object present) after a grasping hand action than after the flat hand action suggesting that infants are indeed able to infer the presence of a hidden object from watching the manual actions of others. These results, showing an ability to infer hidden objects from observing actions, concur with other results which show that infants can infer the presence of a hidden object from ostensive communication towards an occluder (Csibra & Volein, in press) and in order to rationalize a particular action pathway that an agent takes (Csibra et al., 2003). This finding will also form the basis for future studies exploring the neural correlates of action perception in infancy.

**Fr1-21**

### Infants' Predictive Looking during Eating Observation

Olga Kochukhova[1] **Gustaf Gredebäck**[2] Claes von Hofsten[1]

*1. Uppsala University, Department of Psychology, Uppsala, Sweden; 2. University of Oslo, Department of Psychology, Oslo, Norway*

When performing visually guided actions, action plans encode prospective goal-directed eye movements, which are crucial for planning and control (Land, & Furneaux, 1997; Johansson, R. S. et al., 2001). Previously it was shown that adults and 12-months-old infants (Flanagan, & Johansson, 2003; Falck-Ytter et al, 2006) also perform such eye movements when they observe actions that are performed by others. It indicates that action plans guide the occulomotor system when people are observing others' actions. It also supports the view that the mirror neuron system maps an observed action onto motor representations of that action (Fadiga et al, 1995; Flanagan, & Johansson, 2003). One of such goal-directed actions that elicit intensive response of mirror neurons in monkeys is the observation of food, grasped in order to be eaten (Rizzolatti et al. 2006). In this study we examined 10- and 6-month-old infants' abilities to understand other people's goal-directed actions. During the experiment infants observed a person eating bananas and their eye movements were measured with cornea-reflection technique Tobii. The results show that 10-month-olds and to a less degree 6-month-old infants were able to produce proactive goal-directed eye movements: they moved their eyes to the agent's mouth area before the agent reaches it with the spoon.

**Fr1-22**

### Perception and Production of Object-Related Grasping Movements in 6-Month-Old Infants

**Moritz Daum**, **Wolfgang Prinz**, **Gisa Aschersleben**

*Max Planck Institute for Human Cognitive and Brain Sciences, Department of Psychology, Leipzig, Germany*

Adults alter the opening of the hand as a function of the size of an object to grasp (Jeannerod, 1981). This ability is present already in 9 but not in 5-6 months old infants (von Hofsten & Rönnqvist, 1988). However, at the age of 6 months, infants are already able to infer the goal of an object-directed grasping action (Daum et al., in press, under review). In the present study, 6-month-olds' understanding of an object-directed human grasping action in a perception task was directly compared to their actual level of grasping performance in an action task. In the perception task, using a preferential looking paradigm, infants were presented with the video of an actor's grasping movement towards an occluded target object (a cup with its handle oriented either towards or away from the actor). The aperture size of the actor's hand was varied between subjects; the grasp was either conducted with a large or a small hand aperture size. This grasping movement was presented until the hand was next to the occluded target object. Subsequently, an expected and an unexpected final state of this grasping movement were presented simultaneously without the occluder. Infants' looking times were measured towards either final state. In the action task, infants were presented sequentially with 5 graspable objects (rod, pellet, cube, and two differently sized spheres), and their grasping behavior was coded. Results indicate that infants who performed a scissor grasp (thumb opposite to index finger as presented in the perception task) looked longer at the unexpected final state in the perception task while infants who only used radial palmar grasps during the action task looked equally long

towards each final state. This finding supports the assumption that action perception and control are closely interrelated already in infants as young as 6 months.

**Fr1-23**

### Detecting Intentionality: Not All Contingencies Are Equal

**Jonathan Beier**, Susan Carey

*Department of Psychology, Harvard University, Cambridge, USA*

Infants who engage a novel object in contingent interaction will attribute intentionality to it (Johnson, Slaughter, Carey, 1998). They do the same after witnessing it participate in a contingent social interaction with a confederate experimenter (Johnson, 2003). This poster investigates whether third-person observation of contingency alone is sufficient for attributing intentionality, or whether the contingency must occur within a social context to be interpretable as evidence for intentionality.

Following Johnson's (2003) method, 12-month-old infants observed a confederate interact contingently with a faceless novel object, which then turned in different directions. Infants' gaze-following was measured. In two experiments, we manipulated the social cues present within the interaction, while maintaining the contingency between the confederate's and object's actions. Experiment 1 tested the influence of the confederate's speech on infants' evaluations of the contingent novel object. Experiment 2 eliminated the social context of the contingent interaction more fully.

The first two conditions of Experiment 1 replicated Johnson's earlier contingent conversation and non-contingent conditions. In the first, the confederate looked, smiled, and spoke to the novel object, which responded by beeping and blinking a light on its front end. In the non-contingent condition, the object exhibited exactly the same behavior, while the confederate looked down without reply. In a third condition, the confederate looked and smiled at the object, but clapped his hands instead of speaking. We calculated difference scores for the total duration spent looking in the "gazed-at" minus "incorrect" directions. Infants in the clapping condition showed above chance levels of gaze-following ($t(24) = 2.22$, $p = .037$); however, their scores were intermediate between, and not significantly different from, those in contingent conversation ($t(48) < 1$) and baseline non-contingent conditions ($t(48) = 1.57$, p = n.s.). Although their response was not as robust as those who witnessed a full conversation, replacing the confederate's speech with hand claps did not extinguish gaze-following completely.

Experiment 2 again replicated Johnson's contingent conversation and non-contingent conditions. In a third condition, the confederate neither looked nor smiled at the object, and clapped two sticks together instead of talking. In this much less social context, infants showed no gaze-following response, despite equivalent evidence for the object's contingent responsiveness to the confederate. They did not follow the object's gaze more than chance ($t(24) < 1$). They were no different from those in the baseline non-contingent condition ($t(48) < 1$), and significantly different from those in the fully social conversation condition ($t(48) = 1.99$, $p = .05$).

When determining a novel object's intentionality, infants perform a more sophisticated analysis of an object's behavior than previous accounts considered. Observed contingency alone is not sufficient for detecting intentionality, but a social context can help.

**Fr1-24**

### The Effects of Active vs. Passive Experience on Infants' Action Understanding

**Sarah Gerson**, Amanda Woodward

*University of Maryland, College Park, College Park, USA*

Previous work demonstrates that infants begin to understand goal-directed actions around six-months (Woodward, 1998). However, when given experience producing goal-directed actions themselves, they can come to understand actions such as grasp as goal-directed as early as three-months (Sommerville, Woodward, & Needham, 2005). Previous studies have not explored which aspects of this experience are critical to infants' change in understanding. It has long been hypothesized that self-produced actions play a unique role in the development of action understanding (Barresi & Moore, 1996; Meltzoff, 1995; Tomasello, 1999). In this study, we examined the relative contributions of active versus observational training with a novel action.

**Methods:** Three-month old infants (mean age = 3.48) were assigned to one of two experimental conditions: active manipulation (n=15) or observation (n=15). Infants in the active condition wore Velcro mittens, allowing them to move and pick up Velcro-covered toys. Infants' looking and touching were coded and this coding was used to generate scripts for the observation condition, during which the baby observed the experimenter move the toys. Then, both groups of infants were habituated to a mittened hand reaching for one of the two toys on a stage. Following habituation, toys' positions were reversed so the hand either reached for a new goal in the old place or the old goal in a new place. Longer looking at the new goal trials indicates encoding the action as goal-directed.

**Results:** Based on prior research, only infants with 60 seconds or more of experience were included in further analysis. Planned comparisons revealed that infants in the active condition looked longer on new goal trials (mean = 13.52s, SE = 4.20) than old goal trials (mean = 6.82s, SE= 1.75), $t(14)= 2.42$, $p=.03$. In contrast, infants in the observation condition did not show a significant difference in looking to the new goal trials (mean = 9.70s, SE = 2.40) and old goal trials (mean = 7.46s, SE 1.29), $t(14)<1$, although the means fell in the same direction as in the active condition.

The fact that similar trends were found in both groups indicates that information is likely gained from both types of experience. However, the more robust findings in the active condition is consistent with a number of theoretical proposals, including a recent assertion that this phenomenon may be mediated by mirror neurons, claiming active experience plays a unique and important role in the development of understanding of intentional action.

**Fr1-25**

### What Are You Looking At? Infants' Neural Processing of an Adult's Object-Directed Eye Gaze

**Stefanie Hoehl**[1] Jeanette Mooney[1] Vincent Reid[2] Tricia Striano[1,3]

*1. Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany; 2. Durham University, Durham, UK; 3. Hunter College, CUNY, New York, USA*

**Background and Aims:** Eye gaze provides essential information about others' communicative intentions and future behaviour (Langton et al., 2000). The functional relevance of gaze cueing in infancy has been illustrated recently in a range of studies. Young infants shift attention in the direction of others' gaze and use eye gaze cues to

determine what they should attend to in their environment (Hood et al., 1998; Reid et al., 2004; Reid & Striano, 2005). However, it is currently unknown how infants process the relation between another person's eye gaze and an external object. Here we investigated 4-month-old infants' neural processing of eye gaze that was directed at an object vs. gaze that was averted from an object.

**Methods:** 17 infants (4 months ± 9 days) were presented images of faces directing eye gaze toward an object next to the face or averting gaze away from an object, while EEG was measured. ERPs were assessed on fronto-central channels for the Negative central (Nc) component (400-600 ms) and the Positive Slow Wave (PSW) (700-1000 ms).

**Results:** A repeated measures ANOVA showed a significant main effect of condition on mean amplitude of the PSW, $F(1,16)=4.68$, $p=0.046$. For the Nc there was a significant main effect of condition on peak amplitude, $F(1,16)=4.8$, $p=0.044$, and on latency, $F(1,16)=5.52$, $p=0.034$.

**Conclusion:** Infants distinguished between an adult's gaze, which was directed at an object compared to non-object-directed eye gaze. Amplitude of the Nc, reflecting attentional processes (Richards, 2003), was enhanced in the averted gaze condition, indicating that infants allocated more attention towards averted gaze. Latency of the Nc was shorter in the direct eye gaze condition, suggesting that object-directed eye gaze was easier to process for infants. The PSW, which is involved in memory encoding (Nelson & Collins, 1991), was larger in the object-directed gaze condition, indicating that object-directed eye gaze led to more efficient memory encoding of the simultaneously presented object. In sum, the present findings suggest that infants are able to process object-directed eye gaze more rapidly than non-object-directed gaze, and encode socially cued information more efficiently than information that is not socially cued. Eye gaze that is averted from a target object presumably contradicts infants' social expectations. Therefore, they allocate additional attentional resources to non-object-directed eye gaze compared to object-directed eye gaze. The implications of these findings for the development of joint attention and related social cognitive functions are discussed.

**Fr1-26**

### Infants Learn to Imitate: Evidence From Infants' Failed Attempts at Mimicry

**Susan Jones**

*Psychological & Brain Sciences, Indiana University, Bloomington, USA*

**Background:** This study concerns the origins of mimicry - the ability of one individual to intentionally reproduce the actions of another. Mimicry is clearly of lifelong importance for acquiring motor skills. It is widely believed that newborn infants can mimic adult behaviors. However, when mothers tried to elicit mimicry from infants aged 6 to 20 months, few infants matched any modeled behaviors before 12 months of age (Jones, 2007). Instead, majorities of infants matched different behaviors at different ages across the second year. Early-matched behaviors appeared to be learned responses to sound cues. Mimicry without apparent cues began for most infants at 16 to18 months of age.

**Aims:** The purpose of the present study is to discover developmental precursors of mimicry by examining the behavior of those infants in Jones (2007) sample who failed to mimic their mothers.

**Methods:** 162 infants from 6 to 20 months of age were each shown 4 of a set of 8 behaviors, each for up to 3 minutes, and encouraged to mimic. Video recordings were coded for infant actions involving the same body parts or body regions being moved by the model. For example, in Tongue Protruding, the model protruded her tongue between closed lips. Infant behaviors coded, in descending order of similarity, were: 1) protrudes tongue; 2) moves tongue inside an open mouth; 3) opens mouth, no visible tongue movements; 4) No visible tongue, mouth, or jaw movements. Infants were categorized by their closest approximation to the specific movement using the specific body part modeled.

**Results:** The numbers of infants in each category at each age level were compared separately for each behavior. In each case, the data show that as age increased, infants increased the specificity of their choice of muscles to move, and of the movements those muscles made, so that overall similarity of infants' movements to the models' movements increased.

**Conclusions:** The results appear to document increases with age in infants' abilities, first to find specific muscles, and then to move those muscles in specific ways. The findings suggest that these increases in body knowledge are products of experience specific to each body region and body part; that this learning extends well into the infant's second year; and that infants cannot mimic the behaviors of others until this learning is accomplished.

**Reference:**

Jones, S.S. (2007). Imitation in infancy: The development of mimicry. Psychological Science, 8(7), 593-597.

**Fr1-27**

### Are Number Gestures Easier Than Number Words For Preschoolers?

**Elena Nicoladis**[1] Simone Pika[2] Paula Marentette[3]

*1. University of Alberta, Edmonton, Canada; 2. University of Manchester, Manchester, UK; 3. University of Alberta, Augustana Faculty, Camrose, Canada*

**Background and Aims:** Some researchers have argued that children's earliest symbols are based in their sensorimotor experience so arbitrary symbol-referent mapping poses a challenge. If so, then an iconic symbol system (such as one-finger-for-one-object manual gestures) might help children's mastery of a difficult domain like number concepts. Wiese (2003) argued that exact number conceptualizations can only be acquired through the use of symbols and that iconic representations of number (such as gestures) are easier for children to acquire than arbitrary representations. Previous research has not unequivocally supported this argument. For example, Sinclair, Siegrist, & Sinclair (1983) showed that children invented both arbitrary and iconic written representations of number before they started to use conventional numbers. The purpose of this study is to test if children are more accurate in producing and interpreting number gestures (iconic) over number words (arbitrary).

**Methods:** Forty-four children between the ages of two and five years participated in this study. All children were asked to perform two tasks with number gestures and number words: production and give-a-number. In the production tasks, we gave children a number of objects and asked them to tell us (with their fingers in one task and in words in another) how many objects there were. In the give-a-number tasks, we asked (with fingers and with words) the children to give us a particular number of objects. The number of objects in all tasks was all the numbers between 2 and 10, as preschool children are still learning the referents of these numbers (Gelman & Gallistel, 1978).

**Results:** The children were more correct in mapping number words onto an exact number of toys than number gestures. This difference was particularly strong for the numbers greater than 5. Some researchers have argued that children's number concepts are not

exact quantities but approximate quantities. For that reason, we also analyzed the children's answers to see if they were correct +/-1 of the exact answer. This analysis also showed that the children were more correct with number words than number gestures.

**Conclusion:** These results disconfirm Wiese's (2003) hypothesis that children benefit from iconic symbol representations in acquiring number concepts. We discuss these results in light of a sociocultural framework of language acquisition, in which children learn symbols in terms of their interactive function.

**Fr1-28**

### Can Infants Parse the Dynamic Actions of an Inanimate Agent?

**Diane Poulin-Dubois**, Kara Olineck
*Concordia University, Montreal, Canada*

Previous research has clarified that infants from 10-11 months can segment dynamic actions into units coinciding with actors' goals and intentions (Baldwin, Baird, Saylor, & Clark, 2001). In this study, we explored the scope of early action segmentation skills by exposing infants to novel events in which a person or a robot manipulated objects. In the first experiment, 10-month-old infants (N= 22) were presented with two digitized movies in which the same female actor was shown performing a sequence of simple goal-directed actions using different toy props (e.g., pushing a toy truck down a ramp). In the habituation phase, infants were presented an 8 sec movie that displayed the actor performing a continuously flowing action. Once the infant had habituated to this movie, he/she was shown two different versions of the same movie. Both versions had a 1.5 sec still frame pause inserted at some point during the course of action. In the "completed" test video, the still frame pause was inserted at a point in time that corresponded with the completion of an intentional action. In the "interrupted" test video, the still frame pause was inserted at a point in time that did not correspond with the completion of an intentional action. As expected, infants' average looking time on the last block of three familiarization trials (M=10.37) was significantly less than their average looking time on the first block of three familiarization trials (M=22.93), $t(21)=6.82$, $p<.05$. Further analyses revealed that, when looking times during the first trial of each test video was isolated, infants looked longer at the interrupted test video (M=7.71) than at the completed test video (M=5.77), $t(21)=1.78$, one-tailed $p<.05$. In Experiment 2, we tested a second group of infants (N =22) using the same movies, except that a humanoid robot played the role of the agent in both movies. Results indicated that infants habituated to both movies (M = 23.93 s vs. M= 10.60 s, on first block and last block of trials, respectively). However, no looking time difference was observed between the two test trials (Interrupted= 8.86 s; Completed= 10.83 s, p= .35). These findings suggest that human morphological features and self-propulsion are not sufficient cues for infants to detect disruption in the structures inherent to intentional actions.

**Fr1-29**

### Parental Reports of Childrens' Scale Errors

**Karl Rosengren**, Isabel Gutierrez, Kathy Anderson
*University of Illinois, Urbana-Champaign, USA*

Scale errors are behaviors performed by young children when they try to perform actions on objects that are too small to allow the action. Previous research based on anecdotal reports of scale errors has elicited scale errors in laboratory settings. These scale errors include children's interactions with small scale objects (i.e., attempts to fit their bodies into or onto small objects; DeLoache et al., 2004) or the interaction of two objects (i.e., trying to insert one object into a miniature replica of another object; Ware et al., 2006). The goal of the present study was to investigate how often scale errors occur in natural settings.

For the present study, a total of 30 parents were enrolled to complete diaries for 6 months. Preliminary data on reports of 15 children (8 females, 7 males), ages ranging from 14-26 months at the beginning of data collection (average age at beginning of study 19.6 months) have been analyzed. The parents first attended a 40-minute orientation where they observed video clip examples of the target behaviors and learned how to complete the "scale error diaries". The "scale errors diaries" included information about the size of the object, description of the scale error, number of attempts, and parents' rating of how serious the child was in their attempt. Other information documented included setting, people present, description of what child was doing pre- and post- scale error, and children's response to the realization that they did not fit in (or other object did not fit in). Parents were then asked to observe their children at home and document each episode of a scale error that they observed for a period of six months.

Most of the parents (14/15) reported that their child performed at least one scale error that they considered "serious" (total serious errors = 45). An additional 8 scale errors were reported by parents to be somewhat ambiguous in nature and an additional 12 behaviors were considered by parents to be examples of pretense. The total number of reported scale errors was 65. On average, each child performed 3.0 "serious" scale errors. Children performed 38 scale errors involving their own body and a miniature object (e.g., trying to put on a doll shoe). The remaining errors involved two objects (7/45; e.g., trying to fly a toy plane through a miniature tunnel).

**Fr1-30**

### Assessing Infant's Intention Understanding and Imitation Though a Video Method

**Elena Sakkalou**, Merideth Gattis
*School of Psychology, Cardiff University, Cardiff, UK*

**Background and Aims:** Two studies investigated intention understanding and imitation. We had two aims: 1) to develop a video method for studying intention understanding and imitation and 2) to use that method to investigate how vocal intonation influences 14- to 18-month-olds' intention understanding. In the basic paradigm, infants watch an adult perform two actions on novel toys followed by an interesting end result. Each action is marked by a vocal cue as intentional or accidental. Infants copy actions marked as intentional more often than actions marked as accidental, even in the absence of meaningful lexical cues, suggesting that infants can infer intentions from intonation cues (Sakkalou & Gattis, 2007). The current studies investigated whether infants exhibit the same behavior when presented with pre-recorded videos instead of live demonstrations. Past studies using video presentation have resulted in lower performance compared to live demonstrations, leading some researchers to propose that infants display a "video deficit effect" (Anderson & Pempek, 2005).

**Methods:** In our study, 14- to 18-month-olds watched videos showing a demonstrator's arm/hand (but not the demonstrator's face or other body parts) perform two actions on a novel toy, accompanied by extralexical vocal cues. Afterward infants were given the actual toy and their actions were coded.

In a subsequent study, we compared the contribution of intentionality and valence of the extralexical vocal cues. This study presented 18 month old infants with the same video method but this time we controlled for the emotional valence of the extralinguistic vocal cues. Adults listened to different intonations and rated them on whether they sounded accidental or intentional. They next rated the intonations according to how positive or negative they sounded. Two equally positive intonations which expressed a different mental state (one rated as accidental and one rated as intentional) were chosen for the study.

**Results:** Infants in this pre-recorded video paradigm copied intentional actions more than accidental actions, as marked by extralexical vocal cues. The results of this second study suggest that emotional valence might be important for infants as it might help them when making a distinction between the two mental states.

**Conclusion:** Video demonstrations thus appear to be a viable method for studying imitation. Video demonstrations have important methodological advantages, including stimulus consistency and the possibility of manipulating variables that cannot be manipulated during live demonstrations.

**Fr1-31**

### Young Infants' Perception and Learning About Foods

**Kristin Shutts**[1] Kirsten Condry[2] Elizabeth Spelke[1]

*1. Harvard University, Cambridge, USA; 2. R.I.T., Rochester, USA*

Adults, preschool children, and nonhuman primates detect and categorize food objects according to their substance properties (conveyed primarily by color and texture), whereas they perceive and categorize artifacts according to shape and rigidity. Six preferential looking experiments investigated the origins of domain-specific parsing and learning about foods at the age when infants first begin to consume them.

Two experiments investigated 9-month-old infants' perception of the unity and boundaries of food objects. After habituation to two stationary adjacent foods of contrasting colors, textures, and shapes, infants looked equally at events in which the foods moved naturally as separate bodies or unnaturally as one connected body ($t(9)<1$), suggesting that infants did not parse the objects appropriately. After habituation to a single food object, infants looked longer when the object broke unnaturally into two pieces than when it moved naturally as a whole ($t(9)=2.34$, $p<.05$), suggesting that infants perceived the food object as a connected, commonly movable body. In contrast to children and to monkeys presented with the same displays, infants parsed the food objects by analyzing surface arrangements and motions but not colors, textures, or shapes.

Additional experiments investigated the visual properties by which 8-month-olds infants categorize foods. In one experiment, infants were habituated to an actor eating one type of food (e.g., green sugar in a glass), and then were tested with a new container holding either a new substance (e.g., orange juice in a bowl) or the familiar substance (e.g., green sugar in a bowl). Infants looked equally at these test events ($t(15)<1$), failing to generalize by color/texture across a change in shape. In another experiment, infants habituated to the same display were tested with a new food in either the same or a novel container. Infants looked equally long at these test events ($t(15)<1$), failing to generalize by shape across a change in color/texture. Two further experiments demonstrated that infants discriminated and remembered the colors, textures, and shapes used in the experiments. Although infants detected food substances and shapes, they did not use substance information to categorize foods, again in contrast to monkeys and to older children.

These findings provide evidence that the category-specific patterns of perception and categorization shown by children and adults are not present at the time when infants first begin to consume and choose among foods. The later development of these patterns remains to be investigated.

**Fr1-32**

### Infants' Interpretation of Impossible Objects in Pictures

**Sarah Shuwairi**[1] Judy DeLoache[2]

*1. NYU Department of Psychology, New York, USA; 2. University of Virginia, Department of Psychology, Charlottesville, USA*

Previous research using a preferential looking procedure demonstrated that 4-month-old infants are able to discriminate between 2D depictions of structurally possible and impossible objects. Specifically, they looked differentially at cubes with possible intersections of elements versus cubes with an impossible one. Additionally, in an eye-tracking paradigm, infants not only showed longer looking times for impossible relative to possible object displays, but they also engaged in active comparison of critical regions in these stimuli, regions in which depth order of junction parts was reversed in impossible displays. This research thus revealed that sensitivity to the pictorial depth cue of interposition and the ability to detect inconsistencies in global object structure are present early and guide young infants' oculomotor behavior.

Here, we asked whether these perceptual skills would also guide reaching and manual exploration of pictures by 9-month-olds. We reasoned that the degree to which infants manually explore depictions of possible versus impossible objects might provide an index of their interpretation of such displays. Accordingly, we measured differences in the number of manual behaviors attempted towards realistic photographic displays of possible and impossible cube stimuli. Infants directed a greater amount of manual investigation (e.g., grasping, pinching, scratching, rubbing, patting and lifting) towards the impossible relative to the possible cube display.

These results showed that by 9 months, infants use the pictorial depth cue of interposition to guide manual investigation of 2D depictions of objects, and they behave differently in response to images of possible and impossible objects. More specifically, the detection of anomalous depth information inspires greater manual exploration of pictures of impossible objects. In addition, the impossible cube display elicited significantly more social referencing to the parent and experimenter, as well as a higher frequency of frustrated vocalizations (e.g., whining and grunting sounds) relative to the possible object displays.

These data suggest that the infant's visual system extracts structural information contained in 2D images in an attempt to analyze the projected 3D configuration, and this information serves to control both oculomotor and manual action systems. Our findings provide important insights into the development of mechanisms for processing pictorial depth cues and extracting information about global 3D structure from pictures of objects.

**Fr1-33**

## Conflicting Prior Knowledge Hinders Category Learning in Eight- and Thirteen-Month-Old Infants

**Sarah Snoxall**, Denis Mareschal

*Centre for Brain and Cognitive Development, Birkbeck College, London, UK*

This study examines whether information that is inconsistent with prior knowledge hinders eight- and thirteen-month-olds' ability to learn a novel perceptually-defined category.

Using a habituation paradigm, we taught infants a novel category, in which exemplars with one pattern are placed into a container, whilst those with another pattern are set aside. The container size is varied to produce an inconsistency with their prior knowledge about containment. Half of the infants are shown exemplars 'magically' vanishing into a short container, whilst the other half see the same exemplars being placed into a tall container. Both groups see the same exemplars and patterns, the only difference being the size of the container. Following habituation, the infants are given three test trials, in which the rule pattern, the non-rule pattern (violating the category rule) and a novel item (a toy elephant) are placed into the container.

Results confirm that there is an effect of inconsistent prior knowledge during habituation, with both age groups taking longer to habituate in the inconsistency condition, $F(1,52)=25.94$, $p<0.0001$. Analysis of the three tests further indicates the effect of inconsistent prior knowledge. Table 1 illustrates the average proportion looking time at the test trials, by age and by inconsistency, with standard deviations.

| | No Inconsistency | No Inconsistency | No Inconsistency | Inconsistency | Inconsistency | Inconsistency |
|---|---|---|---|---|---|---|
| Age (Months) | Rule | Rule-Violation | Elephant | Rule | Rule-Violation | Elephant |
| 8 (n=14) | 0.60 (0.25) | 0.73 (0.21) | 0.80 (0.21) | 0.72 (0.18) | 0.75 (0.20) | 0.73 (0.27) |
| 13 (n=14) | 0.69 (0.27) | 0.81 (0.21) | 0.89 (0.17) | 0.85 (0.17) | 0.80 (0.30) | 0.93 (0.18) |

Analysis indicates that the thirteen-month-olds looked longer at the tests than the eight-month-olds, $F(1,52)=5.76$, $p<0.05$ and that looking time at the rule, rule-violation and elephant tests increased significantly, $F(2,104)=6.42$, $p<0.005$. In addition, a test by inconsistency interaction reveals a different pattern of results on the tests in the two inconsistency conditions, $F(2,104)=3.21$, $p<0.05$. This was caused by a significant difference between the rule and rule-violation tests only with no inconsistency, $t(27)=2.82$, $p<0.01$.

We conclude that where eight- and thirteen-month-olds learn the category rule with no inconsistency, neither age group learns the category rule when information contradicts prior knowledge about containment. This extends evidence of the effect of prior knowledge on category learning in infants from ten to eight months.

**Fr1-34**

## Human Fetuses are Sensitive to Unfamiliar Sounds and Familiar Voices

**Hideko Takeshita**, Masako Myowa-Yamakoshi

*The University of Shiga Prefecture, Hikone, Japan*

**Aims:** Recent studies have revealed that experience influences human fetal voice processing in the later gestational period. For example, the heart rate of human fetuses at 38 weeks of gestation accelerates when they hear their mothers' voices (Kisilevsky et al., 2003). Using fetal mouth movements obtained with four-dimensional (4D) ultrasonography, we tested human fetuses' ability to discriminate between "familiar" and "unfamiliar" auditory stimulations including both human voices and machine sounds.

**Methods:** Fifty-seven fetuses at 23 to 35 weeks of gestation were assigned to one of two experimental groups: human voice group ($n = 30$, $M = 28.8$ weeks GA) and machine sound group ($n = 27$, $M = 28.7$ weeks GA). In the human voice group, fetuses were exposed to a digital recording of their mothers and a female stranger reading a book. In the machine sound group, fetuses were exposed to two types of novel sounds produced by the sound design software. These stimuli were delivered through two loudspeakers that were held approximately 10 cm away from the maternal abdomen and played at an average of 105 dB SPL. Each condition consisted of three 2-min periods: no stimulus, human voice (either a mother's or the stranger's) or machine sound (either one of the two types), and no stimulus. All the testing conditions were videotaped.

**Results:** The number of mouth movements exhibited during each period in each session was counted. Mouth movements were defined as movements of the jaw, which may or may not include tongue movements. Nonparametric analyses were conducted for the within-subject factor in the human voice condition and in the machine sound condition. In the human voice group, mouth movements increased only in the period when the mothers' voices were presented ($Z = 2.72$, $p < 0.01$). In the machine sound group, the mouth movements increased in both the periods in which the machine sounds were presented ($Z = 2.41$, $p < 0.02$, $Z = 1.95$, $p < 0.05$).

**Conclusion:** These results suggest that human fetuses in the mid-pregnancy period react sensitively to unfamiliar auditory stimulation through mouth movements. With regard to human voices, however, they do not react to unfamiliar voices but to familiar maternal ones. Human fetuses may be sensitive to two types of external auditory stimulations, unfamiliar nonhuman sound and familiar human voices.

Note: The research reported here was financially supported by JSPS and MEXT (nos. 16203034 to H.T and 16683003 and 19680013 to M. M. Y.).

**Fr1-35**

## Do Infants Understand Sharpness as a Causal Property?

**Tania Tzelnic**[1] Marc Hauser[2] Valerie Kuhlmeier[1]

*1. Queen's University, Kingston, Canada; 2. Harvard University, Cambridge, USA*

**Background:** Hauser and Spaulding (2006) reported that rhesus macaques are able to differentiate between possible and impossible transformations caused by a tool (e.g., a knife slices an apple vs. a glass of water slices an apple). Using a modified task, we examined whether infants are also sensitive to the fact that certain physical features—such as sharpness for knives—are critical components of a tool's function.

**Methods and Results:** 9-month-old infants infants participated in one of three experiments in a violation of expectancy, looking-time task. In Experiment 1, an experimenter placed a ball of clay on a stage, then raised a screen to hide the clay. On alternating trials, she lowered a sharp wooden "knife" (possible trials) or dull knife (impossible trials) behind the screen and motioned as if cutting the clay. The screen was then lowered to reveal two clay halves. Infants looked longer at dull knife events ($M = 6.5$s) than sharp knife events ($M = 4.86$s), ($t(19) = 2.74$, $p = .01$, two-tailed), suggesting that they saw the dull knife

cutting the clay as a physical violation, but that the sharp knife could cause the slicing of the clay. Experiments 2 and 3 were designed to rule out the alternative hypothesis that infants' reasoning was not causal, but based on associations between sharp objects and cut items. In Experiment 2, infants saw the two clay halves become one whole ball of clay after the experimenter "cut" it with the sharp and dull knives (both impossible since neither knife can adhere two halves together). In Experiment 3, infants saw two halves of clay before the screen was raised, and two halves remained after the "cutting". As predicted, infants in Experiments 2 and 3 looked equally at dull and sharp events (Experiment 2: dull knife M = 6.33s, sharp knife M= 6.23s; t(18)= .13, p = .89, two-tailed; Experiment 3: dull knife M = 6.84s, sharp knife M= 4.11s; t(11)= 2.29, p = .04, two-tailed).

**Conclusion:** Infants in this study spontaneously demonstrated an understanding of a transformative feature of an object (e.g. sharpness). However, understanding may not go beyond an association between sharpness and 'things that are cut'. If so, this sort of association may be the basis from which infants are able to bootsrap an understanding of the functional features of tools.

**Fr1-36**

### Do Babies Learn from Baby Videos?

**Mieke VanderBorght**, Cynthia Chiong, Judy DeLoache, Kathleen Van Eron, Georgene Troseth, Gabrielle Strouse, Nadia Islam

*University of Virginia, Charlottesville, USA*

Television plays an increasingly prominent role in the lives of American infants, as reflected in large-scale surveys of media use and the extraordinary success of videos/DVDs marketed specifically for infants. Many of the companies that produce these products either directly claim or disingenuously suggest that watching their videos will make babies smarter.

Existing research, including a recent large-scale correlational study and several lab studies of imitation from video, cast suspicion on these claims. However, there has been no direct examination of how much infants learning from baby videos in the home.

We report an experiment examining of the extent to which 12- to 18-month old infants learn new words from watching a very popular video produced and marketed specifically for infants and toddlers. This video shows a variety of common household objects while a voice names each object 3 times.

At the first of 3 home visits, each child's knowledge of 13 target words from the video was tested. Whichever words the child did not know were the target words for that child. The child was tested for knowledge of those words in 2 subsequent home visits, one after 2 weeks and another after 4 weeks.

Seventy-two infants were randomly assigned to one of three conditions. The parents of the children in the *Baby Video* condition were asked to show their child the target video (approximately 39 minutes in length) for a minimum of 5 times a week for 4 weeks. Parents of children in the *Parent Teaching* condition were given a list of the words shown on the video and asked to try to teach them to the child over the next 4 weeks. The parents in both conditions were instructed to interact with their children in whatever way was natural for them while viewing the video or teaching the words. The parents of children assigned to the *Baseline* condition were told that we were interested in how many new words their children would naturally learn in a month

Preliminary analyses reveal that the infants in the Parent Teaching condition learned more words than did those in either the Baby Video or Baseline conditions. These (and other) results indicate that infants of this age learn more effectively from interacting with their parents than from watching television--even commercial baby videos designed specifically to teach them. The results have important theoretical and practical importance.

**Fr1-37**

### Early Representations of Directed Motion Events in an Imitation Choice Task

Anna Yocom, Maia Greene-Havas, **Laura Wagner**

*OSU, Columbus, USA*

Directed Motion (DM) events have multiple components, including at least a Manner of motion, a Path for the motion, and a Goal to which the motion is directed. They are a critical organizing force in language (Talmy 1985) and are important in cognition more generally. Previous work (Carpenter et al. 2005) showed that 12 and 18-month-olds preferentially imitated the Goal of a DM event, but others have found infants to be more flexible (Wagner, 2006).

This study looked at infants' ability to imitate DM events in a forced choice setting to determine the extent of their flexibility and to identify potential preferences among the DM components. A new paradigm was used: the Imitation Choice method. In this task, an experimenter modeled a DM event on a board containing a ramp with a goal object at both the top and bottom (e.g. sliding up the ramp to the orange bowl; hopping down the ramp to the red platform). The child's board had the objects in the opposite configuration with respect to the ramp, so both of the modeled Path and Goal components could not accurately be imitated in a natural motion event. Thus, the child had to choose between matching the model's Goal or the model's Path. Children's choices reflect how they prioritize these components in their representations.

The dependent measure was which modeled components the child chose to imitate. Coders were blind to the model, and imitations were coded for presence and substance of the Manner, Path, and Goal components. Across the 8 study trials, we determined if each child had a preferred analysis of the DM event. The results found that 27-month-olds and 34-month-olds had no preference at all, and matched the model's Path and Goal components approximately equally often. The 40-month-olds, however, had a significant preference for matching the Path component ($t(11) = 3.3$, $p < .01$).

In addition, two other correlations were found: (1) Subjects were more likely to correctly imitate Manner when they matched the model's Path (and not the Goal); (2) Subjects who interacted more with the goal objects during a prior free-play session were more balanced in their preference between Path and Goal components.

Overall, these results suggest that infants have a rich representation of DM events that integrates across components (such as Path and Manner) and is partially mediated by their prior experience with the specific elements involved.

Fr1-38

### Infant's Ability to Infer Agents' Dispositions Based on Underlying Intentions

**Jung-eun Yun**, Hyun-joo Song
*Dept. of Psychology, Yonsei University, Korea, Seoul, Korea*

During the first year of life, infants can understand others' goal-directed actions (e.g., Woodward, 1998) and encode agents' dispositions (Kuhlmeier, Wynn & Bloom, 2003a, 2003b). In Kuhlmeier et al. (2003a, 2003b), 9- and 12-month-olds could infer an agent's preference for other agents based on previous actions: the infants expected the agent to approach another agent who had helped him to fulfill a goal. However, the results do not tell us whether infants infer the agent's disposition on the basis of positive behavioral outcomes or another agent's intentions to help. The present study examined whether infants can attribute dispositions to agents based on the intentions of past actions even when the actions do not lead to the intended results.

Sixteen- and 12-month-olds were assigned to either a successful-help or a failed-help condition. In the successful-help condition, we used computer animated movies similar to those used in Kuhlmeier et al. (2003b). The infants were first familiarized with two kinds of events. In the helping movie, a circle attempted to climb a hill and another agent (either a square or a triangle) helped the circle reach the top of the hill. In the hindering movie, the other agent hindered the circle from climbing the hill. In the failed-help condition, infants watched similar familiarization events except that in the helping movie, the agent who attempted to help the circle failed to do so: At the end, two agents rolled down the hill together. Thus, the event outcomes of the helping and hindering movies were the same. During test, infants in both conditions watched events in which the circle approached either the helper (helper-approach event) or the hinderer (hinderer-approach event).

In the failed-help condition, 16-month-olds who watched the hinderer-approach event looked reliably longer than those who watched the helper-approach event. In contrast, 12-month-olds looked about equally whether they watched the helper- or hinderer-approach event. Preliminary data from the successful-help condition showed that both 16- and 12-month-olds who watched the hinderer-approach event looked longer than those who watched the helper-approach event.

Our results add to the story of how infants develop sophistication in recognizing others' dispositions. Sixteen-month-olds, but not 12-month-olds, could expect the circle to prefer and approach the helper regardless of the event outcomes. Thus, at least by 16 months, infants can infer agents' dispositions based on underlying intentions of agents' actions. The results are discussed in terms of possible relations to moral reasoning development.

## *Communication and Language*

Fr1-39

### One-Year-Olds Appreciate the Referential Nature of Words and Communicative Gestures

**Teodora Gliga**, Gergely Csibra
*Birkbeck College, London, UK*

**Background:** One-year-old infants already have a small receptive vocabulary and, around the same age, they follow gaze shifts and pointing gestures, but it is debated whether they understand the potential communicative reference indicated by these behaviours or merely their spatial attention is being directed by them. We reasoned that if infants can map concurrent words and non-verbal referential gestures onto each other, this can be taken as proof for referential understanding.

**Method:** Forty 13 months-old infants were tested, 20 in a social cueing condition and 20 in a non-social cueing condition. Both groups observed an actress naming an object with a word within their receptive vocabulary, while only two occluders but no objects were visible. At the same time, infants' attention was directed to one of the occluders by either referential gestures (social cueing condition) or by conspicuous flashes on the occluder (non-social cueing condition). Two objects were subsequently revealed, the named object being either behind the referred occluder ("match" trials) or on the opposite side ("mismatch" trials).

**Results:** Longer looking times to the "mismatch" trials were found only in the social cueing condition (match: 10.5 s vs. mismatch: 12.5 s, p=.042) but not in the non-social cueing condition (match: 11.7 s vs. mismatch: 11.7 sec). Infants were also more likely to look first at the referred than the opposite location after the occluders moved away in the social cueing condition (p=.017) but not in the non-social cueing condition.

**Conclusion:** We demonstrated that 13-month-olds expect that, in a naming context, words and communicative gestures co-refer to the same object. This capacity allowed them to infer the location of the referent of a familiar word when it was indicated by gaze shifts and pointing but not when it was highlighted by a non-social cue. Thus, even at this young age, infants' response to non-verbal communicative cues cannot be simply explained by general attention directing mechanisms.

Fr1-40

### 'Talking Heads' in an Intermodal Preferential Looking Task

**Emily Mather**, Kim Plunkett
*University of Oxford, Oxford, UK*

**Background and Aims:** The intermodal preferential looking task (IPL task; Golinkoff et al., 1987) enables rigorous control over the study of lexical development. However, the standard procedure lacks social stimuli present in everyday naming contexts. Therefore, we investigate infants' attention to labelled images in the presence of a video of the speaker.

**Method:** In Experiment 1, 26 19.5-month-olds and 20 22.5-month-olds received 12 trials presenting three different image pairs of common items (cheese, apple, bird, etc...). A video of the speaker, looking forwards and naming one item, was centrally presented between images. Each infant was tested twice on six labels across two blocks; side

of presentation and the labelled target was counterbalanced within-infants. Each trial lasted 5s, with label onset at 2.5s. In Experiment 2, six 19.5-month-olds were presented with 8 trials, each presenting a different image pair.

**Results:** Experiment 1 found a remarkably strong naming effect; 48% pre-naming target preference increased to 67% post-naming ($F(1, 42) = 77.2$, $p < .001$, partial $?2 = .65$), with no age interaction. There was an interaction between sex and naming ($F(1, 42) = 9.7$, $p < .003$, partial $?2 = .19$); target preference increased 52% to 66% for males, and 42% to 70% for females. The blocked design may have led to a pre-naming distractor preference in females. Using a similar procedure in Experiment 2, image pairs were never repeated. Infants displayed a strong naming effect (50% to 83%; $F(1, 4) = 32.6$, $p = .005$; partial $?2 = .89$) and no interaction with sex.

**Conclusion:** The use of a 'talking head' produced a highly robust naming effect; the procedure is likely to be useful for other IPL experiments. The effect may be due to the presence of a social stimulus or low-level attentional factors. Continuing investigation explores these possibilities.

**Fr1-41**

## Three-Year-Olds Trust Inaccurate Native Language Speakers over Non-Native Language Speakers

**Douglas Behrend**[1] Cari Bogulski[2] Rachel Schwartz[1] Ashley Cowles[1]

*1. University of Arkansas, Fayetteville, USA; 2. Pennsylvania State University, University Park, USA*

Recent research by Koenig, Harris, and colleagues has shown that children as young as 3 monitor speaker accuracy during word learning and are more likely to learn novel words from a previously accurate speaker than from a previously inaccurate speaker. In an increasingly multilingual society, children will often be confronted with words being spoken by non-native language speakers. The current study investigated children's trust of non-native language speakers when contrasted with accurate and inaccurate native language speakers.

**Methods:** 24 3-year-old children recruited from local preschools participated. Participants were all native English speakers and were assigned to either the native language accurate (NLA) or native language inaccurate (NLI) condition. All children observed a video in which two adults labeled familiar and unfamiliar objects. One adult was a native English speaker and one was a native Spanish speaker. They were of similar appearance and wore different color shirts. During training, speakers labeled familiar objects (e.g. shoe, clock). In the NLA condition the English speaker labeled the objects correctly and the Spanish speaker labeled them with an incorrect Spanish word. In the NLI condition the English speaker labeled the objects incorrectly and the Spanish speaker labeled them correctly. In the test phase, speakers labeled four novel objects with novel words that were consistent with their own native language phonology (e.g. *dax* for English and *oba* for Spanish). After each speaker had labeled the novel object, the experimenter asked the child what the object should be called (e.g. "Is this a *dax* or is this an *oba*).

**Results and Discussion:** The number of times children chose the novel word provided by the native language speaker was calculated. Unsurprisingly, children in the NLA condition usually (88%) chose the word provided by the native-language speaker. However, children in the NLI condition also chose the word provided by the native language speaker significantly more often (71%) than chance and not significantly less often than children in the NLA condition. It appears that speaker language trumped speaker accuracy in this study. Follow up studies demonstrate that this effect is not due either to children's ignorance that the non-native language speaker was labeling the objects correctly in Spanish nor because children were avoiding saying words inconsistent with the phonology of their native language. The results have important implications for understanding the limitations of relying on speaker accuracy during word learning and, potentially, for early second language learning.

**Fr1-42**

## Examining Maternal Vocabulary Diversity in Book Sharing and Play Interactions: A Longitudinal Study of Latino Toddlers Living in Poverty

**Lisa Boyce**, Mark Innocenti, Eduardo Ortiz, Gina Cook

*Utah State University, Logan, USA*

Diversity in maternal vocabulary has been shown to be a better predictor of low-income children's vocabulary growth than maternal frequency of talk (Pan, Rowe, Singer, & Snow, 2005). Less educated parents with lower incomes tend to talk less to their children using fewer different words than more advantaged parents (Hart & Risely, 1995). This puts these children's vocabulary development at risk. The gap in vocabulary growth between children from low-income homes and those from middle-class homes begins as young as 3 years old (Pan et al.) and continues to widen as children age (Hart & Risely).

Parent-child conversation context seems to matter in word use during an interaction. Middle-class and working-class parents talk more and use more diverse words during book reading interactions than play interactions with their children (Hoff-Ginsberg, 1991). It is not known if these patterns are true for young, Latino children living in poverty in the United States and their parents. These children represent some of the most disadvantaged children in terms of school readiness. The present study extends the current literature by examining differences and predictors of the number of word types used by Latino mothers and their children living in poverty during book sharing and play interactions.

As part of a larger assessment, mothers and their children were given two bags, one contained three books (a wordless book, a book in Spanish, and the same book in English) and the other developmentally appropriate toys. The mothers were asked to begin with the books and then move on to the toys whenever they wished. Interactions were videotaped and transcribed. Assessments occurred when the children were 18, 24, and 36 months old. The amount of time spent with the books varied among dyads. Mothers used significantly more word types during book sharing interactions than play interactions when their children were 24 and 36 months, but not 18 months. Children used more word types during book sharing interactions than play interactions at 18 and 24 months, but not at 36 months. Mothers also asked more open-ended questions during play at 18 and 36 months than during book sharing interactions. Parents used more prohibitions during play interactions at all ages than during book sharing interactions. Models predicting children's vocabulary growth and maternal vocabulary diversity during play and book sharing interactions will be presented. Implications for early intervention efforts with Latino families living in poverty will be discussed.

**Fr1-43**

### Do Nouns Influence the Alignment of Events in Verb Learning?

**Jane Childers**, Lashelle Sydenham
*Trinity University, San Antonio, USA*

Verb learners would benefit from attention to the range of situations in which a verb is heard. Our research examines whether children compare events using structural alignment (e.g., Gentner, 1983; 1988). Two studies extend this research by examining how words in sentences influence the comparison process.

In Study 1, 32 2 1/2-year-old children heard familiar nouns ("I can use a hook to meek it"), familiar verbs ("I can grab it and can meek it") or pronouns ("I can meek it") in sentences with new verbs. Familiar nouns could help focus attention on an important tool, and thus help children align events. For each of 4 verbs, children saw an initial event, and then were shown 3 events that could be compared. At test, children were given a new object to extend the verb (extension) and a distractor (familiar action).

A repeated measures ANOVA computed with Condition (Noun, Verb, Control) as a between-subjects factor, and Response type (extension, affordance) as a within-subjects factor (dependent measure: proportion of responses at test) revealed a main effect of Response type, $F(1, 29) = 47.10$, $p<.001$, and a trend for Condition by Response type, $F(2, 29) = 2.62$, $p< .10$. Post-hoc tests revealed that children in the Noun condition produced significantly more distractor responses than the control condition, suggesting that hearing new nouns did not help children align multiple events. However, in this study, the object named was always a tool. Nouns may be most helpful if they name the affected object (patient) because this object is changed in the event.

In Study 2, 2 1/2-year-old children hear sentences with an initial noun (e.g., "The spoon koobs it"), sentences with a final noun (e.g., "It koobs the cord"), or no nouns (e.g., "It koobs it"). In 2 of the 4 sets, the named entity is an object that is changing across the set of events; in the other 2 it is not. At test, children are given a new object to reproduce the result (extension) or a distractor. We predict that children in the Noun final condition will perform more extensions at test than other conditions, particularly on trials in which the affected object is changing.

Results will be discussed in terms of the structural alignment and comparison view, an important mechanism children may use to deduce the meaning of new verbs.

**Fr1-44**

### Native-Language Prosody Facilitates Segmentation: Evidence From Infant Learners of Canadian English and Canadian French

**Suzanne Curtin**[1] Linda Polka[2] Shani Abada[2] Sally-joy Reaper[3]
*1. University of Calgary, Calgary, Canada; 2. McGill University, Montreal, Canada; 3. University of Alberta, Edmonton, Canada*

**Background and Aims:** Research shows both prosodic and distributional cues are used for speech segmentation by 7 months. When these cues conflict, infants younger than 7 months rely on distributional cues (Thiessen & Saffran, 2003), while older infants rely on prosodic cues (Johnson & Jusczyk, 2001). When perceivers track the occurrence of stressed syllables and their unstressed counterparts as unique units, the distributional information and stress align making these stressed syllables more salient word boundaries (Curtin, et al., 2005). Our study explores the role of prosodic information, when it is not aligned with distributional cues, in segmentation to determine whether or not language-specific rhythmic biases guide segmentation as suggested by studies using natural speech (Jusczyk, et al., 1999; Polka, et al., 2002; but see Nazzi et al., 2006).

**Methods:** English- and French-learning 8-month-olds were familiarized to an artificially constructed continuous stream of naturally produced syllables for 2 minutes. Each stream (English; French) consisted of six trisyllabic strings created from nine syllables permissible in both languages. Each syllable had a .5 probability of preceding or following the two other syllables within a string; each string contained a stressed syllable in either initial, medial, or final syllable position; only three syllables occurred as stressed syllables. Following familiarization, infants were tested on equally emphasized trisyllabic strings corresponding to either initial or medial stress sequences (Initial Group, IG) or to final or medial stress sequences (Final Group, FG) in the familiarization stream. Both groups were presented with control sequences consisting of syllables that did not co-occur in the familiarization.

**Results:** English IG infants (n=16) listen less to words that contain a SWW syllable sequence within them than control items ($p<.05$). However, English FG infants (n=16) listen equally long to all sequences. Preliminary results from French infants point to potential differences from their English peers. French IG babies (n=14) show a significant difference in looking times between the control and medial (WSW) sequences ($p<.05$). French FG infants (n=10) listen least to words with final stress, most to control items, and show intermediate listening times to medial stress words, suggesting some reliance on both types of cues.

**Conclusions:** The findings suggest that like adults, English infants appear to make use of an initial stress parsing strategy whereas French infants appear to be influenced by prosody but do not consistently apply an iambic template. Overall the distribution of stress information in the native language guides segmentation strategies.

**Fr1-45**

### The Role of Social Feedback in the Development of Prelinguistic Communicative Pragmatics

**Julie Gros-Louis**
*Indiana University, Bloomington, USA*

For effective communication, infants must develop the correct sounds that comprise adult speech and learn the pragmatics of communication. However, few studies have examined the development of pragmatics during the prelinguistic period and even fewer have considered the developmental mechanism. Prior to language, vocalizations and gestures in combination with visual gaze (toward objects or social partners) can lead to more complex communication rather than just the production of 'correct' adult-like speech in that the infants' attentional focus can bring functionality to vocalizations.

The current study investigated the mechanism for the development of converging vocal and pragmatic skills. Following up on recent observational and experimental findings that social feedback can shape phonological development, the influence of maternal responses on both phonological and pragmatic development, i.e. the effective use of prelinguistic communicative behaviors, during the prelinguistic period was examined. Twelve mother-infant dyads visited the lab biweekly over a 6-month period starting when infants were 8 months old. Infraphonological characteristics of infant vocalizations were coded, in addition to infants' attentional focus when they vocalized (directed to object, mom, or undirected). Maternal responses were

coded for verbal content, in addition to whether mothers were following-in to infants' attentional focus or redirecting infants' attentional focus. An index of maternal response specificity was calculated based on the differentiation of maternal responses to vocalizations that were directed (to object or mom) and undirected.

Results revealed that although infants showed similar overall progression through vocal stages, infants showed different patterns of pragmatic usage of vocalizations that varied relative to the response specificity of their mothers rather than overall response rates. Because mothers provide information about the focus of infants' attention, they provide feedback about vocal usage and referential labeling. Specifically, infants of mothers who showed more specificity in their responsiveness showed an increase in vocalizations directed to their mothers in social interactions and scored higher on the MCDI. Furthermore, infants showed more differentiated uses of vocalizations, directing vocalizations to objects and their mothers in "conversational" exchanges, which elicited more complex interactions with their mothers at 14 months of age. Thus, there is a bi-directinal influence on both pragmatic and vocal development that is embedded in real-time social interactions.

**Fr1-46**

### Fast-Mapping a Proper Name in 26- and 30-Month-Old Japanese Children

**Etsuko Haryu**[1] Mutsumi Imai[2] Hiroyuki Okada[3] Sachiyo Kajikawa[3]

*1. University of Tokyo, Tokyo, Japan; 2. Keio University, Kanagawa, Japan; 3. Tamagawa University, Tokyo, Japan*

When children hear a novel noun introduced for an object and infer the meaning of the noun, they have to determine whether the noun refers to an object as a category member or as an individual. It has been reported that English-learning 24-month-olds can do this by attending to syntactic information (Hall, Sharon & Belanger,2001). In contrast to English, Japanese does not syntactically distinguish a proper noun from a common noun. Therefore, it is interesting to consider how Japanese-learning children can learn proper nouns and common nouns without syntactic clues.

Imai and Haryu (2001) have shown that Japanese 32-month-olds decide whether a novel noun is a common noun or a proper noun by attending to the familiarity of the named animal. That is, 32-month-old children interpret a novel noun introduced for a familiar animal as a proper name, whereas they take a novel noun associated with an unfamiliar animal as referring to the category of the named animal. However, it remains unknown whether Japanese children younger than 32 months of age use this strategy to distinguish proper nouns from common nouns.

To explore this problem, Japanese 26- and 30-month-olds were assigned to either the familiar or the unfamiliar condition. In the familiar condition, a novel word was introduced for a familiar animal, a toy cat wearing a distinctive accessory. The child's interpretation of the word was assessed by asking the child to select the referent of the novel word from an array of 4 toy animals; 1) the named cat, 2) another cat without the accessory (subordinate item), 3) a toy rabbit with the same accessory as the named cat (same attribute item), and 4) another toy rabbit without the accessory (distracter). The procedure for the unfamiliar condition was the same except that monster-like unfamiliar animals were used for the named object and the subordinate item.

The results showed that both 26- and 30-month-olds were more likely to select the named animal in the familiar condition than in the unfamiliar condition, suggesting that even 26-month-olds can fast-map proper nouns by attending to the familiarity of the named object. However, 26-month-olds in the familiar condition were more likely to select the same attribute item and the distracter, indicating that the strategy to learn proper nouns is not established so firmly as it is in 30-month-olds.

**Fr1-47**

### Toddlers Use Mutual Exclusivity Even When it Conflicts with Pragmatic Information

**Vikram Jaswal**

*University of Virginia, Charlottesville, USA*

**Background and Aims:** Children learn much--probably most--of their vocabulary indirectly, without explicit instruction from a parent or tutor. One strategy that can facilitate indirect word learning is a type of reasoning by exclusion. Shown a shoe (an object with a known label) and a whisk (an as-yet unnamed object), for example, and asked to find the "whisk," infants as young as 17 months will indicate the whisk--even though they have never heard that word before (e.g., Halberda, 2003).

Two competing hypotheses have been proposed to account for this phenomenon. On the social-pragmatic explanation, children select the unnamed object because they are reasoning about the intent of the speaker who uses the new word: If the speaker had meant for them to select the known object, s/he would have used the known label (e.g., Clark, 1997; Diesendruck & Markson, 2001). According to the explanation provided by mutual exclusivity, by contrast, children select the unnamed object because they expect that each object belongs to just one category and so has just one category label (Markman, 1989). In this study, we sought to distinguish between these two explanations by providing 30-month-olds with explicit, behavioral evidence about the speaker's intent.

Procedure: Thirty-month-olds (N = 32) watched as an experimenter showed several pairs of objects, each consisting of one novel object and one familiar one (e.g., a whisk and a shoe). The experimenter requested one of the two objects of each pair either by using a novel name (e.g., "Can you hand me the blicket?") or no name (e.g., "Can you hand it to me?"). Importantly, when the experimenter made the request, s/he looked at the familiar object, providing clear behavioral evidence of an intent to refer to the familiar object.

**Results:** Toddlers who heard the experimenter request an object using a novel name selected the familiar object that s/he was looking at on just 20% of trials. By contrast, those who heard the experimenter request an object using "it" selected the familiar object that s/he was looking at on 56% of trials, significantly more often, $t(30) = 3.86$, $p < .001$.

**Conclusion:** These results, along with similar findings from older children (Jaswal & Hansen, 2006), suggest that children's expectations about words cannot be explained entirely by social-pragmatic reasoning processes. Toddlers expect words to be mutual exclusive even when a speaker provides some kinds of explicit, behavioral pragmatic evidence to the contrary.

**Fr1-48**

### Phonetic Variability Can Influence Performance in a Word Learning Task

**Karen Mattock**[1,2] Linda Polka[1] Susan Rvachew[1] Madelaine Krehm[1]

*1. McGill University, Montreal, Canada; 2. Lancaster University, Lancaster, UK*

Bilingual infants' phonetic development is complex and different from that of monolinguals. A U-shaped developmental pattern has been found for bilinguals' discrimination of vowels that are native to one of their languages (Bosch & Sebastian-Galles, 2003a, 2003b), whereas monolinguals show age-related improvement in discrimination of native phonetic contrasts (Polka et al., 2003). For word learning tasks relying on phonetic discrimination, Fennell et al (2007) found later emergence of word learning skills in bilingual infants when a speaker of one of the infants' languages named the objects.

Previously, we reported that 17-month-old English/French bilinguals are superior word learners under conditions that simulate their bilingual experience (ICIS 2006). Object names were "bos" and "gos", selected because in English and French /b/ and /g/ are phonetically similar, and phonemic. The /bos/ and /gos/ strings were "bilingual", comprised of half English and half French tokens. Infants were habituated to two word-object pairings and were then presented two trials, a switch trial, where a switch in word-object pairing was presented and a same trial where a familiar pairing was presented. Longer looking/listening to the switch trial indicated word learning. Bilingual infants looked significantly longer to switch vs. same trials, but English and French monolinguals did not, suggesting that bilingual infants can learn word-object associations when the conditions favour their input. Monolingual infants likely failed because the bilingual mode of presentation increased phonetic variability and did not match their real world input.

In the present study monolingual infants were tested for word learning with /bos/ and /gos/ tokens restricted to their native language. New tokens were selected from the original recordings and added to the tokens from Experiment 1 to create /bos/ and /gos/ strings for each language that reflected native-like variability. French infants were presented French strings; English infants, English strings. French infants noticed the switch in word object pairings ($p<.05$) as evidenced by longer looking to the novel word-object pairing. English infants failed the task ($p>.05$), but there was a gender effect - when boys were removed, girls looked significantly longer to the switch vs. same trials ($p<.05$).

These findings suggest that phonetic variability clearly impacts how infants perform in the switch task in ways that contribute to differences in monolingual and bilingual performance and both monolinguals and bilinguals are developing speech processing skills that are adaptive for the specific language learning challenges that they encounter.

**Fr1-49**

### Why Japanese Parents Use Baby-Talk

**Toshiki Murase**

*Shimane University, Matsue, Japan*

**Background and Aims:** Japanese parents use many 'baby-talk' words involving phoneme repetition, onomatopoeia, and personification suffixes in reference to objects. However, the reasons for using such words have not been clarified. This study investigated the relationships between baby-talk in parental speech and parents' socialization goals, beliefs regarding parental speech, and picture-book reading style.

**Methods:** Japanese parents (n = 62) of children aged 18-20 months responded to questionnaires on their use of baby-talk words with repeated phonemes for actions and states and added personification suffixes for objects when speaking to their children. Parents also responded to questions regarding their picture-book reading style, beliefs about parental speech to toddlers, and socialization goals for their children at age five.

**Key Results:** An empathy-oriented picture-book reading style related positively to the repetition of phonemes ($r = 0.36$, $p < 0.01$) and the addition of personification suffixes ($r = 0.30$, $p < 0.05$), whereas a dialogic picture-book reading style showed no relationship with those aspects of baby-talk. Based on a factor analysis, the 'independence-orientation' and 'interdependence-orientation' goal factors related to parental socialization goals, and the 'empathy-orientation', 'scaffolding-orientation', and 'information-orientation' factors related to beliefs about parental speech. A covariance structure analysis indicated that interdependence-orientation goals concerning socialization were significantly related to empathy orientation for parental speech ($\beta = 0.44$, $p < 0.001$), and that empathy orientation was related significantly to the addition of personification suffixes ($\beta = 0.29$, $p < 0.05$) and marginally to phoneme repetition ($\beta = 0.23$, $p < 0.10$). Covariance structure analysis also showed that the independence-orientation goal concerning socialization was significantly related to the scaffolding orientation of beliefs regarding parental speech ($\beta = 0.26$, $p < 0.05$), and that the scaffolding orientation was significantly related to phoneme repetition ($\beta = 0.29$, $p < 0.01$).

**Conclusions:** These results suggest that the use of baby-talk by Japanese parents is motivated by affectionate-empathetic relationships with their children. The interdependence goal of socialization leads to an empathy orientation of their belief about parental speech, which in turn motivates the addition of personification suffixes and repetition of phonemes. Scaffolding orientation, associated with the independence goal of socialization, also motivates the use of phoneme repetition.

**Fr1-50**

### The Relationship Between Imitation Types and Language Development

**Tamiko Ogura**[1] Shoji Itakura[2] Aya Kutsuki[3] Misa Kuroki[3] Sonoko Egami[4]

*1. Kobe University, Kobe, Japan; 2. Kyoto University, Kyoto, Japan; 3. Japan Science Technology Agency, Kyoto, Japan; 4. Hokkaido University of Education, Asahikawa, Japan*

**Background and Aims:** Stone, Ousley and Littleford (1997) reported imitation of body movements and imitation of actions with objects represent independent dimensions, and the imitation of body movements was concurrently and predictively associated with expressive language skills in two-year-old autistic children. The present longitudinal study examined the relationship among three imitation types: vocal, body movements, and actions with objects. The study also examined the relationship between imitation types and language development in normal children.

**Method:** Thirty-two Japanese children (16 boys and 16 girls) at 5, 7, 9, 11, 13, 15, and 18 months old took the imitation tasks of vocal, body movements, and actions with objects derived from Dunst (1980) and Stone et al.(1997). One or two tasks for three imitation types were given at each age. Response accuracy is scored on a 3-point scale: a complete imitation earns 2 points, partial imitation earns 1 point, and a failure earns no points. For the language measures, vocabulary

comprehension and vocabulary production were assessed at 9, 11, 13, 15, and 18 months using the Japanese version of CDIs.

**Results:**

1) The relationship between different imitation types

Significant correlations were found between vocal imitation and body movements at 11 and 15 months of age. There were not any significant correlations between other types of imitation.

2) Imitation and language

There were significant correlations between production and comprehension except at 15 months of age, and so we computed partial correlations between imitation and language controlling vocabulary production or vocabulary comprehension. No significant correlations were found between imitation of body movements and language measures. For the vocal imitation, significant partial correlations between imitation of a familiar word at 13 and 15 months and production at 15 months, and between imitation of a familiar word at 18 months and production at 18 months were found. For the imitation of actions with objects, there were significant partial correlations between unfamiliar actions with objects at 15 months and comprehension at 15 months and 18 months, and between unfamiliar actions with objects at 18 months and comprehension at 18 months.

**Conclusions:** 1) vocal imitation may be associated with imitation of body movements, 2) vocal imitation may be associated with language production, and imitation of actions with objects may be associated with language comprehension. Different imitation types were related to different language domain. We could not find the relationship that Stone et al.(1997) found in autistic children.

**Fr1-51**

### Lexical Knowledge in Bilingual Infants

Annick De Houwer[1,2] Marc Bornstein[2] **Diane Putnick**[2]

*1. University of Antwerp Antwerp, Belgium; 2. NICHD, Bethesda, USA*

Little is known about the acquisition of vocabulary in very young bilingual children. This study draws together findings on vocabulary acquisition of 31 infants aged 13 months who are acquiring Dutch and French from birth. All children are firstborn and growing up with both their parents in a middle to upper middle class environment. The data were collected using Dutch and European French versions of the MacArthur Communicative Development Inventory.We focus on three subtopics: (1) infants' comprehension of words from both languages for a single referent ('translation equivalents'), (2) the relation between production and comprehension across the children's two languages, and (3) a comparison with a matched monolingual Dutch-speaking group of infants. The overall picture gained from these analyses is one of intra- and inter-individual variation. Nonetheless, all the 13-month-old infants in the sample are already clearly bilingual in that they understand words from both languages and know words from both languages to refer to one and the same referent. As a group, bilingual infants have a greater lexical repertoire than monolingual infants.

The implications of these findings for theories of early word learning are discussed.

**Fr1-52**

### Educational Television? Children's Potential to Learn Verbs From Television

**Sarah Roseberry**, Kathy Hirsh-Pasek, Roberta Golinkoff, Julia Parish-Morris

*Temple University, Philadelphia, USA*

**Background and Aims:** Can children under age three learn language from video displays? Despite increased programming for children under three (Garrison & Christakis, 2005), the little research investigating this question suggests only that children learn object words from video displays and that they learn better from live interaction (Krcmar, Grela & Lin, 2007; Naigles, Bavin & Smith, 2005). The current study builds on this literature by addressing two questions. First, can young children learn a novel verb - words that are the gateway to grammar - from telelvision? Second, does live human interaction facilitate verb-learning from video displays?

**Methods:** Using video clips from *Sesame Beginnings*, children saw two novel verbs presented in one of three ways: televised characters only, televised characters plus live interaction, or televised characters plus a televised experimenter. Eighteen 30- to 35-month-olds and eighteen 36- to 42-month olds, evenly split across gender, participated in a four phase experiment using the preferential looking paradigm: In the *Introduction Phase*, children were introduced to the characters used in the video (e.g., "This is Cookie Monster!"). During the *Salience Phase*, children saw the two scenes to be presented at test to gauge *a priori* preference. Indiscriminant audio supplemented this phase (e.g., "What's going on?"). In the *Training Phase*, children saw a character perform an action (e.g., wiggling) accompanied by twelve instances of a novel verb uttered in full syntax (e.g., "Look at Cookie Monster *wezzling*!) At *Test*, children were prompted to find a novel actor performing the familiar action on a split-screen video display (e.g., "Look at *wezzling*!"). Importantly, all children were required to extend their knowledge to a new actor at test. Learning was evidenced by looking time toward either side of the screen at test.

**Results:** Results suggest that younger children learned verbs only when live action accompanied the video display $F(1,17)=5.625$, $p<.05$. In contrast, older children successfully learned a verb regardless of condition, $ps<.05$.

**Conclusions:** These results extend the literature in three ways. First, by advancing beyond nouns, the current study extends the repertoire of what children learn from television. Second, by requiring children to extend their knowledge to a new actor at test, the current study offers a stronger test of verb learning. Finally, these results indicate that human interaction and co-viewing improve children's ability to recruit and use information presented on a video display.

**Fr1-53**

### Use of Syntactic Frames for Word Mapping by French-Speaking Children

**Simcha Samuel**, Yuriko Oshima-Takane

*McGill University, Montreal, Canada*

The present study investigated whether French-speaking children under two years of age are sensitive to noun and verb morphosynactic cues in word learning. Few researchers have examined children's sensitivity to noun/verb morphosyntactic cues when more than one interpretation (object and action) is possible. In the present study we tested children when the object and the action interpretations were equally possible.

**Method:** Forty-two 19- to 21-month-old French monolingual children participated in an infant-controlled habituation paradigm with a switch design. All children were habituated to two different events in which one of the two novel objects was pushed or turned. Children were randomly assigned to the noun or the verb condition. They heard each event paired with a novel word embedded in a syntactic frame which suggested that the novel words referred to objects in the noun condition (*C'est un laf/nim* ) and actions in the verb condition (*Je laf/nim le jouet* ). They were then tested with the same event (baseline) and three switch tests in which the word, the object, or the action of the same event was switched.

**Results:** Children in the noun condition looked significantly longer at the word-switch trial than the baseline ($M = 11.62$ and $M = 7.83$ respectively; $t$ (20) = -3.18, one-tailed, $p$ =.005), indicating that they learned the event-sentence association. They also looked significantly longer at the object-switch but not at the action-switch trial than the baseline ($M = 12.83$ and $M = 9.92$, respectively; $t$ (20) = -3.99, one-tailed, $p$ =.001). Furthermore, the object-switch looking time was significantly longer than the action-switch looking time ($t$ (20) = 2.35, one-tailed, $p$ =.029), indicating that they thought the novel words referred to the objects and not to the actions. Conversely, children in the verb condition did not look significantly longer at the word-switch trial than the baseline ($M = 10.33$ and $M = 8.70$, respectively), indicating that they did not learn the event-sentence association. Moreover, the action-switch looking time was not significantly longer than the object-switch looking time ($M = 12.50$ and $M = 11.21$, respectively), indicating that they were unsure whether the novel words referred to objects or actions.

**Conclusion:** These findings demonstrate that French-speaking children can use noun morphosyntactic cues to learn new nouns by 20 months of age. However, there is no clear evidence that they can use verb morphosyntactic cues to learn new transitive verbs. This is consistent with the literature that nouns are easier to learn than verbs.

**Fr1-54**

### Cortical Responses to Lexical Pitch-Accent in Japanese Infants

**Yutaka Sato**[1] Yuko Sogabe[1] Reiko Mazuka[1,2]

*1. RIKEN, Wako, Japan; 2. Duke University, Durham, USA*

**Background and Aims:** During the first year of their life, infants' perceptions of speech sound become increasingly attuned to their native language. The aim of this study is to investigate the neural mechanisms that underlie such changes in infants. We studied Japanese infants' processing of lexical-pitch accent using Near Infrared Spectroscopy (NIRS). Imaging studies with adults have shown that while speech processing is generally left-dominant, processing of prosodic cues is associated with right-lateralized or bilateral activation. Lexical level prosody such as Japanese lexical pitch-accent involves acoustic cues typically associated with prosody (i.e., pitch-change). But its role in distinguishing word meanings is linguistic; as 'me (High-Low: "rain") vs. ame' (Low-High: "candy"). Recent NIRS study with Japanese adults showed that while the non-lexical pitch-changes in pure-tone stimuli were processed bilaterally, the pitch-changes in real lexical items induced left-lateralized activation (Sato et al., in press), demonstrating that the same acoustic cues are processed differently depending on its linguistic role. Do Japanese infants show similar asymmetry in processing lexical and non-lexical pitch cues as they become attuned to the Japanese phonological system?

**Methods:** Using multi-channel NIRS, twenty Japanese infants at 10 months of age were tested. Fourteen pairs of existing Japanese disyllabic words that minimally differ in HL or LH pitch-accent patterns, and their pure-tone counterparts, were presented in a block design.

**Results:** Results of the ANOVA, comparing the activation of left- and right-hemisphere for lexical and non-lexical pitch accent stimuli showed a significant interaction [$F(1, 19) = 11.88$, $p < .01$], showing the relative activation of the left- and right-hemispheres differed between lexical and pure-tone stimuli. The response on the left-side was larger when word-pairs with HL vs. LH pattern were presented [$p < .05$], while bilateral activation was found for pure-tone stimuli.

**Conclusion:** We found that 10-month old Japanese infants showed left dominance activation while listening to Japanese lexical pitch-accent changes, but not for pure-tone stimuli. These results suggest that the neural mechanism recruited in the processing of lexical pitch accent is different from that of simple pitch change for 10-month old Japanese infants. The results of the present study replicate those of Japanese adults in Sato et al (in press), and show that by 10 months of age, the neural mechanism involved in processing lexical-pitch accent in Japanese infants is a similar to that of Japanese adults.

**Fr1-55**

### Building Talk: Parental Utterances during Construction Play

**Wendy Shallcross**, Tilbe Goksun, Roberta Golinkoff, Kathy Hirsh-Pasek, Marianne Lloyd, Nora Newcombe, Sarah Roseberry

*Temple University, Philadelphia, USA*

Spatial learning is a key competency that provides a foundation for the disciplines of science, technology, engineering and mathematics (Casey, Nuttall, & Pezaris, 1997). However, relatively little is known about how spatial experiences might enable cognitive growth in young children. Intuitively, play with construction toys seems to offer a vital tool for spatial skill development, as it offers the opportunity to manipulate objects which consequently could assist children's developing representations of spatial relationships between objects (Reifel, 1984). The potentially interactive environment of block play may promote spatial learning because relevant concepts are conveyed through parental talk (Loewenstein & Gentner, 2005).

We investigated two questions. First, does block play between parents and children stimulate spatial talk? Second, do particular kinds of block play offer richer contexts for spatial language than others? Thirty-six child-parent dyads (M child = 45.80 months) played with blocks in one of three play contexts: A preassembled block structure (e.g., a heliport), free play with a set of blocks (figures and vehicles) or guided play with step-by-step pictures that help parents and children build a particular structure. All groups had the same number and types of blocks. All then engaged in a second session of guided play where they were asked to build another structure (e.g., a garage).

Proportions of parent words/utterances with a spatial focus (e.g., into, out, in the middle, etc.) were calculated. Results demonstrate that parents use the most spatial language when actively building in guided play (M = .09, SD =.03) as compared to free play (M = .05, SD = .02) or preassembled play (M = .06, SD = .02). In the second guided play condition, all participants showed high spatial language (M = .07-.09, SD = .02- .03). Eight transcripts of comparably-aged parent-child interactions in non-block play (e.g. with puppets, books, and materials for playing store) found that baseline proportions of spatial language ranged from .03- .06 (M = .04, SD = .01). Thus, block play elicits a comparatively high degree of spatial conversation, especially when parents and children are actively building.

Since adult talk about spatial concepts fuels children's learning (Gentner & Loewenstein, 2002), interactive block play using materials that require structured assembly encourages just the sort of language that might help children build early skills related to math and science.

**Fr1-56**

### Infant Feedback Modulates Mothers' Infant-Directed Speech

**Nicholas Smith**[1] Laurel Trainor[2]

*1. Boys Town National Research Hospital, Omaha, USA; 2. McMaster University, Hamilton, Canada*

**Background and Aims:** When mothers engage in infant-directed (ID) speech, their voices change in a number of characteristic ways including adopting a higher overall pitch. Studies have examined infants' preferences for these acoustical modifications. However, little is known about how mothers' speech modifications are related to the feedback that infants provide in the context of interaction.

**Method:** Eighteen mother-infant (4-month old) dyads were tested. Mothers and infants were physically separated: the infants were seated in a sound attenuating booth, and the mothers were outside the booth, watching their infants on a silent video screen. Mothers were asked to try to make their infants happy by talking to them through a microphone, believing that their infants could hear their voices. In reality, the mothers' ID speech was analyzed in real-time for changes in mean pitch. For half of the infant-mother dyads an experimenter in the booth surreptitiously positively engaged the infant when the voice analysis revealed a rise in pitch, thereby producing positive reinforcement to the mothers for higher pitched ID speech. For the other half of dyads, mothers were reinforced for low-pitched ID speech.

**Results and Conclusions:** For both groups ID speech was higher in pitch than their adult-directed speech. However, mothers who were reinforced with positive infant feedback for high-pitched ID speech had higher pitched ID speech than those who were reinforced for low-pitched ID speech. Furthermore, the pitch of their ID speech rose over the course of almost 10 minutes of testing, whereas the pitch of the other group did not.

**Conclusions:** These results illustrate that ID speech is dynamically affected by feedback from the infant. However, positive infant feedback in response to low-pitched ID speech was not able to drive mothers' ID to lower pitches, at least for the short period of testing. This suggests that the modulation of mothers' ID is constrained by instinct and more entrenched patterns of interaction.

**Fr1-57**

### Joint Attention Helps Infants to Learn New Words: ERP-Evidence

**Manuela Stets**[1,2] Tricia Striano[3] Masako Hirotani[4]

*1. Neurocognition and Development Group, University of Leipzig; Leipzig, Germany; 2. Max-Planck-Institute for Human Cognitive and Brain Sciences, Leipzig, Germany; 3. Hunter College, The City University of New York, New York, USA; 4. Carleton University, Ottawa, Canada*

**Background and Aims:** Social cues like eye contact or pointing have a great impact on infants' learning (cf. Striano & Reid [2006]; Tomasello [1995]). They help them to learn facts about the world and they assist them in the acquisition of language (Baldwin [1995]). Various behavioural and ERP studies examined different aspects of language acquisition and we tried to find a connection between joint attention and the acquisition of new words. We reasoned that joint attention helps 18- to 21-month olds to learn words and that this would show up in an N400 effect in the parietal regions.

**Methods:** In this ERP-study, 18- to 21-month olds experienced a familiarzation phase with a live experimenter showing them un-/familiar objects on a screen. Half of the objects were presented with joint attention between adult and infant, the others were presented in non-joint attention. The adult labelled the objects (German article "ein" + pseudo-/word; 4 times each). In the test phase, the infants heard the same tape-recorded words via loudspeaker and saw mis-/matching objects. Each word was presented 8 times: 4 matches, 4 mismatches. The EEG was recorded continuously and edited off-line. A series of 2 x 2 Anovas for Condition and Region was conducted for the new words only.

**Results:** The analyses revealed a significant interaction between attention and congruency $F(1, 9) = 6.65$, $p < .05$ (1,100ms to 1,300ms after stimulus onset) and $F(1, 9) = 10.88$, $p < .05$ (1,300ms to 1,500ms after stimulus onset). We also found a significant difference between the difference waves for joint attention mismatch minus joint attention match and non-joint attention mismatch minus non-joint attention match: the difference wave for the joint attention conditions was significantly more negative. The effects were delayed (between 700ms and 1,500ms after stimulus onset) and broadly distributed (in parietal, centro-parietal, and frontal sites).

**Conclusion:** The significant interactions show that there is a relationship between joint attention and word learning in infancy. When infants are taught new words in a joint attention situation, the ERPs are more negative in a mismatch paradigm than for the ones presented with non-joint attention. Learning and processing new words seemed to be hard for the infants although they should undergo the vocabulary spurt at this age. The latencies and the distribution are seen as markers of the cognitive burden the new words placed on the infants' brains.

**Fr1-58**

### Do Lexical Aspects of Maternal Input Affect the Language of Children with Autism?

**Lauren Swensen**[1] Deborah Fein[2] Letitia Naigles[2]

*1. NYS Institute for Basic Research in Developmental Disabilities, Staten Island, USA; 2. University of Connecticut, Storrs, USA*

**Introduction:** Research on maternal input has found positive effects on typical children's subsequent development of both specific and general aspects of language. Previous work with this sample of children has found relationships between grammatical elements of maternal input and child language that have previously been seen in typically developing children (Newport, Gleitman, & Gleitman, 1977; Hoff-Ginsberg, 2006). But, differences in the timing of these relationships were found. Is there any type of maternal input where we see children with autism "make use" of input at the same time as a group of language matched children? Previous work with typically developing children has found both general and specific relationships between lexical aspects of maternal input and subsequent child language (Pan et al, 2005; Harris et al, 1994; Hart, 1991). The current study investigated whether typically developing children and children with autism will show a relationship between mother's usage of nouns and children's subsequent language.

**Method:** 10 boys with Autism Spectrum Disorder (ASD) and 14 typically developing children (TYP) were studied longitudinally. Every

four months (ASD: 33-45 months old; TYP: 17-29 months old), mother-child dyads participated in 15 minute free play sessions, which were transcribed and analyzed. The groups were roughly equivalent in language production at visits 2 and 3.

**Results:** Two input variables were used in the analysis: # noun types & % nouns in the input at visits 2 and 3. Partial correlations were run with child # of word types in spontaneous speech partialed out, as well as the number of maternal utterances partialed out. Looking at maternal input at visit 2, for both the ASD and TYP children there were significant relationships between both the number of noun types and the % of nouns in the input with children's spontaneous speech, Vineland, Mullen, and CDI scores at visits 4, 8 and 24 months after (rs=.69-.99, p<.001-.048). For both groups, when maternal noun use at visit 3 was analyzed there were very few relationships with subsequent child language (4 and 20 months later).

**Conclusions:** Both the TYP group and the ASD group demonstrated significant correlations between maternal noun input and subsequent child language. These results suggest that while children with autism may take longer to garner the ability to use grammatical maternal input (previous analyses), they are making use of lexical maternal input, when matched for language, at the same developmental time as typically developing children.

## *Biological Processes*

**Fr2-01**

### Mother and Infant's Heart Rhythms Synchronize during Episodes of Face-to-Face Affect Synchrony

**Ruth Feldman**, Romi Magor-Cohen, Giora Galili, Magi Moshe, Yoram Louzoun
*Bar-Ilan University, Ramat-Gan, Israel*

Beginning with the work of Schneirla (1946) and Rosenblatt (1965) on the evolution of parenting in mammals, synchrony is conceptualized as an overarching system that coordinates the ongoing exchanges of sensory, hormonal, and physiological stimuli between parent and child during social interactions and provides critical inputs for growth and development of the young. Research in humans has similarly showed that mothers and infants synchronize their gaze, affect, and vocalizations during early interactions, and these experiences play a critical role for infant growth (Feldman, 2007). Infant cardiac vagal tone supports the development of synchrony and provides the physiological substrate for social engagement (Porges, 2003). Yet, no research to date examined whether maternal social stimulation regulates infant heart-rate, whether mother and infant synchronize their heart rhythms during social interactions, and whether peak moments of affect synchrony are accompanied by an increase in physiological synchrony.

We measured cardiac output from 37 mothers and their three-month old infants during a 3-minute face-to-face interaction. The two time-series of inter-beat-intervals (IBI) were filtered for lower frequencies (below 1/20 Hz) and cardiac synchrony assessed. The cross-correlation between the mother and her own baby IBI's was significantly higher than the ones of mothers with other infants ($p<0.05$). The significance was estimated using 100 randomizations of mother-child couples.

Micro-analysis of social behavior was conducted for each partner using a .01-second time-window. Four indices of synchrony were assessed; Gaze Synchrony -coordination of social gaze; Vocal Synchrony -coordination of positive vocalizations; Affect Synchrony - coordination of affective level; and Affective-Vocal Synchrony - episodes when mother and child co-vocalize while both in high positive affect.

Spectral analysis showed coherence between cycles of infant and mother's IBIs: infant heart-rate acceleration was followed by maternal heart-rate acceleration within time-lag of <1 second, and similar findings emerged for heart-rate deceleration. Synchrony between mother and own infant's IBIs was significant at $p < .05$ compared to random.

Next, we assessed cardiac synchrony only during episodes of visual, vocal, affective, and vocal-affective synchrony. In each, cardiac synchrony was tighter than during the entire session: visual synchrony (0.52% of the interaction), $p <.05$; vocal synchrony (0.095%) $p <.03$; affect synchrony (0.4%), $p <.01$. During the rare, highly-charged moments of vocal-affective synchrony (0.05% of the interaction), cardiac synchrony peaked and was maximized ($p <.0001$). The findings provide the first evidence that during early human ontogeny the experience of social contingencies, regardless of actual touch, can regulate the child's autonomic reactivity.

**Fr2-02**

### Event-Related EEG Mu Rhythm Responses to Point-Light Actions in 5-Month-Old Infants

**Peter Marshall**, Thomas Shipley, Kelly Fisher, Lauren LaFrance, Stephanie Catella
*Temple University, Philadelphia, USA*

**Background and Aims:** There is much current interest in the mu rhythm in the EEG as an index of mirror neuron system (MNS) activity. However, very little is known about the early development of the mu rhythm or its responsiveness to action observation in infants. This study examined EEG responses to canonical and scrambled point-light actions in 5-month-old infants, and included a comparison with waveforms from adults.

**Methods:** EEG was recorded from 5-month-olds and adults while they watched point-light, whole-body actions (e.g., walking, throwing) that were either canonical or scrambled. EEG was recorded using a 21-site array referenced offline to average mastoids. Event-related EEG responses were computed at C3 and C4 according to Pfurtscheller (1999). In order to locate the infant mu rhythm, responses were computed for five narrow frequency bands: 4-6 Hz; 6-8 Hz, 8-10 Hz; 11-13 Hz; 14-16 Hz. In the adult data, analyses were restricted to the lower (8-10 Hz) and upper (11-13 Hz) mu bands. Event-related desynchronization (ERD) in a given band reflected a decrease in band power over the action sequence, relative to a -1000 to -200 ms prestimulus baseline. Event-related synchronization (ERS) reflected an increase in band power during presentation of the action sequence relative to the prestimulus baseline. Analyses were restricted to trials in which participants showed quiet attention to the stimuli.

**Results:** In infants, the canonical point-light actions produced an ERD response in the 4-6 Hz band, no change in power in the 6-8 Hz and 14-16 Hz bands, and an ERS response in the 8-10 and 11-13 Hz bands. The scrambled point-light action sequences produced infant ERD responses in all frequency bands except 11-13 and 14-16 Hz, in which there was no change in power. In adults, the canonical point-light actions were associated with widespread desynchronization of the 8-10 Hz band across the scalp. However, while the upper mu band (11-13 Hz) was strongly desynchronized at other scalp sites, this band showed an ERS response at C3 and C4 to the canonical stimuli.

**Conclusion:** An ERS response to canonical point-light actions occurred in specific mu frequency ranges in infants (8-10 and 11-13 Hz bands) and adults (11-13 Hz band). This ERS response is interpreted

in the context of inhibition of the hand areas of somatosensory cortex (underlying C3 and C4) by observation of whole body movements (Pfurtscheller et al., 2006). The findings suggest a mechanism for Bertenthal's behavioral findings of discrimination of canonical and scrambled walkers in early infancy - that this process may partly involve the MNS, as indexed indirectly here by changes in mu rhythm amplitude.

**Fr2-03**

### Impact of Growth, Cardiac Physiology and Parental Stress on Development at 6 Months of Age

**Barbara Medoff-Cooper**, Sharon Irving, Danica Sumpter, Virginia Stallings, Gil Wernovsky, Babette Zemel

*University of Pennsylvania, Philadelphia, USA*

Approximately 50% of infants with complex congenital heart disease will experience adverse nutritional sequelae early in their lives, most often resulting in failure to thrive and poor developmental outcomes. The purpose of this study was to explore factors related to growth and development in infants with complex CHD.

**Sample:** Fifty infants with complex CHD were evaluated for growth and development at 3 and 6 months of age. All of the infants underwent surgical palliation or correction within the first six weeks of life. Approximately half of the infants were classified as single ventricle (SV) physiology.

**Methods:** At 3 months a comprehensive anthropometric assessment and the Parenting Stress Index (PSI) were completed. The 6 month visit also included the Mental Development Index (MDI) and Psychomotor Developmental Index (PDI) subscales of the Bayley Scales of Infant Development-II. Data analysis included descriptive statistics, including Z-score calculations for weight, height and head circumference, t-tests, and multivariate regression models.

**Results:** There was no significant difference in weight or post menstrual age (PMA) at birth between the groups. At 3 months infant mean weights, length and head circumference were significantly lower for infants with SV physiology. The Child Domain (CD) of the PSI demonstrated significant differences between the groups ($p = .03$). The Acceptability (AC) subscale within the CD was significantly different at $p = .03$. In addition, the Competence (CO) subscale within the Parent Domain showed a significant difference, $p = .05$. At 6 months, the mean PDI was $74.2 \pm 16$ and $80.90 \pm 15.9$ (ns) for infants with SV and BV physiology respectively. Mean MDI for infants with SV versus BV physiology was $86.80 \pm 10.8$ vs. $91.9 \pm 10.7$ (ns). Weight (Z-score), , cardiac physiology and the Reinforces parent (RE) subscale of the PSI explain 35% of the variance for MDI at 6 months of age. Only weight and height were significantly correlated with PDI ($p=0.01$).

**Conclusions:** Infants who have experienced cardiac surgery within the first weeks of life continue to be at risk for poor weight gain during the first 6 months of life. Growth trajectories in the BV physiology group continue to be significantly greater than the SV group at 3 and 6 months of age. Parenting stress, namely the Child Domain subscales of Acceptability and Reinforces Parent, appear to contribute to both growth and development. Helping parents reframe perceptions of their infants and identifying reinforcement cues sent to one another may prove beneficial in fostering the growth and development of infants with CHD

Funded by NIH/NINRR01 NR002093; M01 RR000240

**Fr2-04**

### Methylation of Glucocorticoid Receptor Gene (NR3C1) in Newborns Following Prenatal Exposure to Depressed Maternal Mood

**Tim Oberlander**, Angela Devlin, Michael Papsdorf, Ruth Grunau, Shaila Misri, Joanne Weinberg

*University of British Columbia, Vancouver, Canada*

**Background:** In animal models variations in early maternal care giving are associated with differences in hypothalamic-pituitary-adrenal (HPA) stress response in the offspring, mediated via epigenetically altered expression of the glucocorticoid receptor (GR) gene (Nr3c1). To study this in humans, relationships between prenatal exposure to 2nd and 3rd trimester maternal mood and the methylation status of a CpG-rich region in the promoter and exon 1F of the human GR gene (NR3C1) in newborns and HPA stress reactivity at 3 months were examined.

**Methods:** Antenatal maternal mood was assessed in 36 depressed mothers treated with a serotonin reuptake inhibitor antidepressant (SRI) and 46 non-treated mothers. The methylation status of a CpG-rich region of the NR3C1 gene, including exon 1F in genomic DNA from cord blood mononuclear cells was quantified by bisulfite pyrosequencing. To study the functional implications of the newborn methylation status of NR3C1 in newborns, HPA function was assessed at 3 months using salivary cortisol obtained before and following a non noxious stressor and at a late afternoon basal time.

**Results:** Prenatal exposure to increased third trimester maternal depressed mood (HAM-D and EPDS) was associated with increased methylation of NR3C1 (5′ CpG in the potential NGIF-A consensus binding site) ($\beta = .244$; $t=2.105$, $p=0.039$, $\acute{\eta}2 = 0.054$ and $\beta = .284$, $t=2.314$, $p=0.023$, $\acute{\eta}2= 0.065$, respectively). Further, increased NR3C1 methylation at the CpG3 site in newborns was also associated with increased salivary cortisol stress responses (baseline minus post stress) at 3 months, even when accounting for prenatal exposure to SRIs and maternal mood ($\beta = .390$, $t= 2.466$, $p= .018$, $\acute{\eta}2=.110$). Afternoon-early evening cortisol levels in infants at 3 months of age were not associated with the methylation status of NR3C1 at birth ($p> 0.05$), but were significantly lower in infants with prenatal exposure to maternal SRIs (beta = .355, $t= 2.437$; $p=.018$, $\acute{\eta}2=.100$).

**Conclusions:** Methylation status of the human NR3C1 gene in newborns is sensitive to prenatal exposure to maternal mood. Specifically, increased methylation of CpG3 in newborns, which corresponds to the 5′ CpG in the potential NGIF-A consensus binding site 5′ to exon 1F of the NR3C1 gene, was associated with prenatal exposure to increased third trimester depressed maternal mood and infant HPA stress, but not basal function at 3 months. These findings may offer a potential epigenetic link between antenatal exposure to maternal mood and altered HPA stress reactivity during infancy.

**Fr2-05**

### Neurodevelopmental Prediction of Preterm Infant Feeding Performance

**Rita Pickler**, Al Best, Barbara Reyna

*Virginia Commonwealth University, Richmond, USA*

**Background and Aims:** The relationship between neurodevelopmental function and feeding performance in preterm infants has received little attention. Early feeding performance may predict later developmental outcomes, including those associated with feeding disorders and speech. The purpose of this analysis was to examine the effect of two components of neurodevelopment, the autonomic nerv-

ous system (ANS) as assessed by heart rate variability and oxygenation and the central nervous system (CNS) as measured by characteristics of nutritive sucking, on feeding performance in preterm infants.

**Methods:** The sample included 95 preterm infants who were observed feeding daily for 14 days beginning at 32 weeks post-menstrual age (PMA). Data were collected electronically for all measures and analyzed using correlation and regression analyses while controlling for specific infant characteristics (PMA, weight, pre-feeding behavior state, feeding experience). Feeding performance was measured by feeding rate (volume per minute) and percent consumed. The study was approved by an institutional review board and parents signed informed consent.

**Results:** Measures of both ANS and CNS function were found to mature over the observation period, although only CNS changes as measured by sucking characteristics were significant [$F(14)=3.8$, $p<.001$]. Changes in specific ANS measures (i.e. high frequency heart rate variability) were moderately correlated with sucking characteristics (i.e. average number of sucks) [$r=.16$, $p<.01$] and with feeding performance outcomes (i.e. consumed) [$r=.14$, $p<.01$]. CNS measures were more strongly correlated to performance outcomes (i.e. consumed) [$r=.26$, $p< .001$]. A preliminary model shows that components of ANS and CNS function predict 12% of the variance in feeding performance when infant characteristics are controlled [$t(3)=13.29$, $p<.001$].

**Conclusion:** This preliminary analysis demonstrates the need for comprehensive consideration of behavioral development in infants born preterm. Further study of the implications of these findings, including the predictive value of these findings on later development, is needed.

**Fr2-06**

### A Comparison of Electrophysiological Activity during Working Memory and Recognition Memory in 5 & 10 Month Old Infants

**Vinaya Raj**, Katherine Morasch, Christy Wolfe, Martha Bell

*Virginia Polytechnic Institute and State University, Blacksburg, USA*

**Background and Aims:** The use of electrophysiological measures (EEG) has aided the study of the neural bases of infant memory development. Recognition memory in infancy is well-developed by the end of the first year of life and is associated with medial temporal lobe functioning (Carver, Bauer, & Nelson, 2000; Nelson, 1995). Working memory, a higher order cognitive process, only begins to develop within the second half of the first year of life and has been linked to frontal lobe activation - although such processes recruit the use of other brain areas as well during infancy (Bell & Wolfe, 2007). This study provided a longitudinal investigation comparing patterns of baseline-to-task EEG activity during a working memory and recognition memory task during two separate ages in infancy.

**Methods:** At both 5 and 10 months, EEG activity was recorded from 100 healthy, full-term infants during a resting baseline and during recognition and working memory tasks. Research protocols were identical at both ages and consisted of a looking version of the Piagetian A-not-B working memory task and a visual paired comparison recognition memory task. EEG power values at 6-9 Hz were analyzed (Bell, 2002; Marshall et al, 2002).

**Results:** Repeated measures MANOVA analyses of the 5-month data revealed no regional differences between baseline EEG and task EEG for either working memory ($p = .37$) or recognition memory tasks ($p = .27$). At 10 months, regional differences were found with increased EEG power values from baseline to task for both working memory [$F(1,7) = 2.49$, $p < .05$] and recognition memory [$F(1,7) = 5.20$, $p < .001$]. During working memory, this EEG increase occurred at all electrode sites, as in previously reported work (Bell, 2002). During recognition memory, baseline to task changes in EEG only occurred at lateral frontal (F7/F8), anterior temporal (T3/T4), and occipital (O1/O2) sites.

**Conclusion:** These data demonstrate the developmental progression in EEG within the first year of life during two different cognitive tasks. At 5 months, EEG patterns observed between baseline and both memory tasks did not differ. At 10 months, power values increased from baseline to task during both memory tasks, with changes in all scalp sites apparent during working memory. In contrast, changes in EEG power values during recognition memory were more localized to lateral frontal and anterior temporal sites. Such findings suggest that neural activity associated with recognition memory is localized to specific brain areas earlier than working memory.

**Fr2-07**

### Are Big Babies More Beautiful? Rating Infant Faces For Attractiveness Depending on Apparent Weight Variations

Victoria Maskell, **Nadja Reissland**, Michael Burt

*University of Durham, Durham, UK*

**Background and Aims:** It is well known that physical attractiveness plays a role in how people are judged. For example, Langlois et al (2000) in meta-analyses of facial attractiveness found that attractive children are treated more positively. Waller et al (2004) established that infant facial characteristics, specifically faces manipulated to show various degrees of fetal alcohol syndrome (FAS) in the face were judged to be more or less attractive depending on whether or not they showed FAS signs and that cuteness or attractiveness was the best predictor of adoption likelihood. Perrett et al (2003) found that people judged older faces as more or less attractive depending on the age of their parents at birth. People whose parents were older when they were born judged older faces as more attractive compared to people whose parents were younger when they were born. Given that appearance does play a role in judgements of attractiveness and that people find the "familiar" more attractive we expected that heavier and taller people would prefer plumper baby faces compared to lighter and smaller people who are expected to prefer slimmer baby faces.

**Methods:** Participants were asked to select out of 64 morphed faces (8 faces in 8 rows varying in apparent weight) the face they found most attractive. Pilot data were collected from 21 participants and data of 100 participants formed the main study, which was posted on the web.

**Results:** In the pilot study ($n =21$) Pearson's correlation 0.572 $p<0.05$ revealed a strong positive relationship between participant' Body Mass Index (BMI) and their preference for baby faces. As BMI increased so did their preference for plumper faces. The web data ($n =100$) showed a similar relationship to the pilot study. Spearman's correlation 0.232 $p<0.05$ revealed a positive correlation between participant's weight and apparent weight of the baby faces they preferred. As participants weight increased so did their preference for plumper faces.

**Conclusion:** Attractiveness of slimmer or plumper infant faces varies with the weight of the judge.

**Fr2-08**

### EEG Right Asymmetry Correlates with NBAS

**Akira Saito**[1] Hiroshi Tada[2] Naoki Uga[3]

*1. Tsurumi College, Yokohama, Japan; 2. Jissen Women's University, Hino, Japan; 3. Toho University School of Medicine, Ohtaku, Japan*

**Aims:** The correlations of EEG right asymmetry and infant behavior has captured an attention for last two decades. But no research has reported the correlation between EEG and Neonatal Behavioral Assessment Scale (NBAS). NBAS gives us information of neonatal behaviors, i.e. orientation and regulation of state. The aim of the study was to examine how EEG right asymmetry correlates with neonatal behavior assessed by NBAS.

**Methods:** 1) Participants: Twenty-one pre-term healthy Japanese neonates, 5 boys and 16 girls, served as participants. The mean of their gestational age was 219.1 days, the birth weight 1596.5 grams, Apgar scores at one/five minutes 6.3/ 7.8.

2) Procedure: Infant characteristics, the result of NBAS and EEG were measured once, within one week after being discharged from the hospital, post-conceptional age 297.7 days. EEG was measured when infant was sleeping. NBAS was rated by a certified examiner.

**Results:** FFT extracted powers of four frequency bands, delta, theta, alpha, and beta from EEG. Those four powers are summed up to a total power (TP). The right asymmetry group was defined as having a positive value of EEG right asymmetry, (right TP - left TP) / (right TP + left TP), and the left asymmetry group as having a negative value of EEG right asymmetry. The values of right/left group and NBAS scores were evaluated with Mann-Whitney U Test.

The right asymmetry group of the frontal region showed a higher score of inanimate-auditory-orientation cluster than the left asymmetry group ($p<.05$). The right asymmetry group of both the central and the occipital regions showed a higher score of animate-auditory item ($p<.05$) than the left asymmetry group. The right asymmetry group of the temporal region showed a higher score of regulation of state cluster ($p<.05$) than the left asymmetry group.

**Conclusions:** Ray and Cole (1985) reported that EEG alpha activity reflects attention and beta activity in temporal region reflects emotional processes in adult. There was no significant correlation between alpha/beta frequency bands and NBAS orientation item/cluster. We found a correlation between right asymmetry activity in temporal region and regulation of state cluster which is one of the aspect of emotional regulation in neonate. This would corroborate their finding.

Although EEG was measured at sleep state, the right EEG asymmetry showed some correlations with results of NBAS. These results would contribute to the further research that studies the relation between EEG and neonatal behavioral characteristic.

**Fr2-09**

### Infant & Child Temperament Correlates of Social Responsiveness at Age 4

**Brenda Salley**, Angela Scarpa, Katherine Morasch, Martha Ann Bell

*Virginia Tech, Blacksburg, USA*

Temperament has been well established as a contributor to individual differences in developmental pathways and outcomes, including a range of biological, cognitive, and social-emotional sequelae. In the present study, our aim was to explore the relationship between social outcomes associated with autistic symptomatology (social responsiveness) and temperamental differences beginning in infancy in a typical population.

**Method:** Thirty-seven full-term, healthy children (males=18, females=19; Caucasian) were included in the current study (these preliminary data are from approximately half of an ongoing study). Measures of temperament were obtained from mother-report during lab visits at 5 and 10 months, 2, 3, and 4 years (Infant Behavior Questionnaire, Early Childhood Behavior Questionnaire, and Children's Behavior Questionnaire). Measures of social responsiveness were also collected from mother's report (Social Responsiveness Scale; SRS) at the 4-year visit. The SRS provides a measure of social behaviors characteristic of the autistic spectrum (e.g., interpersonal behavior, communication, and repetitive/stereotyped behaviors). In addition to screening and clinical diagnosis, the SRS identifies sub-threshold levels of autistic symptomatology among a typically developing population.

**Results:** At 5-months, infants show a temperamental profile of high fear and low cuddliness significantly related to low social responsiveness at 4 years (low social motivation, social awareness, and social communication). Beginning at 10-months, infants show an increasingly consistent pattern of temperamental associations with later social responsiveness outcomes. These correlates include high fear, low shyness, low activity level, low inhibitory control, and low surgency (see Table 1) associated with lower social responsiveness at age 4.

**Conclusions:** Results indicate clear relationships between dimensions of social responsiveness and temperamental correlates, beginning in early infancy. Results suggest the possibility that temperamental factors may provide a useful window into features of autism and social responsiveness. In addition, these results may have implications for identifying a particular at-risk population in research populations.

Table 1. Correlations Between Temperament and Social Responsiveness

| | SRS 5-months | SRS 10-months | SRS 2 years | SRS 3 years | SRS 4 years |
|---|---|---|---|---|---|
| Cuddliness | r = -.401, p = .015 | | | | |
| Fear | r = .293, p = .083* | r = .440, | | | |
| p = .008 | r = .420, p = .014 | | r = .514, p = .001 | | |
| Shyness | | | r = -.511, p = .002 | r = -.616, p = .000 | r = -.466, p = .004 |
| Activity Level | | | | r = -.433, p = .03 | r = -.386, p = .020 |
| Inhibitory Control | | | r = -.524, p = .001 | r = -.326, p = .069* | r = -.453, p = .005 |
| Surgency | | | | r = -.435, p = .013 | r = -.480, p = .003 |
| | | | | | |

*p approaches significance.

Note: SRS Total score indicates severity of autistic symptomatology; a higher score indicates increased risk and greater impairment in dimensions of social responsiveness.

**Fr2-10**

### Effect of Prenatal SSRI and Depression on Newborn Cry Characteristics

**Aimee Santucci**[1] Barbara Hanusa[2] Katherine Wisner[2]

*1. University of Pittsburgh, Division of General Internal Medicine, Center for Research on Health Care, Pittsburgh, USA; 2. University of Pittsburgh, Department of Psychiatry, Pittsburgh, USA*

**Background and Aims:** Cry serves the important function of alerting the caregiver to the needs of the infant. However, analysis of the infant cry can also provide a window into the neurological status of the infant. Infant cry was utilized to examine the neurological integrity of the infant following prenatal exposure to selective serotonergic reuptake inhibitors (SSRIs) and/or depression.

**Method:** Cry pitch characteristics were examined in 71 newborn infants (45 female), within 24 hours of birth, in a brief and noninvasive protocol in which a standardized stimulus was utilized to elicit a pain cry. All infants were in a quiet alert state prior to the administration of the protocol, which was performed in the hospital room with the infant's mother present. The entire session was recorded using a digital recording device. Following presentation of the stimulus, infants cried for up to 1 minute, with a minimum of 10 seconds required for analysis purposes. Each cry was visualized and edited to remove noise (e.g., researchers or parents talking at beginning or end of protocol) using a freeware program called Audacity. The cry signal was then spectral analyzed using an R-based automated computer program written for the purposes of this research study. Maternal depression status, based on whether the women met full criteria for major Depressive Disorder (MDD), was ascertained at the week 20 interview which included a SCID. Maternal interviews were completed at 20, 30 and 36 weeks gestation, during which continued SSRI use was ascertained.

**Results:** Analysis of Variance tests were utilized to examine the relationship between prenatal SSRI use and depression and neonatal cry parameters. Results indicate that prenatal SSRI use, regardless of trimester of exposure, resulted in a neonatal cry with a higher maximum pitch [$F(1,69)=1.63$, $p=.034$]. Depression during pregnancy was associated with a higher mean pitch [$F(1,69)=5.91$, $p=.017$].

**Conclusions:** Preliminary findings indicate that both prenatal SSRI use and depression exert independent effects on infant cry parameters. These findings are consistent with previous studies that found a relationship between prenatal substance exposure and acoustic characteristics of the infant cry. Cry analysis may provide an effective and noninvasive means for determining neurological characteristics of the newborn.

**Fr2-11**

### The Association between Cortisol Levels and Sleep in Toddlers

**Anat Scher**[1] Wendy Hall[2] Anat Zaidman-Zait[2] Joanne Weinberg[2]

*1. University of Haifa, Haifa, Israel; 2. University of British Columbia, Vancouver, Canada*

**Background and Aims:** A meta-analysis on cortisol levels in children attending daycare (Vermeer & van Ijzendoorn, 2006) showed that they displayed higher cortisol levels compared to children who were cared for at home, and that their diurnal patterns revealed significant increases from morning to afternoon. The effect of daycare attendance on cortisol levels was especially notable in children younger than 36 months. Little is known about the nocturnal pattern of cortisol secretion in young children and how it relates to their sleep patterns. Because children's adjustment and behavioral regulation in childcare contexts are related to both the hypothalamic-pituitary-adrenocortical axis (e.g., Watamura et al., 2003) and their sleep (e.g., Hall et al., 2006), research that addresses night to day patterns is warranted. This report aims to examine the association between cortisol levels at bedtime and in the morning and their associations with sleep quality in young children attending daycare.

**Method:** As a part of a sleep study with young children attending daycare (n=67), we obtained salivary cortisol for a sub-sample of 27 children aged 12 to 36 months. Mothers collected saliva samples at bedtime and in the morning, and their children's sleep was objectively monitored with actigraphs worn for three nights. For the purpose of this report, we use sleep efficiency, defined as time asleep out of the total "sleep" period, as a marker of sleep quality.

**Results:** The mean bedtime cortisol level was 0.036 (Sd = 0.034) and the mean awakening level (typically collected within 30 minutes of waking) was 0.338 (Sd = 0.149). We found that awakening cortisol level, but not bedtime level, was significantly associated with the quality of sleep. Higher cortisol levels were associated with less efficient sleep ($r= - .35$, $p<.05$). Moreover, the nocturnal change pattern, which was calculated as a difference score from bedtime to awakening, was significantly and positively associated with sleep efficiency.

**Conclusion:** The results support our hypothesis that the hypothalamic-pituitary-adrenocortical axis is associated with sleep-wake regulation. Our findings contribute by drawing attention to the association between sleep quality and awakening cortisol levels. Future investigations should continue to examine the relationship between aspects of the child's sleep pattern and cortisol levels across the 24-hour period. How variations in these variables relate to children's daytime functioning, across different contexts, is yet to be fully understood. Forthcoming data from our study will partially address this issue.

**Fr2-12**

### An Examination of the Neural and Behavioral Correlates of Visual Perceptual Narrowing

**Lisa Scott**, Alexandra Monesson, Jessica Buchinski

*University of Massachusetts, Amherst, USA*

Development of face perception during the first year of life has been characterized by a process of perceptual narrowing, whereby the perceptual window through which sensory information is received is broadly tuned at first, and then narrows with experience (Scott, Pascalis & Nelson, 2007). The present investigation utilized both behavioral and electrophysiological techniques to further characterize the development of visual perceptual narrowing and the role of visual experiences. Two groups of 6-month-old infants completed pre-training behavioral (Visual-Paired Comparison; VPC) and electrophysiological (Event-Related Potentials; ERP) assessments, which indexed face discrimination abilities for familiar and unfamiliar faces. Following this assessment, one group of infants was sent home with picture books of monkey faces which were labeled at the subordinate level (i.e. all faces have individual names) and the second group was sent home with picture books of monkey faces labeled at the basic level (i.e. all faces were named "monkey"). Parents were instructed to read this book to their infants according to a fixed reading schedule. Infants were brought back in at 9-months of age and post-training behavioral and ERP assessments were conducted. Results revealed both behavioral and electrophysiological (N290; P400) differences from 6 to 9 months, and between training conditions such that infants trained at the subordinate level exhibited a differential pattern of neural

activity compared to those trained at the basic level. These results are discussed in relation to visual perceptual narrowing, the development of face processing, and the development of categorization abilities within the first year of life.

**Fr2-13**

### Maternal Verbal Behaviors, Parenting Stress and Cortisol Response to Immunization in Preterm Infants

**Mai Thanh Tu**[1] Ruth Grunau[2] Michael Whitfield[2] Joanne Weinberg[3]

*1. Universite de Montreal, Dept Social and Preventive Medicine, Montreal, Canada; 2. Department of Pediatrics, University of British Columbia, Vancouver, Canada; 3. Department of Cellular & Physiological Sciences, University of British Columbia, Vancouver, Canada*

Early life adversity, such as very premature birth, can disrupt hypothalamic-pituitary-adrenal (HPA) activity and regulation. As early as during the first 6 months of life, infants born full-term exhibit cortisol reactivity to painful procedures, such as immunization. However, it is not known whether infants born preterm show a differential response, given their extensive prior exposure to procedural pain during neonatal intensive care. Maternal behaviors and parenting stress can modulate stress systems in young children, but the role of maternal verbal behaviors during painful procedures, e.g. immunization, in altering cortisol reactivity in preterm compared to full-term infants is not known. In this study, we assessed both infant stress reactivity, parenting stress and maternal verbal behaviors prior to and during immunization in very preterm (n = 89, born ≤ 32 weeks gestation) and full-term (n = 34, born >37 weeks gestation) infants at age 4-6 months. Results show that cortisol reactivity to immunization was comparable in preterm than full-term infants. However, preliminary findings regarding maternal verbal behaviors revealed that in preterm but not full-term infants, a greater number of distress-promoting verbal behaviors was correlated with greater cortisol reactivity to immunization. In contrast, parenting stress reported during daily life situations did not correlate with cortisol reactivity in either preterm or full-term infants. Our findings extend the role of maternal behaviors as mediators of infant physiological responses to the context of procedural pain in preterm infants and suggest that infants at risk for poor stress regulation may benefit from preventive interventions that encourage optimal verbal behaviors from parents during stressful and painful situations. Supported by grant MOP127865, Canadian Institutes for Health Research (REG) and Fonds de la Recherche en Sante du Quebec (MTT).

**Fr2-14**

### Behavioral Stress Reactivity and Stress Regulation in Newborns

**Bea Van den Bergh**[1] Sofie De Vos[2] Marijke Fraussen[2] Elke Maes[2] Maya Magnus[2] Silvia Pinna Puissant[2] Mitchell Silva[3] Annelies Simons[2] Sara Weckhhuyzen[2] Karel Allegaert[4]

*1. Department of Welfare, Public Health and Family, Brussels, Belgium; 2. Department of Psychology, University of Leuven, Leuven, Belgium; 3. Department of Biosystems, University of Leuven, Leuven, Belgium; 4. Group Biomedical Sciences, University of Leuven, Leuven, Belgium*

**Background and Aims:** Several authors have theorized that it is important to differentiate between adaptive and non adaptive stress responses if one wants to understand the development of self-regulation problems (Ramsay & Lewis, 2003). We studied behavioral stress reactivity and stress regulation in 55 newborns, before and after a routine venipuncture. Our aim was to study the association between reactivity and regulation measures of their stress response.

**Methods:** Healthy newborns (n = 55) were observed by trained research assistants at the third or fourth day after birth, for 45 minutes. All mothers gave their written informed consent. Behavioral stress reactivity was observed in the first three minutes after the venipuncture. The behavior of the baby was videotaped and off-line coded with the Modified Behavioral Pain Scale. Vocalization by the newborn was recorded at a distance of 0.5 m of the head of the baby. The signals were filtered and using a 256 sample hamming window, the fundamental frequency and intensity contour was extracted. Behavioral stress regulation was observed in the next 42 minutes. The observers directly registered every 30 seconds, the body movements, eye movement, and regularity of the breathing patterns and crying of the baby on standardized observation sheets. These data were entered in a data file and used to calculate behavioral state measures; i.e. the distributions of the 5 behavioral states and periods of no-coincidence (according to the definition of Prechtl) and the duration and frequency of transition between different states.

**Results:** Multiple regressions revealed that, after statistical correction for covariates (i.e., Agar scores, time elapsed since the last feeding session, gender and type of delivery, use of pain- relieving drugs), the intensity of the stress reactivity was negatively associated with the percentage of time that the newborn spend in state 1 (deep sleep); $F = 6.63$, $p < .0001$) and with the percentage of time that the newborn spend in state 1(active sleep) + state 2 (active sleep); $F = 3.52$; $p = 0.021$). Several covariates had a significant effect on measures of behavioral states.

**Conclusion:** These results of our study seem to indicate that babies with a strong behavioral stress reactivity pattern have more problems in regulation their sleep pattern, which can be seen as one aspect of self-regulation in the newborn. Whether these regulation problems have an influence on the developmental outcome of the newborn cannot be concluded on the basis of our data.

**Fr2-15**

### Mother-Infant Synchrony of Salivary Cortisol Response to Emotional Challenge: the Role of Infant Feeding Choice and Parity

**Kristin Voegtline**[1] Cynthia Stifter[1] Heather Lorenc[1] Family Life Project Key Investigators[1,2]

*1. Pennsylvania State University, University Park, USA; 2. University of North Carolina-Chapel Hill, University Park, Chapel Hill, USA*

Breast-feeding is traditionally recommended as the 'best bet for babies'; providing nutritive and immunological benefits to infant health, while enhancing the infant-mother bond. However, there are also less researched benefits specific to maternal health. Gaining initial attention in animal studies, breastfeeding has been associated with a marked dampening in the physiological and behavioral response to environmental stress. More recently, human prospective research has shown suppression in the activation of the sympathetic nervous system; specifically quantified by secretion of salivary cortisol stimulated by the hypothalamic pituitary adrenal (HPA) axis among breast-feeding, in comparison to, bottle feeding mothers. Further, past caregiving experience may lend multiparous mothers to feel more efficacious in the caregiving role, and they have been found to have lower basal cortisol, as well as, decreased reactivity to infant distress.

The current investigation explores the impact of infant feeding choice and parity on mother and infant salivary cortisol response to emotional challenge in a predominately low-income, rural sample of 700

infants (35% African-American) and their mothers (42% multiparous). At 2 and 6 months, mothers answered questions regarding infant feeding practices. Item responses were used to index exclusively breast fed (n=68), bottle fed (n=320), and mixed method (n=312) infants. Also at 6 months, salivary cortisol assays were attained from mother and infant prior to the administration of a series of emotional challenge tasks designed to elicit infant fear and frustration (Lab-TAB), and at 20 and 40 minutes post peak arousal. All cortisol variables were log transformed to adjust for non-normality. Time of day, relating to the cortisol diurnal rhythm, was included as a covariate.

Findings indicate that compared to bottle feeding and mixed feeding counterparts, exclusively breast-feeding mothers, $F(1, 698) = 5.27$, $p < .05$, and their infants, although non-significant, $F(1, 698) = 1.75$, $p = .18$, had lower basal cortisol. Further, breast-feeding mothers had lower salivary cortisol 20 minutes after peak arousal, $F(1, 698) = 3.92$, $p < .05$, and 40 minutes after peak arousal, $F(1, 698) = 3.72$, $p = .05$. There were no differences in mother-infant cortisol reactivity or recovery synchrony by feeding practice. However, in examining the effect of parity, primiparous mothers showed greater synchrony in cortisol reactivity with their infants, $F(2, 697) = 3.91$, $p < .05$, suggesting that multiparous mothers showed lower arousal at a time of infant distress. Overall, exclusive breast-feeding and multi-parity appear to have a protective effect on mothers' physiological arousal to infant distress, which may have more general implications for parenting and mothers' experience with postpartum stress.

**Fr2-16**

### DRD2 Genotype and Prenatal Exposure to Tobacco Interact to Influence Infant Attention and Reactivity

**Sandra Wiebe**, Kimberly Espy, Christian Stopp, Jennifer Respass, Travis Jameson, Jodi Huggenvik

*University of Nebraska-Lincoln, Lincoln, USA*

**Background and Aims:** Infant temperament encompasses individual differences in reactivity and regulation, and is typically conceptualized as biologically based (Rothbart & Derryberry, 2002). Candidate genes related to dopaminergic neurotransmission have been implicated in individual differences in temperament (e.g., Auerbach et al., 2001). Prenatal tobacco exposure (PTE) has been shown to influence the development of dopamine systems through activation of nicotinic acetylcholine receptors (Muneoka et al., 1997). The present study examined the effects of dopamine receptor D2 genotype and PTE status on early temperament.

**Methods:** The sample included 119 mother-infant pairs. Smoking and non-smoking women enrolled in the study prior to their 28th week of pregnancy; smoking status was verified by assessing urine cotinine levels. Infants were genotyped on the TaqIA allele using buccal cell samples, and were classified as either A1+ (A1A1 n = 4; A1A2 n = 40) or A1- (n = 75). The Neonatal Temperament Assessment (NTA; Riese, 1983) was administered when infants were 4 weeks old. Scores were calculated for Attention, Irritable Reactivity, and Dysregulation to Stress.

**Results:** For both Attention and Irritable Reactivity, there was a significant effect of genotype, qualified by a genotype X exposure status interaction. The genotype effect was examined separately for tobacco-exposed (TE) and non-exposed (NE) infants. In the NE group, A1+ genotype was associated with higher attention and lower reactivity. In the TE group, there was no difference by DRD2 genotype. For Dysregulation to Stress, there were no genotype or exposure effects, but there was a gender difference: girls had more difficulty with stress regulation and were less soothable.

**Conclusions:** Prenatal tobacco exposure appears to moderate the effect of genotype on infant attention and irritable reactivity. Infants with the A1+ genotype were more attentive and less reactive, but only in the absence of exposure. Infants with the A1+ genotype may have a heightened response to novelty (Berman et al., 2002), which could result in increased orienting and decreased irritability to novel stimuli. Response to novelty may then be dampened in prenatally-exposed infants, as previously demonstrated in nicotine-exposed animal models (Golub et al., 2007). These results exemplify the interplay between genetic and environmental factors in infant development.

## *Emotional Development*

**Fr2-17**

### Observed and Reported Coparenting as Predictors of Infant-Mother and Infant-Father Attachment

**Geoffrey Brown**[1] Sarah Schoppe-Sullivan[2] Sarah Mangelsdorf[1] Cynthia Neff[1]

*1. University of Illinois at Urbana-Champaign, Champaign, USA; 2. The Ohio State University, Columbus, USA*

**Background and Aims:** Dyadic parent-child interaction quality is consistently identified as a primary determinant of infant-mother (DeWolff & van Ijzendoorn, 1997) and infant-father (van Ijzendoorn & DeWolff, 1997) attachment security. Recent research has expanded the domain of parental influences to document associations between coparenting (the relationship between adults in the family as parents) and parents' perceptions of attachment security (Caldera & Lindsey, 2006). This study extends that work by examining whether early observed and perceived coparenting behaviors are related to observational assessments of infant-mother and infant-father attachment.

**Methods:** Sixty-seven couples were observed in the home interacting with their 3.5-month-old infants in a free-play episode and a childcare task in which parents changed their child into a new outfit. Episodes were coded for coparenting dimensions that yielded composite variables for *Supportive Coparenting* (pleasure, warmth, and cooperation) and *Undermining Coparenting* (anger, coldness, and displeasure). Parents also completed the Parenting Alliance Inventory (PAI; Abidin & Brunner, 1995) individually. PAI responses were combined to yield total scores on *Parenting Alliance* and *Perceptions of Spousal Support*. Families visited the laboratory when infants were 12- and 13-months old to assess infant-mother and infant-father attachment in the Strange Situation Procedure (Ainsworth et al., 1978). Each infant-parent dyad was classified as secure or insecure based on standard 4-category classifications (A, B, C, D). Additionally, individual scores on a scale assessing *Proximity-Seeking vs. Avoidance* for each dyad were obtained from the Strange Situation coding (see Fraley & Spieker, 2003) to provide a continuous measure of children's attachment-related behavior.

**Results:** Bivariate correlations revealed several significant associations between early coparenting and infants' attachment-related behavior. Children's proximity-seeking to fathers in the strange situation was significantly related to greater levels of supportive coparenting in both free-play ($r = .24$, $p < .05$) and childcare ($r = .30$, $p < .05$) contexts at 3.5 months. Undermining coparenting during the free-play episode at 3.5 months was related to lower proximity-seeking to mothers during the strange situation ($r = -.25$, $p < .05$). Furthermore, families with secure infant-mother attachment relationships reported higher levels

of parenting alliance ($t = 1.73$, $p < .10$) and greater feelings of spousal support ($t = 2.03$, $p < .05$) at 3.5 months than did families in which the infant-mother attachment relationship was insecure.

**Conclusion:** Results suggest that coparenting behavior in early infancy may contribute to the development of secure parent-child relationships. Findings are discussed in terms of the impact of triadic interaction on dyadic relationship functioning, and possible differential pathways from actual and perceived coparenting to infant-mother and infant-father attachment security.

**Fr2-18**

### To Look or Not to Look? Proximity and Toddlers' Looks to Mothers in Negative and Positive Emotion Tasks

**Amy Dribin**, Kristin Buss

*The Pennsylvania State University, University Park, USA*

Looks between toddlers and mothers are forms of early communication and self-regulation (Martin, Crnic & Belsky, 2003). Buss and Kiel (2004) found that, in certain contexts, toddlers' affect during looks to mothers most often conveyed facial sadness, even when the predominately expressed emotions in the task were fear or anger. Additionally, the frequency and intensity of sadness expressions increased during and after toddlers' looks to mothers. Because toddlers' movement was constrained during the tasks, questions remain about how access to mothers influences the frequency of looks and the affect expressed. In the previous study, the tasks were designed to elicit negative affect, so the relation between positive emotions and looks should be examined.

This study asks (1) if toddlers' proximity to mothers or (2) the target task emotion (negative vs. positive affect) influences the frequency of toddlers' looks to mothers. We expect toddlers will look less frequently when they maintain close proximity with mothers and more frequently during tasks eliciting negative affect. Finally, this study seeks (3) to replicate and extend Buss and Kiel's findings to examine if looks to mothers modulate toddlers' affect. We hypothesize that the intensity of sadness, in negative tasks, and pleasure, in a positive task, will increase during and after toddlers' look at their mothers.

One-hundred-ten toddlers (24-month-olds, 47 girls) and mothers completed 12 laboratory episodes varying in novelty. Tasks were coded for the frequency and intensity of facial expressions of fear, sadness, and pleasure, looks to mother, and proximity to mother using a second-by-second coding procedure. Three tasks, hypothesized to vary along these scored behaviors were selected for analyses. In Unpredictable Robot(UR) and Female Stranger(FS) the target emotions were negative, and in Puppet Show(PS) the target emotion was positive affect.

Preliminary analyses support our hypotheses. Proximity correlated with the frequency of looks only in UR ($r$ =-.31, $p$ <.05), the task that elicited the most distress. We also found significant differences in the frequency of looks across tasks, with a higher frequency in FS ($m$=4.4, $sd$=4.5) compared to UR ($m$=1.13, $sd$=1.65) and PS ($m$=2.65, $sd$=3.2). Across tasks, the most frequently expressed emotion during looks was pleasure. Finally, dynamic changes in toddlers' emotions before and after looks to mothers will be explored (goal 3). This work makes important strides in understanding circumstances in which toddlers' look to mothers, what affective information is included in those looks, and how those looks modulate toddlers' negative and positive emotionality.

**Fr2-19**

### Toddlers' Behavioral Strategies during a Frustrating Situation with Mothers and Fathers

**Naomi Ekas**, Diane Lickenbrock, Shannon Zentall, Lauren Bohn, Julia Braungart-Rieker

*University of Notre Dame, Notre Dame, USA*

This study examined 20-month-old toddlers' behavioral strategies in a frustrating situation, with mothers and fathers. There is considerable research demonstrating toddlers' use of behavioral strategies when the mother is present; however, little research exists documenting strategy use with fathers. The limited research available suggests that younger children, 12- and 14-months old, are not consistent in strategy use across parent context (Bridges & Connell, 1991; Bridges, Grolnick, & Connell, 1997). The current study attempts to fill the gaps in the research regarding emotion regulation in toddlers, as well as gaps in the literature examining mother-child and father-child dyads. Specifically, we examined toddler affect and observable behavioral strategies during a frustrating situation with mothers and with fathers to examine whether toddlers displayed a consistent style of regulation regardless of parent context.

This study involved 116 families who visited the laboratory when toddlers were 20 months of age. Each parent participated separately in the Parent-Ignore-Toddler-Situation (PITS) with their toddlers, which involves three 90-s episodes, in which parents are instructed to teach their child how to play with a novel toy, followed by ignoring the child, and then resuming play with their child. Toddlers' positive and negative affect were coded during the ignore episode. In addition, toddlers' use of a variety of observable behavioral strategies were coded. Ten behavioral strategies included behaviors from three domains of functioning: visual, motor, and verbal.

HLM analyses indicated that toddlers became significantly more distressed as the ignore episode progressed, with mothers and with fathers. A repeated measures ANOVA indicated that there was no significant difference in toddlers' average level of affect with mothers as compared to fathers. Mixed model ANOVAs indicated that toddlers displayed more instances of looking at the toy and actively playing with the toy as compared to other behavioral strategies, with mothers and fathers. Mixed models ANOVAs also indicated that toddlers were significantly more distressed while vocalizing and gesturing to the mother and with the father. Correlations indicated that toddlers showed similar response patterns across parent context in levels of affect across all behavioral strategies except vocalizing to the parent. These results suggest that toddlers have developed a regulatory style that is not dependent on the parent with whom they are interacting.

**Fr2-20**

### Developing Confidence during Infancy: An Analytical Study of Infant Emotional Behavior Patterns

**Angela Fisher**

*Union Institute & University, South Orange, USA*

The first year of life is a crucial period in a child's social-emotional development. One aspect of social-emotional behavior is the level of confidence demonstrated by the infant. This study examined whether ethnicity, gender, temperament, and parental nurturing skills are related to infant confident behavior during situations of play and attachment/separation transitions. The study served as the beginning test phases of reliability and validity for the 10-item FIOT™ (Fisher Infant

Observational Tool), an observational assessment instrument created for use by parents and practitioners working with infants between the ages of 6-12 months. The FIOT is intended to measure confident behavior and is designed to be sensitive to infants and parents from bicultural contexts as well as from the dominant culture.

The sample included 77 infants and 77 parents of these infants from three cultural groups: African American, Caucasian American, and Latino/Hispanic American. Infants between 6-7 months and 11-12 months were observed. Parents of the participating infants completed the Nurturing Quiz to assess their parental nurturing skills. Temperament (Easy, Difficult, or Slow To Warm Up) was classified by the researcher based on a discussion with the parent.

The FIOT demonstrated an internal consistency reliability of .79 using Cronbach's alpha. Inter-rater reliability of the FIOT was measured by percent agreement (items ranged from 87.5% to 100%) and Cohen's Kappa (items ranged from .63 to 1.0). The utility and content validity of the FIOT was examined through conducting a focus group with parents. The parents reported no recommendations for revisions of accuracy, content, or structure of the FIOT, but they were dissatisfied with the Nurturing Quiz. The analyses showed a relationship between the infant's FIOT score and two variables, ethnicity and temperament. Infants from the dominant culture and those with Easy temperaments showed higher levels of confident behavior. No significant relationship emerged between the FIOT and gender or parental nurturing skills. Continued research on the FIOT is recommended in order to increase the validity and reliability of the tool as a potentially worthwhile observational instrument.

**Fr2-21**

## Smiles in 8-Month-Old Infants and Caretakers: Relevance of Self Produced Locomotion and Emotion Development

**Atsuhiko Funabashi**[1] Takae Funabashi[2]

*1. Aichi University of Education, Kariya City, Japan; 2. kyushu University, Kariya City, Japan*

**Background and Aims:** It has been recognized by developmental psychologist that self produced locomotion (SPL) has an influence on perceptual, cognitive and emotional development (Campos et al, 2000). Some of the most compelling studies have focused on relevance of SPL and perceptual, cognitive development. However, there seems to be no established theory to explain relevance of SPL and emotional development. This study was aimed to examine relevance of SPL and emotional development in 8-month-old infants, including emotional expressions of caretakers.

**Methods:** 8-month-old infants and their caretakers (24 pairs) were observed infant-caretaker interaction (free play in 10 minutes). The situation of interaction was recorded with two VCR. 24 infants were classified in SPL group (SPL:N=13) and not SPL group(NSPL:N=11) with video records and interviews for caretakers. Smiles which may be divided into the following three types of infants and caretakers were extracted with event sampling method. (1:SS) a simple smile (2:SRS) a smile with resonance of partner's smile (3:SOI) a smile that occurred as a result of interaction.

**Results:** It was found from the result (group(2)×smiles(3) mixed design ANOVA) that infants in SPL group were showed total smiles frequency and SS frequency significantly more than NSPL group [$F(1,88)=21.44$, $P<.01$; $F(1,88)=5.16$, $P<.03$]. Moreover, there was not total smile frequency significantly in both caretakers group. However, caretakers in SPL group were showed SRS and SOI frequency significantly more than NSPL group[$F(1,88)=4.72$, $P<.05$; $F(1,88)=8.86$, $P<.01$] and caretakers in NSPL group showed SS frequency significantly more than SPL group [$F(1,88)=16.29$ $P<.01$]. This clearly shows that infants and caretakers in SPL group were different from NSPL group in quantity or quality about a smile.

**Conclusion:** Infants who can move alone show a smile well. So far, it has been reported that acquisition of locomotion in infants may increase their pleasures, namely, some studies have focused on relevance of locomotion development and emotion development as inner-individual factor. However, what has to be noticed is locomotion development in infants change their caretakers. A further direction of this study will be to provide more evidence for relevance of SPL and emotion development as inter-individual factor.

**Fr2-22**

## Temperament in Infancy and the Toddler Period: Patterns Observed in Japan, Russia, and the U.S.

Helena Slobodskaya, Alexandra Kolmagorova, Atsuko Nakagawa, Masune Sukigara, Rie Mizuno, **Maria Gartstein**, Brandi Young

*State Research Institute of Physiology, SBRAMS, Novosibirsk, Russia*

Cross-cultural temperament research has not been widespread, especially during early childhood. The existing findings can be divided into those that address mean differences between the cultural groups and results pertaining to differences in the structure of temperament across cultures. For example, Japanese preschoolers were rated as more active in sleep, more withdrawal-oriented, less flexible, expressing less positive affect, and as less regular than American children (Windle, Iwawaki, & Lerner, 1988). Rothbart, Ahadi, Hershey, and Fisher (2001) reported that factor analyses performed with U.S. and Japanese samples led to a regulatory/attentional factor that included indicators of positive affect, whereas for Chinese samples this relationship between regulatory attentional functions and positive emotionality was not observed.

The present study was designed to address differences in infant and toddler temperament, utilizing translations of the Infant Behavior Questionnaire-Revised (IBQ-R; Gartstein & Rothbart, 2003) and the Early Childhood Behavior Questionnaire (ECBQ; Putnam, Gartstein, & Rothbart, 2006), for children growing up in the U.S.A. (IBQ-R, N=530; ECBQ, N=319), Russia (IBQ-R, N=325; ECBQ, N=319), and Japan (IBQ-R, N=284; ECBQ, N=229).

ANOVAs were conducted in order to examine cross-cultural differences, effects associated with the child's age gender, and possible culture-by-gender and culture-by-age interactions. Results indicated a number of significant differences in childhood temperament between the three cultural groups. Scores for Positive Affectivity/Surgency were significantly different for infants from U.S., Russia, and Japan ($F=21.61$; $p<.001$), along with Negative Affectivity ($F=15.74$; $p<.001$), and Regulatory Capacity/Orienting ($F=37.63$; $p<.001$). During the toddler period, significant differences emerged for Extraversion/Surgecy ($F=3.80$; $p<.05$), Negative Affectivity ($F=11.04$; $p<.001$), and Effortful Control ($F=9.98$; $p<.001$); however, only U.S. and Russian toddlers differed on the Extraversion/Surgency factor, whereas U.S and Russian toddlers' scores for Negative Affectivity and Effortful Control were not significantly different, but differed significantly from the scores of the Japanese toddlers. Significant culture-by-gender interactions were observed ($F=6.18$; $p<.01$), wherein girls were described as exhibiting higher levels of fear in the U.S., but not in Japan or Russia (however, sex differences in Russia and Japan were not significant). A number of significant culture-by-age interactions also emerged, indicating

a pattern of decreasing cultural differences with age (i.e., cultural differences were more prominent among the IBQ-R dimensions and the youngest age group for which ECBQ data were available). We are following-up on these analyses, computing effect sizes for comparison across different age groups, and also conducting factor analytic procedures aimed at discerning similarities and potential differences in the structure of temperament.

**Fr2-23**

### Contagious Crying as an Early Precursor of Empathy

**Elena Geangu**[1] **Tricia Striano**[2] **Oana Benga**[3]

*1. Romanian Academy of Science, Babes-Bolyai University, Cluj-Napoca, Romania; 2. Hunter College, Department of Psychology, New York, USA; 3. Babes-Bolyai University, Cluj-Napoca, Romania*

Empathy is the result of three major components' interaction: affective sharing, emotion regulation and self-other awareness. Newborns' crying in response to the cry of another baby is one of the first signs of empathic-like responses. Little work has been done in order to study the characteristics of this phenomenon throughout the first year of life, despite its significance for empathy development.

**Aims:** Emotional regulation and of self-other awareness develop significantly up to the age of 1, therefore we aim investigating their relation with contagious crying.

**Methods:** 1- (N=19), 3- (N=32), 6- (N=36) and 9-month-old (N=34) infants were presented with the pain cry of another infant. Responses were recorded in terms of vocal distress (*presence*, *intensity*, *latency*), facial expression of distress (*anger* for the entire sample, *sadness* for 3-, 6-, and 9-month-olds). 3-, 6- and 9-month-old infants were also tested for the ability to discriminate between their own and another baby legs (preferential looking), and for emotional regulation abilities (thumb sucking, escape behavior, and IBQ-R scores).

**Results:** We found significant age effects for crying ($F(3, 121)=2.886$, $p< .05$); latency to cry ($\chi^2=7.80$, $p< .05$); and a significant age effect for facial expression of sadness ($\chi^2=6.71$, $p< .05$) for the age groups of 3-, 6-, and 9-month-old. When looking at the relation between self-other awareness and contagious crying, we found that only 9-month-olds manifest preferential looking for the other leg movements ($t(43)=8.59$, $p< .05$). Their ability to discriminate between self and other significantly predicts reduced contagious crying: less crying ($F(1,34)=4.381$, $p= .044$; $R2 = .124$; $\beta = -.342$, $p= .044$), longer latency to cry ($F(1,34)=4.11$, $p= .051$; $R2 = .11$; $\beta = .33$, $p = .051$), less anger ($F(1,34)=5.09$, $p= .03$; $R2 = .13$; $\beta = -.366$, $p= .031$). In terms of emotion regulation abilities, 3-month-olds who use thumb-sucking show less vocal distress ($T=2.04$, $p=.050$), with lower intensity ($T=2.86$, $p=.008$) and delayed onset ($Z= -2.024$, $p= .054$); and less sadness ($Z=-2.74$, $p= .006$). Also, their falling reactivity scores significantly correlates with less vocal distress ($r= -.40$, $p< .05$), less anger ($r= -.60$, $p< .01$), and longer latency to cry ($r= .38$, $p< .05$). Six-month-old infants with higher duration of orientation abilities cry less intense ($F(2, 23)=6.61$ ($p=.006$), have longer cry-latency ($F(2, 23)=4.03$ ($p=.034$) and express less anger ($F(2, 23)=9.45$ ($p=.001$).

**Conclusions:** The relations of contagious crying with self awareness and emotion regulation suggest it as an early precursor of empathy.

**Fr2-24**

### Infant Self Regulation and Parenting Stress in Low-and Middle Income Samples

**Deann Jones**[1] Lori Roggman[2] Kaelin Olsen[2]

*1. Utah State University, Providence, USA; 2. Utah State University, Logan, USA*

Infants learn to regulate their behavior mainly in the context of caregiver-child relationships. When mothers experience parenting stress, their relationships with their infants are likely to be influenced in ways that affect infant self regulation. The way a mother's stress affects her child may be different for children in low-income families versus children in middle-income families, because the stresses associated with poverty can be quite different from the stresses not associated with poverty. This study used extant data on parenting stress and infant's behavior from two longitudinal samples: a low-income sample and a middle-income sample to test the different associations of parenting stress on children's behavior

Participants included 262 mother-infant pairs (141 low-income and 121 middle-income). When the children were 14 months old, mothers filled out the Parenting Stress Index short form (PSI) subscales of parenting distress and dysfunctional interaction, and infants were observed during testing using the Bayley Scales of Infant Development: Behavior Rating Scale (BSID/BRS).

There were different associations between parenting stress and infant's behavior for middle- versus low-income families, and the associations were stronger in low-income families. In low-income families, mothers' greater parenting stress was related to their infants' greater hypersensitivity and lower persistence during tasks in the assessment. Also in low-income families, the PSI subscale measuring parent-child dysfunctional interaction was associated with less energy level, less attention to the task, and less cooperation by the infants during the assessment. For middle-income families, mother's total stress had no associations with infants' self-regulation behavior. However, the parent-child dysfunction subscale was positively related to infants' adaptation to change between tasks during testing.

The stresses a middle-income mother experiences may lead to supporting her child's adaptation to change, whereas the stresses that a mother in poverty experiences may lead to poorer outcomes. The results of this study indicate a greater need to assist mothers in poverty who are experiencing stress. Middle-income mothers may have more resources to deal with their stress so that their infants are not affected as much as those in poverty. The results, however, were only correlations at one point in time, and it cannot be concluded that the stress the mothers experience caused their infants' behavior. It is also possible that low-income mothers are more affected than middle-income mothers by difficult behavior in their infants. Nevertheless, these results suggest the importance of further research regarding the pathways between parenting stress and children's early self-regulatory behavior.

**Fr2-25**

### Affective Intersubjectivity between Mother and Toddler as a Predictor of Emotion Understanding

**Marina Klimenko**, Hui-chin Hsu

*University of Georgia, Athens, USA*

Intersubjectivity, a term coined by Trevarthen (1979), is a multifaceted concept capturing affective processes between two social partners.

Research evidence suggests that positive contingent responsiveness between mothers and preschoolers is concurrently correlated with children's emotion understanding (e.g., Denham & Kochanoff, 2002). However, little is known about whether affective intersubjectivity between mother and toddler would predict later development of emotion understanding. Thus, the present study aimed to explore the longitudinal association of mother-toddler affective intersubjectivity with later development in emotion understanding at preschool age.

Twenty-five mothers and their children participated in the present longitudinal study. At 2 ½ years, mothers read wordless picture books to their toddlers. Mothers' and their toddlers' positive and negative affective expressions were coded from videos using a 5-second time sampling strategy. The interpersonal intersubjectivity was derived from the proportion of matches and mismatches between maternal and toddler affective expressions. At 4 years, the emotion understanding task was administered. The experimenter presented children with 20 vignettes describing situations in which the protagonist felt happy, sad, scared, or mad. At the end of each story, the children were asked about how protagonist felt. Higher scores in this task indicated higher levels of understanding of emotions in 4-year-olds.

Results from preliminary analysis showed that the majority of the mother-toddler dyads were positively matched in their affective expressions during book reading. Toddlers who had more positive matches with their mothers performed better on the emotional understanding task at 4 years ($r=.45$, $p< .05$). In contrast, children who had more affective mismatches with their mothers scored lower on emotion understanding task ($r=-.67$, $p< .01$).

Affective intersubjectivity between mother and toddler predicts children's emotion understanding at preschool age. This finding provides preliminary evidence for the developmental association between the affective quality of mother-toddler interaction and the development of emotional knowledge. Unlike dyads experiencing lower levels of affective intersubjectivity, mothers and toddlers engaging in mutual and positive interactions may be not only more likely to share their emotional states but also more likely to engage in frequent and open talks about emotions. Both nonverbal and verbal affective intersubjectivity between mother and toddler may promote secure attachment relationship. Through the process of mother-child affective intersubjectivity, children not only develop their relationship with parents but also learn about human emotions.

**Fr2-26**

### Longitudinal Relations of Maternal Personality and Depression to Infant Temperament in a Japanese Population

**Emiko Kusanagi**[1] Shigeru Nakano[2] Megumi Sekine[2] Kiyomi Kondo-Ikemura[2]

*1. Kokugakuin Junior College, Takikawa City, Japan; 2. Hokkaido Health Science University, Sapporo City, Japan*

**Background and Aims:** Many studies have reported that the development of children's temperament is affected by psychological disorders of mothers, such as depression. However, a limited number of studies have explored the influence of maternal personality on children's temperament, few of which have investigated the developmental changes associated with these influences. Therefore, the present study measured maternal personality and depression and examined the longitudinal relationships with children's temperament from early to late infancy.

**Methods:** The participants were mother-infants dyads who consented to participate in our longitudinal study. In order to measure maternal personality and depression, mothers completed the Japanese Adult Temperament Questionnaire (ATQ) short form one month before and after delivery and the Japanese Self-Rating Depression Scale (SDS) one month after delivery. Infant temperament was assessed using the Japanese Infant Behavior Questionnaire-Revised (IBQ-R) at 3 (n=49), 10 (n=38), and 16 months (n=35).

**Results:** The ATQ scale scores before and after delivery were highly correlated (rs = .49-.82). Maternal postnatal depression was found to be correlated with the "Negative Affect" (NA) ($rs = .65$, $p < .001$ before delivery and .57, $p < .001$ after delivery) and "Effortful Control" (EC) ($rs = -.33$, $p < .05$ before delivery and $-.49$, $p < .001$ after delivery) ATQ factor scales. Although no significant correlations were observed between maternal depression and the IBQ-R at any age, significant correlations were observed between the NA of the IBQ-R and NA of the ATQ before ($r = .34$, $p < .05$) and after delivery ($r = .28$, $p < .05$), between "Orienting Sensitivity" of the ATQ after delivery and "Surgency/Extraversion" (SE) ($r = .30$, $p < .05$) and "Orienting/Regulation" (OR) ($r = .32$, $p < .05$) of the IBQ-R at 3 months, and between the SE of the ATQ before delivery and OR of the IBQ-R at 10 and 16 months (rs = .39 and .40, $p < .05$, respectively).

**Conclusion:** The present findings indicate that each mothers' personality was stable from before to after delivery and that maternal postnatal depression could be predicted based on maternal personality before delivery. Although maternal depression was not found to be related with children's temperament, maternal personality was associated with the temperament of the infant. In addition, these associations differed according to the developmental stage of the infant. These results will be discussed in terms of both the direct influence of heredity and the indirect influence of parenting behavior.

**Fr2-27**

### Attachment and Emotion Regulation at 10 Months: Psychometric Qualities of a New Measure For Assessing Dyadic Emotion Regulation

**Eva Martins**[1] Isabel Soares[2] Carla Martins[2] **Ana Osório**[2]

*1. ISMAI, Maia, Portugal; 2. Universidade Minho, Braga, Portugal*

This poster reports some findings from a larger study aimed to analyze the role of developmental predictors (at 10 months) - infant's cognitive development and temperament, mother's emotional availability and quality of the dyadic emotional regulation - of the attachment quality (at 12/16 months). It is expected that the quality of the infant's attachment is closely related to the quality of the dyadic emotion regulation (Sroufe, 1996; Cassidy, 1994). The study targeted a low-risk sample, with 46 mother-infant dyads. A new measure - The Dyadic Negative Emotion Regulation Scale (RED, Martins & Soares, 2006) - was developed to assess the quality of the dyadic emotion regulation based on a challenging task with a shape sorter - The Shape Sorter Task (Martins, 2007). Mother-infant dyads were videotaped at home (10 min long), when the babies were 10 months of age. A good inter-rater reliability was found (ICCs = .76, $\alpha = .75$, $p < .001$) based on 63% of the tapes, each one coded by two out of four judges blind to the other measures. After coding the quality of infant-mother interaction based on the RED, each dyad was assigned to one out of the following categories: a) optimal emotion regulation, b) difficulties in emotion regulation, c) no negative emotion expression. Related to the new measure, the results about discriminant validity show that the quality of the dyadic emotion regulation is not predicted by the infant's cognitive developmental level in terms of his/her mental and psychomotor functioning (Bayley Scales of Infant Development- 2nd ed.: Bayley, 1993). In terms of construct validity, the optimal dyadic emo-

tional regulation category is predicted by higher levels of interactional quality with the mother (Emotional Availability Scales: Biringer et al., 1998) and easier temperament (Infant Characteristics Questionnaire: Bates et al., 1979) at 10 months of age and the "no negative emotion expression" category (on a task designed to elicit negative emotions) predicts the avoidant pattern of attachment at 12/16 months (Strange Situation Procedure: Ainsworth et al, 1978). These results support the notion that the emotional regulatory strategy is related to the baby's attachment pattern (Sroufe, 1996; Schore, 2001) which in the case of avoidant babies is characterized by over-control (Cassidy, 1994) already at an early age (10 months) and that temperament by itself is not sufficient to explain the differences between the dyadic emotion regulation quality (Sroufe, 1996) and the attachment patterns (Vaughn & Boost, 1999).

**Fr2-28**

### Behavioral and Affective Precursors to Disorganized Attachment in the Still-Face at 4-months

**Lindsey Forbes**, **Greg Moran**, David Pederson

*Department of Psychology, The University of Western Ontario, London, Canada*

**Background and Aims:** Disorganized attachment in infancy is associated concurrently with an overall deficit in emotion regulation (e.g., Hertsgaard et al., 1995) and prospectively with psychopathology (e.g., aggression and dissociation) in childhood and adolescence (van IJzendoorn et al., 1999). However, little is known regarding the behavioural and affective precursors to attachment disorganization in the Strange Situation (SS) at the end of the first year. Whereas organized attachment relationships have been extensively studied both in the naturalistic home context (Ainsworth et al., 1971) and in the experimental Still-Face (SF) procedure (e.g., Tronick Als, Adamson, Wise, & Brazelton, 1978; Braungart-Rieker, et al., 1999), there is a paucity of research investigating disorganized relationships before 12-months of life. A single study by Koos and Gergely (2001) utilized a modified version of the SF procedure and provided preliminary evidence that distinct precursors to disorganized attachment can be observed prior to the laboratory SS. The SF procedure has been suggested to provide an age-appropriate parallel to the SS in younger infants. The present study investigated whether attachment disorganization in the SS at 12-months can be predicted from aspects of infant behaviour and affective expression in the SF procedure at 4-months of age.

**Methods:** A community sample of 59 adult mothers and their 4-month-old infants participated in the SF procedure. The SF procedure consisted of 2 periods of face-to-face interaction (Period 1 and 3) separated by a period where the mother was asked to adopt a "still-face" and be unresponsive (the SF period). The Infant Regulatory Scoring System (Weinberg & Tronick, 1990) was employed to assess the infant's affect and behaviour throughout the SF Procedure. At 13-months of age the dyads participated in the laboratory SS, the standard separation-reunion paradigm (Ainsworth et al., 1978).

**Results:** Disorganization at 13-months was positively associated with Distancing/Escape behavior(e.g., arching, turning away from mother) in the SF period, $r = .28$, $p < .05$, and Period 3, $r = .30$, $p < .05$, of the SF. Infants in later disorganized relationships also displayed increased smiling across the SF procedure ($M = 20.80$, $SD = 20.98$) $F(1, 57) = 4.94$, $p<.05$, and were quicker to smile in Period 3, $F(1, 56) = 4.66$, $p<.05$, compared to those in organized relationships ($M = 34.93$, $SD = 24.98$).

**Conclusion:** These results suggest that behavioural and affective precursors to disorganization can be identified during mother-infant interaction at 4-months, prior to the SS at 12-months. Further, the combination of infant Distancing and Smiling may be precursors to the contradictory behaviours expressed by infants in the SS at the end of the first year.

**Fr2-29**

### The Predictive Function of Observed and Reported Measures of Infant Temperament to Child Anger at 2 1/2 Years

**Kristin Mount**, Susan Crockenberg, Esther Leerkes

*University of Vermont, Burlington, USA*

Two methods of assessing temperament are maternal report and direct observation. However, researchers often find a weak connection between mother report and observations of temperament (negative emotionality), raising the question of which better predicts later temperament. Other temperament dimensions (approach and withdrawal) have also been linked to later temperament. The goals of this study were to: 1) test predictions from mother-reported and observed infant distress to frustrating events, withdrawal, and approach to mother-reported child anger; 2) determine if results are similar for father-reported anger.

Participants were 65 mothers and children (45 fathers). At 5 months, mothers completed the Infant Behavior Questionnaire, yielding measures of distress to limitations (frustration), and soothability. At 6 months, temperament was observed in a laboratory setting designed to elicit frustration. The tasks were: a) toy removal; and b) arm restraint. At 2 1/2 years, mothers and fathers completed the Toddler Behavior Assessment Questionnaire, yielding measures of child anger and parental social desirability.

Mother-reported distress to limitations correlated positively with mother-reported child anger, whereas observed distress showed a negative trend. Neither measure of infant distress correlated significantly with father-reported child anger. Controlling for social desireability, continuity in mother-reported anger varied also as a function of infant soothability, withdrawal negatively, and approach interactively with gender (females only). In follow-up regressions within gender, approach was linked positively with anger for female infants, but not for males. Results were the same for father-reported anger.

That mother-reported distress to frustration predicts anger, whereas observed distress does not, supports the validity of maternal report measures of temperament. That this association is not apparent for father-reported anger suggests that the association for mothers may reflect method variance. That infant withdrawal and approach predict both mother and father reported anger shows that temperamental anger is rooted in infancy and indicates that it is already a well-developed and clearly expressed emotion system at six months. It indicates also that behavioral approach and avoidance are as or more important than distress in predicting the development of anger.

**Fr2-30**

### Twelve-Month-Olds Understand Fear in Adults, But Not in Children

**Sara Nichols**, Margarita Svetlova, Elizabeth Posti, Catherine Henderson, Celia Brownell

*University of Pittsburgh, Pittsburgh, USA*

Recent research suggests that children begin to respond to others' emotions and intentions between 9 and 15 months of age. In "social referencing" paradigms infants look to adults for information in ambiguous situations, and then adjust their behavior in reaction to

the adults' facial and vocal expressions. Studies have shown that by 12 months of age, children will avoid touching a toy towards which an adult has displayed fear. However, little is known about what young children understand about fear in other children. Infants are interested in their peers, but prior to 18 months of age, peer interactions are comparatively rare and limited in complexity. Moreover, from an evolutionary perspective, it may be more adaptive for young children to understand the fear expressions of an adult, whose message may bear life-or-death importance, than those of another child, whose fear may be less informative. Thus, we hypothesized that while infants as young as 12 months will utilize negative emotion information (fear) from an adult to influence their play with novel toys, they will not do so if the emotion informant is another child.

Participants were 26 12-month-old infants who were shown a 20s video clip featuring an emotion-informant: either a 6-year-old girl (n=10) or an adult woman (n=16). The emotion informant expressed fear (vocal and facial expression) toward one of two unfamiliar, neutral toys (hereafter referred to as the target toy and distracter toy; adapted from Mumme and Fernald, 2003). Toys and presentation side (R, L) were counterbalanced. After watching the video, children had a 30s play period with both toys. Videotapes were coded for touch time to each toy (the target and the distracter).

Preliminary results for the proportion of time children touched each of the two toys revealed that children played less with the target toy toward which an adult had expressed fear ($M$ = .21) than with the distracter toy ($M$ = .42), ($t$ = 1.88, $p$<.10). In contrast, children who observed an older peer display fear towards a toy did not play with that target toy significantly less than they played with the distracter toy ($M$ = .19 & .24, respectively). Data collection is ongoing, but these preliminary findings indicate that infants' understanding of other children's emotions may lag behind their understanding of adults' emotions. Discussion will focus on growth in social understanding and peer relations in this period.

**Fr2-31**

### Taiwanese Infants' Response to Arm Restraint at 4 Months

**Hsin-ju Tsai[1] Suh-fang Jeng[1] Hui-chin Hsu[2] Yen-ting Yu[1] Yen-tzu Wu[1]**

*1. School and Graduate Institute of Physical Therapy, College of Medicine, National Taiwan University, Taipei, Taiwan; 2. Department of Child and Family Development, University of Georgia, USA*

**Background and Aims:** Noninvasive arm restraint procedure has previously been used as an elicitor of stress response in American and Japanese infants. This study was aimed to replicate and extend previous research. The goals of this study were to (1) develop a behavioral coding system examining Taiwanese infants' reactivity to mild stress in early infancy, (2) investigate changes in infant behavioral response to arm restraint and release, and (3) examine relations of infant gaze, vocalization, and body movement in response to arm restraint and release.

**Methods:** Thirty-seven full-term Taiwanese 4-month-olds participated in this study. The infant was placed in a semi-reclining infant chair. An experimenter implemented the procedure while the mother was sitting aside quietly. The arm restraint procedure consisted of two separate episodes: (1) a restraint episode during which the experimenter gently grasped the infant's wrists and held them down for 2 minutes, and (2) a release episode during which the infant's wrists were released for 1 minute. The infant was videotaped during this experimental procedure. Infants' gaze direction [0-4 points], vocalization [0-5 points], and body movement [0-4 points] were coded using a 10-second time sampling strategy. The latency to the first negative vocalization during the restraint episode was also measured.

**Results:** Inter-coder reliability indexed by the kappa coefficient for infant vocalization, gaze direction, and body movement was .87, .67, and .60, respectively. The average latency for infants to utter the first negative vocalization was 55.2 seconds during the restraint episode. Although no significant changes were observed in infants' behavioral response to arm restraint and release, high consistency was found in their vocalization (r=.92, p<.01) and body movement (r=.46, p<.05), but not gaze direction (r=.20, ns). Furthermore, whereas infants' vocal response to arm restraint predicted body movement response to arm release (r=.45, p<.05), their body movement response to arm restraint predicted vocal response to arm release (r=.67, p<.01).

**Conclusion:** Acceptable inter-rater reliability was found for the coding system. Similar to previous studies with Japanese and American infants, Taiwanese infants reacted negatively to the arm restraint procedure. However, it takes longer for Taiwanese infants (55.2 s) to utter their first negative vocalization than did Japanese (51.6 s) and American (45.0 s) infants (Camras et al. 1992). The high consistency in infants' vocalization and body movement between episodes suggest that 4-month-olds may not be efficient in self regulating their distress. External regulation such as maternal soothing may be necessary.

**Fr2-32**

### The Development of Wariness of Heights: a Comparison of the Descent and the Locomotor Crossing Paradigms on the Visual Cliff

**Mika Ueno**, Ichiro Uchiyama, Joseph Campos, David Anderson

*Department of Psychology, Doshisha University, Kyoto, Japan*

**Background and Aims:** When infants start crawling, they begin to show wariness of heights. Two methods of testing infants on the visual cliff permit this conclusion. In the "descent paradigm," prelocomotor and locomotor infants are slowly lowered onto the deep or the shallow side while heart rate is assessed. In the "locomotor crossing paradigm," the latency of the infant to get all four limbs onto the deep side is measured while the mother calls the infant. In the locomotor crossing paradigm, not all infants avoid the deep side; some get onto the deep side. The aim of this study is to compare the heart rate reactions to descent onto the deep side of those locomotor infants (a) who go onto the glass over the deep side, and (b) who do not go onto the glass during the testing trial.

**Method:** 18 ten-month-old locomotor infants participated. They were tested using both the descent and the locomotor-crossing paradigms on a visual cliff. At first, in the crossing paradigm, we determined whether the infant moved onto the deep side or not. Once the infant put his hands on the glass of the deep side, the experimenter picked the baby up, and ended the trial. Such an infant was a "crosser." If the infant did not go onto the deep side, the trial ended after 60 sec, and the infant was called a "no crosser." Next, infants were tested on the descent paradigm.

**Results:** There were 12 "no crossers" and 6 "crossers." In the descent paradigm, both "crossers" and "no crossers" showed significantly greater accelerations on the deep than the shallow, F(1, 11)=16.18, p<.001 for no crossers; F(1,5)=6.89, p<.05, for crossers. In the crossing paradigm, the "crossers" looked down on the deep side significantly longer than the "non-crossers," F(1,16)=8.73, p<.01.

**Conclusion:** Regardless of whether infants avoided or tried to cross the deep side, every infant showed cardiac acceleration on the deep side. To the extent that such accelerations tap defensive responses,

it follows that "crossers" had some wariness of heights, despite their attempts to cross to the mother. "Crossers" clearly could tell that there was a dropoff, because they paid so much attention to the deep. Future research needs to address questions such as: Are the observed differences due to temperament? To differences in compliance to maternal bids to cross? Or to differences in the intensity of wariness of heights?

**Fr2-33**

### Parenting, Coparenting, and Infants' 3-Month Inhibition

Lisa Zawistowski, **Claire St.Jacques**, James McHale
*University of South Florida, Saint Petersburg, USA*

Infants' early social environments involve not only dyadic, parent-infant relationships but also a climate in which co-parents work cooperatively or uncooperatively to socialize the baby. Coparenting alliances supporting infant development are characterized by coordination, validation, and mutual engagement; non-supportive alliances are characterized by oppositionality, intrusiveness, and/or detachment. Recently, Fivaz-Depeursinge and Favez (2006) made a case for attending to coparenting dynamics early in the baby's first year. They determined that infants' early triangular capacities can be traced to the quality of family (mother-father-baby) alliances at 3-4 months post-partum, arguing persuasively that infants are active parties to early family, as well as mother-infant, dynamics.

In this study, we examined the interconnectedness of early coparenting conflict and infant inhibition, hypothesizing that greater infant inhibition at 3 months would coincide with greater interparental disagreement about parenting efforts. To determine whether coparental conflict was uniquely important in explaining variability in infant inhibition, we examined its contributions after accounting for variability explained by parental sensitivity.

110 infants were assessed in home twice at 3 months post-partum, where researchers completed individual, dyadic, and coparenting assessments. Babies completed the temperament assessment procedure of Garcia-Coll and colleagues, during which increasingly intense stimuli (wiping the baby's nose, putting a hat on the baby's head, playing a human scream, introducing a noisy robot) are introduced; videotaped records are then scored for infant responses. Behaviors reflecting inhibition include verbal and facial protest and physical posturing away from stimuli. Researchers trained in Garcia Coll's lab to an acceptable level of inter-rater reliability (average ICC across facial, vocal, and bodily categories = .77). Parental sensitivity was evaluated from face-to-face diaper changes and scored using a system adapted from Tronick et al. (1978). In this report, overall maternal and paternal sensitivity scores are used.

Coparenting was assessed using a multi-method approach including a "Who Does What" discussion and attempt to resolve differences in perspective while tending the baby (Elliston et al., 2006); a recounting of the day the baby was born (a co-constructed birth narrative; Dickstein et al., 2000); Fivaz and colleagues Lausanne Trilogue Play; and coparenting during a StillFace procedure where both parents rather than just one played with the infant, posed a still face, and then reengaged with the baby. For each observational assessment, independent teams of blind, trained coders evaluated coparental competitiveness and disputatiousness; inter-rater reliabilities (ICCs) ranged from .71 to .89. All competition and disputatiousness scores were standardized and summed to create an overall conflict score (alpha = .71; range = -.84 to 5.23, SD = .65).

Infant inhibition was significantly and negatively correlated with maternal sensitivity, and significantly and positively correlated with coparental conflict. It was unrelated to paternal sensitivity. In regression analyses, both maternal and coparental predictors explained a statistically significant proportion of the variance, whether stepped in first or second. Findings indicate that infant researchers miss out on important social processes when attending solely to early mother-infant dynamics. Study limitations and implications for theory-building are discussed.

**Fr2-34**

### Adult Attachment Classification and Maternal Mind-Mindedness in a Normative Sample of First-Time Mothers

**Megan Beers**, Jennifer Ablow, Lynne Huffman
*University of Oregon, Eugene, USA*

Maternal mind-mindedness refers to the extent to which a mother attributes an independent mental state to her preverbal infant (Meins et al., 2001). Research has demonstrated that higher levels of maternal mind-mindedness are associated with a variety of positive developmental outcomes, including attachment security (Meins et al., 2001) and subsequent theory of mind performance (Meins et al., 2002). However, there has been little examination of the maternal characteristics that predict higher levels of maternal mind-mindedness. Because maternal mind-mindedness is a predictor of infant attachment security, it is particularly critical to understand how adult attachment classification is related to maternal mind-mindedness, with the ultimate goal of bridging the "transmission gap" identified by attachment researchers. This study examined the relation between adult attachment classification and mind-mindedness in a sample of 39 women pregnant with their first child. Women participated in a laboratory session during their third trimester of pregnancy, during which they completed the Adult Attachment Interview (AAI). In addition, women participated in a home observation at 9 months postpartum, during which they completed two structured play episodes (one with and one without toys). Mind-mindedness was coded for both play episodes. Results revealed a significant main effect of attachment classification and a significant play episode by attachment security interaction, indicating that individuals with a secure state of mind with respect to attachment showed disproportionately higher frequencies of mind-mindedness during the no toy episode than their insecure counterparts. These findings have both theoretical and methodological implications, demonstrating that adult attachment appears to be related to maternal mind-mindedness and that the no toy condition appears to be a particularly salient task that highlights differences in mind-mindedness between attachment groups. Additional analyses will examine relations between mind-mindedness and maternal sensitivity, as well as relations with other prenatal predictor variables (e.g. ideas about parenting).

**Fr2-35**

### Maternal Mind-Mindedness and Infant Attachment: Examination in a High-Risk Sample

Jennifer Ablow, Megan Beers, Cynthia LaMorticella
*University of Oregon, Eugene, USA*

The concept of maternal mind-mindedness refers to the tendency for a mother to attribute an independent mental state to her infant,

whether through imitation of her infant's vocalizations, the encouragement of her infant's autonomy, or comments directly addressing her infant's mental state (Meins et al., 2001). Researchers have demonstrated that, in normative samples, higher levels of maternal mind-mindedness are predictive of infant attachment security (e.g. Meins et al., 2001). Accordingly, mind-mindedness has been identified as a possible mechanism that may help to explain the gap in our understanding of the intergenerational transmission of attachment (i.e. the "transmission gap"). The current study seeks to extend previous research in the area of mind-mindedness and infant attachment security by examining the prospective relations between maternal mind-mindedness and infant attachment security in a sample of 100 high-risk mother-infant dyads. Women included in the study met criteria for two out of three risk factors known to be associated with problematic parenting: low socioeconomic status, risk for abuse, and/or current depressive symptoms. Dyads were assessed at 5 and 16 months postpartum. At 5 months, dyads participated in a 5-minute free play assessment, which is being coded for mind-mindedness using a scheme based on work by Meins et al. (2001). At 16 months, dyads completed the Strange Situation Paradigm. Strange Situation tapes are being rated by a certified coder and each infant is being placed into one of four attachment classifications. Analyses will test the hypothesis that higher levels of maternal mind-mindedness are associated with subsequent infant attachment security. This paper will help to elucidate whether the established relation between mind-mindedness and infant attachment security generalizes to a high-risk sample and, as such, will expand our understanding of mind-mindedness as a candidate mechanism in the intergenerational transmission of attachment.

**Fr2-36**

### Maternal and Child Characteristics as Antecedents of Maternal Mind-Mindedness

Isabelle Demers, **Annie Bernier**, George Tarabulsy
*University of Montreal, Montreal, Canada*

The aim of this study is twofold. First, we seek to improve the measurement of maternal mind-mindedness by adding two aspects to the original descriptive, interview-based measure of mind-mindedness (Meins et al., 1998). In addition to assessing the proportion of mind-related descriptors provided by mothers when asked to talk about their child, we assess the valence and the richness of the description. We use concurrent maternal sensitivity as the criterion against which this new measure is validated. Second, we seek to investigate the antecedents of maternal mind-mindedness measured in this way. 106 mother-infant dyads were met when the child was 6, 10 and 18-months old. The Adult Attachment Interview was conducted at T1 to assess maternal state of mind with respect to attachment. At T2, maternal depression (Radolf, 1977), parenting stress (Abidin, 1995) and infant temperament (Bates et al., 1979) were assessed through maternal reports. Finally, mind-mindedness was assessed using a maternal interview at T3, as part of a 2-hour home visit during which mother-infant interactions were observed and later coded for maternal sensitivity using Pederson and Moran's (1995) Maternal Behavior Q-Sort. The results show that the proportion of mental descriptors provided by mothers during the interview is not associated with maternal sensitivity. However, the expanded measure reveals a positive link between positive mind-mindedness and maternal sensitivity, and between richness of the description and maternal sensitivity, suggesting that richness and valence may be important indicators of maternal mind-mindedness. The second part of the study investigates predictors of positive mind-mindedness. The results reveal that, as expected, an autonomous attachment state of mind is predictive of positive mind-mindedness. However, parenting stress adds further to the prediction, suggesting that mind-mindedness is influenced not only by parents' past attachment experiences, but also by current factors related to parenthood.

## *High Risk and Pediatric Issues*

**Fr2-37**

### Kangaroo Care Effects on Hospital Acquired Infections through Alteration of Stratum Corneum Barrier function in Preterm Infants

**Amel Abouelfettoh**, Susan Ludington-Hoe
*Case Western Reserve University, Cleveland, USA*

**Background:** The stratum corneum (SC) is the outermost layer of skin. It protects the infant from infection by acting as a barrier to antigens.Two parameters of barrier function that can be non-invasively assessed in preterm infants are Skin Hydration and Transepidermal Water Loss (TEWL). Kangaroo Care (KC) is the proposed independent variable that might affect barrier function by decreasing transepidermal water loss and increasing skin hydration, thereby improving stratum corneum barrier function and consequently decreasing the rate of infection.

**Purpose:** To determine the effects of 5 daily sessions of KC on TEWL, skin hydration on Days 1 and 5 of treatment and number of positive blood cultures from onset of treatment until discharge and one month after discharge.

**Methods:** A pretest-test-posttest randomized controlled trial of ten stable 32 week postmenstrual age preterm infants in each of two groups, a treatment group which receives 65 minutes of KC per day for 5 out of 7 days for two weeks, and a control group that does not receive KC, will be conducted in a tertiary level NICU. Pretest is 5 minutes of incubator care, test is 65 minutes of KC or continuing incubator care, and posttest is 5 minutes of incubator care. Computerized minimization technique will be used to randomly assign subjects. TEWL (the rate of water evaporation from the skin) and Skin Hydration (amount of water retained by SC cells) is being measured by a multi-prop NOVA Dermaphase Meter which records data directly onto the computer. Dermaphase probes are placed 1 cm below right costal margin at midclavicular line at the end of the incubator (pretest and posttest) and test (KC or incubator) periods. Positive blood cultures also will be determined by positive lab slips in the infant's medical record. The means of the last 5 readings provided during each measurement will be used in measures of central tendency and repeated measures ANOVA.

**Results:** Data is being collected, demographic, descriptive and inferential statistical analysis of data for all subjects tested by 7 days prior to the meeting will be presented. Preliminary results show that TEWL is lower and skin hydration may be higher during KC than incubator periods.

**Conclusions:** Improved TEWL and skin hydration may influence the number of positive cultures infants have and would suggest that skin-to-skin holding acts as an immunomodulator that positively affects infection in preterm infants.

**Fr2-38**

## Infant-Mother Interaction Quality in Preterm Low Birthweight Infants: Maternal Depressive Symptoms and Social Interactions

**Jon-paul Bianchi**

*Department of Human Development and Family Studies, University of Wisconsin, Madison, USA*

**Background and Aims:** Previous research has identified associations among infant health risks, maternal depression, and poor parent-child interaction quality (Klebanov et al., 2001; Landry et al., 1997). However, the processes underlying these associations are not fully understood. This investigation examined whether maternal social isolation functioned as a mediator of the association between infant health risks and maternal depressive symptoms. The study also examined whether maternal depressive symptoms that persisted across the first four months following the child's birth related to dyadic play interaction quality.

**Methods:** Seventy infant-mother dyads from three Neonatal Intensive Care Units (NICUs) participated in the study. Dyads were assessed at two time points: Hospital discharge (HD) and 4 months postterm. At HD, data were gathered on infant health risks, family demographics, and maternal depression. At 4 months, data were gathered on infant-mother interaction quality (videotaped free play), maternal depression, and maternal perceptions of social isolation. Maternal depression was assessed with the CES-D (Radloff, 1977) and videotaped interactions were coded with the Parent-Child Relational Assessment (Clark, 1985). A semi-structured interview assessed maternal perceptions of change in social interactions with friends and family.

**Results:** Regression analyses did not support the proposed mediator model. However, persistently elevated maternal depressive symptoms across both time points were modestly related to poorer infant engagement during free play ($\beta = -.25$, $p = .054$). Cumulative infant health risks was not associated with maternal depressive symptoms or play interaction quality. However, semi-structured interviews revealed several interesting themes related to perceived maternal isolation. These included concerns about infant health, geographic barriers, and perceiving others as having misconceptions about preterm infants. Some mothers reported that social support protected them against feelings of isolation, such as support from partners, friends/fictive kin, and religious communities.

**Conclusion:** Findings suggest that persistent maternal depressive symptoms were related to the quality of preterm infant play interactions. In addition, content analyses of interviews with mothers yielded themes that support a resilience model and identify important contextual supports for mothers that protect against feelings of isolation that may occur following the birth of a preterm infant.

**Fr2-39**

## Preterm Growth in Perception and Cognition: A Cross-cultural Comparison

Nancy Auestad[1] **Marc Bornstein**[2] Charlene Hendricks[2] Deborah O'Connor[3]

*1. Kellogg, Battle Creek, USA; 2. NIH/NICHD, Bethesda, USA; 3. Univeristy of Toronto, Toronto, Canada*

**Background and Aims:** Significant medical and technological developments in neonatal intensive care have led to equally significant increases in the survival rates of preterm infants. With increased survival rates come concern about long-term prognosis as preterm infants are more likely than term to have developmental and learning disabilities. In the absence of clear organic bases for abnormal development, the degree to which preterm babies develop well or poorly appears to reflect the caregiving environment. We sought to the study the role of environment and culture on perception and cognition in preterms by comparing 145 preterm infants from three countries, Chile, United Kingdom, and the United States on measures of visual acuity and novelty preference.

**Sample:** Preterm infants with birth weights of 750 to 1805 g and whose gestational age was less than 33 weeks were eligible for enrolment (Ross Preterm Infant Study, O'Connor 2001). Infants with serious medical conditions or congenital abnormalities that could affect growth and development were excluded from recruitment. The final sample consisted of 145 preterm infants and their mothers, 47 from Chile, 48 from the U.K., and 50 from the U.S.

**Methods:** The following measures were used to compare individual order stability and mean level continuity across time of infant visual perception and information processing: Visual acuity was determined using the Teller Acuity Card Procedure (Teller, McDonald, Preston, Sebris, & Dobson, 1986) at 2, 4, and 6 months. The Fagan Test of Infant Intelligence (Fagan, & Singer, 1983) was employed to assess the infant's ability to process information at 6 and 9 months. In addition, infant birth weight and Apgar scores, maternal intelligence, and an index of HOME environment were evaluated as covariates for all analyses.

**Results:** Infant measures showed differential stability by country, ranging from rs = .06 to .59 Estimates for continuity showed significant main effects of age and country as well as interactions. Chilean infants demonstrated no change over time; whereas both English and U.S. American infants' acuity increased. American infants also showed higher levels of cognition (higher novelty preference scores and less familiarization duration) than Chilean or English infants.

**Conclusions:** Our analyses point to the differential stability and continuity of perception and cognition when comparing preterm infants who differ by country of origin. These findings highlight the need to look more closely at environment and culture when determining optimal conditions for preterm growth and development.

**Fr2-40**

## Speech Perception Capacities in VLBW Preterm Infants: Vowel Discrimination and Native Language Recognition in the First Months of Life

**Laura Bosch**, Melània Figueras, Martí Iriondo, Pilar Póo

*University of Barcelona (GRNC-PCB), Barcelona, Spain*

**Background and Aims:** While differences in attention, recognition memory and processing speed for visual stimuli have already been shown between full term and preterm infants (Rose et al., 2001; 2002), studies comparing early speech perception abilities are still scarce. This is a relevant area of research since language development is likely to be compromised in this population (Jansson-Versakalo, et al., 2004; Foster-Cohen et al., 2007) and recent research has revealed the predictive value of early speech perception performance for later language development (Tsao et al., 2004). This research explored VLBW preterm infants' ability to discriminate a native vowel contrast (/o/-/u/) at 4 and 8 months of age. A measure of their early capacity to differentiate native vs. non-native language was also obtained so that performance in both tasks could be compared. A sample of eighteen preterm infants from monolingual environments participated in this study (gestational age <32 weeks and birth weight <1,500g, with no congenital, physical or severe neurological anomalies).

**Methods:** Vowel discrimination was assessed through the familiarization-preference procedure, using disyllabic word-form stimuli (multi-speakers). Native language recognition was assessed by means of an orientation latency measure to utterances in two languages (native Spanish or Catalan vs. non-native English). Preterm infants were tested twice, at 4 and 8 months of age, in the vowel discrimination task. Their native-language recognition capacity was explored at 4 months. Independent samples of 4-and 8-month-old full-term infants served as control groups.

**Results:** Vowel discrimination on disyllabic material was not found at 4 ($t<1$), but only at 8 months of age in the pre-term group [$t(17)=2.971$, $p=0.009$], while both 4- and 8-month-old controls succeeded. Data from an additional experiment using simplified material (monosyllables, single-speaker) with an independent group of 4-month-old pre-term infants revealed that vowel discrimination could be reached when overall complexity was reduced [$t(9)= 3.624$, $p<0.006$]. No positive evidence for early language differentiation could be shown in pre-terms ($t<1$) and a significant interaction with the control group was obtained [$F(1,21)=15.384$, $p=0.001$].

**Conclusions:** Results extend previous knowledge on VLBW pre-terms' cognitive disabilities, when tested with visual stimuli, to the speech perception domain. Prematurely born infants show early difficulties in both vowel discrimination and language differentiation tasks compared to full-term infants. Data reveal processing problems when dealing with complex and highly variable linguistic material, although its consequences on later language development require further examination. The incidence of neonatal risk factors will be discussed.

**Fr2-41**

### Developing and Testing the Effects of an Early Parenting Intervention

Kathleen Baggett[1] Edward Feil[2] **Betsy Davis**[2] Lisa Sheeber[2] Susan Landry[3] Carta Carta[1]

*1. Juniper Gardens Children's Project; University of Kansas, Kansas City, USA; 2. Oregon Research Institute, Eugene, USA; 3. University of Texas, Houston Medical School, Houston, USA*

**Background and Aims:** Research indicates that behavioral parent training (BPT) is the single most effective intervention available to improve parent-child relationships and reduce the potential for child maltreatment (Taylor and Biglan, 1998, Haugaard & Feerick,1996). Unfortunately, access to effective behavioral interventions is severely limited for many of those most in need, especially mothers of very young children living in rural areas. Through the use of recent advances in multimedia technology and the rise of computer networking via the Internet, there now exists an opportunity to provide interventions to families with limited access to traditional services. This poster presentation will describe the development of an innovative computer Internet delivery system to provide a psycho-educational parenting intervention (Play and Learning Strategies; Landry & Smith, 2005) to low income mothers of young infants. Preliminary results pertaining to family engagement and implications for future studies will be presented.

**Development/Method:** In addition to delivering PALS parenting sessions via Internet/computer, the intervention provides weekly telephone sessions with a parent trainer/coach and peer group support via the Internet. Computers are equipped with a camera "eye ball" to conduct weekly in-home observations of parent-child interaction. The computer-video recorded interactions serve as a component of the intervention to remotely record mothers with their infants as they practice the program's parenting skills. Computer-mediated co-viewing of these interactions by the coach and parent will facilitate treatment progress monitoring and guide therapeutic intervention. To evaluate the impact of the Internet-adapted PALS program intervention for improving maternal parenting behavior, 50 mothers will be randomly assigned to either the intervention condition or to a usual care condition. The primary outcome variables will be measures of parenting behavior including maternal sensitive responsiveness and negativity.

**Preliminary Results:** Results pertaining to program completion rates and participant satisfaction will be presented. We also expect to show that initial effect size estimates of changes in parent sensitivity behavior, with this type of delivery methodology, can be used to improve the lives of families with infants.

**Conclusion:** The primary benefit of the Internet as a mode for delivering parenting interventions is that it reduces barriers to access. Interactive Computer Mediated Interventions in the home overcome common obstacles for parent participation, such as lack of transportation, long distances or scheduling conflicts. Parent training through the Internet allows distance-free, on-demand, schedule-free interactive interventions with low ongoing maintenance costs, which increase the likelihood of adoption by early intervention and other mental health programs.

**Fr2-42**

### Nursing Support Intervention for African American Mothers: Effect on Maternal psychological Well-Being and the Mother-Child Relationship

**Diane Holditch-Davis**[1] Margaret Miles[2] Mark Weaver[2] Suzanne Thoyre[2] Linda Beeber[2] Beth Black[2] Janice Wereszczak[2] Stephen Engelke[3]

*1. Duke University, Durham, USA; 2. University of North Carolina, Chapel Hill, USA; 3. East Carolina University, Greenville, USA*

**Background and Aims:** African American premature infants are at higher risk for parenting problems than other prematures. This health disparity is probably due interactions among poverty, barriers to service usage, and the mothers' emotional distress from the infant's birth and hospitalization. This study examined the effectiveness of a culturally congruent, nursing intervention providing support to African American mothers of prematures (weighing less than 1500 grams or requiring mechanical ventilation). Mothers receiving the intervention and mothers receiving usual care were compared to determine whether the intervention affected psychological well-being and the mother-child relationship.

**Methods:** 177 African American mothers and their prematures (76 boys, 101 girls, mean birthweight 1102 gm) were recruited when the babies were no longer critically ill and followed until 24 months corrected for prematurity. Mothers were randomly assigned to control and intervention groups. The intervention consisted of an in-person contact in the hospital followed by a home visit 1-2 weeks after discharge and at 5, 10 and 15 months. Phone contacts were made weekly during the first month, bimonthly for 2 months, and then monthly. Depressive symptoms, anxiety, posttraumatic stress symptoms, parenting stress, worry about child health, and daily hassles were measured at 2, 6, 12, 18, and 24 months. The mother-child relationship was measured using 45-minute videotapes of mother-infant interaction and the HOME Inventory at 6 and 18 months and maternal perceptions of child vulnerability at 12, 18, and 24 months. Behaviors from the videotape and the HOME were combined into 7 interactive dimensions. Data was analyzed using general linear mixed models.

**Results:** Intervention mothers had less depressive symptoms, state anxiety, worry, and parenting stress than control mothers, but only

worry was significantly lower for the intervention mothers in intent-to treat analyses. State anxiety was significantly reduced when the dosage of the intervention was considered. The percent of mothers with elevated depressive symptoms was reduced at 2 and 6 months. Maternal developmental stimulation and child social behaviors were improved for the intervention group at 6 months. When infants were healthier, intervention mothers exerted significantly more negative control than control mothers, but for sicker babies they exerted less negative control. For sicker infants, mothers in the intervention group had significantly higher developmental stimulation. Worry did not mediate the effects of the intervention on the mother-child relationship.

**Conclusions:** The intervention appeared to have direct positive effects on the mother-child relationship and moderate positive effects on maternal psychological well-being.

**Fr2-43**

## Fathers' Experiences in the Neonatal Intensive Care Unit: A Search for Control

**Liisa Holsti**[1,2,3] Vincent Arokiasamy[4] Susan Albersheim[3,5]

*1. Department of Occupational Science and Occupational Therapy, University of British Columbia, Vancouver, Canada; 2. Child and Family Research Institute, Vancouver, Canada; 3. Women's and Children's Health Center of British Columbia, Vancouver, Canada; 4. University of Northern British Columbia, Prince George, Canada; 5. University of British Columbia, Vancouver, Canada*

**Background:** Having a critically ill newborn is extremely stressful for both parents. Fathers are important participants in the care of their infants and involvement of fathers with their children is crucial for optimal development. Little is known about the experiences of fathers in the Neonatal Intensive Care Unit (NICU).

Objective: This qualitative study aimed at understanding the experiences of fathers of very ill neonates in the NICU.

**Patients and Methods:** Sixteen fathers of very ill and/or very premature babies who had been in the NICU for more than 30 days were interviewed by a male physician. Fathers were asked about their level of comfort with or concerns about staff communication regarding their baby, about accessing information, and about more general perceptions of their experience in the NICU. Interviews were audiotaped and transcribed for analysis. Coding used content analysis with construction of themes by 3 researchers.

**Results:** The over-arching theme for fathers was a sense of lack of control. Their world view, as a "backdrop" theme, provided context for all the themes. Four other inter-related sub-themes were identified including accessing and receiving adequate and relevant information about their baby; communicating effectively, particularly with the health care team; developing or re-defining their new and expanded roles, such as overseers of the baby's care, fathers, husbands/partners, breadwinners, and protectors; and participating in external activities, such as getting away from the NICU, working, exercising, praying, or attending community religious services. Scheduling regular meetings with a primary physician was cited by half of the fathers as being the most helpful support strategy. Seven fathers suggested that receiving short written materials would have helped them understand their infants' conditions better. Only one father stated that a support group exclusively for fathers would have been supportive. The fathers said that speaking to a male physician was a positive and useful experience.

**Conclusions:** Fathers experience a sense of lack of control when they have an extremely ill baby in the NICU. Specific activities help fathers regain a sense of control and help them fulfill their various roles of protectors, fathers, partners and breadwinners. Understanding these experiences helps the health care team offer targeted supports for fathers in the NICU.

**Fr2-44**

## Phonemic Perception Differences in Infants of Mothers who Smoked during Pregnancy

**Julie Kable**, Claire Coles, Mary Ellen Lynch, Katrina Johnson

*Emory University School of Medicine, Atlanta, USA*

**Background and Aims:** Approximately 25% of women of childbearing age are smokers and the majority continues to use while pregnant. The impact of smoking on fetal growth was observed sometime ago but the neurobehavioral outcomes are less well understood. Fried and his colleagues have suggested that offspring have a differential deficit in the area of auditory processing, which manifests later as impairments in language and reading. This study examined the processing of phonemic stimuli using a habituation/dishabituation paradigm to assess differences in phonemic perception associated with maternal smoking.

**Methods:** Participants were recruited from two large hospitals and seen at 6-months. Maternal report of consumption of cigarettes was obtained shortly after delivery. All infants had to pass the newborn hearing exam. At 6-months, infant cardiac orienting responses (OR) to phonemic stimuli were assessed. Infants were exposed to 10 consecutive 12-sec trials of "ba" followed by 5 consecutive 12-sec trials of "da" to assess group differences in initial encoding of phonemic stimuli and then differences in the ability to differentiate "da" from "ba."

**Results:** A repeated measures analysis of covariance was done and averaged baseline HR was used as a covariate. For habituation trials, a significant group*trial*sec effects was found ($F(16,1264)=2.11$, $p < .006$) and the differences were linearly related to group status ($F(2, 158)=4.5$, $p < .013$). The heavy dose group registered the stimuli with the same magnitude of response on the first trial but did not maintain the same degree of sustained attentional focus, as indexed by maintenance of cardiac suppression, on the two subsequent trials as did the control sample and on trial 2 as did the light dose group. On the dishabituation trials, a group by trial interaction ($F(2,164)=2.43$, $p < .048$) and a group by trial by sec interaction were found ($F(16, 1320)=2.21$, $p < .004$). Group differences were linearly related to dosage group for both effects (group * trial: $F(2, 165)=4.32$, $p < .015$ and group* sec* trial: $F(2, 165)=5.2$, $p < .006$). The heavy dose group did not dishabituate to the new stimuli ("da") on trial one as did both the control and light dose group, suggesting that the heavy-dose group did not perceive differences in "ba" and "da" stimuli as well as the other two groups.

**Conclusion:** These results suggest that maternal smoking negatively impacts phonetic perception skills, which may influence subsequent language development.

Fr2-45

## Self-Regulation and Early Working Memory in Children Born ELBW (<1000 grams)

Peggy MacLean, **Susanne Duvall**, Jean Lowe, Michele Shaffer, Kristi Watterberg
*University of New Mexico, Albuquerque, USA*

**Introduction:** Infants born preterm and extremely low birthweight (ELBW; <1000 grams) are at risk for early cognitive, attention, learning, and self-regulation difficulties (Hack, Friedman, & Fanaroff, 1996). Early working memory impairment contributes significantly to later risks of global intellectual and academic difficulties in children born preterm (Wolke & Meyer, 1999).

Although many studies have compared working memory abilities of infants born preterm and full-term, few studies have examined the factors that are associated with working memory within this population. The study's purpose is to better understand factors associated with early working memory; measured by object permanence. The role of self-regulation, neonatal medical severity, family socio-economic status, ethnicity, and gender in object permanence performance was examined in 244 children, 18-22 months, born preterm and ELBW.

**Methods:** Early working memory was assessed using object permanence items of the Bayley Scales of Infant Development-II (BSID-II). Participants were grouped by the number of object permanence items (84, 96, 102) successfully completed; with higher items representing more complex object permanence. For the logistic regression models, we grouped the sums as 0-1 and 2-3 (0=none, 1= one item, 2= two items, 3= all three items). Self-regulation was assessed using the Emotion Regulation and Orientation/Engagement Scale of the BSID-II Behavior Rating Scale using percentiles adjusted for age. Demographic (child ethnicity, maternal education, family income) and neonatal medical severity variables (birthweight, gestational age, CRIB score) were also obtained.

**Results:** Logistic regressions were used to analyze the relationship between the above factors and object permanence. Both Orientation/Engagement and Emotional Regulation significantly predicted object permanence mastery (p<.0001 & p=.0004, respectively), lower Orientation/Engagement and Emotional Regulation predicted poorer performance on object permanence items. A significant gender difference between object permanence mastery was found (p=.002); with girls performing better. These findings remained significant even after controlling for neonatal medical severity, maternal education, and family income. Maternal education, family income, and neonatal medical severity (birth weight, gestational age, CRIB scores) were not significantly associated with object permanence mastery.

**Conclusion:** Within 18-22 month old children born ELBW self-regulation is significantly associated with object permanence mastery; given that higher Orientation/Engagement and Emotional Regulation was associated with better performance on object permanence items. Additionally, girls performed better on object permanence items than boys. A proposed mechanism for the relationship between self-regulation abilities and emerging working memory (as measured through object permanence) is that higher self-regulation facilitates attention; which is a necessary precursor to working memory.

Fr2-46

## Associations between Maternal Prenatal Risk and Protective Resources during Pregnancy and Infant Temperament

**Kristy McDonald**[1] Kathryn Lemery-Chalfant[2] Linda Lueken[2]
*1. Department of Psychology, Arizona State University, Gilbert, USA; 2. Department of Psychology, Arizona State University, Phoenix, USA*

The literature focusing on maternal prenatal stress as a risk factor for child development has recently documented associations between maternal prenatal stress and infant temperament. Findings from these studies suggested higher levels of maternal prenatal stress may be a potential risk for difficult temperament, attentional problems, and lower cognitive skills during infancy that may persist into the toddler years. Most studies have not yet investigated associations between positive maternal psychological states during pregnancy and infant temperament. Additionally, despite the need, scientific investigations in the past have excluded families with diverse cultural backgrounds. This study longitudinally explored the associations between maternal prenatal risks and maternal protective resources during pregnancy and aspects of temperament assessed at five and nine months of age.

In the present study, 131 low-income mothers were interviewed in the hospital after giving birth, and again when their infants were five and nine months of age. The majority of mothers were Latina (79.6%), spoke Spanish (70%), and were born in Mexico (71.1%). Structural Equation Modeling with Full Information Maximum Likelihood was utilized and completely standardized loadings are presented to describe the direction and strength of associations. Model 1 proposed maternal prenatal risks (stressful life events, anxiety, and depression) and maternal protective resources during pregnancy (personal mastery, ego resilience, and social support during pregnancy) independently influence infant temperament (smiling and laughter, distress to limitations, and soothability) at five and nine months of age. Surprisingly, results revealed maternal prenatal risks were not related to infant smiling and laughter, distress to limitations, and soothability at either age. Interestingly, maternal protective resources during pregnancy significantly predicted more smiling and laughter (.31** at 5 mos; .19** at 9 mos) and less difficulty soothing (.39* at 5 mos), but was unrelated to infant distress to limitations. In a second model, we examine whether or not five-month smiling and laughter mediates the association between maternal protective resources during pregnancy on nine-month smiling and laughter. Results highlight the importance of investigating relations between maternal prenatal risks and infant temperament in diverse samples. Furthermore, results underscore the need to explore protective resources during pregnancy in addition to risk, in order to capture early influences on infant temperament.

Fr2-47

## Pattern of Relationships Among Rural African American Mothers and Fathers of Prematurely-Born-Infants

**Margaret Miles**[1] Diane Holditch-Davis[2] Suzanne Thoyre[1] Linda Beeber[1]
*1. University of North Carolina, Chapel Hill, USA; 2. Duke University School of Nursing, Durham, USA*

Fathers of prematurely-born-children have an important role in helping mothers cope with the infants' stay in the NICU and in providing ongoing financial, emotional, and physical support after discharge. Support from fathers is important in improving the quality of parent-

ing especially for mothers at risk for problems and also may directly facilitate infant development. However, the birth of a preterm or high risk infant places additional stress on the relationship of couples during the transition to parenthood. Challenges faced by rural low-income African American parents, such as racism, low education, chronic joblessness, drugs, and poverty, may profoundly impact on patterns of coupling relationships and paternal involvement with the baby. Thus, it is important to know more about parental relationships and paternal support in these families. As noted by Harris (2002) and Murry and colleagues (Murry, Bynum, Brody, Willert, & Stephens, 2001), much remains to be learned about parenting processes among low-income African American mothers and fathers. The purpose of this paper is to describe the relationships among low-income rural African American mothers and fathers of preterm infants. This includes patterns of coupling relationships and changes in these patterns over time, paternal support to the mother, and sources of conflict in the relationships. This qualitative descriptive study is part of a larger nursing support intervention with rural African American mothers with preterm infants. Participants were 65 mothers who participated in the intervention for six months (infant corrected age) or longer. In the larger study, nurses provided support to mothers in the hospital and home and via telephone contacts from time of enrollment during hospitalization to up to 18 months corrected age. Part of the intervention focused on the mothers' relationship with the father and extended family. Field notes written by the nurses following each intervention contact were used for content analysis. Most mothers had an ongoing relationship with the father of their baby. While only about a third were married, most of the others were living together or, if living apart, had an ongoing relationship with the father at enrollment. There was stability over time; few relationship patterns changed. Most mothers reported some level of support from the fathers, particularly childcare and financial. Emotional support, although desired, was less often provided. Patterns of support were stronger for married couples. There was more variable support patterns for the unmarried living together and living apart but maintaining a relationship. As expected, fathers in the couples with little or no relationship provided the lowest levels of support. A small number of mothers reported conflicts in the relationship with the father. The most salient conflicts revolved around his romantic relationship with her, financial support for the child, and his paternal role and relationship with the child. Factors affecting patterns of relationship and level of support included joblessness, drug abuse, incarceration, multiple partners, and inadequate housing due to availability and cost. This study supports the importance of understanding parental relationships in rural African American couples from an ecological perspective.

**Fr2-48**

### Early Screening for Autism in the Tuberous Sclerosis Complex

**Shafali Jeste**, Mustafa Sahin, Vanessa Farley, **Charles Nelson**
*Children's Hospital, Boston, USA*

Tuberous Sclerosis Complex (TSC) is a genetic disorder characterized by benign tumors in various organ systems, including the brain. TSC serves as an ideal study population for characterizing early signs and neural correlates of autism for two reasons. First, 40-60% of children with TSC develop autism. Second, they are usually diagnosed in utero and followed longitudinally with clinical examination, neuroimaging, and EEGs. Therefore, they can be followed from early infancy, when atypical behaviors may first emerge. In the mouse model, an over-exuberance of axonal projections has been found in the Lateral Geniculate Nucleus. One could hypothesize that abnormalities in axonal connectivity in the visual pathway impair visual processing at a time when an infant's social development largely depends on visual experience, which then may predispose the child to autism. In this setting, we designed a study to screen infants with TSC for autism using electrophysiological and behavioral testing. Infants with TSC will be tested at ages 3, 6, 9, 12, and 18 months with the following: Event Related Potential (ERP) paradigm of mother vs. stranger face, Autism Observation Scale of Infancy (AOSI), and Mullen Scales of Early Learning. We will record clinical data including neurological examination, brain MRI, and EEG. Diagnosis of autism will be made at 24 months using the Autism Diagnostic Observation Schedule (ADOS), and the two groups (TSC with autism, TSC without autism) will be compared with regards to all variables gathered. To demonstrate the feasibility of this protocol, we already have studied five children, ages 12 months to 2 years. All had cortical tubers and two had seizures and abnormal EEGs. In all children, ERPs showed clear face components (N290, P400). Interestingly, the amplitude of each component was higher than that seen in the control children, perhaps reflective of the exuberant axonal projections in the visual cortex.

**Fr2-49**

### Leaving a Crying Infant Alone: an Improbable Approach to Shaken Baby Syndrome Prevention

**Beth Russell**
*Worcester State College, Worcester, USA*

**Introduction:** Most Shaken Baby Syndrome (SBS) prevention efforts recommend that caregivers leave an infant crying inconsolably alone, without helping ease any anxiety over doing so. Recent data from Barr, Trent and Cross (2006) support the hypothesis that crying is the only consistent precursor to most SBS occurrences. For this reason SBS prevention efforts are wise to focus more attention on coping with infants' inconsolable cries.

**Method:** The present study collected data on adult ethnotheories for responding to a crying infant. In a broader SBS prevention study, over 360 adult participants (mean age = 21 years, 90 males (25%), 190 = caregivers for children (53%)) were asked to rate for how long it is acceptable to leave a crying infant alone. The 5 likert scale responses ranged from "never" to "over 30 minutes".

**Results:** Preliminary results indicate that the modal response was that it is never acceptable to leave a crying infant younger than 2 years of age alone. The majority of the entire sample indicated either the "never" response or "for less than 5 minutes" best fit their sentiment on the issue. There is no significant relationship between caregivers' demographic characteristics (including caregiver/non-caregiver status, age, income, ethnicity, or gender) and their responses to this item.

**Discussion:** This indicates that the average American caregiver is unwilling to leave a child alone, perhaps because parenting advice stresses caregivers be consistent and timely in their response to an upset infant in order to be considered sensitive. Certainly an awareness of general sensitivity is part of the best practice for most abuse interventions, however, educational materials must not take for granted that a crying child held by a parents is always a safe child. Along these lines, it is prudent of intervention studies to help parents and other caregivers find comfortable ways to distance themselves from a crying child that do not compromise parents self-efficacy as soothers for their children.

**Conclusion:** As prevention science increases our understanding of the role inconsolable crying plays in the escalation of events leading to shaking an infant, current intervention efforts must respond by tailoring their programs to reflect an awareness that not all caregivers are comfortable leaving distressed children alone for any length of time. Asking caregivers to leave a crying infant alone will not be a useful or effective strategy for preventing SBS if caregivers are unwilling to employ the suggestion. Recommendations for intervention strategies in individual level and group level program designs are presented to increase participant comfort with the notion of leaving a crying infant alone.

**Fr2-50**

### Resolution of Grief Following Preterm Birth: Implications for Early Dyadic Interactions and Attachment Security

**Prachi Shah**[1] Melissa Clements[2] Julie Poehlmann[2]

*1. Baylor College of Medicine, Houston, USA; 2. University of Wisconsin, Madison, USA*

**Background:** For some mothers, the birth of a preterm infant is a vulnerable time, characterized by feelings of grief, loss and trauma (Kaplan, 1960; Macey, 1987; Kersting, 2004). The mother's ability to adapt to the stress of a preterm birth has implications for the quality of early dyadic interactions and infant attachment security (Forcada-Guex, 2006). Previous research has shown that unresolved grief regarding a child's medical diagnosis is associated with attachment insecurity (Marvin, 1996), although this construct has not been explored with mothers of preterms.

**Objective:** To explore the association between maternal unresolved grief regarding a preterm birth and infant attachment security.

**Methods:** This is a secondary analysis of data collected as part of an ongoing longitudinal study of infants born preterm or low birthweight. 181 dyads were recruited initially, and the final sample size consisted of 150 dyads (attrition rate= 17% across 2 years). Data for this report were collected at the infant's NICU discharge and at 4, 9, and 16 months postterm. Assessments included review of infants' medical records, videotaped parent-infant play (coded with the Parent-Child Relationship Assessment: PCERA), the Reaction to Preterm Birth Interview (RPBI), and the Strange Situation Procedure (SSP).

**Data Analysis:** RPBI narratives were coded using the Reaction to Diagnosis Interview Coding Manual (Pianta, 1994) and were classified as "resolved" or "unresolved". The proportion of resolved mothers with secure infants was compared with the proportion of unresolved mothers with secure infants using chi-square analysis. The contributions of maternal sensitivity (PCERA), maternal resolution of grief (RPBI) and infant birthweight on infant attachment security were analyzed using logistic regression.

**Results:** Preliminary data analysis is reported for 19 dyads. Narratives of RPBI transcripts revealed elements of resolution (i.e. assertion of moving on in life, suspending a search for a reason for premature birth, and balanced statements regarding benefit to self) as well as lack of resolution (i.e. continued search for reason why infant was born prematurely, demonstration of being "emotionally cut-off," and a denial of the impact of diagnosis on self.) Mothers who were more sensitive on the PCERA at 4 months were more likely to be resolved at 9 months, after controlling for birthweight (p=0.05). Maternal sensitivity at 4 months, infant birthweight and resolution of grief at 9 months predicted attachment security, with lower birthweight infants more likely to be secure (p=0.06). There was no association between resolution of grief and infant attachment at 16 months (p= 0.21).

**Conclusions:** Resolution of grief regarding a preterm birth was associated with maternal sensitivity during early dyadic interactions, whereas infant birthweight was associated with infant attachment security. Further analyses are warranted to ascertain the potential effects of birthweight and neonatal risk on maternal resolution, infant attachment, and the quality of early dyadic interactions.

**Fr2-51**

### Prematurity Stereotyping and NICU Hospitalization

**Marilyn Stern**, Monica Durrette, Rebecca Foster, Katherine Karraker

*Virginia Commonwealth University, Richmond, USA*

**Background and Aims:** The stress of having an infant in the NICU leads some mothers to manifest negative expectations for their infants and to view their infants as vulnerable to negative developmental and health consequences. Previous research has shown that some mothers of premature infants engage in "prematurity stereotyping," subsequently affecting mothers' relationships with their infants (Stern et al., 2006). We expand on previous work by evaluating to what extent individual differences in prematurity stereotyping, coupled with NICU hospitalization, relate to subsequent maternal coping and self-efficacy.

**Methods:** Thus far, 60 mothers (Mage = 29.7 years; 50.0% Caucasian, 45.8% African-American) have participated in the first phase of the study. Infants were, on average, 31.24 weeks gestational age and 3.48 pounds at birth. One-half of the babies (50%) required ventilation (M = 16.4 days).

**Results:** Mothers rated their infant(s)' hospitalization as a highly stressful experience. Mothers who reported that the NICU experience was most stressful also perceived their infant as more vulnerable during their NICU hospitalization ($p < .02$). Mothers of infants who required longer stays in the NICU were more likely to perceive their infants as more vulnerable during the NICU stay ($p < .04$) and again at one month after discharge ($p < .04$). Repeated measures MANOVAS indicated that overall prematurity stereotyping was found ( $p < .007$), with mothers during NICU hospitalization rating infants labeled full-term more positively than infants labeled premature, especially in terms of physical potency. Moreover, mothers who at discharge reported that they believed they coped well with the NICU experience and were able to use more emotional coping strategies, such as emotional expression, were more likely to rate premature infants more positively on physical potency.

A series of hierarchical multiple regressions showed that the number of days in the NICU and birth weight were not related to maternal self-efficacy, but that perceived vulnerability and stereotyping were significantly related to maternal self-efficacy, with lower levels of stereotyping, $\hat{a} = .36$, $t = 2.53$, $p = .02$, and lower levels of perceived vulnerability, $\hat{a} = .42$, $t = 2.94$, $p = .01$, associated with higher maternal self-efficacy. Optimism was not significantly related to maternal self-efficacy.

**Conclusion:** These results clearly suggest the critical role maternal cognitions play in maternal self-efficacy development. Moreover, prematurity stereotyping begins as early as an infant's NICU hospitalization and maternal characteristics and cognitions may play a moderating role in their development.

Fr2-52 *Social Development*

## The Relationship of Fathers and Their Very Low Birthweight Infants: the Impact of Anxiety and Stress in the Neonatal Intensive Care Unit

**Phyllis Zelkowitz**[1,4] Claudette Bardin[2,4] Apostolos Papageorgiou[3,4]

*1. Department of Psychiatry, SMBD-Jewish General Hospital, Montreal, Canada; 2. Montreal Children's Hospital, Montreal, Canada; 3. SMBD-Jewish General Hospital, Canada; 4. McGill University, Montreal, Canada*

**Background and Aims:** There has been limited research on factors associated with paternal adjustment to the birth of a very low birthweight (VLBW, < 1500g) infant. Fathers who experience high levels of distress following the birth of a VLBW infant may find it difficult to interact sensitively and responsively with their infants. This study examined the relationship between paternal anxiety and feelings of stress and father-infant interaction in the Neonatal Intensive Care Unit (NICU) and at 3 months corrected age. In addition, we assessed the impact of early father-infant interaction on measures of infant cognitive and behavioral development at 24 months corrected age.

**Design/Methods:** A group of 47 VLBW infants (24 males, 23 females) was followed until 24 months corrected age. In the NICU fathers completed questionnaires measuring trait anxiety and stress associated with the NICU experience. Their behavior with their infants was assessed in two feeding interactions in the NICU, yielding measures of awareness and responsivity to the infant's need state. At 3 months corrected age, father-infant interaction was observed at home. At 24 months, mothers completed the Child Behavior Checklist for children aged 1.5 - 5 years. Cognitive development was assessed using the Bayley Scales.

**Results:** Birthweight, gestational age, and neonatal risk were not related to paternal interactive behavior. However, paternal anxiety and stress in the NICU was associated with less warm and responsive behavior towards the infant both in the NICU and at 3 months. Paternal contingent responsivity, warmth, and ability to read the infant's cues sensitively and appropriately at 3 months, were all associated with fewer internalizing problems in their children at 24 months (r's = -.25, -.43, and -.29, p< .05), and with better Mental Development Index scores (r = .38, p< .05 with warmth, and r = .29, p < .05 with positive physical contact). Infants who at 3 months were observed in interaction with their fathers to be fussy and difficult to soothe, had lower Mental Development Index scores at 24 months (r = -.29, p < .05), and were rated by their mothers as more anxious (r = -.36, p < .01) and withdrawn (r = -.34, p < .05).

**Conclusion:** At-risk father-infant dyads can be identified in the NICU, and offered preventive intervention so that fathers may interact more sensitively and responsively with their infants. This may promote the cognitive and social development of these vulnerable children.

Fr2-53

## Mother-Toddler Mutual Regulatory Processes, Child Gender, and General Cognitive Functioning in a Healthy Term African American Sample at 18 Months

**Marjorie Beeghly**[1,2,3] Karen Olson[1,2] Edward Tronick[1,2,4] Elizabeth Bronkoski[2,5] Laura Rose[2,5] Nicole Rodier[2]

*1. Harvard Medical School, Boston, USA; 2. Children's Hospital, Boston, USA; 3. Wayne State University, Detroit, USA; 4. University of Massachusetts, Boston, USA; 5. Boston College, Boston, USA*

**Background and Aims:** Prior work in mostly White middle-class samples suggests that mother-child mutual regulatory (MR) processes (i.e., level of contingent responsivity, positive affect sharing) during social interaction are foundational to children's general cognitive outcomes. The purpose of this analysis was to replicate this association in an understudied single-racial sample of African American mothers from heterogeneous socioeconomic (SES) backgrounds and their full-term healthy toddlers. Specifically, we evaluated whether MR processes observed during two contrasting interactive tasks (free play and teaching) at 18 months were significant predictors of children's concurrent Bayley Mental Developmental Index (MDI) scores after controlling for child gender, HOME inventory score, and SES.

**Methods:** Analyses were based on longitudinal data collected for 164 African American mother-toddler dyads (50.6% girls, M maternal age = 29.6, SD = 5.5 years; M maternal education = 14.5, SD = 2.3 years; mean Hollingshead SES = 43.7, SD = 11.5) participating in a larger study in which dyads were followed from birth to the preschool period. MR was defined as the level of contingent responsivity and positive affect sharing exhibited by the mother-toddler dyad during two successive interactive tasks (free play and teaching) at the 18-month visit, and was scored from videotapes by reliable coders using 7-point likert ratings. To evaluate level of SES risk, a composite variable was constructed combining Hollingshead SES, income-needs ratio, maternal age, and maternal satisfaction with the adequacy of income ($\alpha$ = 0.73). The quality of the child's proximal caregiving environment was evaluated using the HOME inventory during a 12-month home visit.

**Results:** MR variables in the free play and teaching contexts were significantly correlated (r = 0.48, p < 0.0001) and were averaged for analytic purposes. In bivariate analyses, MR was correlated with 18-month Bayley MDI (r = 0.394, p < 0.0001) and 12-month HOME score (r = 0.265, p< 0.006). MDI was also correlated with 12-month HOME score (r = 0.23, p <0.003) and SES risk (r = -0.18, p < 0.05). A multivariate linear regression was carried out to evaluate whether MR continued to predict Bayley MDI when child gender, SES risk, and HOME Inventory score were included in the model. Results confirmed that MR (p < 0.0001) and gender (p < 0.01) but not SES risk (p < 0.148) or HOME score (p = 0.156) were significant predictors of 18-month MDI (model $R^2$ = 0.214. p < 0.001).

**Conclusion:** In this sample of African American mother-toddler dyads from heterogeneous SES backgrounds, MR processes during social interaction at 18 months and female gender were significantly linked to higher Bayley MDI scores, after controlling for HOME Inventory score and SES. Results are consistent with previous findings in mostly White middle class samples and highlight the importance of mother-child MR processes in children's early cognitive development.

**Fr2-54**

## The Role of Causal and Intentional Structure of a Perceived Action in Early Moral and Social Judgements

**Marine Buon**, Emmanuel Dupoux

*Laboratoire de Sciences cognitives et de Psycholinguistqiue, Paris, France*

Recent investigations into the psychological bases of moral judgments have put a lot of emphasis on intuitive/emotional automatic processes as opposed to elaborate reasoning and explicit representations. Haidt demonstrated indeed, that in adults, reasonning may be unecessary to judge whether an action is moral or not (Haidt, 2001). However, the processes underlying moral intuitions have mostly been studied in adults: Some authors have emphasized the role of emotion processing in the emergence of moral intuitions (Greene, 2001,2004). Others have claimed that causal analysis of an action's structure would be fundamental (Hauser, 2006 ; Mikhail, in press).

The aim of this study was to investigate whether early moral judgements in infants and toddlers depend on the causal structure of the perceived action. In this purpose, we designed animated cartoons containing agents and victims: in a first cartoon, one agent intentionaly harm the victim (intentional condition). In a second cartoon, another agent makes an action which is not causally linked to the victim's suffering (coincidental condition). Only the structure of the agent's action differed between the two situations. Suffering of the victim as displayed by distress cues was exactly the same in the two cartoons.

We investigated 10 and 30 month old children's preference for the agents depending on which action the agent performed. In the first experiment, 32 30-months-old children responded to verbal questionnaires regarding their social and moral judgments of the agents. Results showed that 30-month-olds preferred the agent in the coincidental rather than in the intentional condition.

In the second experiment, we asked 32 10-month-old infants to give an implicit social judgment in a forced choice task: At the end of the cartoon, both agents gave an identical toy to the baby, and we measured the spontaneous preference for the toys as a function of the status of the agent. This forced choice procedure was repeated 5 times. Results indicated that babies made significantly more choices toward the agents whose act did not cause the suffering of a victim.

These experiments indicate that the causal and intentional structure of an agent's action is crucial in early social and moral judgements. These results fit others results showing early complex socio-cognitive capacities (Tomasello,2005 ; Csibra, 2003). Our paradigm allows us to test whether these capacities are effective in the early emergence of moral intuitions.

**Fr2-55**

## Why is Her Hand Doing That? 9-Month-Olds Use of Action-Effects to Infer a Goal

**Erin Cannon**, Amanda Woodward

*University of Maryland, College Park, USA*

**Background:** It has been claimed that infants interpret unfamiliar actions as goal-directed when given proper behavioral cues, such as action-effects, in studies involving either human agents (e.g., Kiraly et al., 2003) or artifacts as agents (e.g., Biro and Leslie, 2007). These studies involve a methodological confound: an action-effect present during both the habituation and test phase, leaving room for alternative explanations. We tested 32 nine-month-olds in Woodward's (2003) paradigm, adding a behavioral cue to an unfamiliar action to investigate if infants could interpret it as goal-directed.

**Method:** In Study 1 infants were habituated to a person who sat in front of two objects and reached towards one specific object each trial. The presenter either grasped the object, or touched it with the back of her hand (BoH). At test, object placement was reversed, and the presenter alternated her reach to the objects across 6 test trials. Based on previous work (Woodward, 1999, 2003), it was predicted infants would look longer to new goal trials than old goal trials in the grasp condition, but not the BoH condition, because the former was the familiar gesture.

In Study 2 an action-effect was added to the habituation phase only. The presenter reached toward one object with the unfamiliar BoH gesture and pulled the object towards her. At test, the presenter alternated her reach using the unfamiliar gesture, but did not pull. A static BoH condition as described in Study 1 served as the control.

**Results:** In Study 1 infants looked longer to new goal trials than old goal trials in the Grasp condition ($p < .05$), but not in the BoH condition, confirming the hypothesis that a grasp is viewed as an object-directed action, but an unfamiliar hand gesture (BoH) is not.

In Study 2, again the BoH gesture was not viewed as object-directed. However, in the Action condition, the action-effect during habituation led infants to view the BoH gesture as object-directed, with longer looking to new goal than old goal trials $p < .05$.

**Conclusion:** Preliminary results indicate that an action-effect may enhance an infant's ability to view an unfamiliar action as goal-directed by nine months. We argue the current methodology makes a stronger claim for such a case.

**Fr2-56**

## Maternal Behaviors in a Teaching Context with Infants of 9 Months Old

**Yi-chieh Chen**, Keng-ling Lay, Su-ying Huang

*National Taiwan University, Taipei, Taiwan*

Recent studies have documented the determinants of maternal affect and involvement while facing the schoolwork of children in preschool and school age ( e.g., Pomerantz et al., 2005 ). However, few have studied maternal behaviors in learning contexts for babies ( e.g., Kelley et al., 2000 ). This study attempts to investigate maternal teaching behaviors toward their 9-month-old infants in tasks with different level of difficulty and its relation with maternal belief about achievement, and infant temperament.

A total of 40 mother-infant dyads are expected to complete the following three 3-minute teaching sessions. Currently, nine mothers and their babies ( mean age = 9m/15d ) have participated in the study. In the first two teaching sessions, two weeks apart, each mother teaches her baby to complete an age-appropriate task ( TaskS ); while the third session, administered at the same day of the second session, is a more difficult task ( TaskD ). Data of maternal belief about achievement and infant temperament ( IBQ-R ) were also collected. Twelve categories of maternal behaviors were coded by time sampling with 10-second-interval, namely, (1) autonomy support, (2) active response, (3) hold back, (4) encouragement, (5) positive feedback, (6) positive affect, (7) control, (8) directives, (9) negative feedback, (10) corrective feedback, (11) negative affect, and (12) demonstration. In addition, maternal degree of task-centered versus child-centered engagement is rated for each session by a 5-point Likert scale. The mean inter-observer reliability is .79.

Preliminary analyses revealed no differences on all maternal behaviors between the two sessions of TaskS. Thus, data of the two TaskS sessions were combined for subsequent analyses. Thirteen t-tests between TaskS and TaskD revealed that mothers apply more autonomy support ( t = -2.54 , p < .05 ) and are more child-centered ( t = 2.48 , p < .05 ) in TaskD. Pearson correlations between the observed maternal behaviors and maternal beliefs of achievement suggested that mothers with stronger tendency of learning goal apply less negative feedback to her baby ( r = -.71 , p < .05 ). Besides, maternal autonomy support positively correlates with the temperament dimensions of activity level ( r = .69 , p < .05 ), low pleasure ( r = .69 , p < .05 ), and vocal reactivity ( r = .74 , p < .05 ); maternal positive feedback positively correlates with activity level ( r = .77 , p < .02 ) and sadness ( r = .86 , p < .01 ); maternal positive affect positively correlates with smiling and laughter ( r = .68 , p < .05 ). Maternal directives positively correlates with infant temperament of falling reactivity ( r = .85 , p < .01 ) and cuddliness ( r = .74 , p < .05 ), while negatively correlates with activity level ( r = -.77 , p < .02 ) and approach ( r = -.72 , p < .05 ). Maternal corrective feedback negatively correlates with soothability ( r = -.77 , p < .02). In conclusion, current data suggested that mothers of 9-month-olds infant would adjust their behaviors to support their baby's problem-solving endeavors. They behave more responsively when the baby is active, happy ,sad, or reactive to low stimulus intensity. On the other hand, they apply more directives and demand while the baby is non-active and easy-going.

**Fr2-57**

## The Relationship Between Temperament and Effortful Control: the Moderating Influence of Maternal Behavior and Affect

**Elizabeth Cipriano**, Cynthia Stifter
*Pennsylvania State University, University Park, USA*

Research has demonstrated a linkage between behavioral inhibition in toddlerhood and effortful control in the preschool years (Aksan & Kochanska, 2004). Children's temperamental propensities influence their behavior; however, children's expression of temperament is modifiable by interactions with the environment, such as parenting behaviors. To date, no studies have assessed parents' behaviors and the emotional tone they used in a context that gives them the opportunity to engage in temperament-specific parenting (e.g., to encourage exploration in inhibited children, redirect exuberant children away from situations that are off-limits). The goal of this study was to investigate the relationship between temperamental inhibition and later effortful control and how maternal behavior and affect moderate this relationship.

Parents and children came to the laboratory and participated in a series of tasks at 24/25 months and at 4.5 years. At 24/25 months, toddlers participated in several procedures to assess approach/inhibition, positive affect, and negative affect, and three temperament groups were formed: exuberant, inhibited, and low reactive (Putnam & Stifter, 2005). At 24 months, parent behaviors were assessed in a task where mothers were instructed to fill out a questionnaire while their toddlers were given five uninteresting toys to play with. The affective tone and presence and absence of parent behaviors were coded in 5 second intervals. This resulted in five behaviors: positive redirection/reason, neutral redirection/reason, positive command/prohibitive, neutral command/prohibitive, and ignoring (no affective tone was coded for this behavior). Children's effortful control was measured observationally and from parental report at 4.5 years.

Results revealed a main effect for neutral redirection/reason in predicting observed effortful control, B = -307. 71, p < .05. Mothers who used more neutral redirection/reason with their toddlers had children who displayed less observed effortful control, regardless of their temperament. Additionally, a significant main effect was revealed for positive redirection/reason in predicting parent-reported effortful control, B = .882, p < .05. Mothers who used more positive redirection/reason with their toddlers was related to greater child effortful control at 4.5 years. Finally, a temperament X positive command/prohibitive interaction was revealed in predicting parent-reported effortful control. Mothers who used more positive command/prohibitives with their exuberant toddlers was related to more parent-reported effortful control in their children two years later (B = 1.53, p < .05). Results from this study indicate that maternal behavior and affect can impact children's effortful control development and this relationship can be further influenced by children's temperament.

**Fr2-58**

## Coparenting Adjustment is Linked to 3-Month-Olds Eye Gaze Patterns during Still-Face

Matthew Daley, **Janet Robertson**, Elisabeth Fivaz-Depeursinge, James McHale
*University of South Florida, St. Petersburg, USA*

In 2005, Fivaz and colleagues reported on a remarkable, early emerging capacity of 3-4 month old infants that they called "triangular capacity". It refers to the babies' propensity to make multiple rapid eye gaze transitions between mothers and fathers during face-to-face interaction. This capacity was documented as parents played together during the en face Lausanne Trilogue Play. In 2006, we replicated this finding with an independent sample, linking gaze patterns during the LTP to concurrently assessed coparenting solidarity. Unclear from these analyses is whether these early emerging capacities are phenomena only of the LTP paradigm in which they are elicited, or whether they capture a broader socially embedded capacity transcending the assessment paradigm itself.

This report examines whether infant gaze patterns during a different stressful paradigm (Tronick's StillFace) can likewise be linked to quality of coparenting in the family at 3 months. 94 infants participated with their mothers and fathers. The standard StillFace procedure was used, but with both parents rather than just one playing with the infant, posing a still face, and then reengaging with the baby. Substantial distress (quantified, following Ham & Tronick, 2006, as protest enduring for at least 25% of the StillFace and/or reunion segments) was shown by 25% of the infants. Trained coders assessed number of rapid (< 3 second) multi-step (e.g. mother-to-father-back to mother) gaze transitions infants showed during the procedure (M = 2.53, SD = 4.03, range = 0 - 22).

We also completed multi-method assessments of coparenting cohesion and coparenting conflict at 3 months. These included a "Who Does What" discussion and attempt to resolve differences in perspective while tending the baby (Elliston et al., 2006); a recounting of the day the baby was born (a co-constructed birth narrative; Dickstein et al., 2000); and coparenting during LTP and StillFace assessments. Couples also independently completed Abidin and Brunner's Parenting Alliance Measure (PAM; higher scores signifying greater "felt" parenting support from the partner). For each observational assessment, independent teams of blind, trained coders evaluated coparental competitiveness, disputatiousness, cooperation, and warmth. Inter-rater reliabilities for all variables were within acceptable bounds (ICCs of .71 to .89). All competition and disputatiousness scores were

standardized and summed to create an overall conflict score (alpha = .71; range = -.84 to 5.23, SD = .65). Warmth and cooperation scores were handled the same way and added to the standardized PAM total score to create an overall cohesion score (alpha = .73; range = -1.69 to 4.63, SD = .71).

Analyses revealed no mean level differences in either StillFace coparenting behavior or infant gaze patterns for low distress babies and babies who became upset, or for babies who recovered and babies who did not. Regression analyses indicated that multiple rapid gaze transitions in the StillFace were significantly associated with the overall composite index of coparental cohesion in the family, but not the overall coparental conflict composite. Study limitations and theoretical considerations will be discussed.

**Fr2-59**

### Toddler's Expectations of Responsiveness: Attention-Seeking Patterns Distinguish Social Mastery and Dependency

**Marie-pierre Gosselin**, Amanda Aldercotte, David Forman

*Concordia University, Montreal, Canada*

In the literatures on social mastery, attachment, and reciprocity, a theoretical role is posited for children's expectations of parent responsiveness. Despite this, operational difficulties cause them rarely to be researched. We believe different expectations of parent responsiveness can be measured by assessing the quality of child attention-seeking when the parent is rendered temporarily unresponsive. Affectively negative bids reflect dependency- anxiety or resentment grounded in low confidence in the parent's response, while persistent, positive bids reflect social mastery-a desire to interact based on positive expectations of response (Cassidy & Berlin, 1994; Combs & Wachs, 1995).

Caregivers and toddlers ($N$ = 109, $M$ age = 26.4 months) visited our lab. For eleven minutes, parents were occupied with a questionnaire, and five qualities of toddlers' attention-seeking were rated in 1-minute intervals (reliability alphas ranged from .87 to .95). Raters also globally classified the child's motivation as Object Oriented, Social Mastery, Dependent, or Passive/Disengaged. A separate team coded nine behaviors at 5-second intervals to measure the quantity of child attention seeking (alphas = .81 to .98). Finally, children's eagerness to learn from the caregiver during imitation and block-building tasks were rated (alphas = .79 to .82).

Latent Class Analysis (LCA) was used to identify patterns of attention seeking. Four groups emerged. One (60 children), which we labeled LCA-Low Social, was low in nearly all attention-seeking behaviors, low in persistence and intensity, but affectively relatively positive. Group Two (17 children), labeled LCA-Social Mastery, was very high in all attention seeking behaviors, high in positive affect and confidence, and low in negative affect. Group Three (23 children), called LCA-Dependent, was negative in affect and moderate in the quantity of attention-seeking behavior. Finally, a Highly Dependent group (7 children) was very high in attention seeking quantity, very high in negative affect, and very low in positive affect and confidence.

The face validity of the LCA-derived groups was tested through comparisons with the global classifications. A significant chi-square statistic showed the correspondence of these classifications across latent groups was not random ($X^2$ = 82.92, $p$ < .001). Specific category matches were consistent with theoretical predictions. External validity was also confirmed, as eagerness to learn was higher in the social mastery group than in the dependent groups. Overall, results show this paradigm effectively distinguishes motivational styles in toddlers, believed to reflect expectations of parent responsiveness, with potential to move research forward on several fronts.

**Fr2-60**

### Unwilling or Unable Play Partner: 2-Year-Olds' Understanding of Their Partner's Reason for Interrupting a Social Game

**Maria Graefenhain**[1,2] Felix Warneken[1] Michael Tomasello[1]

*1. Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany; 2. University of Leipzig, Germany, Leipzig, Germany*

**Background and Aims:** Previous studies have shown that young children engage in joint cooperative activities with others. Moreover, they even try to reengage their partner when he suddenly interrupts their joint activity (e.g., Warneken, Chen, & Tomasello, 2006). However, in these studies the partner's reason for interrupting the activity was not made explicit. It is thus not clear whether children responded merely to the behavioral outcome of the partner (i.e., the termination of the joint activity) or the partner's prior intentions leading to it. The current study aims at investigating this question in varying the partner's intentions to interrupt the joint activity while keeping the behavioral outcome equal.

**Methods:** Twenty-four 2-year-old children participated in the study (mean age = 27 months). An experimenter engaged the child in a social game, which both played together for a fixed amount of time. The experimenter then interrupted her play for one of two different reasons: She either expressed to be unwilling to continue to play (e.g., by shaking her head saying "no") or she expressed to be unable (e.g., by acting clumsily). Each child participated in four games, two games in the unwilling and two in the unable condition. In each game, children witnessed four interruption trials. We assess whether children respond differently to the two conditions, with a particular focus on their communicative attempts towards the partner.

**Results:** Data collection and coding is still in progress but pilot results showed that children tended to protest or to disengage from the game more frequently in the unwilling than in the unable condition. In contrast, children tended to help the experimenter or to teach her how to play the game more frequently when she seemed unable than when she seemed unwilling to play.

**Conclusion:** This study will enable us to determine whether children discriminate the different intentions that had led their partner to interrupt their joint play. This contributes to a better understanding of young children's monitoring and sharing of their partner's intentions when engaging in joint cooperative activities.

**Fr2-61**

### Infant Behaviors in Problem Solving Contexts:Does Social Resourcefulness Matter?

**Su-ying Huang**, Keng-ling Lay, Yi-chieh Chen

*Department of Psychology, National Taiwan University, Taipei, Taiwan*

This study is to understand the contribution of different facets of infant endeavors to a problem solving task and the correlation between these behaviors and temperament. According to the self-determination theory (Deci & Ryan, 1987), problem-solving behaviors are affected not only by intrinsic motivation but also by significant others in social contexts. However, prior empirical research has rarely touched the issue of babies' utilizing their human resources as a means for problem solving. This study specifically includes social resourcefulness

and social dependency as part of infant endeavors and examines their contribution to infants' problem-solving outcomes.

Twenty 9-month-olds (range=8m18d~9m14d ), half boys and half girls, and their mothers participated in an 8-minute laboratory play session, including 3 minutes of task demonstration followed by passive interaction performed by the experimenter, 2 minutes of maternal passive interaction, and 3 minutes of maternal teaching interaction. During sessions of passive interaction, the experimenter and the mother sat beside the baby busying with paper work. During the teaching interaction, mothers were free to use any method to help her child learn to reach for a squeaky toy in a box. Coding schemes of 18 seven-point items for baby's Resourcefulness, Persistence/Reengagement , Social Dependency, Positive and Negative Emotion were developed (range of Cronbach α's =0.55~0.89). The mean inter-observer reliability was .74. Babies' developmental status was measured by Mullen Scales of Early Learning (AGS Edition) and data of their temperament (IBQ-R) were collected through mothers.

Among the five coding dimensions, only the correlation between Persistence/Reengagement and Social Dependency was significant ($r = -.70$, $p < .01$). Between-gender comparison revealed that baby boys display significantly more negative emotions than baby girls, $t18 = 2.51$, $p < .05$. The infant temperament dimension "fear" was negatively correlated with Persistence/Reengagement ($r = -.44$, $p < .05$); the dimension of "falling reactivity/rate of recovery from distress" correlated positively with Resourcefulness ($r = .46$, $p < .05$). Stepwise regression analysis with task outcome as the criterion variable indicated that, after controlling for Mullen score, only Persistence/Reengagement significantly predicted task success (Standardized β=.59).

This study replicated prior findings of gender difference in infant emotions. This study also found resourceful babies are easier in calming down from distress. Among the five facets of infant endeavors, persistence, which is more of a behavior displayed by non-fearful babies, is most important in predicting task success.

**Fr2-62**

## Maternal Depressive and Anxious Feelings, Accuracy in Predicting Their Toddlers' Inhibited Behavior, and Parenting Practices

**Elizabeth Kiel**[1] Kristin Buss[2]

*1. University of Missouri-Columbia, Columbia, USA; 2. The Pennsylvania State University, University Park, USA*

Maternal depressive and anxious feelings have been linked to more negative reports of children's temperaments (e.g., Lang et al., 1996; Hocevar, et al., 1996) and decreased concordance between maternal report and observation of temperament (Leerkes & Crockenberg, 2003), although some have found no relation (Wolk et al., 1992) or argued that reporting bias actually occurs in non-symptomatic mothers (Kendziora & O'Leary, 1998). An existing limitation of this research is the difference in the contexts on which mothers report and those used in the laboratory. Given this, the current study investigates how symptoms relate to mothers' accuracy in anticipating their toddlers' reactions to laboratory tasks and whether maternal symptoms relate to accuracy differently than to maternal report of inhibited temperament. Maternal internalizing symptoms and perceptions have been linked to non-optimal parenting behaviors (e.g., Belsky & Jaffee, 2006; Dadds & Roth, 2001), so the current study examines how symptoms, report of temperament, and accuracy relate to perceived and observed parenting.

Seventy (expected n = 100) 24-month-old toddlers and their mothers participated in questionnaire completion and a laboratory visit. At the visit, mothers were asked to predict how their children would react to wariness-eliciting episodes, which will be scored for toddler behaviors corresponding to predictions. Accuracy will be calculated as the statistical relation between predictions and behaviors. Episodes will be scored for parenting behavior. Mothers completed the Toddler Behavior Assessment Questionnaire (TBAQ; Goldsmith, 1996), Parenting Practices Questionnaire (PPQ; Robinson et al., 1995), Center for Epidemiological Studies Depression Scale (CES-D; Radloff, 1977), Penn State Worry Questionnaire (PSWQ: Meyer et al., 1990) Generalized Anxiety Disorder Questionnaire - IV (GADQ-IV; Newman et al., 2002), and Social Interaction Anxiety Scale (Mattick & Clarke, 1998).

Initial multilevel analyses suggested that mothers who reported feeling more worry (PSWQ) predicted more distress for their toddlers in the laboratory episodes ($b = .12$, $t = 2.95$, $p < .01$). Further analyses will investigate how maternal symptoms relate to the accuracy of these predictions. Bivariate correlations suggested that mothers who reported more depressive feelings (CES-D) were more Authoritarian ($r = .29$, $p < .05$) or Permissive ($r = .25$, $p < .05$) in their parenting. Mothers who reported more worry (GADQ-IV) reported more Permissive parenting ($r = .29$, $p < .05$). Further analyses will examine how perceptions of inhibited temperament (TBAQ) and accuracy additionally contribute to observed and perceived parenting behavior.

**Fr2-63**

## Individual Differences in Maternal Contingent Responsiveness and Infant Social Expectations

**Nancy Mcquaid**, Maximilian Bibok, Jeremy Carpendale

*Simon Fraser University, Burnaby, Canada*

**Background and Aims:** Individual differences in infant social expectations have been shown to be related to the quality of the caregiver-infant relationship. The Still Face procedure, in which the mother suddenly becomes unresponsive following a period of interacting with her infant as she normally would, provides a striking illustration of young infants' social expectations. Although the Still Face effect, which refers to infants' initial attempts to reengage their mother followed by decreased positive affect and gaze aversion, is well-documented, few researchers have examined individual differences in infant social expectation behaviour during the Still Face phase. The present study investigated the relationship between young infants' social expectations and their mother's form of interaction with them, specifically whether level of maternal contingent responsiveness during the initial interactive phase of a Still Face procedure predicted infant social expectation behaviour during the Still Face phase.

**Method:** Sixty-one 4- and 5- month-old infants (35 girls and 26 boys) and their mothers participated in a Still Face procedure in which the mothers were instructed to interact with their infants for 2 minutes (Interactive phase), and then be still-faced for 1 minute (Still Face phase), then interact again for 2 minutes. Mother and infant behaviour was assessed for the frequency of infant and mother social smiles (i.e., smiles while looking to partner), mother social smiles that were contingent to infant social smiles during the Interactive phase, and infant social bids to mother during the Still Face phase.

**Results:** Hierarchical regression showed that mother contingent social smiles during the Interactive phase accounted for unique variance (11%) in infant social bids during the Still Face phase beyond that accounted for by the frequency of mother and infant smiles during the Interactive phase, $F(1,55) = 8.98$, $p = .004$.

**Conclusion:** The results of this study support the view that individual differences in how mothers respond to their infants in face-to-face interaction are related to young infants' developing social knowledge, including expectations about how their caregivers respond to them and their sense of effectiveness in eliciting caregiver responses.

**Fr2-64**

### A Sociocultural Approach to Preschoolers Dreams Content

**Adrian Medina-Liberty**

*Facultad de Psicologia, Universidad Nacional Autonoma de Mexico, Mexico City, Mexico*

**Background and Aims:** Although in general, children's dreams have received a minimum attention in psychological meetings and journals, a growing number of researchers are devoting systematic attention to them (Foulkes, 1999, Domhoff, 2003). This paper precisely presents preliminary data about the type and frequency of topics dreamt about by preschool children. The main goal was to illustrate how the cultural milieu and specific social activities children are involved in (rather than only a subjective or cognitive individual states) are primordial determinants of how dream content is constituted.

**Method:** Data were collected from 21 middle class children (ages 3 to 7; seven boys and five girls). During four months 75 dreams were collected once a week by the parents and/or by the researcher using a mini tape recorder. Direct observations and in-depth interviews were conducted to gather information about children's typical day, family and school activities, favorite films and TV shows, etcetera. An analytical model based on Kenneth Burke's approach (Burke, 1989) was applied to explore the narrative nature of dreams. Specifically, Burke's Pentad (Act, Scene, Agent, Agency, and Purpose) was applied to examine and interpret children's dreams. Each dream was analyzed trying to answer five main questions: What actions were accomplished? What were the scenarios in which they occurred? Who performed the actions? How were they done? Why were they done?

Focus of inquiry was dream content and its possible cultural source.

**Results:** Data confirmed previous studies (Medina-Liberty, 2005, 2006) that showed that several culture expressions-notably Media, school, and family-were appropriated by children and constituted importantly their dreams content. In children's dreams these cultural elements were combined in novel ways and produced original meanings.

It is concluded that Burke's Pentad can be a powerful tool for analyzing dream content and exploring its cultural sources.

**Fr2-65**

### Developmental Trajectory of Early Social Cognition: Suggestions From Longitudinal Survey From 8 Months to 7 Years of Age

Hidehiro Ohgami, Wakako Sanefuji, Atsuhiko Funabashi

*Kyushu University, Fukuoka, Japan*

**Background and Aims:** Developmental trajectory of the same sample from joint attention (JA) to later social cognition including language has not been revealed yet, although JA is suggested to play an important role in the subsequent development. The present study aimed at investigating (1) the typical developmental trajectory of social communication from 8 months to 7 years of age and (2) the influence of lack of JA on the subsequent social-cognitive development using the data of the individual differences of the developmental outcome of 10 children with Pervasive Developmental Disorders (PDD).

**Methods:** Participants were 1702 infants and their caretakers. Their communicative development was longitudinally assessed at 8, 10, 12, 14, 16, 18 months, 3, 5, and 7 years of age by questionnaires composed of items of JA, motor skill, peer relation, social affect and language. Item Response Theory (IRT) was applied to the analysis of the typical/atypical developmental trajectory of social cognition. The developmental characteristics at 18 months commonly shown by children who had medical diagnosis of PDD later were retrospectively analyzed, in order to identify the early signs of PDD.

**KeyResults:** The results of IRT showed that our questionnaires were available in assessing social cognitive development from infancy to entering into elementary school. The developmental characteristics at 18 months of 10 children with PDD were (1) -1SD or less JA scores, (2) lack of declarative pointing, responsive pointing and response to distress, and (3) lack of denomination of the picture in a book and spontaneously saying a few meaning words. The lack of JA till 7 years of age observed in 3 children with PDD produced serious developmental outcome of the subsequent development such as language and concept formation, compared to delayed emergence of JA observed in other children with PDD.

**Conclusions:** The present findings directly suggest the importance of JA for the subsequent development of social cognition. However, it remains question whether the diversity of developmental outcome of children with PDD is based on the atypical developmental course of the individuals or the effects of early intervention. Further investigation should be needed to clarify the underlying mechanism of early signs of PDD and effective intervention for children with PDD in early development.

**Fr2-66**

### Responses to "Like-Me" Characteristics in Toddlers With/Without Autism: Self, Like-Self, and Others

**Wakako Sanefuji**, Hidehiro Ohgami

*Kyushu University, Fukuoka, Japan*

**Background and Aims:** Typically developing (TD) infants detect relative values of similarity between self and other, which we presented at ICIS 2006. However, individuals with autism (ASD) do not seem to prefer similar features as themselves, because of low interests in others. The present study examined toddlers' responses to self/other (Exp. 1), responses to peer/adult (Exp. 2), and responses to adult's imitative/contingent behaviors (Exp. 3), for the comparison of the responses to "like-me" characteristics between TD and ASD.

**Methods:** Experiment 1: 16 TD toddlers (CA = 29.2 months, SD = 8.2) and 16 ASD toddlers (MA = 28.3 months, SD = 8.7) participated. The pairs of photographs of self and peer were presented twice, one at a time for 15 seconds. Looking times of the stimuli were measured. Experiment 2: The same participants in Exp. 1 participated. The pairs of photographs of peer and adult were presented twice, one at a time for 15 seconds. Looking times of the stimuli were measured. Experiment 3: 32 TD toddlers (CA = 27.4 months, SD = 7.4) and 32 ASD toddlers (MA = 27.9 months, SD = 8.7) participated. Participants were randomly assigned to imitation and contingency condition. Mothers were instructed to engage their child based on the still-face (SF) paradigm: free play 1, SF1, intervention (imitation/contingency), SF2, and free play 2. The duration of each toddler's gaze behavior toward the mother during the SF1, intervention, and SF2 phases was measured.

**Results:** Experiment 1: Toddlers, regardless of ASD, looked longer at the facial photograph of self as compared to those of peer (F (1, 30) =

96.32, p < .0001). Experiment 2: TD toddlers looked longer at the facial photographs of peer, as compared to those of adult (F (1, 30) = 78.06, p < .0001). The facial photographs of peer were looked at longer by TD toddlers than by ASD toddlers (F (1, 60) = 20.34, p < .0001). Experiment 3: During intervention and SF2, both conditions of TD toddlers and imitation condition of ASD toddlers looked at their mothers for a longer duration than contingency condition of ASD toddlers (F (2, 120) = 3.09, p = .04).

**Conclusions:** These results suggested that sensitivity to "like-me" characteristics were different between TD toddlers and ASD toddlers, although both of them showed their looking preference for self. The possible method of early intervention as well as understanding others as "like-me" beings in ASD toddlers should be discussed.

**Fr2-67**

### Testing the wear-cam. A new tool for Infant Social Studies

**Clara Schmitow**[1] Gunilla Stenberg[1] Claes von Hofsten[1] **Helena Grönqvist**[2]

*1. Uppsala University, Uppsala, Sweden; 2. Uppsala University, Department of Psychology, Uppsala, Sweden*

By attaching a small camera to the forehead of an infant, one can see the outside world from the perspective of the wearer. As long as the child moves the head when shifting gaze, the camera will correctly reflect what the child sees. The advantage of this device is that it can be applied to everyday situations where the infant moves around and acts freely.

The purpose of the present study was to estimate how well such a wear-cam measures gaze direction. We did this by measuring how an eccentric fixation target was displaced on the projection plane relative to where it would be projected when the infant looked straight ahead. By measuring the displacement at different horizontal and vertical eccentricities, we could estimate how head direction and gaze direction differs for different parts of the visual field.

Forty 6 and 12-month-old infants were studied. The vertical displacements of the fixation target were +50, +40, +30, +20, 0, -20, -30, -40, and -48 degrees of visual angle and the horizontal displacements were 0, 20, 30, 40, 50 degrees to the right and left.

The results show that the head turns less than the eyes when looking at a peripheral target and that this tendency increases with the eccentricity of the fixation target. The tendency is more substantial in the vertical than in the horizontal dimension.

**In Conclusion:** The wear-camera seems to be a promising method for the future. The results provide some guidance in the design of future experiments in the field of Social Development.

**Fr2-68**

### Gender Salience as a Predictor of Early Gender Knowledge

**Maya Sen**[1] Amanda Rosenburg[2] Erin Fettes[1] Megan Johnson[1] Colette Dixon[1] Megan Salvano[1] Craig Winkowski[1]

*1. Psychology Dept, Northern Michigan University, Marquette, USA; 2. Teachers College, Columbia University, New York, USA*

**Background and Aims:** Very young children's understanding of gender emerges between 24 and 36 months. Previous research has produced conflicting results; some studies find evidence of gender knowledge (identity and stereotypes), others find none (see Martin, Ruble, & Szkrybalo, 2002). Inconsistent findings may indicate that individual differences exist in gender knowledge acquisition. Children vary in the degree of importance and amount of attention they give to gender. These individual differences in *gender salience* are related to differences in older (preschool-age) children's levels of gender knowledge (e.g., Levy & Carter, 1989). This study examines the relationship among gender stereotype knowledge (GSK), gender identity (GI), and gender salience (GS) in 24- to 30-month-olds.<p>

**Method:** GI Task: Children sorted themselves through one of two child-size doors, one with female pictures, one with male pictures. Each trial was coded as "hit" or "miss." GSK Task: Sequential touching - each child was presented with 8 toys (4 feminine, e.g., teapot, helicopter). Order and items touched were coded. GS Task: Children were shown pictures of toys on a touchscreen and asked to touch the one they wanted. Trials were one of three types, F/F, M/M, or F/M. Reaction time was recorded in milliseconds. Two groups of 27-month-olds (24-30 months) participated: 27 children (12 girls) performed the GI/GS tasks; 40 children (17 girls) performed the GSK and GS tasks. Final N = 48 children per group.<p>

**Results:** Preliminary data comparing GI and GS were analyzed; GSK/GS data will be analyzed soon. We found trends towards GS differences for children with high vs. low GI scores. Girls and boys showed different patterns. Girls with high GI scores chose more slowly on F/M trials (r[10] = 0.500, p = 0.098), and more quickly on M/M trials (r[10] = -0.576, p = 0.05). Boys with high GI scores took chose more slowly on M/M trials (r[13] = 0.433, p = 0.107), and chose more quickly on F/F trials (r[13] = -0.412, p = 0.127). This is the opposite of what we expected - in previous research, choosing between an F/M pair should was easier for older children with high GS than choosing between F/F or M/M pairs (e.g., Levy & Carter, 1989). However, it is possible that when younger children are faced with two toys they do not want, they choose more quickly in order to move on to the next set. Implications for gender schema theory will be discussed.

**Fr2-69**

### Social Cognition in Everyday Life: A Longitudinal Study from 5 through 36 Months

**Joan Test**

*Missouri State University, Springfield, USA*

Early social cognition has been well studied in laboratory settings (Carpenter, Nagell, & Tomasello, 1998), but how do children use their social understanding and social thinking in daily life? This study looks at infants' and toddlers' social cognitive behaviors-those behaviors that show evidence of social understanding or cognitive processing-in daily interactions with peers and teachers in child care in order to understand how very young children build up or develop their social cognitive abilities during daily social interactions. Such an understanding can contribute to our knowledge of how, and through what processes or mechanisms, social cognition develops in the early years.

Sixteen infants and toddlers (8 male) were followed over eight months. Children were videotaped for 45 minutes in everyday situations at their child care center. Children were taped initially and 6 weeks later (10 children) and/or 7 or 8 months later (10 children). This sampling pattern resulted in a partial cross-sectional, longitudinal design. Mean age at initial taping was 20 months (range 5-33 months), 6 weeks later was 22.5 months (7-35 months), and 8 months later 26 months (17-40 months).

An inventory of social cognitive behaviors across all tapes was made. Durations and frequencies of each social cognitive behavior for each child at each age point were calculated. Differences from time 1 to

time 2 were calculated to look at changes over time. Correlations between frequencies at time 1 and time 2 looked at relatedness over time.

Of the 25 social cognitive behaviors identified, 14 showed correlations over 6 weeks, and four showed correlations over 8 months. These four behaviors (follows point, references peer, joint visual attention, joint touch) also changed significantly in frequency of use over time, indicating that while social cognitive abilities change in how often they are used in everyday life, there is also a continuity in frequency of use by individual children over time. This continuity is more common over 6 weeks than over 8 months. In addition, frequencies of use of two social cognitive behaviors (eye contact, joint visual attention) were correlated each with more "advanced" social cognitive behaviors (approach another person and tune in to other's focus, respectively), indicating some continuity from earlier behaviors to later social cognitive behaviors. The continuity found here argues for the importance of children's early involvement in everyday situations that include social cognitive behaviors.

**Fr2-70**

## Maternal Sensitivity Over Time and Its Relationship to Infant-Mother Attachment

**Jennifer Vu**, Allison Fuligni

*University of California, Los Angeles, Los Angeles, USA*

**Background and Aims:** Central to attachment theory is the idea that a sensitive and appropriately responsive caregiver is of essential importance to the development of attachment security (Ainsworth, 1973). While during the infancy period, ratings of maternal sensitivity have been found to correlate with observer AQS scores (Pederson et al., 1990; Pederson & Moran, 1995), these studies have focused on a single time point rating of sensitivity. Little, also, is known about the patterns of maternal sensitivity longitudinally and their relation to infant-mother attachment.

**Methods:** 101 children were drawn from a larger study looking at cultural communities and parenting in Mexican-heritage families. All mothers self-identified as Mexican-heritage and average years of maternal education was 10 years (SD = 3.7). At 8, 14, 24, and 36 months, we assessed maternal behavior during home visits using the Maternal Behavior Q-Sort (MBQS; Pederson & Moran, 1995), which measures maternal sensitivity towards and interactive behavior with her child. At 36 months, observers also completed the Attachment Q-set (AQS; Waters, 1995) to measure mother-infant attachment security, and at 54 months, we assessed mother-child security using the Attachment Story Completion Task Q-sort (Miljkovitch, Pierrehumbert, Bretherton, & Halfon, 2004) to code story-stem narratives from the Attachment Story Completion Task (ASCT; Bretherton, Ridgeway, & Cassidy, 1990).

**Results:** Growth mixture modeling revealed three groups of mothers. Group A (n = 82) consisted of mothers who had relatively high stable MBQS scores across the four time points. Group B (n = 15) consisted of mothers whose MBQS scores were relatively low at 8 months, but increased across time. At 36 months, Group B's MBQS scores were similar to Group A's. Group C (n = 4) consisted of mothers whose MBQS scores at 8 months were similar to those of Group A's, but decreased over time. ANOVAs show no differences between Group A and Group B in terms of children's AQS scores at 36 months and child-mother attachment security at 54 months, but there are differences between those two groups and Group C on both measures of attachment.

**Conclusion:** Consistent with previous findings, observational measures of maternal sensitivity and attachment were found to correlate with one another (Pederson et al., 1990; Pederson & Moran, 1995); there was also a significant relationship between sensitivity and attachment (DeWolff & van IJzendoorn, 1997). Furthermore, our findings indicate that it is important to consider maternal sensitivity over time rather than at one time point in order to take into consideration the dynamic relationship between mother and child.

**Fr2-71**

## Effects of Maternal Mirroring on Infants' Response to the Still Face and Replay Tasks

Laura Walden, **Ann Bigelow**

*St. Francis Xavier University, Antigonish, Canada*

Maternal mirroring of infants' behavior is thought to facilitate infants' sense of self efficacy, i.e., their awareness that their behavior affects external changes. Yet few studies have examined this premise. Two procedures that examine infants' ability to notice changes in the effects of their behavior are the Still Face and Replay Tasks. The present study examined the effects of maternal mirroring on infants' responses to these tasks.

Four-month-old infants (N=38) and their mothers engaged in a Still Face Task and a Replay Task over closed circuit TV (order counterbalanced). In the Still Face Task, the mother became still and expressionless (still face phase) between two normal interaction phases (initial and reunion phases). In the Replay Task, after an initial interaction phase, the mother's behavior was played back to the infant (replay phase) and then normal interaction resumed (reunion phase). Infant behaviors were scored for attention, facial affect, and vocalizations across all phases of each task and for social bids (smiling or vocalizing while gazing at the mother) during the still face phase. Mothers' interactions were scored for mirroring behavior (salient, exaggerated imitation of infant behavior). Infants were grouped by those whose mothers did (N=13) and did not mirror their behavior.

In the Still Face Task, infants demonstrated the still face effect (reduced behavior in the still face phase compared to the initial and reunion phases) by attention and smiling. Infants with maternal mirroring showed more engagement with their mothers in attention and smiling across all three phases. Infants' frequency of social bids correlated with mothers' frequency of mirroring behavior. In the Replay Task, infants demonstrated smiling carryover effects (reduced smiling in the replay phase that was maintained in the reunion phase) if the Replay Task was presented second; if the Replay Task was presented first, infants with maternal mirroring showed the replay effect, including reengagement with smiling in the reunion phase. Infants with maternal mirroring maintained their attention to their mothers during the Replay Task regardless of the presentation order, whereas infants without maternal mirroring did not.

Maternal mirroring of infants' behavior facilitates infants' engagement with their mothers during the Still Face and Replay Tasks and enhances infants' ability to demonstrate the replay effect, suggesting maternal mirroring facilitates infants' sense of self efficacy. Four-month-olds demonstrate the still face effect more easily than the replay effect, even when the Still Face Task is presented over closed circuit TV.

**Fr2-72**

### Behavioral Problems Reported by Taiwanese Mothers of Children Ages 2 to 3

**Yen-tzu Wu**, Suh-fang Jeng, Wu-shiun Hsieh, Pau-chung Chen, Wei-j. Chen

*School and Graduate Institute of Physical Therapy, College of Medicine, National Taiwan University, Taipei, Taiwan*

**Background and Aims:** Although the Child Behavior Checklist for Age 11/2-5 (CBCL/11/2-5) has been widely used for child behavioral assessment in Western societies, its usefulness and psychometric features in Eastern populations remain unclear. The aims of this study were therefore to examine the internal consistency and factor structures of the CBCL/11/2-5 in Taiwanese children and to compare Taiwanese children's behavioral scores with those of the U.S. normative data.

**Methods:** The Hong-Kong version of the CBCL/11/2-5 was modified in some items to accommodate it to application in Taiwanese society. The scale consists of 100 items with each item scored on a 3-point scale and features seven behavioral syndromes: Emotionally Reactive, Anxious/Depressed, Somatic Complaints, Withdrawn, Sleep Problems, Attention Problems, and Aggressive Behavior. A total of 249 Taiwanese mothers of children ages 2 to 3 years participated in this study by rating their children's behavioral performance on the CBCL/11/2-5. Confirmatory factor analyses were performed using the Mplus program with categorical factor indicators.

**Results:** Alpha coefficient for individual behavioral syndromes ranged from 0.64 to 0.87, and that for the total problem scores was 0.94. Confirmatory factor analysis based on the seven-factor structure of behavioral syndromes revealed acceptable model fitting with estimation of the root mean square error of approximation of 0.05 and the comparative fit index of 0.925. Taiwanese children had significantly higher scores in individual behavioral syndromes and the total behavioral problem than their counterparts of the U.S. (all $p < .05$).

**Conclusion:** This study demonstrated acceptable internal consistency and comparable factor structures of the CBCL/1-5 when used in Taiwanese children of ages 2 to 3 years. However, Taiwanese children were reported to have more behavioral problems than the normative US sample. Future study needs to investigate whether cultural factors or age effects account for these behavioral differences.

**Fr2-76**

### Maternal Emotion and Use of Infant-Directed Speech Affects Infant Behavior and Brain Activity

**Yi Xiao**[1] Rebecca Bitsko[2] **Elizabeth Sheehan**[3] Molly Larson[3] **Debra Mills**[3]

*1. Bard College, Annandale on Hudson, USA; 2. Center for Disease Control, Atlanta, USA; 3. Emory University, Atlanta, USA*

Maternal depression is a wide spread problem associated with infant depression, abnormal brain activity, and increased psychopathology later in development. It is not known to what extent poor infant outcomes are related to genetic, neurobiological, or experiential factors. Mothers with depression do not talk to or smile as much at their infants as healthy mothers. They also have flatter affect in their infant-directed speech (IDS). A recent study from our lab showed that, unlike infants of healthy mothers, 6-month old infants of depressed mothers do not show increased neural activity to IDS and have smaller vocabularies later in development. The present study examined the effect of maternal emotional state on mother-child interactions, infant behavior, and neural activity to infant-directed speech. We tested the specific hypothesis that the mother's use of IDS would be linked to infants' increased neural activity to IDS. Participants included 21 6-month olds and their mothers. Eight of the mothers had a history of depression. Videotapes of 3-minute mother-infant interactions were scored for 12 different mother and infant behaviors. Mother's behaviors included an assessment of overall emotional state, nonverbal behaviors such as smiling, attention toward the infant or engaging the infant in a shared activity, amount of speech to infant, pitch of speech and variability in pitch, and clarity of articulation. Infant behaviors included overall emotional state, interest in toys and mother, amount of vocalization. Additionally brain activity to IDS was measured using event-related potentials (ERPs). The results showed that maternal depression scores from the Beck Depression Inventory were correlated with mothers' emotional state during the interaction. Positive emotional ratings from the videotaped session were in turn associated with increased use of IDS, positive non-verbal behaviors, increased infant vocalizations and positive emotional state. Of particular interest was that infants' neural activity to IDS was exclusively linked with a composite score of maternal IDS including more variable and higher pitch and clearly articulated speech. The correlation held for mothers with and without a history of depression. The results provide new behavioral and neurobiological evidence that the quality of maternal interactions, rather than a history of depression per se, affect infant brain, emotional, and language development. We propose that intervention programs specifically designed to improve the affective quality of maternal speech will facilitate language development in infants of depressed mothers.

**Fr2-77**

### Unhappily Married Dads are No Fun at All: A Longitudinal Investigation of Change in Father Play Predicted by Marital Happiness

**Shannon Zentall**, Diane Lickenbrock, Naomi Ekas, Julia Braungart-Rieker

*University of Notre Dame, Notre Dame, USA*

Studies that have examined father involvement indicate that fathers have been found to participate in play activities more often than care activities with their children (e.g., Bailey, 2001). Few studies, however, have focused on predictors of change in father play during the child's first year (see Pleck, 1997). Previous studies indicate that marital satisfaction is related to the amount of time fathers are involved with their infants (e.g., Volling & Belsky, 1991) as well as quality of interactions (Grych & Clark, 1999). This study is unique in that it investigates change in father involvement across infancy and how early and later marital satisfaction may influence that change.

The sample consists of 132 primarily white, middle-class, and married fathers. Fathers independently completed the What I Did With My Baby Today Checklist and the Short Marital Adjustment Test (SMAT; Locke & Wallace, 1959) when the infant was 3, 5, 7, 14, and 20 months of age (+/- 14 days). The checklist is a brief diary for a typical weekday indicating the amount of play (e.g., physical or object play) and care (e.g., feeding) interactions. The present study focused only on play. The SMAT assesses global marital satisfaction and relative positivity of marital relations. For both measures, higher scores are better. In order to test whether early or late marital happiness predict changes in play, two average SMAT scores were computed-EarlySMAT (3, 5, and 7 month reports) and LateSMAT (14 and 20 month reports).

Hierarchical Linear Modeling was conducted using SAS Proc Mixed. EarlySMAT predicted play slope = .000244 (SE = .000100), $t(327) = 2.43$, $p < .05$. In other words, fathers who are happier with their marriages when their infants are young show greater increases in play behaviors over the first 20 months. Conversely, LateSMAT scores were not related

to changes in father play, suggesting that marital happiness in fathers during early infancy may reflect a critical time for establishing a more involved pattern of father-infant interaction.

## *Attention, Memory and Learning*

**Fr3-01**

### Caught in the Act: English- and Mandarin-learning Infants' Mapping of Novel Words to and Discrimination of Agents, Actions, and Objects

**Cheri Chan**, **Jie Chen**, Rachel Pulverman, Marianella Casasola, Xiangzhi Meng, Twila Tardif
*University of Michigan, Ann Arbor, USA*

Research shows that English learners typically have early vocabularies dominated by nouns. Traditional accounts of this developmental pattern propose that noun referents, including objects and agents, are conceptually privileged to invite labeling (e.g., Gentner, 1982). Interestingly, naturalistic observations and parental checklists reveal that verbs, primarily action words, are acquired early and in large quantities by Mandarin Chinese, Korean, and Tzeltal learners (Brown, 1998; Choi & Gopnik, 1995; Tardif, 1996). However, little evidence exists regarding whether these production differences are accompanied by differences in comprehension. Here, we present two experimental studies exploring English- and Mandarin-learning infants' abilities to map novel words to and discriminate between Agents, Actions, and Objects in dynamic scenes.

Study 1 tested 14- and 18-month-old monolingual learners of English (n=67) and Mandarin (n=72) on their ability to fast-map bare novel words to Agents, Actions, and Objects situated in dynamic scenes. In Study 2, we tested 6- and 18-month-old English (n=25) and Mandarin (n=15) monolinguals in the absence of language, to explore whether differences might also be found in English- vs. Mandarin-learning infants' discrimination of Agents, Actions, and Objects.

Data from Study 1 show that at 18 months, English and Mandarin learners map novel words to both Actions and Objects. Emerging trends suggest that 14-month-old Mandarin learners are able to map novel words to Actions but not Objects. Intriguingly, 14- *and* 18-month-old Mandarin learners failed to map novel words to Agents, whereas English learners succeeded in doing so at both ages.

Preliminary findings from Study 2 reveal a similar picture in infants' discrimination of the agents, actions and objects. Whereas 18-month-olds of both languages discriminate between contrasting Actions, only learners of English, but not Mandarin, showed equivalent sensitivity to Agent changes. These patterns were observed in attenuated form in 6-month-olds.

These results converge on previous findings by showing that under well-controlled word-learning situations, Mandarin-learning infants can map novel words to Actions at an earlier age than English-learning infants. Also, that even English 6-month-olds discriminated between contrasting Actions suggests that the differential ease of acquiring verbs across languages might be attributed to cultural processes specific to word learning, rather than differences in early attentional preferences across cultures. Surprisingly, despite the prominence of person words in children's early productive vocabularies, Mandarin learners failed to map novel words to Agents, possibly due to the difficulty Mandarin learners displayed in discriminating between Agents in the context of a dynamic action.

**Fr3-02**

### Developmental Transitions in Latent Learning during Infancy

**Kimberly Cuevas**, Amy Bullman, Carolyn Rovee-Collier
*Rutgers, The State Univeristy of New Jersey, Piscataway, USA*

Human infants spend much of their waking moments simply observing their surround. Recent research on latent learning suggests that during this time, they are constantly picking up information, only a small fraction of which they will ever express. In the present experiments, we modified a latent learning procedure (sensory preconditioning, or SPC) from the animal literature to use with human infants. In SPC, an association is formed between two stimuli ($S_1$ and $S_2$), and this association is subsequently used to transfer responding from one stimulus to the other. During the preexposure phase of SPC, adult animals are typically exposed to $S_1$ and $S_2$ sequentially. Chen et al. (1991), however, had found that the effective preexposure regimen changed developmentally. Newborn rat pups exhibited SPC *only* when $S_1$ and $S_2$ were preexposed simultaneously; at 12 days, *both* simultaneous and sequential preexposure produced SPC; at 21 days, *only* sequential preexposure produced SPC. Using a deferred imitation task with human infants, Barr et al. (2003) had found that 6-month-olds exhibited robust SPC when preexposed to $S_1$ and $S_2$ (two hand puppets) simultaneously. In a later study, we found that the simultaneous preexposure procedure was unsuccessful with 12-month-olds.

Experiment 1 examined whether the effective preexposure regimen also changes developmentally for human infants. Six- to 12-month-olds were simultaneously or sequentially preexposed to $S_1$ and $S_2$ (*days 1-2*). Next, three target actions were modeled on $S_1$ (*day 3*). Finally, infants received a 24-hr deferred imitation test with $S_2$ (*day 4*). Infants exhibited SPC (i.e., deferred imitation on $S_2$) *only* after simultaneous preexposure at 6 months, after *both* simultaneous and sequential preexposure at 9 months, and *only* after sequential preexposure at 12 months. We view this developmental pattern as reflecting a shift from contiguous to predictive stimulus relationships. This shift parallels the development of independent locomotion, when infants increasingly encounter stimuli successively.

Experiment 2 examined how quickly infants form an $S_1$-$S_2$ association. We found age-related changes in both the rapidity of association formation and the effective preexposure regimen for 1 session. Six-month-olds formed the association (i.e., learned *"what goes with what"*) in less than 2 minutes, but older infants, surprisingly, took longer. These data suggest that infants could form innumerable and relatively enduring associations each day that contribute in untold ways to their growing knowledge base. These results will be considered in terms of the functional significance of latent learning early in development.

**Fr3-03**

### What to do Where--to Imitate or to Perserverate?

**Evelina Dineva**[1] Gregor Schöner[2] Shin Maruyama[3] Esther Thelen[4] John Spencer[1]
*1. University of Iowa, Iowa City, USA; 2. Ruhr-Universität-Bochum, Bochum, Germany; 3. Waseda University, Tokyo, Japan; 4. deceased, Bloomington, USA*

Infant imitation is recognized as an important achievement with broad implications for the development of motor, cognitive, and social abilities, yet imitation has rarely been integrated with developmental changes in these other domains. Here, we examine whether a key signature of the developing action system--perseveration--shows

up in an imitative context. Further, we generalize a formal theory of motor planning--the dynamic field theory (DFT)--to account for the underling processes.

We designed an A-not-B-type task using a toy with two manipulanda, each affording a different action to elicit attractive sounds. On four consecutive trails (A), the experimenter presented one action and allowed the infant to interact with the toy. Infants generally imitated. Infants tended to perseverate, however, when on subsequent B trails the alternative action was presented. Preservation was weaker (and imitation stronger) for the 18-months-olds compared to 12- and 15-month-olds. Moreover, imitative tendencies were stronger with more salient actions.

We extended DFT to specify the processes behind these imitative/perseverative tendencies and their changes over development. In a two dimensional motor planning field each neuron was responsive to both action location and type. The population response thus specified the location and type of the planned action. The model received task input that captured the affordances of the toy. The more

familiar manipulandum induced stronger input. A cue input captured the demonstration by the experimenter--possibly mediated by a mirror neuron system. Task and cue inputs ware precisely localized in space (since manipulanda were visible) and broadly distributed across action types (reflecting weak or distributed affordance information).

Activated neurons passed positive activation to close neurons and negative activation everywhere else. Such interactions can generate self-sustained peaks of activation, reflecting motor decisions. These decisions leave traces in a long-term memory field through a simple Hebbian mechanism which can influence motor decisions on subsequent trials. We propose that younger infants have relatively weak neural interactions such that the field is strongly inputs driven; by contrast, older infants are better able to sustain action decisions. Simulations show that the model effectively captures infants' performance and developmental changes in perseveration/imitation.

The DFT situates imitation in the context of an infants' emerging motor planning abilities and their task-specific interactions with toys. Demonstrations by the experimenter do influence infants' actions, but the final decision is also guided by the infants previous experiences and overall ability to sustain an action decision.

**Fr3-04**

### The Effects of Kindermusik Training on Infants' Abilities to Encode Musical Rhythm

David Gerry, Ashley Faux, Laurel Trainor

*McMaster University, Hamilton, Canada*

**Background and Aims:** Phillips-Silver and Trainor (2005) demonstrated a link between movement and the metrical interpretation of rhythm patterns in 7-month old infants. In particular, they found that when infants were bounced on every second beat of a rhythmic pattern with no accents (as in a march), they later preferred to listen to an accented version of the pattern with accents every second beat, whereas infants bounced on every third beat of the same rhythmic pattern with no accents (as in a waltz) preferred to listen to an accented version of the pattern with accents every third beat. The present study tested the same hypothesis, but used infants who were participating in Kindermusic classes to determine whether musical training affects the ability to interpret metrical structure.

**Methods:** Infants were randomly assigned to one of two conditions: duple meter (march) or triple meter (waltz). Infants were trained by having them listen to a 2-minute 6-beat ambiguous (without accented beats) rhythm pattern. Half of the infants were bounced every two beats (duple) and half were bounced every three beats (triple). After training, infants' listening preferences were tested for two auditory versions of the rhythm pattern, one with accents either every two beats, and one with accents every three beats. Using a 20-trial head-turn preference procedure, infants controlled how long they listened to each pattern.

**Results:** Results for the first half showed significant effects of Rhythm Pattern (duple vs. triple accents at test), $F(1,6) = 30.13$, $p = .002$ and Rhythm Pattern *Movement Experience (duple vs. triple bouncing experience), $F(1,6) = 30.13$, $p = .002$. Infants who were bounced in duple looked longer at the accented duple pattern, whereas infants bounced in triple showed no preference. Results for the second half showed a trend for infants bounced in duple to switch to a preference for the triple pattern, indicating efficient encode of the duple pattern.

**Conclusions:** Unlike the infants in the previous study, those taking Kindermusik showed a general bias to interpret patterns in groups of two rather than in groups of three. This bias is consistent with the musical materials of their classes, which are predominantly in march as opposed to waltz rhythms. These results show that not only how infants are moved but also the type of music they experience in early childhood music classes affects how they interpret rhythmic structures.

**Fr3-05**

### Non Verbal Recall After Delays of 24 Hours and 1- 3- and 6 Weeks Among 6- and 9-Months Old Norwegian Infants

Kine Knoph, Gina H Landro, **Mikael Heimann**

*University of Bergen, Bergen, Norway*

**Aim:** Deferred imitation has emerged as a widely-used paradigm for measuring non-verbal recall memory (Bar & Hayne, 2000; Meltzoff, 2002; Rovee-Collier, Hayne & Colombo, 2001). This study explores memory and long term recall through deferred imitation.

**Method:** Sixty Norwegian infants (23 boys) participated in a combined cross-sectional and longitudinal study. In the cross-sectional part, 25 six-months-old and 26 nine-months-old infants were observed for recall after 24 hours, 3- or 6 weeks. In addition, nine children were observed longitudinally at both 6- and 9-months after a recall delay of one week. An observation-only design, as proposed by Meltzoff (1995), was used for presenting the tasks and measuring deferred imitation. The hand doll used at 6 months was an exact replica of the doll used in the study by Barr, Dowden, and Hayne (1996) and the three tasks used at 9 months were identical to the ones used by Heimann and Meltzoff (1996).

**Results:** Preliminary analyses of the cross-sectional observations reveals that infants at both 6 months and 9 months of age recall events over a period of three weeks. A 2 (age) x 3 (delay) ANOVA revealed a significant effect of the length of the delay period ($F(2,45) = 6.59$, $p = .003$) as well as for age ($F(1,45) = 8.99$, $p = .004$). There was no significant interaction. For both age groups, recall after 6 weeks was significantly ($p < .05$) lower than after 24 hours or 3 weeks. The results also show that 9 months old children retain larger amounts of information than what 6-months olds are capable of. In the longitudinal part nine children were observed at both age points. The results two show that most (7 out of 9) of the children either remained stable or increased their response rate from 6 to 9 months age.

**Conclusion:** In total these finding indicate abilities of recall memory in infants that are better than what has been shown in earlier studies. However, caution is warranted since the analyses are still preliminary and the sample size relatively small.

**Fr3-06**

## Effects of Prenatal Nicotine Exposure on Infants' Level of Arousal during Information Processing Tasks

**Katrina Johnson**, Julie Kable, Mary Ellen Lynch, Claire Coles

*Emory University, Atlanta, USA*

**Background and Aims:** Existing studies link prenatal exposure to nicotine with increased childhood behavior problems, including attention deficits. Problems with auditory processing and language development have also been noted in prenatally exposed children. Few studies have examined potential developmental precursors to the behavioral deficits identified. The current study examined the effects of prenatal nicotine exposure on infant arousal during information processing tasks.

**Methods:** Using a longitudinal, prospective design, smoking and non-smoking women were recruited just after birth. Prenatal nicotine exposure was determined using maternal report and cotinine levels were also measured. Women were divided into three groups based on average number of cigarettes smoked per day during pregnancy: none (n=57), 1-14 (n=80) and >14 (n=32). A sample of 169 6-month-old infants completed a habituation-dishabituation paradigm using three sets of stimuli: phonemes, auditory tones, and pictured faces. Infants were exposed to 10 habituation trials and 5 dishabituation trials for each stimulus for a total of 45 trials. Infants' level of behavioral arousal was rated by an examiner for each trial using a 6-point Likert scale ranging from deep sleep to intense crying. Arousal ratings were collapsed into blocks of five trials and a mean arousal rating for each block was calculated.

**Results:** Mean arousal ratings generally fell between "4" which reflected "quiet alert" and "5" which reflected "active alert" (Mean for all trials=4.77, SD=0.49). Significant group differences in arousal ratings were identified for speech and auditory tones conditions, but not the picture condition. Results of a mixed-factorial analysis of variance confirmed group differences in mean arousal ratings across the speech and tones conditions combined ($F(2,163)=4.78$, $p=0.01$), while controlling for prenatal alcohol exposure and infant gender. The results of a polynomial contrast showed a significant linear effect of exposure group ($p<0.01$), supporting a dose-response association between prenatal nicotine exposure and arousal ratings. Infants of the non-smoking mothers showed the highest level of arousal, while infants of the heaviest smokers (>14 cigarettes per day) showed the lowest levels of arousal and infants of light smokers (1-14 cigarettes per day) fell in between the other two groups.

**Conclusions:** These findings suggest infants of non-smokers were more active and engaged during the speech and auditory tasks (e.g., increased vocalizations, greater excited, positive affect) compared to exposed infants. Lower levels of arousal in the nicotine-exposed infants suggest differences in attention, particularly during auditory-mediated tasks, though more research is needed to understand these findings and their clinical implications.

**Fr3-07**

## The Role of Caregiver Sensitivity and Attention-Direction within Interaction

**Jennifer Jones**[1] Patricia Self[2]

*1. Oklahoma State University, Oklahoma City, USA; 2. Oklahoma State University, Stillwater, USA*

**Background and Aims:** Champion (2000) raises the important issue of focusing on the social and emotional development of infants with disabilities in early intervention programs by highlighting the linked relationship between caregiver and infant, concluding that failure to achieve mutual regulation within social-emotional exchanges, results in disrupted development and lost opportunities for potential learning. We sought to explore the relationship among varying levels of sensitivity of mother-participants to their directive behaviors when interacting with a 5 month old infant diagnosed with hydrops fetalis in utero.

**Methods:** Participants. The same infant, referred to as actor baby, interacted with 28 mother-participants. Measures: Mother-participants completed a brief demographic questionnaire and the Knowledge of Infant Development Inventory (KIDI: MacPhee, unpublished work 1981).

Mother-infant interactions. Each mother-participant engaged in five minutes of free-play interaction with the actor-baby while being video-taped.

Coding of interactions. Maternal sensitivity was rated on a 9 point scale using the caregiver sensitivity subscale from the Emotional Availability Scales adapted for infants with disabilities (Biringen, Fidler, Barrett, & Kubicek, 2005). Based on these ratings, mother-participants were categorized into three groups: high sensitivity (n=7), mostly sensitive (n=15), and moderate to low sensitivity (n=6).

A separate coding of the frequency and timing of mothers' attention-directing behavior was coded as (1) maintaining infant's attention, (2) introducing a toy, or (3) redirecting infant's attention (Landry, Garner, Swank, & Baldwin, 1996). Infant affect will be simultaneously coded as (1) negative, (2) neutral, or (3) positive. Mothers' attention-directing behaviors and infant affect were transposed onto state space grids (Lamey, Hollenstein, Lewis, & Granic, 2004). The grids provided an analysis of the state changes within the mother-infant interaction.

**Results:** Preliminary analyses reveal the differences in participant-mothers' sensitivity when interacting with the actor baby are not explained by SES, maternal education, or mother's knowledge of infant development. State space grids utilized to analyze mothers' attention-directing behaviors and infant affect revealed state changes which reflect mutual regulation between infant and mother-participants for mothers who were highly sensitive. Patterns of asynchrony existed among the infant and mother-participants who were low to moderately sensitive. Further analyses are expected to identify thresholds of sensitivity within the mostly sensitive group of mother-participants.

**Conclusion:** These results reaffirm the importance of mutual regulation for optimal infant development and learning. The uniqueness of this study in using an actor-baby diagnosed with hydrops fetalis and mother-participants allows the authors to apply findings to both childcare providers and mothers of infants with mild developmental delays.

Fr3-08

## Redundant, Multisensory Information Boosts Infant Numerical Performance

**Kerry Jordan**[1] **Sumarga Suanda**[2] Elizabeth Brannon[3]

*1. Utah State University, Logan, USA; 2. Emory University, Atlanta, USA; 3. Duke University, Durham, USA*

**Background:** Recent studies show that preverbal infants possess rudimentary numerical competence (e.g., Brannon, 2002; Jordan and Brannon, 2006; Lipton and Spelke, 2004). Their numerical discriminations are limited by ratio when tested with stimuli from either the visual *or* auditory modalities; six-month-old infants tested with large numerical sets, for example, require a 1:2 ratio for success (e.g., Lipton and Spelke, 2003; Wood and Spelke, 2005; Xu and Spelke, 2000; Xu, 2003; Xu et al., 2005). Multisensory stimuli providing redundant information enhance infants' stimulus discrimination in other domains (e.g., Bahrick and Lickliter, 2000; Gogate and Bahrick, 1998). Here, we present the first evidence that redundant, numerical multisensory information increases six-month- olds' numerical precision. We also show that this improved precision cannot be attributed to a general increase in salience or arousal from nonnumerical, multisensory information.

**Methods:** We used a habituation-dishabituation paradigm to test the ability of six-month-old infants to discriminate between 8 and 12 sequential ball bounces. There were 16 infants each in the Unisensory and and Non-Redundant Multisensory conditions and 32 infants in the Redundant Multisensory condition. Infants in each condition were habituated to and tested with the following stimuli:

Unisensory, visual sequential ball bounces; Redundant Multisensory, visual sequential ball bounces synchronized with auditory tones; Non-Redundant Multisensory, visual sequential ball bounces with music playing.

**Results:** Infants who received only visual numerical information failed to discriminate 8 from 12 ball bounces (looking time difference in test between novel and familiar numerosities: t(15)=.15, p=.87; binomial 8/16, p=.598), replicating previous findings from other labs with this age and this numerical contrast in both the visual and auditory modalities. In contrast, infants who received redundant, multisensory numerical information succeeded (looking time: t(31)=2.43, p=.021; binomial: 23/32, p=.010). Importantly, infants who received multisensory information in the form of music playing while watching the visual numerical sequence failed to make this discrimination (t(15)=.97, p=.34; binomial: 10/16, p=.227).

**Conclusion:** Results demonstrate that infants' discriminations of multimodal and unimodal numerical displays do not adhere to the same ratio limit. With multisensory stimuli, six-month-old infants make more precise numerical discriminations than previously reported with unimodal stimuli. Our experiments rule out the possibility that *any* auditory information paired with a visual numerosity enhances discrimination, and instead demonstrate that increasing numerical precision results from redundant *numerical* information provided by synchronous auditory and visual numerical stimuli.

Fr3-09

## Parasocial Interactions Increase Infants' Learning from Videos

Alexis Lauricella, Rachel Barr, Sandra Calvert

*Georgetown University, Washington, USA*

The American Academy of Pediatrics (1999) recommended that parents should not expose their children to screen media before age 2, in part because they are unable to learn anything of value from viewing video content. Even so, recent reports indicate that 79% of children under the age of 2 have watched television and 43% do so daily. Moreover, parents report that infants attend to videos that have been created for them, and can imitate novel actions on real-world objects that were originally introduced via television. Most recently, studies have demonstrated that contingent social interactions enhance learning from television in toddlers. In addition, research with preschool-aged children has shown that learning is particularly likely to occur when the character "interacts" with the child. "Parasocial" interactions occur when the character looks directly at the camera and talks to the audience. At this point, we do not know whether parasocial interaction can improve infants' learning from videos.

The purpose of this study is to investigate how parasocial interactions influence 18-month-olds' imitation of, and learning from, television content. All participants are shown a video segment of a woman putting a toy rattle together. In the parasocial interaction condition, the woman looks directly at the camera and addresses the audience while providing directions about how to put the rattle together. In the non-parasocial interaction condition, the woman puts the rattle together but never looks at the camera; she speaks to herself rather than to the audience. Infants are then given the same objects presented in the video and asked to make the rattle.

Findings indicate that the 18-month-olds in the parasocial interaction condition imitate more of the behaviors demonstrated in the video than do the infants in the non-parasocial interaction condition. Both conditions perform above baseline controls. The results suggest that specific qualities of screen characters, such as eye contact in which the viewer is directly addressed, promote learning in infants. These findings can inform scholars, program creators, policy makers, and parents about how to improve infants' learning from media.

Fr3-10

## Word-Learning in Infant- and Adult-directed Speech

**Weiyi Ma**, Roberta Golinkoff, Derek Houston, Kathryn Hirsh-Pasek

*University of Delaware, Newark, USA*

**Background and Aims:** Infant-directed speech (IDS), compared with adult-directed speech (ADS), is characterized by a slower rate of speech, a higher fundamental frequency, greater pitch variation, longer pauses, characteristic repetitive intonational structures, and short sentences (e.g., Fernald, 1992; Gleitman et al., 1984). Correlational research suggests that IDS facilitates children's word learning over ADS (e.g., Huttenlocher et al., 1991). Even adult word learning is aided by Chinese IDS (Golinkoff et al., 1995). Yet, there are no experimental studies with children that manipulate IDS versus ADS. This study addresses that gap by asking whether children learn novel words better when presented in IDS than in ADS. A positive answer to this question has significance for normal and delayed language acquisition.

**Method:** English-speaking children (M = 21.07 months) were randomly assigned to either an IDS or ADS condition. During training,

children watched a video containing two novel objects introduced consecutively while listening to either IDS or ADS (audio matched for volume and sentence starting points). Each object received a novel label (blick or modi) in full sentences (e.g., "It's a blick! See the blick!). Then, children were directed to look at the target in four blocks of trials, each of which contained four word-learning tests (two for each object). Between test blocks, two reminder trials offered children the label for the novel objects again.

**Results:** Overall attention to the video did not differ across conditions. Yet, across the four trial blocks (as well as in the first and second blocks examined separately), only children in the IDS condition looked at the target (M = 2.04s) significantly more than the non-target object (M = 1.36s) ($p < .05$). ADS children looked at the target marginally more than the non-target ($p = .06$), and only in the first block. Children's vocabularies, based on a short form of the MacArthur CDI, were highly correlated with children's looking time in every test block and across conditions.

**Conclusion:** While research has hinted that IDS facilitates lexical acquisition relative to ADS, this is the first experimental study to report this outcome. Furthermore, the effect of IDS did not occur simply because it increased children's attention to the video. Additionally, the relation between children's vocabulary and word learning suggests that having acquired more words, children are poised to learn new ones more readily. Alternatively, better word learning ability may lead children to develop a larger vocabulary.

**Fr3-11**

### Experimentally Manipulated Unfamiliar Social Partner Responses Influence Infants' Attention

**Jennifer Miller**, Erin Ables

*Indiana University, Bloomington, USA*

Attention is essential for the development of cognitive and social skills in infants. To understand how learning different skills in these domains, it is necessary to understand both the mechanisms and functions of attention. The process of attention can be divided into understanding the infant's selectivity including objects and social partners, engagement, and high-level control. One part of the process, engagement, can be defined as an infant's ability to attend to objects, social partners, or a combination of both. Previous research has demonstrated an infant's social environment can assist in increasing or decreasing the levels of engagement depending on different levels of stimulation. Because infants are not passive participants, we were interested in experimentally manipulating unfamiliar responses of social partners to examine how different levels of social stimulation influenced attention levels.

The current study investigated different levels of social stimulation to examine the relationship between the social ecology and an infant's attention. We selected two types of social stimulation, sensitivity and intrusiveness, based on characterizations of caregiver responses in normal infant-caregiver free play. A total of 19 mother-infant dyads visited the lab once when infants were 9 months old. The visit was divided into three 7-minute periods. During the first period, mothers and infants played in a large room. During the remaining two periods, two different unfamiliar individuals each interacted separately with the infant. Infants were exposed to both the sensitive and intrusive unfamiliar individuals. Attention was coded based on visual gaze. Engagement was calculated based on sequences of the infant's attention and the unfamiliar individual's responses. Results revealed infants maintained longer durations of engagement during the sensitive than the intrusive unfamiliar individual period. This study demonstrates young infants can detect subtle differences in social stimulation and these differences can potentially influence social and cognitive development.

**Fr3-12**

### Infants' Ability To Recognize Speech in Noise: Effects of Noise Type and Location

**Rochelle Newman**

*University of Maryland, College Park, USA*

Most research on infant speech recognition occurs in quiet laboratories with no outside distractions. Yet the modern household can be a far more chaotic place, full of noise from radios, televisions, and children.

In order to acquire their native language in such settings, infants must separate one stream of speech (for example, the caregiver's voice) from that of others. Newman (2005) demonstrated that 5-month-old infants listened longer to their own name than to foil names in the presence of multitalker babble, but only if the target voice was 10 dB more intense than the distractor voices. Thus by the time infants reach 5 months of age, they can separate streams of speech produced by different talkers. However, their ability to do so remains quite limited, and only improves after their first birthday.

The present research examines two factors that could influence infants' abilities to separate streams of speech: the number of background voices and the spatial location of those voices.

In Experiment 1, we examined 5-month-old infants' abilities to recognize their own name in the context of two different types of background speech: a single talker versus multitalker babble. Infants recognized their name at a 10-dB signal-to-noise ratio (SNR) in the multiple-voice condition, consistent with prior findings. But infants failed to do so in the single-voice condition. This pattern is opposite that of adults, who typically are better able to recognize speech when the noise consists of a single talker rather than multitalker babble.

In Experiment 2, infants heard the names in the presence of multitalker babble that either originated from the same location in space as the target voice, or originated from the opposite side of the room. Adults find it easier to separate two streams of speech when there is a spatial location difference across them. Infant did not: with a 10 dB SNR, infants listened longer to their name than the foil regardless of spatial location of the noise; with a 5 dB SNR, they failed to do so. In neither situation did the location of the noise influence performance.

In both studies, infants demonstrate an ability to separate speech from background noise, a critical factor in their ability to learn language in real-world environments. But they show a very different pattern of performance than do adult listeners. The implications of these results will be discussed. [Work supported by NSF].

**Fr3-13**

## Hypothalamic-Pituitary-Adrenal (HPA) Axis Function in 3 Month Old Infants with Prenatal Serotonin Reuptake Inhibitor (SRI) Antidepressant Exposure

**Tim Oberlander**[1] Linda Mayes[2] Ruth Grunau[1] Wayne Riggs[1] Dan Rurak[1] Michael Papsdorf[1] Shaila Misri[1] Joanne Weinberg[1]

*1. University of British Columbia, Vancouver, Canada; 2. Yale University, New Haven, USA*

**Background:** Early exposure to maternal depressed mood increases HPA stress reactivity in offspring and this in animal models appears to be "normalized" following prenatal serotonin reuptake inhibitor (SRI) antidepressants exposure. Whether this also occurs in human infants following prenatal SRI exposure is unknown.

**Methods:** Salivary cortisol levels were obtained before and following a non noxious stress and again at a basal late afternoon time from 31 infants with gestational SRI exposure (mean exposure 230.2 ± 72.2 days) and compared with responses from 45 non-exposed infants at 3 months. To control for post natal medication exposure breast feeding status at 3 month was used as a covariate.

**Results:** Infants with prenatal SRI exposure had similar stress reactivity to non-exposed infants. However, among non-exposed, non exclusive breast feeding infants higher baseline and lower stress cortisol levels were observed compared with non-exposed and exposed breast feeding infants, even controlling for maternal mood during and following pregnancy ($F[2,96]=5.425$, $p=.009$). Similarly, in the non exclusive breast feeding, non exposed group the cortisol reactivity slope was significantly lower compared with breast feeders and exposed infants ($F[1,51]=13.056$, $p<0.001$). In SRI-exposed infants, lower late afternoon cortisol levels were observed ($F=5.863$; $P=.019$) compared with non exposed infants, even controlling for maternal mood and mode of feeding. Postnatal SRI drug exposure via breast milk was not associated with stress or basal cortisol levels.

**Conclusions:** Prenatal SRI exposure appeared to alter or "normalize" the pattern of cortisol stress responses observed in non-exposed, non exclusive breast feeding infants. Prenatal SRI exposure was however associated with reduced evening cortisol at 3 months. Maternal mood was not associated with HPA stress or basal function in this study.

**Fr3-14**

## Short Lookers - Good Categorizers? Validating Comparator Theory for Categorization Tasks

**Janna Pahnke**, Sabina Pauen

*University of Heidelberg, Psychology Department, Heidelberg, Germany*

**Background and Aims:** According to comparator theory (Sokolov, 1963), habituation performance in infancy mirrors a process of stimulus encoding. Individual differences in habituation indicate differences in speed of processing, whereas differences in dishabituation responses are assumed to reflect discriminatory memory abilities. While this cognitive model has received support from studies investigating visual recognition memory for a single stimulus, the validity of comparator theory is less clear with respect to categorization studies habituating infants to multiple stimuli. If habituation in infancy indicates a general encoding ability, however, this ability should underlie the processing of single stimuli as well as of categorical stimuli. Thus, a consistency of habituation performance over different task contexts should exist. The present study tested this assumption by examining the interplay of habituation and dishabituation responses as predicted by comparator theory within and between different visual habituation tasks in the first year of life.

**Methods:** Two visual habituation tasks involving abstract geometric stimuli were developed, one requiring the encoding of a single stimulus, the other the encoding of a stimulus category. In three experiments, both tasks were presented to the same sample of infants (within-subject-design), realizing three different habituation procedures. In experiment 1, N = 40 5-months-olds and N = 40 7-months-olds were tested with both type of tasks in a consecutive, infant-control design. In experiment 2, N = 21 5-months-olds and N = 20 7-months-olds dealt with both tasks in a consecutive, fixed-trial design. In experiment 3, both tasks were presented to N = 40 5-months-olds and N = 40 7-months olds in a fixed paired-comparison design. Individual differences in habituation-dishabituation responses were analyzed within and between both tasks, taking into account different visual attention measures.

**KeyResults:** In all three experiments, total looking duration was significantly correlated between single-stimulus and categorization task ($r = .34$-$.48$, $p < .01$), while neither amount of habituation decrement nor dishabituation response was correlated between tasks. Habituation-dishabituation-relations within the tasks varied systematically with experimental procedure and attention measure; e.g., the relation between habituation performance (looking time, habituation decrement) and novelty response was more pronounced in fixed-trial than in infant-control procedures. However, the pattern of relations within tasks changed symmetrically for single-stimulus and categorization tasks. Thus, regarding the existence and direction of relations between habituation and dishabituation responses, a uniformity of relations over different task contexts could be observed that was consistent with comparator theory.

**Conclusions:** The uniform pattern of results for both type of tasks points to similar cognitive processes (encoding speed, memory) underlying the encoding and discrimination of single as well as of categorical stimuli. A specification of the comparator model with respect to the investigated habituation and categorization behaviour is presented, stressing the importance of differentiating between attention measures, while proposing general cognitive processes that apply independently of specific stimulus characteristics. Implications for the structure of intelligence in infancy and for clinical use of the present paradigm are discussed.

**Fr3-15**

## Infants' Use of Contextual Cues For Generalizing Causal Actions

**David Sobel**[1] **Dahe Yang**[2] **Emily Bushnell**[2]

*1. Brown University, Providence, USA; 2. Tufts University, Medford, USA*

Yang and Bushnell (2006) found that 15-month-olds may understand a demonstrated action as causal within the context of a particular object, but cannot generalize that causal relation to a novel object. When shown one action that produced an effect and another that did not on similar objects, infants generated the effective action when given a version of the same toy which afforded both actions. However, infants responded indiscriminately when the two actions were available on a novel object. Infants may construe causes as highly specific to individual objects. Alternatively, the single object demonstrated might have been inadequate to support generalization. Numerous studies indicate that young children need multiple exemplars to categorize objects or acquire word labels. Accordingly, we investigated whether additional demonstration exemplars would promote causal generalization.

Forty-eight 15-month-old infants participated: 24 in a single-exemplar paradigm (a replication of Yang & Bushnell, 2006) and 24 in a multi-exemplar paradigm. In the replication, the experimenter demonstrated two toys sequentially. The toys were identical except that one had a handle the experimenter pressed down and the other had a different handle she pulled out; one action yielded an exciting effect while the other had no consequence (counterbalanced across infants). Following these learning trials, a test toy different in appearance but with both the press and pull handles was offered without any demonstration. Infants' first action and patterns of response were recorded. The multi-exemplar paradigm was identical except that the two demonstrated toys were different from each other as well as from the test toy.

Infants in the single-exemplar paradigm replicated the prior findings: They did not systematically produce the effective action first (only 10 of 24, or 42%, did so). However, infants in the multi-exemplar procedure were significantly more likely to produce the effective action first (17 out of 24, or 71%, did so). Similarly, while just half of the infants in the replication study reached for the effective handle first, 75% of the infants in the multi-exemplar procedure did so.

These results suggest that infants may understand a demonstrated action as causal not just for a particular object, but also for a novel object, provided that variable exemplars are demonstrated. When the demonstration objects are identical, infants' learn something "about" the object, but with multiple exemplars their learning is 'about" the actions. Expanding demonstrations to incorporate variability seems to be a catalyst for infants to generalize causal actions from imitation.

**Fr3-16**

### Mother and Infant Salivary Cortisol

**Kathy Stansbury**[1] David Haley[2]

*1. Morehouse College/Center for Behavioral Neuroscience, Atlanta, USA; 2. University of Toronto, Scarborough, Canada*

**Background and Aims:** Multiple studies with nonhuman animals have indicated that mothers show adrenocortical stress responses in some caregiving contexts and in response to separation from their infants, as do their offspring (Mendoza et al., 1978; Smotherman et al., 1977; Stanton & Levine, 1985). Additionally, reports of complementary as well as synchronous behavior between mothers and their infants (e.g., Ainsworth et al., 1978; Stern, et al., 1987; Tronick & Gianino, 1986), in both human and nonhuman populations (Coplan et al., 2006), are ubiquitous in the literature on child development, and indeed form the basis for most of our knowledge of socioemotional development and developmental psychopathology. Surprisingly, the connection between physiological attunement (i.e., similar physiological responses to a situation) and behavioral synchrony has only rarely been studies, either in humans or in nonhuman animals. One exception is the study by Sethre-Hofstad, Stansbury, & Rice (2002), which indicated that mothers of preschoolers demonstrated attunement with their children in adrenocortical function, but only when their behavior toward the child was characterized as sensitive. The current study explores these questions in a population of 132 6-month-old infants and their mothers.

**Methods:** Infants and their mothers were studied in their homes during routine caregiving activities (diaper change, feeding, freeplay) and in response to a modified Still-Face. Saliva samples were collected at three time points from both mothers and infants: upon arrival at the home (T1), at the end of routine caregiving activities (T2), and 30 minutes after the beginning of the Still-Face (T3). In addition to the T1, T2, and T3 variables, we constructed means to represent the caregiving portion of the visit (mean of T1 and T2; CARE) and the entire visit (mean of T1 T2 and T3; AVG 3) separately for mothers and infants. Demographic data were collected from all families, and behavior was videotaped during the entire home visit.

**Results:** Salivary cortisol levels of mothers and infants were significantly correlated at T1, T2, T3, CARE, and AVG 3. Subtle differences existed in physiological attunement, however, between mothers who reported depressed mood, and those who did not. Unlike the group as a whole, mothers reporting depressed mood did not show physiological attunement with their infants at T1, or at T3. Additionally, socioeconomic status of the family was a factor. Unlike the group as a whole, higher SES mothers did not show T2 attunement with their infants. Analyses of connections between behavioral synchrony and physiological attunement are currently underway and will be reported at the conference.

**Fr3-17**

### Imitation versus Emulation and the Role of Prepotency: One Outcome, Different Actions

**Doreen Thompson**

*University of Strathclyde, Glasgow, UK*

Infants are very good at learning from observation. If children successfully use imitation to achieve their goals then they must reproduce what the model does, not what the model's actions resulted in (i.e. emulation). A study is reported which asked the following questions to young children aged 15 -26 months a) whether children would imitate modelled actions, even when those means were not the most direct route to achieving a goal and b) whether children are more likely to engage in imitation as they get older or are more likely to show insight to the best route to a goal. In this study, two tasks were used, both of which afforded three different routes to retrieve an otherwise inaccessible toy. Demonstration of the different means either involved three different bodily actions (depressing a lever using hand, chin or elbow) or involved acting on three different parts of the same object (top, side or front of a toy-containing box). This draws the distinction between 'emulating the outcome' or imitating what the model is doing. If there turned out to be more reproduction of the modelled action in case A than in case B, one might conclude that means-end imitation is operating more strongly than emulation and vice versa. Results suggest that the younger group (15-21 months) almost never abandon what a baseline condition has shown to be their naturally preferred route. In contrast, slightly older children (aged 21-26 months) tend to imitate the model's actions but not sufficiently to override the prepotent response. The fact that older children are more likely to take the modelled awkward route whereas the 15-20-month-olds take the direct route implies that, at least to a limited extent, older children are using means-end imitation whereas the younger group are not imitating but simply performing the natural action.

**Fr3-18**

### Memory by Association: Deferred Imitation Prolongs Retention for the VRM Paradigm

**Karen Tustin**, Julien Gross, Harlene Hayne

*Psychology Department, University of Otago, Dunedin, New Zealand*

Prior research with 6-month-olds has shown that infants remember some experimental tasks longer than others. For example, when tested in a standard deferred imitation task, 6-month-olds exhibit

retention for 1 day, but when tested in the operant train task, infants of the same age exhibit retention for at least 2 weeks. If these two tasks are presented together within the same session, however, infants exhibit retention of the deferred imitation task for as long as they exhibit retention of the train task (Barr, Vieira, & Rovee-Collier, 2001). Apparently, retention in the imitation task is facilitated by its association with a task that is typically remembered longer.

In the present experiment, we assessed the generality of this phenomenon in older infants. To do this, 24-month-old infants were tested in the Visual Recognition Memory (VRM) paradigm and the deferred imitation paradigm. Typically, infants of this age exhibit retention in the VRM paradigm for 24 hours, while they exhibit retention in the deferred imitation paradigm for at least 8 weeks. Here, we paired these tasks together and assessed the effects on retention after a delay. In Session 1, infants in the experimental group watched as the experimenter demonstrated the target actions for the deferred imitation task (90 s); the infant was not allowed to touch the stimuli or practice the actions during this session. Immediately following the demonstration, infants were familiarized with the target stimulus in the VRM paradigm (10 s). During Session 1, infants in the control group were allowed to manipulate the stimuli for the deferred imitation task, but they were never shown the target actions. Immediately following this manipulation period, they were familiarized with the target stimulus in the VRM paradigm.

Session 2 was scheduled 2- or 8-weeks after Session 1. During Session 2, infants in both groups were initially tested in the deferred imitation task and then they were tested in the VRM paradigm. Although infants in the control group exhibited no retention whatsoever, infants in the experimental group exhibited excellent retention in both tasks (imitation, VRM) when they were tested after a delay of 2- or 8-weeks. Consistent with Barr et al., retention in the VRM task was prolonged via its association with the deferred imitation task. These data underscore the generality of the memory-association phenomenon originally documented by Barr et al. (2001), suggesting that memory association is a powerful means of prolonging retention of information that might otherwise be forgotten quickly.

**Fr3-19**

### Infants Can Remember the Pitch Structure of Melodies Over Long Retention Intervals

Andrea Unrau, Judy Plantinga, **Laurel Trainor**
*McMaster University, Hamilton, Canada*

**Background and Aims:** Recent research has shown that infants have many skills related to musical processing. Young infants 5 to 8 months of age can distinguish small changes in a melody (Trainor & Trehub, 1992), recognize a melody transposed to new pitch levels (Chang & Trehub, 1977) and remember a familiarized melody for days or weeks (Saffran, Loman & Robertson, 2000; Trainor, Wu & Tsang, 2004). We were interested to see if 6-month-old infants can remember a melody over a long retention interval using only pitch structure information.

**Methods:** The rhythms of one simple folk melody were applied to the pitch structure of a second melody, creating two familiarization melodies with the same rhythmic structure. Sixteen 6-month-old infants were familiarized with one or the other of these two melodies for seven days at home. On the eighth day, infants were tested using a head-turn preference methodology. Each trial began when the infant looked a flashing toy on one side, causing the music for that trial (either the familiarized or novel melody) to begin playing. The trial ended when the infant looked away, causing the music to stop. On the next trial, the toy flashed on the other side and the other music played. Trials alternated between novel and familiarized melodies, and side of first presentation and music of first presentation were counterbalanced. The measure of preference was total looking time in order to hear the novel versus the familiar music.

**Results:** An ANOVA with melody type (novel, familiar) and test half (first half, second half) as within-subjects factors and familiarized melody as a between-subjects factor showed a significant main effect of melody type, $F(1,14)=5.606$, $p=.03$. Infants looked longer in order to hear the novel melody compared with the familiarized melody, suggesting that they remembered and were less interested to hear the familiarized melody, even in the absence of novel rhythmic cues.

**Conclusion:** Six-month-old infants are able to remember a simple melody over a one-day retention interval using only melodic pitch structure information. In an ongoing experiment, we are testing to see whether infants can recognize the familiarized melodies transposed up or down to new pitch levels. If they can, we will conclude that infants' encode relative pitch information in their long-term memory representations of melodies.

**Fr3-20**

### I Know Your Goal! 12-Month-Olds Selectively Predict the Future Behavior of Humans But Not Animals

Diana Del Console[1] **Gretchen VandeWalle**[2]
*1. Rutgers University/Brookdale Community College, Manalapan, USA; 2. Rutgers University, Newark, USA*

A fundamental distinction is that between animate and inanimate objects. Current data suggest that the ability to distinguish instances of these categories originates in infancy, perhaps through differential motion patterns (e.g., Leslie, 1995; Mandler, 1992; Premack, 1990). Infants attribute goal-direction to human hands (Woodward, 1998) as well as to computer-generated displays whose motion follows a "rational," spatiotemporally efficient, path (Gergeley et al., 1995). However, this research demonstrates only that infants interpret animate motion as goal-directed *after the fact*. A crucial component of the animate-inanimate distinction is the ability to predict *future* behavior. It is currently unknown whether infants differentially predict future behavior of animate and inanimate entities. To investigate this question, In Experiment 1, we developed a new, "associative looking" paradigm. Separate groups of infants viewed a puppet stage with a distinctive potential target object at each end. One group was familiarized with a human hand reaching from one side of the stage to one of two targets. The other group saw a box that moved in an inanimate manner (i.e., non-self-starting, linear path) to one of the two target objects. During test, the previously viewed hand or box remained stationary in the center of the stage, equidistant from the two targets. Fixations to all three objects were recorded. Infants in the hand condition shifted fixation between the hand and the target toward which it had previously moved significantly more than between the hand and the other object. Infants in the box condition, in contrast, looked back and forth equally between the box and the two targets. These differences cannot be attributed to reduced overall looking by the babies in the box condition; both groups looked equally long at the test displays. These data suggest that babies inferred that the reach was goal-directed and that this information guided their looking at a display in which no obvious outcome was presented. Infants not only attribute goal-direction to human hands *post-hoc*, they also infer relationships between hands and their targets, and can use this information to predict the future direction of a human reach! These

data stand in contrast to those of infants in Experiment 2, who viewed identical events except that the human hand was replaced by a furry, animately moving entity with a face. These infants showed no consistent scanning patterns during test. Potential sources of information for the prediction of goal-directed behavior are identified and their significance discussed.

## *Cognitive Development*

**Fr3-21**

### Self-Recognition Between 12 and 36 Months: Longitudinal Evidence and Its Relation to Cognition, Language, and Memory Development

**Claudia Goertz**, Thorsten Kolling, Stefanie Frahsek, Monika Knopf
*Johann Wolfgang Goethe-Universität, Frankfurt, Germany*

**Background and Aims:** The development of the self passes several stages in the first years of life. The present self is supposed to develop much earlier than higher order representations of the self, e.g., the temporally extended self, including personal experiences/memories from the past. Although lots of cross-sectional studies on self-development have been conducted, longitudinal investigations involving interrelations between mental components are still rare.

**Method:** In this study self development, cognitive development, memory development, and language development was analyzed cross-sectionally and longitudinally within 80 children at the age of 12, 18, 24, and 36 months. Self development was assessed via mirror self-recognition tasks (Bertenthal & Fischer, 1978) and a delayed video self-recognition task (Povinelli, 1995). Abilities of secondary representations (Perner, 1991) were assessed with a pretend play scenario at the age of 18, 24, and 36 months. Additionally, memory performance was assessed using a deferred imitation task at 12, 18, 24, and 36 months, semantic memory with a free recall and a vocabulary test at 36 months, and language development with a German language test at 36 months.

**Results and Conclusions:** The longitudinal analysis yielded a moderate longitudinal predictive validity of self-measures across time. Furthermore, a strong relation between self development and the cognitive development in the pretend play scenario was found, a clear link between self development and language, whereas the disentangling of components of self development and declarative memory revealed a rather complex picture.

**Fr3-22**

### Developmental Trends in Self-Recognition, Language, Pretend Play, and Empathic Responsiveness during the Second Year

**Paola Molina**, **Daniela Bulgarelli**
*University of Turin, Turin, Italy*

**Background and Aims:** In our study, we investigate the onset of self-recognition in comparison with the development of other competences supposed to be related to early self-awareness. First, empathic concern to distress in others requires an emergent self-other differentiation. Self-awareness may entail a growing psychological lexicon and pronoun use. Finally, some authors hypothesize that a level of symbolic competence (representation) is a prerequisite for mirror self-recognition.

**Method:** We observed 14 toddlers (7 females, 10 firstborns) at 15, 18, and 21 months in a laboratory setting, in the following conditions: the standard mirror-and-rouge task (at 15, 18, and 21 months), a pretend distress task (broken doll) at 18 and 21 months, and a symbolic play session at 15 and 18 months. The Italian version of the SCSP Scale for communicative competence (Guidetti & Tourrette, 1990; Molina, Ongari & Schadee, 1998) was administered at 21 months. Moreover, we collected data on language development from the Italian version of the McArthur Communicative Inventory (Fenson et al., 1993, Caselli & Casadio, 1995) at 18 and 21 months.

**Results:** Results point out a clear developmental trend in mirror responses, in language development and in the level of symbolic play, but not in the responses to the empathic concern task. We find no relationship between self-recognition and empathic responses and a significant correlation between self-recognition and overall language development. The level of symbolic play (Bornstein & O'Reilly, 1993) does not correlate with communicative/linguistic capacities. The mirror self-recognition, however, is linked to higher averaged scores of representational competence: level of symbolic play at 18 months and SCSP score at 21 months.

**Conclusion:** Our data are coherent with second year development literature, supporting the role of representational competences in self-recognition, while we found no role of self-recognition in empathic responses: these results are discussed in terms of theoretical and methodological aspects.

**Fr3-23**

### Infants Tracking of Objects Through Occlusion in 2-D Animated Displays

**Jennifer Armstrong**, Teresa Wilcox, Gerianne Alexander
*Texas A&M University, College Station, USA*

Developmental psychologists have long puzzled over infants' representational capacities. Recently, infant researchers have turned to eye-tracking techniques to gain insight into infants' representation of occlusion events. In one study 5- to 7-month-olds were presented with live 3-D events in which a ball and a box (ball-box event) or only a ball (ball-ball event) emerged successively and repeatedly to opposite sides of a screen. Analyses revealed that during the occlusion interval infants shifted their gaze from one-half of the screen to the other in the direction of object motion, suggesting that the infants tracked the spatiotemporal coordinates of the ball or the ball and the box while they were occluded. However, ball-box infants were more persistent in showing this behavior. These results suggest that infants readily build representations of occlusion events but have more difficulty representing different-features events (which involve two objects that move on two different trajectories) than same-features events (which involve a single object that moves on a continuous trajectory). The present research sought to replicate and extend these findings.

9-month-olds (n=6) were presented with the test event displayed in Figure 1. These events were similar to those of the experiment described above except that (a) after one cycle of the event the screen was lowered to reveal only the ball at the left edge of the platform and (b) animated 2-D displays were used. An ASL 6000 eye tracker recorded infants' gaze patterns to the event.

During the occlusion interval, infants in both conditions shifted their gaze in the direction of object motion, replicating the results obtained with the 3-D displays. However, infants spent less time looking at 2-D than previously used 3-D displays. Once the screen was lowered, ball-ball infants evidenced more fixations to, and spent a significantly greater proportion of time looking at the ball (77%) than the center of

the platform (23%). In contrast, the ball-box infants evidenced similar looking patterns and fixations to the ball (47%) and the center of the platform (37%). Ball-box infants also looked at the opposite edge of the platform (17%). This shifting of gaze suggests that the infants were puzzled by the absence of the box when the screen was lowered and were visually searching along the platform.

These preliminary results suggest that eye-tracking techniques can reveal new information about the way that infants build and use representations of occlusion events. Future research will investigate the relation between visual scanning during the occlusion phase (when infants are building representations) and the no-occlusion phase (when infants are using their representations) of test events.

**Fr3-24**

### "An Eye For an Eye"? Reasoning About Reciprocated Actions in 15.5-Month-Old Infants

**Matthias Bolz**, Renee Baillargeon, David Premack
*University of Illinois, Champaign, USA*

Premack and Premack (1995) suggested that infants generally expect agents to act in accord with the maxim "an eye for an eye": specifically, they expect a reciprocated action to share the same positive or negative valence as the original action. Is this suggestion correct? The present research represents a first step toward answering this question.

Our initial experiments examined whether 15.5-month-olds could detect two different goals: in one, agent-A returned agent-B's possession (positive-valence condition), and in the other, agent-A kept agent-B's possession (negative-valence condition). In each condition, infants received familiarization trials in which agent-B brought a cookie on a plate into an apparatus, said "My cookie!" twice, and then left. While agent-B was gone, agent-A hid the cookie in one of two identical containers. When agent-B returned, she asked "Where is my cookie?", and agent-A gave her either the cookie box (positive-valence condition) or the empty box (negative-valence condition). The test events were similar except that new containers were used and agent-A simply pointed to one of the containers in response to agent-B's question. Infants expected agent-A to point to the cookie box in the positive-valence condition, and to the empty box in the negative-valence condition, suggesting that they had detected agent-A's goal in the familiarization trials.

Our next experiments asked how infants would respond if the agents switched roles in the test events: would infants expect agent-B's actions to match those of agent-A in valence, so that Agent-B returned agent-A's cookie in the positive-valence condition, but kept agent-A's cookie in the negative-valence condition? Or would they have no expectation as to how agent-B should behave?

Infants saw the same familiarization trials as before, followed by an orientation trial which signaled that the agents had switched roles: agent-A now brought a cookie into the apparatus, said "My cookie!" twice, and then left; while she was gone, agent-B hid the cookie in one of two containers, and the trial ended. The test events were similar, except that agent-A returned and asked "Where is my cookie?". Infants expected Agent-A's actions to match those of Agent-B in the familiarization trials: thus, they expected Agent-A to return the cookie if agent-B had done so earlier, and to keep the cookie if agent-B had done so earlier, and they looked reliably longer if either expectation was violated. By 15.5 months, infants thus expect a reciprocated action to share the same valence as the original action.

**Fr3-25**

### Action-Perception Progress in Tool-Use Development

**Cho Kin Cheng**, Mark Schmuckler
*University of Toronto, Toronto, Canada*

Recently, Schlesinger and Langer (1999) found that children were able to use a hook to retrieve an out-of-reach object before they could visually discriminate an impossible hook-use event from a possible one. One problem with this study, however, involves the classification of children's tool-use proficiency. Specifically, these researchers suggested that a proficient tool-user should use a hook to retrieve an object only when the object was placed inside the crook of the hook and should abandon the hook if the object was outside of the crook. Such a definition is puzzling, given that understanding that tools can be moved through space to perform their function is a critical aspect of tool-use knowledge. One consequence of this failure to acknowledge this form of tool-use behavior is that Schlesinger and Langer (1999) may have overestimated children's tool-use abilities. The aim of this study was to examine this possibility using a more comprehensive coding scheme, as well as adding an additional control condition.

Groups of 8, 12, and 16-month-old children participated in this work. In the first part of this study children used a hook to retrieve an out-of-reach toy. In two of three conditions, this hook was long and the toy was place inside or outside of the crook; children were expected to attempt to retrieve the toy in both cases. In the third condition, the hook was short, and could not encircle the toy; in this case, children were expected to abandon the hook. Children's behaviors were coded according to their ability to use the hook to retrieve the toy. The second part of this experiment was a preferential looking task in which children saw video displays of an adult using a hook to retrieve an object. Some of these displays were physically possible whereas others were not. Looking times towards these displays were recorded.

In the action condition, the "outside the crook" and "short hook" condition were significantly more difficult than the "inside the crook" condition ($F(1,22)=13.974$, $p<0.05$; $F(1,22)=7.332$, $p<0.05$ respectively). Age was also a factor, with 12-month-olds and 16-month-olds doing significantly better than 8-month-olds ($F(1,18)=8.053$, $p<0.05$; $F(1,13)=4.977$, $p<0.05$ respectively). Most importantly, none of the age groups demonstrated true competency in tool-use. For the perception task, only the 16-month-olds discriminated the possible and impossible displays. These results call into question the notion that action competencies precede perceptual abilities, and suggest that earlier findings might have resulted from overestimating infants' abilities.

**Fr3-26**

### Do 9-Month-Olds Expect Distinct Labels to refer to Kind: The Effect of Object Domain

**Kathryn Dewar**
*University of British Columbia, Surrey, Canada*

**Background:** If object labels reference kind, then infants should expect that objects marked by distinct labels should not only be perceptually different from one another, but should differ along perceptual dimensions relevant for kind membership. It has been demonstrated that, for artifacts, 9-month-olds expect objects differing in a kind relevant property (shape) to be marked by distinct labels, but they don't hold this expectation for objects differing in a property unrelated to kind (color) (Dewar & Xu, 2007). However, which features are

the relevant perceptual correlates of kind membership depends on the domain of the objects being labeled. In the artifact domain, shape determines kind membership: objects differing in shape are usually different kinds of things. However, in the food domain, color may be a more central feature than shape in determining kind. It is hypothesized that if the objects presented are food items, infants will expect objects marked by distinct labels to differ in color and not necessarily shape. The first experiment explores whether color is central for determining kind membership for food objects, while the second explores whether shape is unrelated to kind membership for food objects.

**Method:** A looking time method was employed. During familiarization, a box was opened to reveal two objects inside: either two identical food objects or two different-colored food objects (Exp. 1). Test trials followed the same procedure except, before the box was opened, the contents were described using either two distinct labels ("I see a wug! I see a dak!"), or the same label twice ("I see a zav! I see a zav!"). Nine-month-olds' looking times to the revealed object outcome were recorded. The second experiment was identical to the first, except, objects were either two identical food objects or two different-shaped food objects.

**Results:** Exp. 1 found that 9-month-old girls, but not boys, looked longer at the identical food objects upon hearing two distinct labels, and they looked longer at the different-colored food objects upon hearing one repeated label. Exp. 2 is on-going. Shape may or may not be important for determining kind membership in the domain of food.

**Conclusions:** In the domain of food, color seems a more central perceptual correlate of kind membership, but it could be that shape continues to be a relevant cue to kind. The question is whether there is a domain difference in the types of perceptual features infants use in determining an object's kind.

**Fr3-27**

### Temperament Moderates Cognitive Function at 15 Months

**Wallace Dixon, Jr.**[1] Hannah Lawman[2] Allison Lowe[3] Hannah Abel[1] Holly Stott[1]

*1. East Tennessee State University, Johnson City, USA; 2. University of South Carolina, Columbia, USA; 3. East Tennessee State University, Bristol, USA*

It is becoming increasingly clear that infants' and toddlers' temperament may play a central role in their cognitive and linguistic functioning. Research has found, for example, that at 21 months of age, children's "attentional focus" moderates the extent that environmental distractions prevent them from learning novel words or solving nonlinguistic problems. The purpose of the present investigation was to explore the extent that dimensions of temperament moderate the performance of 15-month-olds on two typical nonlinguistic problem-solving tasks in the presence of environmental distractions.

Forty-two 15-month olds visited the lab and were presented two tasks: "feed bear" and "make a rattle." Infants were familiarized with the two sets of props initially, and then were presented models of desired action sequences. Half the children experienced a distraction during the feed bear task, the remaining were distracted during make a rattle. For each task, four dependent variables were scored: number of target actions performed, variety of target actions performed, longest chain of target actions performed, and number of pairs of actions performed in order. Temperament was measured via maternal report using the Early Child Behavior Questionnaire.

Multivariate analyses revealed that children's performance varied as a function of task [F(5, 24) = 5.42, p = .001]. The distractions also attenuated the effects of the model for both feed bear [univariate Fs(1, 40) = 4.21 to 9.22, ps = .047 to .018] and make a rattle [univariate Fs (1, 40) = 4.08 to 6.08, ps = .050 to .018]. Interactions of these effects with temperament were many, but complex. For example, low intensity pleasure moderated distracter effects, but only for feed bear [Fs(1, 27) = 5.19 to 9.73, ps = .031 to .004]. In other analyses, toddlers low in perceptual sensitivity benefited more from the model than did children high on that dimension [F's(1, 28) = 3.71 to 6.67, p's = .064 to .015)]. A number of additional temperament related findings also obtained.

There is considerable reason to continue explorations into potential roles that temperament may play in infants' cognitive and language development. Results from the present study extend previous findings to the 15-month age period, which, to our knowledge, has not been investigated in previous research. The present results also suggest that roles played by temperament may be exceptionally complex, and highlight the multifaceted internal and external experiences through which children must navigate to become competent thinkers and communicators in an adult world.

**Fr3-28**

### Face-to-Face: Visual Statistical Learning with Complex Natural Stimuli

**Lauren Emberson**, **Jennifer Misyak**, Jennifer Schwade, Morten Christiansen, Michael Goldstein

*Cornell University, Ithaca, USA*

It is well established that statistical learning (SL) is a powerful mechanism by which infants can extract structure from their environment. While there have been reports of auditory SL in infants using biologically-relevant (e.g., speech) and non-biologically-relevant (e.g., tones) stimuli, there have only been reports of visual SL using simple non-biologically-relevant stimuli (e.g., geometrical shapes: Fiser & Aslin, 2002; Kirkham, Slemmer & Johnson, 2002). The present study therefore examines infants' SL of patterns across visual stimuli that are both biologically-relevant and complex.

In this study, we presented twelve 9-month-olds with photos of female, Caucasian faces grouped into sequential pairs (bigrams). The bigrams were displayed in random order during an infant-controlled habituation task. Each face was presented for 1 second without pauses between faces or bigrams, creating a continuous stream of faces. Thus, transitional probabilities were the sole cue to face pairings. Upon meeting the habituation criterion or maximum number of habituation trials (12), infants were presented with two types of test sequences. Both consisted of the same face stimuli as during habituation. Familiar sequences preserved the bigrams from habituation; novel sequences presented faces in random order, not in bigrams.

Infant preference was assessed with looking time. Infants reliably discriminated test patterns, showing an ability to learn statistical patterns in face sequences. A two-way ANOVA revealed a significant interaction between test trial and habituation status (i.e., whether an infant met the habituation criterion), $F(1,10)=17.798$, $p=0.002$. All infants who habituated to the face bigrams (n=7) demonstrated a familiarity preference (Wilcoxon Signed Ranks: $T=0$, $p=0.016$, $r=-.63$). Habituated infants looked significantly longer at familiar sequences, $t(6)=-5.231$, $p=0.002$. Infants who failed to habituate (n=5) tended to look longer at novel sequences, although this preference was only marginally significant (Wilcoxon Signed Ranks: $T=0$, $p=0.062$, $r=-.64$), with no corresponding significant difference in looking time, $t(4)=1.934$, $p=0.125$.

Thus, infants discerned statistical information from biologically-relevant visual sequences, even using a stimuli set as complex but perceptually similar as Caucasian female faces. This is the first demonstration of infant SL across faces as perceptual units. While there have

been recent claims of the privileged role of biologically-relevant stimuli in infant perception and cognition (e.g., Marcus et al., 2007), the effects of biological relevance and stimulus complexity on SL have not been systematically differentiated. The present study is a first step in rigorous examination of the contribution of factors such as complexity, biological-relevance, and modality in infant SL.

**Fr3-29**

### A Discourse-Based Account of Young Children's Understanding of Three False Belief Problems

**Mikkel Hansen**

*Department of Psychology, Roskilde University, Roskilde, Denmark*

**Background and Aims:** Children's understanding of false belief is crucial to their theory-of-mind development. On a common false belief task, children see a puppet hide some cookies in one location. Another puppet surreptitiously moves the cookies. Children are then asked where the first puppet believes the cookies are. Children below 4 1/2 years typically fail this task saying that the first puppet believes the cookies are in their real location (Wimmer & Perner, 1983). The standard explanation is that younger children do not understand that beliefs can differ from reality.

I propose an alternative discourse-based account of 3-year-olds' difficulties: A third person's belief about reality--reported with expressions like says, thinks, and believes--is interpreted in the context of what is shared knowledge among the speakers. Ordinary context: The listener needs knowledge about reality. A statement about a third person's belief about reality will be interpreted as relevant to this need. Thus, the belief will be interpreted as a likely true representation, e.g., "Where are the cookies?" "Jill thinks they are in the fridge." Conditional context: Both speakers share knowledge about reality. A speaker's statement about a third person's belief about reality is redundant--a violation of Grice's maxim of quantity--unless it is interpreted by implicature as referring to a false representation, e.g., "We know the cookies are in the cupboard, but Jill thinks they are in the fridge."

**Methods:** To clarify the context of the test question, "What does X think?" three types of false belief tasks emphasized the conditional context by asking, e.g., "You and I know the ball is in the blue bucket, where does X think it is?" The tasks were the location false belief task, the unexpected contents task and the representational change task.

**KeyResults:** Once the conversational context clearly implicated false beliefs, 135 3 year-olds in all three tasks passed the modified false belief tasks (at 64% correct answers) while they failed the standard versions of the tasks (at 15% correct answers). Control tasks ensured that children were not using alternative response strategies. $F(2, 126) = 51.36$, $p<.001$.

**Conclusions:** Contrary to current theories, 3-year-olds appear to have the conceptual foundation needed to distinguish reality from mental representations. Three-year-olds' failure on the false belief task may not be due to lack of understanding of beliefs, but to the pragmatics of third-person belief statements and young children's need for clarity about what is shared knowledge.

**Fr3-30**

### Gender Differences in Infant Tool Use

**Elizabeth Hodgson**, **Erika Feldman**, Jessica Sommerville

*University of Washington, Seattle, USA*

**Introduction:** The nature and existence of gender differences in mathematical, spatial, and causal reasoning is a contentious debate. Tool use involves a number of these skills and is one domain in which gender differences have been found. In prior work male children spontaneously used a tool to retrieve an out-of-reach toy more than females, but both performed equally after a hint to use the tool (Chen & Siegler, 2000; Gredelin & Bjorklund, 2005). Whereas some view gender differences in motivations as innate (Baron-Cohen, 2003) or genetically determined (Geary, 1998), others suggest that they are the product of socialization (Spelke, 2005). Thus, a critical question is when gender differences in tool use emerge in development.

**Methods:** Infants (30 females, 26 males) were trained to use a cane to retrieve an out-of-reach toy until they successfully used the cane three out of four times in a row. Infants received praise for obtaining the toy. On test trials infants selected between two novel tools, a rigid and floppy cane, only one of which functioned to retrieve the out-of-reach toy. No praise was given during this portion of the study. We coded two main dependent variables: infants' selection of the rigid cane and their use of social strategies like gesturing towards the experimenter.

**Results:** Although there were no gender differences in terms of the total number of selections for the rigid cane, a repeated measures ANOVA found a significant interaction between gender and performance across problem-solving trials, $F(1,51)=16.21$, $p<0.04$. While female performance declined across trials, male performance improved. On the first trial, females performed significantly better than males, $F(3,52)=2.93$, $p<0.04$; $R^2=0.59$. On average females were more likely to gesture than males, $F(1,53)=-0.11$, $p< 0.12$; $R^2=0.13$. There was a trend wherein females increased their gestures to the experimenter between the first and second half of the test trials $t(29)=1.843$, $p<0.75$. No such difference was found in male gestures.

**Conclusion:** Results suggest that while there were no gender differences in infants' overall tool use performance, the profiles of success over multiple trials varied as a function of gender. Females may find the social aspects of the experiment motivating, as evidenced by their attempts to engage the experimenter after she gave them no feedback on the first trial, while males may have been more interested in exploring the novel tool during early trials.

**Fr3-31**

### Infant Working Memory For Objects Has Two Distinct Capacities: Individuation and Identity

**Melissa Kibbe**, Alan Leslie

*Rutgers University Center for Cognitive Science, Piscataway, USA*

**Background and Aims:** Previous research has shown that infants' visual working memory (WM) capacity for objects appears to increase over the first year of life, from one object at 6 months to three objects at 12 months (Ross-Sheehy, Oakes, & Luck, 2003; Leslie & Káldy, 2007). However, other evidence suggests that infants are able to keep track of multiple objects, without necessarily any identifying information, and that this object-tracking capacity does not seem to change over the first year of life (Feigenson, Carey, & Hauser, 2002; Feigenson & Carey, 2003). This apparent contradiction in findings prompted us to

attempt to tease apart WM for individuated objects and for object identities in infants.

**Methods:** We adapted the violation-of-expectation method used by Káldy & Leslie (2003, 2005) so that WM for object identities was disambiguated from WM for the individuated objects themselves. We asked whether 6-month-olds could remember the existence of two objects even though previous research has shown that they can remember the identity of only one object. We hid two different objects (a disk and a triangle) each behind its own screen, and then raised the screen that hid the harder-to-remember first hidden object, revealing that it had vanished. Six-month-old infants looked significantly longer at this condition than at a control condition.

We then asked whether 9-month-olds were able to remember the identities of two objects when required to pay attention to the identities of three objects. We hid three different objects (a disk, a triangle, and a square), sequentially each behind its own screen, then revealed that the second-hidden object had been swapped with the hardest-to-remember first object. We found that infants did not look longer than controls at this identity change, suggesting that Káldy and Leslie's infants remembered two individuated objects together with the specific identity of only one of those objects. Our more rigorous test suggests 9-month-olds remember the specific shape of the (easy) last-hidden object plus only that the second-hidden object has a different (but unspecified) shape.

**Conclusions:** Our results augment current literature to show that both six-month-olds and nine-month-olds are able to keep track of at least two objects, but have a more limited capacity to remember features of those objects. This suggests that memory capacity for object features increases over the first year of life, whereas the number of objects that can be remembered does not. Thus infant object working memory may have two distinct capacities.

**Fr3-32**

### Seven-Month-Old Infants Imitate Animate But Not Inanimate Agents

**Neha Mahajan**[1] Amanda Woodward[2] Leianna Ridgeway[2]

*1. Yale University, New Haven, USA; 2. University of Maryland, College Park, USA*

Recent findings indicate that infants understand goal structure in others' actions. Most evidence for infants' goal-detection comes from habituation studies, which leaves open the question of whether infants' goal-detection appears outside of their visual responses to habituation events. Further, researchers disagree as to when and whether infants ascribe intentions nonhuman entities. Older infants interpret the movements of abstract or inanimate objects as goal-directed (Kuhlmeier et al., 2003; Gergely et al., 1995), but this response is not always evident in younger infants, even in situations in which they respond to human actions as goal-directed (Biro & Leslie, 2006; Woodward, 1998).

We address these issues by testing infants' sensitivity to others' goals in an imitation task, and assessing whether infants are as likely to imitate the goals of nonhuman agents as they are to imitate human goals. Older infants selectively reproduce goal-directed actions. (Carpenter et al., 1998; Meltzoff, 1995). Hamlin et al. (in press) recently demonstrated that 7-month-olds also do so. In the current studies, we used this paradigm to test infants' responses to human actions versus closely matched inanimate object motions. The experimental events resembled those from Luo and Baillargeon's (2005) looking-time study in which 5-month-old infants responded to the movements of an inanimate object (a self-propelled box) as goal-directed.

In Study 1, we showed 7-month-olds a goal-directed action toward one of two objects, executed by a hand or a "self-propelled" box. Infants imitated the hand's goals (64% of the time, $p<0.001$), but not the box's (44% of the time, $p=0.15$). Performance in the two conditions differed reliably ($p<0.001$). To address potential concerns that the setup was confusing to infants in the box condition (as in Hamlin et al., the experimenter was making vocalizations during the events), in Study 2 the experimenter was occluded entirely and instead of human vocalizations, a squeaky toy drew the infant's attention to the events. As in Study 1, infants reproduced the hand's goals (66% of the time, $p<0.001$) but not the box's (48% of the time, $p=0.57$). Performance in the two conditions differed reliably ($p<0.003$).

These results provide further evidence that 7-month-olds' goal representations are sufficiently robust to drive their own manual actions. However, they indicate that infants' responses to inanimate object movements may not be robust in this way. Although infants responded visually to the goal structure of the object's movement (Luo & Baillargeon, 2005), infants here did not reproduce the box's goal.

**Fr3-33**

### The Role of First-Hand Experience in the Goal-Attribution of 6-Month-Olds

**Su-jeong Ok**[1] Susan Johnson[2]

*1. Stanford University, Palo Alto, USA; 2. Stanford University, Stanford, USA*

Over the last decade researchers have converged on the view that infants have the ability to attribute goals to others by the end of the first year. There is less consensus on how they come to do so. Many researchers have proposed that first-person experience is the cornerstone upon which this ability is built (e.g., Meltzoff, 2007; Sommerville et al., 2005). Others have argued that infants are sensitive to relevant action characteristics, even without personal experience (e.g., Gergley et al. 1995; Johnson, 2003). The current study tested this second hypothesis. Specifically, we hypothesized that (1) 6-month-old infants would be able to attribute goal-directedness to an adult walking toward a target object even though the infants themselves had never walked, and (2) infants performance would be improved by adding redundant cues to the action, specifically that infants would be more likely to attribute goal-directedness to an approach action if the action included unambiguous, perceptually-guided behavior (i.e., a walker approaching a target by navigating around an obstacle), than if it involved approach alone (i.e., a walker approaching a target via a straight, unimpeded path.)

Thirty-three 6-month-old infants were tested in a visual habituation procedure. None of the infants could self-locomote by walking; 2 could crawl. Infants in a Straight Approach condition were habituated to a video of an adult actor walking straight toward one of two possible target objects. Infants in a Detour Approach condition saw the same event, except that the actor had to detour around a large obstacle to reach her target. In test trials, the position of the target objects was reversed and the actor approached each in turn, thus creating new-goal/old-location and old-goal/new-location test events. No obstacles were present in the test trials.

The results supported the hypotheses. An analysis of variance with test trial (new vs. old goal), condition, and gender as variables revealed a main effect of test trial. Across both conditions, infants looked significantly longer at the new-goal test trials than the old-goal test trials, $F=5.62$, $p < .03$, even though none of the infants could walk and only two could self-locomote. A marginal test trial by condition by gender interaction also suggested that the additional information in the Detour condition helped the males interpret the action as

goal-directed, F=3.75, p<.07. Females appeared not to need the extra information, showing the same pattern of success in both conditions.

**Fr3-34**

### Infant and Mother Play in South Korea: A Longitudinal Study across the Second Year of Life

Keumjoo Kwak[1] **Diane Putnick**[2] Marc Bornstein[2]

*1. Seoul National University, Seoul, Korea; 2. NICHD, Bethesda, USA*

**Background and Aims:** Play is a predominant individual and social activity of early childhood and has been related to young children's early cognitive growth, social development, and preparation for formal schooling. Korean values emphasize group harmony and cooperation which may influence children's symbolic play. We examined individual differences and developmental changes in South Korean infant and mother exploratory and symbolic play longitudinally when infants were 13 and 20 months of age.

**Method:** 44 South Korean mothers and their firstborn children, 22 boys and 22 girls, were observed twice, once when the infant was 13 months and again when the infant was 20 months. A female researcher audio/videorecorded children and mothers in the home for two 10-min play sessions: a child solitary play session and a collaborative play session with mother. From those records, child and mother exploratory and symbolic play were coded in accordance with a mutually exclusive and exhaustive category system that included 4 levels of exploratory play, 4 levels of symbolic play, and a default (no play) category.

**Results:** Infants engaged in less exploratory and more symbolic play when playing collaboratively with their mothers than when playing alone. Infants engaged in more symbolic play at 20 months than 13 months. Child solitary and collaborative symbolic play were modestly stable across time, but child exploratory play and maternal play were not stable. Child solitary and collaborative symbolic play were correlated across the two ages. Child and mother play were regularly associated at the two ages, and 13-month maternal play predicted 20-month child collaborative play.

**Discussion and Conclusions:** Our results provide evidence of both general play development and Korea-specific infant-mother play and interaction. Korean mothers tend to think that play offers the chance to communicate and to interact with their children (Lee, 2000; Moon, 1996). South Koreans have high expectations for their children's achievements, and they believe that they play an important role in promoting their children's success. This study affirms the cross-cultural validity of play, and implies that individual differences and age-related changes in child and mother play are partly mediated by matched partner play and partly motivated by processes independent of partner play.

**Fr3-35**

### Infants' Use of Labels and Causal Powers to Individuate Identical Objects

**Mijke Rhemtulla**, Fei Xu

*University of British Columbia, Vancouver, Canada*

Previous studies have shown that infants can use labels as a cue to individuate objects. Nine-month-old infants, who cannot use perceptual differences between different kinds of objects (e.g., a duck and a truck) to individuate them, succeed at individuation when two distinct labels are given to those same objects (Rivera & Zawaydeh, 2006; Xu, 2002). This research asks two related questions stemming from previous work: First, can 9-month-old infants use words alone to individuate objects, in the absence of perceptual differences? And second, do the causal powers of objects share the status of labels in the conceptual scheme of a young infant? Some studies have shown that 3-year-old children can use causal powers for categorization (Gopnik & Sobel, 2000). If infants believe that distinct objects have distinct causal powers, they may be able to use causal information about objects to individuate, in much the same way that they use words.

Infants were randomly assigned to either the *word* condition or the *cause* condition. In both conditions, infants were familiarized to an event in which a single object emerged from behind an opaque screen, first from one side, then from the other. In the *word* condition, each time the object emerged, it was placed on a box in front of the screen, and labelled (e.g., "Look, a dax! See? A dax!"). With each alternating emergence, the object was given one of two *different* labels. In the *cause* condition, the labelling event was replaced with a causal event: two effects occurred, each on alternating emergences- a speaker in the box played music, or flowers on the box spun. This familiarization scenario is ambiguous: there could either be one object behind the screen, or two identical-looking objects. If infants take two labels (in the *word* condition) or two causal powers (in the *cause* condition) to indicate two distinct objects, then they should expect there to be two objects behind the screen. The familiarization phase was followed by 6 test trials, in which the screen was removed to reveal either a single object, or two identical objects. Infants' looking times were recorded.

Preliminary data (N = 14) suggest that infants can use words but not distinct causal powers to individuate identical-looking objects; they looked longer at the one-object outcome than the two-object outcome in the word, but not the cause, condition. At this age, object labels may have a privileged status in individuating objects.

**Fr3-36**

### Shape vs. Color: Examining Perceptual Categorization Biases in 6- and 8-Month-Old Infants

**Valerie San Juan**[1] Suzanne Curtin[2]

*1. Department of Human Development and Applied Psychology, OISE/University of Toronto, Toronto, Canada; 2. Departments of Psychology and Linguistics, University of Calgary, Calgary, Canada*

**Background:** Previous research has demonstrated a shape bias in young children's object labeling (Landau, Smith, & Jones, 1988). It is currently unknown, however, whether this bias to generalize according to shape similarities is dependent on children's concurrent language development (Smith, Jones & Landau, 1996) or whether it is due to children's early understanding of shape as a useful indicator of object kind (Diesendruck & Bloom, 2003). We addressed this issue by examining infants' perceptual biases prior to their acquisition of language. Specifically, we examined whether 6- and 8-month old infants demonstrate a preference to categorize and form expectations about novel objects based on shape vs. color similarities.

**Methods:** Thirty-five 6-month-olds and 29 8-month-olds participated. Procedures were identical for both age groups and infants were randomly assigned to one of two object category conditions: Same Shape or Same Color. Infants were initially habituated to a set of three novel objects that were identical along one perceptual dimension (e.g., same shape or same color) but different along another (e.g., different color or different shape). During habituation, objects were also consistently associated with a specific movement trajectory (e.g.,

moving towards the top right corner of the screen) so that associations between a given object set and its movement could be formed. Following habituation, infants were then presented with 5 test objects that varied in similarity with the habituated set: (1) Perceptually Identical/Same Movement, (2) Perceptually Similar/Same Movement, (3) Perceptually Similar/Different Movement, (4) Perceptually Dissimilar/Different Movement, and (5) Perceptually Dissimilar/Same Movement. Infants' looking times to test objects were recorded and used as a measure of categorization and movement expectations.

**Results and Conclusions:** Six-month-old infants showed a preference to categorize novel objects based on shape similarity but did not use this information to form expectations about object movement. Infants in the Same Shape condition were more likely to attend to objects that were perceptually dissimilar from the habituated set (i.e., different shape) than infants in the Same Color condition, but were not surprised when perceptually similar objects moved in an unexpected direction. Conversely, 8-month-old infants were equally likely to categorize objects based on shape or color similarities but only formed expectations about object movement when objects shared a common shape. These findings suggest that a shape bias in categorization may be present in infants early on but the ability to form expectations about perceptually formed categories may be influenced by age and experience.

**Fr3-37**

### Twelve-Month-Olds' Understanding of Prior Actions and Final Goals

**James Todd**

*University of Toledo, Toledo, USA*

**Background and Aims:** By 12 months of age, infants appear to infer that a sequence of multiple actions can be directed towards the goal of obtaining a single object (e.g. Woodward & Sommerville, 2000). To do so, infants may use prior actions (e.g. reaching for an object) to predict final outcomes (e.g. obtaining an object; Elsner, 2007). In the current study, after being habituated to an actor who grasped and picked up one of two objects, 12-month-olds viewed test events in which the actor either picked up the same object selected during habituation (familiar) or picked up the one ignored during habituation (novel), using either familiar or novel grasping actions.

**Method:** Forty-eight 12-month-olds participated. Infants were habituated to a series of trials, each of which presented an actor who grasped one of two objects present, was concealed by a curtain, and was then presented holding the previously-grasped object. After habituation, infants were shown 3 test trials. These differed by condition and were presented between-subjects. During test trials, the actor used either a *familiar* action to grasp a *novel* object, a *novel* action to grasp a *novel* object, made *no prior contact* with a *novel* object, or used a *novel* action to grasp a *familiar* object. Similar to habituation trials, the actor was always shown holding the object grasped prior to the curtain's closing. A single recovery trial was presented to assess fatigue.

**Results:** Recovery of looking time to test events differed by condition. When the actor was presented holding a new object at test, infants significantly increased their looking times regardless of whether the type of prior grasping action was familiar or novel. However, when there was no prior contact between action and object, infants did not increase their looking to test events even though a new object was held. Further, when the actor used a novel prior action to grasp the same object grasped during habituation, infants significantly decreased their looking. Infants in all conditions significantly increased looking to the recovery trial, indicating there was no fatigue.

**Conclusion:** The results indicate that infants are sensitive to the type of action used in obtaining an object and increase looking whenever a novel object is obtained as long as there is contact involved. Thus, by 12 months of age, infants expect certain prior actions to result in final goal states and understand the causal role actions play in determining the final outcomes of action.

## *Communication and Language*

**Fr3-38**

### The Development of Pointing From 9 to 15 Months of Age in Imperative and Declarative Contexts: Relationships with Actions and Language

**Tiziana Aureli**[1] Paola Perucchini[2] Annalisa Palazzo[1]

*1. University of Chieti-Pescara G. D'Annunzio, Chieti, Italy; 2. University of Rome Roma Tre, Rome, Italy*

**Background and Aims:** Researchers agree to distinguish two types of pointing: the imperative, to obtain a desired object or action from the partner, and the declarative, to share with the partner attention and interest about an object/event in the world. However disagreement exists about the sociocognitive abilities involved in either type of pointing as well as about the ontogenetic sequence of their emergence. Moreover, no study was carried out to investigate other possible differences between them, with respect to their respective origins and role in linguistic development. These questions are addressed by the present study.

**Method:** 18 infants were followed longitudinally from 9 to 15 months of age. Children were tested monthly on a task designed to elicit pointing in imperative and declarative contexts (Camaioni et al., 2004). Experimental sessions took place in a laboratory room equipped with two remotely controlled cameras and were videotaped. All actions, gestures, facial expressions, vocalizations produced by the children during the task trials were transcribed and coded. Expressive and receptive language were evaluated at 15 months through the Italian version of Mac Arthur-Bates Communicative Development Inventory.

**Results:** Preliminary analyses of actions and gestures at 9 and at 12 months showed that "banging the hand" was the predominant action at 9 months in both contexts, whereas it predominated only in the declarative context at 12 months; "index-finger extension" was the predominant gesture at 9 months in both contexts and continued to predominate a 12 months only in the declarative context, together with "pointing"; instead, at the same age "pointing" and "reaching" were the most frequent gestures in the imperative context. Six infants started to point at the same age in imperative and declarative contexts; four infants first pointed in imperative and then in declarative context; three infants first pointed in declarative and then in imperative context. Finally, word production at 15 months was predicted by imperative pointing at 9 months and by declarative pointing at 12 months.

**Conclusions:** Imperative and declarative contexts promoted different developmental pictures of infants' behaviours, both in motoric and communicative repertoire. In particular, at 12 months, pointing was associated with reaching in imperative context, and with index-finger extension in declarative context. Moreover, individual differences were found with regard to the ontogenetic sequence of pointing in the two contexts. Finally, imperative and declarative pointing differed in the predictive relationships with language. Implications for a context-driv-

en development of pointing and for the complexity of the association between prelinguistic and linguistic systems are discussed.

**Fr3-39**

### Coordination of Mother-Infant Vocalizations in Ten Cultures

Marc Bornstein, **Linda Cote**, O. Haynes
*Child & Family Research, NICHD, NIH, DHHS, Bethesda, USA*

**Introduction:** Maternal responsiveness to infant vocalization has been theorized to be an important elicitor of infants' vocalizations and facilitator of children's later language development (Beckwith & Rodning, 1996; Bloom, 1975; Hsu & Fogel, 2001, 2003; Murray, Johnson, & Peters, 1990; Tamis-LeMonda, Bornstein, & Baumwell, 2001; Weisberg, 1963). However, most research exploring these links has done so with European American mother-infant dyads in the United States. Thus, the coordination of mother and infant vocalizations during naturalistic interaction in ten cultures was examined using correlational and sequential analytic techniques. Correlations provide information about associations between partners' behaviors. Sequential analyses explore the sequencing and contingency of mother-infant behaviors in real time.

**Methods:** Mothers and their 5-month-olds from Argentina (n = 100), Brazil (n = 56), Belgium (n = 82), France (n = 57), Italy (n = 89), Israel (n = 30), Kenya (n = 26), Japan (n = 51), South Korea (n = 53), and the United States (n = 100) were videorecorded in naturalistic interaction at home for 50 min. Two behaviors were coded: Mothers' speech to infants and infants' nondistress vocalizations. Interrater reliabilities were acceptable for each country (κs ≥ .62). The proportion of time that mothers and infants vocalized was computed. In addition, GSEQ (http://www.ub.es/comporta/sg.htm) generated two odds ratios for each dyad: the likelihood that mothers' vocalizations began within 2 sec of the offset of their infants' vocalizations, and the likelihood that infants' vocalizations began within 2 sec of the offset of mothers' vocalizations.

**Results:** Mother and infant vocalizations were not related in any country (Pearson *r*s = -.14 to .17). However, one sample *t*-tests revealed that infant nondistress vocalizations were significantly contingent on their mothers' speech (i.e., mean odds ratios were significantly greater than 1.00, $p < .05$) for Argentine, Brazilian, Italian, Japanese, Kenyan, South Korean, and U.S. dyads (Cohen's *d*s =.23 to .68), and in all countries maternal speech was significantly contingent on infants' nondistress vocalizations (Cohen's *d*s ≥ .32).

**Conclusion:** Sequential analyses indicated that mother and infant vocalizations were coordinated in real-time, even though they were uncorrelated. Maternal vocalizations were contingent on infant vocalizations in all cultures and the reverse was true in some cultures, suggesting that mothers universally respond to their infants' vocalizations by talking to their infants, but that infant responsiveness to maternal vocalizations may be culturally mediated.

**Fr3-40**

### Canonical Word Order in Japanese Infant-directed Speech

**Laurel Fais**[1] Tomoya Hashimoto[2] Nozomi Kido[1] Shigeaki Amano[3] Janet Werker[1]
*1. University of British Columbia, Vancouver, Canada; 2. Osaka City University, Osaka, Japan; 3. NTT Communication Science Laboratories, NTT Corporation, Kyoto, Japan*

**Background and Aims:** While a great deal is known about the acoustic properties of infant-directed speech (e.g., Fernald et al. 1989), much less is known about the syntactic structures that infants hear (e.g., Snow 1972), and even less about structure in Japanese infant-directed speech. Canonical word order in Japanese is Subject-Object-Verb (SOV); however, this structure is often violated in adult-directed speech (Ono & Suzuki 1992). Our goal in this study was to determine whether SOV word order is maintained in speech to Japanese infants, by examining whether the part-of-speech of the final content word is noun or verb.

**Methods:** Spontaneous infant-directed speech of one mother to her child (SA) was recorded as part of the NTT Japanese infant speech database, when SA was 0 to 36 months of age. Transcriptions were labeled for part-of-speech, including nouns, verbs, greetings, particles, etc. Japanese utterances often end in pragmatic particles that convey speaker certitude or affect. For that reason, counts of parts-of-speech of utterance-final content words were made both for final words and for immediately pre-final-particle words. Separate counts were made for multi-word and one-word utterances.

**Results:** In all conditions, the proportions of nouns and verbs in final position differed widely in multi-word vs. single-word utterances. In multi-word utterances with final particles, verbs ended a higher proportion of utterances than nouns (average 37% and 24%, respectively); the difference was even more pronounced for utterances excluding final particles (48% and 17%). In contrast, one-word utterances with and without particles were predominantly nouns (with particles: nouns 54%, verbs 16%; without particles: nouns 45%, verbs 17%).

**Conclusion:** Infant-directed multi-word utterances end in verbs more often than nouns, conforming to the canonical SOV order for Japanese. However, results also show a substantial proportion of utterances ending in nominal arguments: verbs occur at the ends of utterances in less than half of multi-word utterances, and are far outnumbered by nouns in one-word utterances. While SA's mother does model SOV word order in her speech to SA, she may also use non-canonical order to increase the salience of nominal arguments in much the same way that Japanese adults use post-predicate material to provide specification or emphasis (Ono & Suzuki 1992). The comparison of the use of nouns in multi- and one-word utterances also sheds light on noun bias in Japanese IDS (Miyata et al. 2003; Ogura et al. 2006).

**Fr3-41**

### A Longitudinal Analysis of Changes in Vocabulary Comprehension: Do Parent Reports and Preferential Looking Offer Complementary Perspectives?

**Margaret Friend**, Yuri Kashima, Erin Schultz
*San Diego State University, San Diego, USA*

**Background and Aims:** The present research explores a Preferential-Looking (PL) approach to the predictive assessment of language development. One limitation noted in using parent report instruments such as the MCDI for prediction is wide variability in parent estimates across infants. The present research asks whether this variability exists

in infant behavior as well as in parent reports. Further, this research seeks to confirm expected age-related change in vocabulary at the group level by using a longitudinal design. We assessed infant language comprehension using parent report and a PL task. The use of both parent report and infant performance measures in a longitudinal design allowed us to assess the stability of both estimates from 12 to 16 months of age. Further, we used two parent report instruments to calculate parent confidence in their estimates of specific vocabulary knowledge.

**Method:** Thirty-one caregiver-infant pairs participated over a 4-month period at 12, 14, and 16 months of age. Caregivers completed the MCDI and the Comprehension Book (CB) measure at each wave. Comprehension on the PL task was measured using latency and duration of fixation to a referent following a prompt. Trials were considered valid if infants looked at both screens during baseline. In addition, inconsistency across the parent report measures was examined as a measure of parent confidence in their endorsements of infant word-level comprehension.

**Results:** Both parent report measures evinced significant increases in infant vocabulary across age and predictive validity from 12 months to 14 and 16 months. Similar changes with age were observed on the PL task. In addition, PL latency was predictive from 12 months to 14 and 16 months. Of particular interest was the marked variability in the individual data across measures. Importantly, in the PL task, infants showed reduced latencies and longer fixations across waves for words that appeared to be newly emerging on the basis of parent report.

**Conclusion:** Parent report and infant performance produce comparable pictures of age-related changes in comprehension. However, both approaches yield marked individual variability limiting predictive assessment. This variability in the PL task can be accounted for, in part, by parent inconsistency in reporting infant comprehension. Words on which parents produce inconsistent report are fixated more quickly and for greater durations than words for which report is consistent across instruments. This suggests that, from 12 to 16 months, infants may attend preferentially to word-referent mappings that are newly emerging.

**Fr3-42**

### Evaluation of a Dialogue Topology in Parent- Infant- Dyads

**Ursula Horsch**, Julia Roth, Andrea Scheele, Sarah Werding, **Monika-maria Goeser**
*University of Education, Heidelberg, Germany*

**Background and Aims:** From the very first days of life parents get in close contact with their infant and introduce both people and their world to the newborn in a mutually dialogical way. Proceeding hand in hand they pass on basic dialogical competence. Knowing about the processes that set the stage for early learning is fundamental for any scientific evaluation which in turn is extremely important for counselling parents and developing educational programs. The research project »Dialogical Development of Infants« (Horsch et al. 2004) aims to document and describe the context for developing relationship, dialogue and early education.

**Methods:** The empirical data is derived from a longitudinal study during the first 18 months of an infant's life. Data is collected monthly by video taping in the natural setting. Participants in Germany (n=97) are: normally developing infants (n=73), infants with hearing loss (n=8), premature infants (n=8), and infants with Down Syndrome (n=8). Computerized analysis (Interact Mangold international) is used for the evaluation of the data in order to study correlations among dialogic variables.

**Results:** The results from the non-handicaped infants demonstrate a negative correlation of greeting behaviours with the dialogic echo of the parent (r= - 0.30) and the infant's vocalizations (r= - 0.34). Furthermore the greeting behaviours correlate with the use of motherese / fatherese (r=0.87). This correlation is highly significant (p= 0.0051**). Another significant correlation exists between the infant's vocalization and the dialogic echo of the parent (r= 0.82; p=0.0126*).

The results of handicaped infants refer to different correlations that will be discussed at the poster session.

**Conclusions:** The dialogic developmental steps will be presented and discussed as they are embedded in the development of infant- parent relationship. Preliminary results from this project demonstrate that handicaped infants have competencies to initiate and to respond to dialogic offers comparable to normally developing infants. The same is true for parents of infants who are handicaped. However we also found that some parents are unable to exhibit dialogic behaviours and to enter the dialogue with their handicaped infant.

**Fr3-43**

### Generics and Inductive Inferences at Two Years of Age

Samantha Nayer, **Susan Graham**, Natasha Nickel
*University of Calgary, Calgary, Canada*

**Background and Aims:** Generic language is an important mechanism for efficiently learning about kinds. In Study One, we examined whether generic language would guide 30-month-olds' inferences about novel kind properties in a rich context versus a less rich context. In Study Two, we examined whether generic language would guide 24-month-olds' inferences in a rich context.

**Methods:** In Study One, 30-month-olds were administered an inductive inference task. During the baseline phase, infants explored two novel exemplars and an accompanying prop (e.g., blue blick, orange blick, and toy cup). During the demonstration phase, the experimenter demonstrated a target action with a model exemplar (e.g., blue blick, drinking motion with the cup), accompanied by either a generic utterance (e.g. "Blicks drink milk") or a non-generic utterance ("This blick drinks milk"). During the generalization phase, the experimenter re-introduced the two exemplars (model: blue blick; non-model: orange blick) and the prop. In the reminder group, the experimenter encouraged the infant to imitate the target action by repeating the generic or non-generic utterance (e.g., "Can you show me: blicks drink milk?"). In the no reminder group, the experimenter encouraged imitation with a general phrase in both groups (e.g., "Show me sip...sip"). In Study Two, 24-month-olds were administered the same inductive inference task as the reminder group in Study One.

**KeyResults:** In Study One, at generalization, 30-month-olds in the non-generic condition performed significantly more target actions with the model (M = 5.23) compared to the non-model (M = 4.02), $t(47) = 2.41$, $d = 0.42$, $p < .05$. Infants in the generic condition performed an equivalent amount of target actions with the model (M = 4.29) and non-model (M = 5.02). There were no effects of group (reminder vs. no reminder). In Study Two, at generalization, 24-month-olds imitated equally as often with both the model and non-model exemplars in the generic and non-generic conditions.

**Conclusions:** 30-month-olds interpreted the non-generic utterance as implying that a property was characteristic of the model. In contrast, 30-month-olds interpreted the generic utterance as indicating that the property was generalizable beyond the model to other exemplars. Furthermore, the presence or absence of a reminder statement

did not influence 30-month-olds' imitative behavior, suggesting that 30-month-olds learned about the generalizability/nongeneralizability of the property during the demonstration phase. Finally, unlike 30-month-olds, 24-month-olds were not sensitive to generic language to guide their inductive inferences about the properties of novel kinds.

**Fr3-44**

### Japanese Infants' Perception of the Function Morpheme, Ga, Which Marks the Morpho-Syntactic Boundary

Sachiyo Kajikawa[1] **Etsuko Haryu**[2]

*1. Tamagawa University, Machida, Japan; 2. University of Tokyo, Tokyo, Japan*

**Background and Aims:** Function morphemes or functors play an important role in recognition of speech, such as finding the morpho-syntactic boundaries. Previous studies have shown that young infants are sensitive to function morphemes (Gerken et al., 1990; Höhle & Weissenborn, 2003), although function morphemes are generally less prominent than lexical words in perception. The Japanese functor ga marks the subject, and it can be omitted without changing the meaning of the sentence. For example, the meaning of "Kame (turtle) ga (subject-marking functor) aruite-iru (is walking)," is not altered when ga is dropped, as in, "Kame _ aruite-iru". On the other hand, replacing ga with a non-functor syllable, e.g., ra, as in, "Kamera (camera) aruite-iru," changes the meaning. Therefore, Japanese infants not only need to detect functors in speech, but also should recognize that some functors can be omitted without altering the sentence meaning. This study explored the developmental process of recognizing the functor ga in Japanese infants.

**Methods:** Japanese infants aged 6, 10, and 15 months were tested using a modified habituation paradigm. During the habituation phase, the infant was repeatedly presented with the standard sentence using nonsense words as the subject and the verb, "Rume (S) ga muwatte-iru (is V-ing) yo (final particle)," which was accompanied with a red-black checkerboard pattern on a display. Immediately after the habituation phase, three test trials started; (a) the standard sentence, (b) the functor-dropped sentence, i.e.,"Rume _ muwatte-iru yo," and (c) a sentence in which the functor ga was replaced with a non-functor syllable, i.e., "Rume ki (non-functor syllable) muwatte-iru yo." The dependent variable was the time that the infant looked at the checkerboard when each of the three test stimuli was presented.

**Results:** Six-month-olds did not respond differently to the three test stimuli, suggesting that they could not detect the functor in the speech. Ten-month-olds reacted only when the functor was dropped, suggesting that they might process speech mainly relying on prosodic information. In contrast, 15-month-olds responded only to the replacement of the functor with a non-functor syllable. Namely, they seem to know that ga can be dropped from the sentence without changing the sentence meaning, while its replacement with a non-functor syllable does make a difference to lexical segmentation of the sentence.

**Conclusion:** By 15 months of age Japanese infants become able to detect a monosyllabic morpheme in a sentence and they begin to recognize the usage of the functor, ga.

**Fr3-45**

### Mother, I Don't Really Like the High-Pitched, Slow Speech of Motherese: Cross-Linguistic Differences in Infants' Reliance on Different Acoustic Cues in Infant Directed Speech

**Ryota Horie**[1] Akiko Hayashi[2] Kyoko Shirasawa[1] Reiko Mazuka[1,3]

*1. Laboratory for Language Development, RIKEN Brain Science Institute, Wako, Japan; 2. Center for the Research and Support of Educational Practice, Tokyo Gakugei University, Koganei, Japan; 3. Department of Psychology, Duke University, Durham, USA*

**Background and Aims:** Infant-directed speech (IDS) is said to have characteristic prosodic properties, such as high-pitch and slow speaking rate, and infants have shown a preference to listen to IDS over adult directed speech (ADS). Although many of the IDS properties are commonly found in many languages, there are cross-linguistic differences in the way acoustic properties are modulated in IDS. For example, IDS in Japanese did not show a large expansion of pitch range typically found in English and other European languages (Fernald et al, 1989), nor does it have a slower speech rate (Igarashi & Mazuka, 2006). The aim of the present study is to examine whether or not infants learning Japanese and English are differentially sensitive to various acoustic cues that are associated with infant directed speech in different languages.

**Methods:** Recordings of IDS and ADS were made by one Japanese, one Chinese, one Korean, and two English speaking mothers. Mean F0, standard deviation (std) of F0, total duration of pause, and mean number of syllables per second, were measured in each speech. A total of 500 Japanese and 500 English learning infants between 4-12 months of age were tested in Head-turn Preference Procedure. In each language, separate multiple linear regression analysis was applied to infant's listening time in five age groups.

**Key Results:** In English infants, the listening time is positively correlated with the mean F0 from 7M to 10M, positively correlated with the std F0 at 11-12M, positively correlated with the pause at 5-6M and from 9M to 12M, and negatively correlated with the number of syllables from 4M to 10M. In Japanese infants, the listening time is not correlated with the mean and std F0 at the all ages, positively correlated with the pause at 5-6M, and positively correlated with the number of syllables at 7-8M.

**Conclusions:** English and Japanese infants' listening time was influenced by different acoustic characteristics. For English infants, while slower speech rate is attractive throughout the first year, high pitch and wide pitch range becomes attractive at relatively late periods. In contrast, neither high pitch nor wide pitch range were positively correlated to Japanese infants' listening time. In fact, Japanese infants actually liked to listen to faster rate of speech at 7-8M. The results suggest that although infants' preference to IDS may be common across languages, the cues by which their attraction is drawn may be tuned to language specific characteristics.

**Fr3-46**

### Word-Action Mapping in Sentential Contexts By 18-Month-Old Japanese Infants

**Tessei Kobayashi**, Ryoko Mugitani, Shigeaki Amano

*NTT Communication Science Laboratories, NTT Corp., Keihanna, Japan*

**Background and Aims:** To learn verbs, infants need to extract a particular word from ongoing fluent speech and then to map the

word onto actions and events. Recent studies have shown that by 14 months, infants can quickly map novel words onto actions when the words are presented in isolation (Kobayashi et al., 2006). However, it still remains unclear whether infants can map novel words onto actions when words are presented in sentential contexts. The present study investigates whether and when infants can extract novel words from sentential contexts and successfully establish word-action mapping in a habituation "Switch" task.

**Methods:** Forty-eight 12-, 14-, and 18-month-old Japanese infants viewed computer-animated events where an object (a butterflyfish) was engaged in two different actions (rotating, rocking) paired with novel words embedded in a subject-verb sequence ("boome ga NEMA teiru na [the boome is NEMA-ing!]", "boome ga DAKU teiru na [the boome is DAKU-ing!]"). The infants were first habituated to the two word-action pairings (NEMA-rotating, DAKU-rocking). In the test phase, the infants were alternately presented with the same pairings (NEMA-rotating, DAKU-rocking) and the switched pairings (NEMA-rocking, DAKU-rotating). If the infants could extract novel words from multi-word utterances and successfully establish word-action mapping during the habituation phase, they should be able to detect the switched pairings in the test phase.

**Results:**> To analyze the infants' looking times during the test phase, 2 (sex: girl vs. boy) x 2 (trial: same vs. switched) mixed-design ANOVAs were performed for each age group. The analysis of the 12- and 14-month-olds revealed no main effects or interactions, indicating that they looked equally long at the same trials (12-month-olds: *M*=9.9s; 14-month-olds: *M*=10.2s) and the switched trials (12-month-olds: *M*=9.6s; 14-month-olds: *M*=10.0s). The analysis of the 18-month-olds revealed the main effect of the trial, indicating that they looked significantly longer at the switch trials (*M*=12.7s) than at the same trials (*M*=10.3s), $F_{(1, 14)} = 5.215$, $p = 0.039$.

**Conclusion:** These findings demonstrate that 18-month-olds can rapidly map novel words in sentential contexts onto actions. Although previous studies found that 14-month-olds can map isolated words onto actions (Kobayashi et al., 2006), the present findings show that 14-month-olds fail to map words in sentential contexts onto actions. This suggests that a more efficient ability to extract words from ongoing fluent speech and then to map words onto actions might emerge around 18 months of age.

**Fr3-47**

### is Visual Monitoring Differentially Associated with Pointing in Infancy?

**David Leavens**, Brenda Todd
*University of Sussex, Falmer, UK*

**Background and Aims:** As infants begin to point, they also display a concomitant and distinctive pattern of looking towards their social partners. This visual monitoring, or gaze alternation, is given immense theoretical weight in contemporary psychology-it virtually defines the transition to intentional communication, and many researchers equate this monitoring with the birth of the infant's social mind. Very surprisingly, however, to our knowledge, nobody has yet asked whether babies who point display this visual monitoring any more or less than babies who do not point. This is a crucial concern because if babies who point do not alternate their gaze between their social partners and the objects to which they point any more frequently than babies who either do not point or who display other kinds of gestures, then there is no empirical basis for interpreting their visual orienting behavior in terms of their appreciation of others' points of view or attentiveness. Accordingly, we tested whether visual monitoring of social agents was differentially associated with pointing in a sample of 67 babies from 6 to 18 months of age.

**Method:** Babies were seated next to their mothers in a 3- x 4-meter laboratory room. Two mechanized dolls were placed 2.5 meters and 20 degrees to the left and right of the childrens' midlines. Babies were encouraged to look straight ahead with an auditory stimulus, then one of the dolls was activated. The sequence of the doll activations was randomized across babies for four trials and these sequences were then repeated for a further four trials. Within each of 5 age classes (6, 9, 12, 15, 18 months), each baby was randomly assigned to one of these sequences. Each baby received 8 trials and gestures and visual orienting were coded. We defined referential looking as any 12-second trial in which a baby looked at both their mothers and the animated dolls.

**Results:** Gestural production increased with age ($F(4,62) = 2.90$, $p = .029$). Referential looking increased with age ($F(4,62) = 2.84$, $p = .031$). Babies who pointed displayed significantly more referential looking than did babies who did not gesture or who reached towards their mothers ($F(2,64) = 7.05$, $p = .002$).

**Conclusion:** Visual monitoring of the mother was differentially associated with referential gestures in this sample of British babies. This finding supports the widespread belief that babies' visual orienting behavior is a functional part of their preverbal, referential signaling.

**Fr3-48**

### Infants' Communicative Acts in Structured Interactions

**Shannon MacLachlan**, Barbara Bernhardt, Carolyn Johnson, Julianne Scott
*University of British Columbia, Vancouver, Canada*

Because early intervention can improve a child's long-term outcome, it is vital to find effective and efficient ways of assessing infants' potential for language development. As a step in this direction, the current study evaluated the communicative performance of 34 children with older siblings (ages 17 to 24 months), some with and some without family history of language impairment. The major purpose of the study was to begin to document the rate, discourse type (initiation or response), mode and type of communicative act in communication of children under 2. Secondary objectives were to determine potential relationships between standardized language test scores and communicative act data, and between children with and without family history of language impairment. Children participated in a structured play session with a book, puppet and bubbles (with minimal experimenter prompting) as part of a longer longitudinal study. Additional testing included the Switch word-object association task (Werker/Cohen), the Preschool Language Scale-4, the Macarthur-Bates Communicative Development Inventories, a tympanometric hearing screening and Mullen Visual Reception and Fine Motor Scales. The structured samples were transcribed and coded for communicative status of the utterance, the child's focus of attention, initiation/response, mode and function of communication. Function was defined according to speech act theory, defined by Searle and Vanderveken (1985) (modified by Klincans, 1991). Average rate of communication was 8.6 utterances/minute (highest with the book). Variation in rate of communication was not explained by the children's age or developmental status. Initiations (but not responses) increased with child age, with much variability between children and activities. Mode differed by activity, with verbalizations related to increasing child age. The order of frequency of communicative acts was directives > assertives (comments) > ambiguous. Number of assertives per minute was the only function related to standardized language test scores. Family history

of language impairment was not related to communicative acts. The poster will describe the study and outline potential implications for future research and clinical application.

**Fr3-49**

### The Meaning of Triadic Interactions Among Peers

Gabriela Markova, Maria Legerstee
*York University, Toronto, Canada*

**Background and Aims:** Selby and Bradley (2003) found that from 6 months infants are able to engage in triadic interactions with their peers. However, it remains unclear what infants understand of these interactions. Some argue that infants merely respond to social signals of their interactive partners (e.g., gazes, smiles; Corkum & Moore, 1998), while others propose that infants engage in meaningful emotional relationships with them (Hay, 1985). To examine this controversy we examined infants in triadic interactions with unfamiliar peers. It was hypothesized that if infants are capable of meaningful relationships with peers, then they should (1) become upset when they are excluded from these social engagements, and (2) actively try to engage and reinstate the relationships with the peers.

**Method:** Ten groups of three unfamiliar, same-aged and same-gender infants were observed in interaction at 6, 9 and 12 months. Infants played with a toy to which they had equivalent access. Infant positive and negative affect and vocalizations, gazes and coordinated attention, and peer- and object-directed behaviors, such as touch and approach were coded.

**Results:** All infants initially engaged in triadic interactions during which they coordinated attention over the toy with peers. However, many infants soon formed a dyadic relationship with one of the peers, while excluding the other. Compared to excluding peers, excluded infants showed more negative affect and vocalizations, gazes at peers, touch and attempts to coordinate attention with excluding infants..

**Conclusion:** Rather than simply responding to the presence or absence of peers' social signals, already at 6 months infants engage in triadic interactions with their peers and try to establish meaningful relationships with them as evidenced by the complex emotional dynamics during these interactions. Discussion will center on the significance of early peer interactions.

**Fr3-50**

### Viewing Infant-directed Videos Attenuates Play and Parent-Child Interaction

Ashley Murphy, Alissa Setliff, Avery Earle, Mary Courage
*Memorial University, St. John's, Canada*

**Background:** Infants and toddlers are the target audience for a plethora of television and video material produced specifically for them. Surveys show that infants as young as 3-months attend to these and become regular viewers over their first year. Consistent with marketing claims, parents report that they use TV/videos to entertain and educate their infants. However, there is also concern that TV/videos might contribute to attention problems in childhood or replace time spent in play and social interaction. The goal of this study was to examine patterns of visual attention and interaction as infants and their parents viewed infant-directed video material in a free play period.

**Method:** 48 6-month-olds and their parents participated in a 20-minute session. The dyads viewed one of 3 videos in the first or second 10 minutes of the session. One video was marketed to promote parent-child interaction, a second implied improved language interaction, and the third made no promotional claims. An array of toys and magazines were available throughout. Parents were asked to interact with the infant as at home.

**Results:** A series of mixed ANOVAs on infant and parent behaviors indicated: (1) There were no effects of video type. (2) Infants who viewed video in the first 10 minutes spent significantly more time looking at the toys (45%) than at the video (33%), whereas those who viewed the video in the second 10 minutes looked longer at it (52%) than at the then familiar toys (32%). When TV/video was off, infants spent significantly more time looking at the toys in both TV-first (68%) and TV-second (76%) groups. (3) The frequency of looks to toys and video were significantly higher in the TV-on than TV-off condition. (4) Infants' looks to the parents were infrequent and brief in all conditions. (5) Parents looked significantly longer at their infants' than at the TV, toys or magazines across all conditions. All parents vocalized to their infants and most (74%) attempted to engage the baby in play, especially when the TV was off.

**Conclusions:** (1) The availability of infant-directed video (a) attenuates the time spent in toy play, especially when the toys are familiar and (b) prompts frequent shifting of attention between video and toys. (2) Parents attempted to engage their infants more frequently when the video was off than on. These interactions were unrelated to the type of video viewed thus failing to support the associated marketing claims.

**Fr3-52**

### Learning Through Overhearing: the Role of Familiarity and Age of Participants in 3rd Party Interactions

Nameera Akhtar, **Priya Shimpi**, Kristin Weisler
*University of California, Santa Cruz, USA*

**Background:** Before two years of age, children are able to learn a word from observing a 3rd party interaction (Floor & Akhtar, 2006). In prior studies the participants in the third-party interactions were two unfamiliar adults. The current study systematically manipulates the age and familiarity of the participants in the third party interaction and assesses children's learning of both actions and words.

**Method:** Participants are 18-20 month-old children. There are four between-subjects conditions varying the identity of the learner/confederate in the 3rd party interaction: familiar adult (the child's mother), unfamiliar adult (a female experimenter), familiar child (the child's slightly older sibling), unfamiliar child of the same age as the sibling.

Half of the children see the novel actions first; half hear the novel word first. Children watch as an experimenter labels an object and demonstrates two novel actions to the confederate. In testing, children are asked to identify the novel word from a set of four objects and reproduce the novel actions when given the appropriate props. Children's attention to different elements of the interaction is being coded. The hypotheses are: 1) that children will be more likely to learn in the conditions with familiar individuals; and 2) that they will be more likely to learn when watching a child versus an adult (Ryalls, Gul, & Ryalls, 2000).

**Results:** Data collection is in process, so it is too soon to draw conclusions (see below for preliminary data). Analyses will examine whether differences in the age and familiarity of the third-party confederate relate to learning. Subsequent analyses will also examine whether

children's attention patterns differ across conditions and whether they predict learning.

Preliminary Data: Percent of Children learning Words and Actions by Condition

| | Word | Action |
|---|---|---|
| **Sibling (n=6)** | 50% | 67% |
| **Mother (n=3)** | 0% | 33% |
| **Experimenter (n=1)** | 100% | 0% |
| **Unfamiliar Child** | N/A | N/A |

**References**:

Floor, P. & Akhtar, N. (2006). Can 18-month old infants learn by listening in on conversations? *Infancy, 9(3)* 327-329.

Ryalls, O., Gul, R., & Ryalls, O. (2000). Infant imitation of peer and adult models: Evidence for a peer model advantage. *Merrill-Palmer Quarterly,46*,1, 188-202.

**Fr3-53**

## First Words in Cantonese-English Bilingual Infants

**Virginia Yip**[1] **Stephen Matthews**[2]

*1. Chinese University of Hong Kong, Hong Kong, China; 2. University of Hong Kong, Hong Kong, China*

The paper reports on the lexical development of two bilingual infants exposed to Cantonese and English from birth, arguing for early differentiation of the lexicon based on the acquisition of translation equivalents from 1;03 to 2;0. An influential principle that is assumed to guide early word acquisition is the Principle of Contrast (Clark 1987, 1993, 2000) which states that every two forms should contrast in meaning. The Principle is taken to imply that the child avoids synonyms in early development. Not only does the principle guide the monolingual child's lexical development, but it has also been claimed to apply in bilingual lexical development (Frank and Poulin-Dubois 2002). In the bilingual context, however, there are additional factors to be considered, including patterns of input and language dominance (Lanvers 1999). A strict interpretation (Clark 1993) suggests that even bilingual children at the earliest stage will accept only one label for an object, despite exposure to another label for the same object from a different language. On a broader interpretation, the Principle could apply within but not across a bilingual child's languages. On this interpretation, the Principle applies within two lexicons which constitute separate and differentiated systems from early on.

Unlike studies which measure lexical development based on parental report using the MacArthur Communicative Development Inventory, this study analyzes longitudinal data produced spontaneously by the bilingual children. The number of translation equivalents shows that the child is regularly using two labels, one from each language, to refer the same object from on. Methodological issues involved in determining translation equivalents will be discussed.

The results show that the bilingual children readily use cross-language synonyms throughout the period of study. The data are argued to support early lexical differentiation and the availability of two lexicons which in turn serve as the basis for syntactic differentiation, the precursor for the construction of two grammars. The results are interpreted as supporting the Principle of Contrast operating in two differentiated lexicons, such that there is no genuine violation of the Principle even when two labels are used to encode the same meaning.

**Fr3-54**

## Understanding Speaker's Communicative Intent - Bilingual Children's Heightened Social Awareness of Referential Gestures

**W. Quin Yow**, Ellen Markman

*Stanford University, Stanford, USA*

**Background and Aims:** Bilingual children grow up facing communicative challenges beyond those that monolingual children have to cope with as they need to constantly monitor the dynamic communicative situation to determine what language a given speaker is using and how to respond appropriately. Past research suggests that bilingual children may be more tuned-in to certain verbal feedback cues than monolinguals (e.g. Ben-Zeev, 1977), thus may have a better ability to understand people's intentions and beliefs. It is unknown, however, whether bilinguals are also more tuned-in to nonverbal referential gestures (e.g. pointing and gaze). Bilinguals' heightened communicative sensitivity may facilitate their development of the mentalistic understanding of such referential gestures (especially gaze, since the ability to understand referential intent behind gaze develops later than that for pointing, e.g. Moore & Corkum, 1994), Our studies examined whether bilingualism facilitates this development in the context of a hiding game.

**Methods:** In three studies, we adapted Povinelli et al. (1997)'s within-subject design and study procedure. Ninety-two monolingual and bilingual children (32 2.5-year-olds, 24 3.5-year-olds, 24 4.5-year-olds, 12 5-year-olds) were asked to find a hidden toy in one of the two boxes on the table while being provided with one of two referential gestures- the experimenter either pointed at or turned her head to look at the correct box but while seated in one of two positions - positioned equidistant from the boxes (body-centered) or seated directly in front of the empty box while gesturing at the correct box (body-biased). Based on Povinelli et al.'s findings, we expected body-biased to be more difficult than body-centered and gaze more difficult than pointing.

**Results:** In Study 1, 2.5-year-old bilingual children performed better than monolinguals in all conditions ($F(1,30)=4.220$, $p<0.05$). Monolinguals performed at chance for both the body-centered and body-biased gaze conditions ($p>0.4$) while bilinguals were performed above chance ($p<0.054$). In Study 2, both 3-and-4-year-old monolinguals did well in the pointing conditions and the body-centered gaze condition but performed at chance in the body-biased gaze condition , while bilinguals were above chance in that condition ($p<0.05$) (as well as the others). In Study 3, showed that by age 5, monolingual children could succeed in all the conditions.

**Conclusion:** Results supported our hypothesis that bilingual children, as young as 2.5 years old, are more advanced in their understanding of intentions of referential gestures than monolingual children in locating hidden objects. This suggested that bilinguals' heightened social awareness in communication facilitates the development of mentalistic understanding of referential gestures.

**Fr3-55**

## Perceptual Factors in Language Acquisition: Discovering Sounds, Words, and Grammatical Relations

**Jessica Hay**
*University of Wisconsin-Madison, Madison, USA*

General learning mechanisms, such as statistical and distributional learning, have received widespread attention as a potential explanation for how children acquire language. Research suggests that infants can use these learning mechanisms to, among other things, acquire native-language sound categories, segment words from continuous speech, and discover grammatical regularities. Perceptual factors (e.g., auditory biases, rhythmic and prosodic grouping strategies, and relative saliencies of grammatical forms) also impact how certain facets of language are acquired. The interplay between perceptual factors and statistical learning is a rapidly emerging field of study.

This symposium will provide evidence for the role of perceptual factors in three facets of language acquisition: a) acquisition of native-language sound categories, b) speech segmentation, and c) processing of word-object associations. Maye will present her views on how infants' perceptual systems affect acquisition of native-language sound categories. Hay & Saffran will show that the acoustic characteristics of sounds affect perceived rhythm and segmentation by infants. And van Heugten, Shi, & Cyr will demonstrate that the perception of function words impacts the processing of nouns in French toddlers. Presenters are experts in their fields and will provide evidence for the relationship between perception and language learning.

The discussant, Patricia Kuhl, is a world leader in the study of infant speech perception and has pioneered much of the research on the link between perceptual considerations and language acquisition. Dr. Kuhl will highlight the importance of including a specific role for perception in theories of language acquisition.

As we further our knowledge of how the complex interplay of auditory biases and linguistic experience shape infants' perceptual systems, we increase our understanding of the role perception plays in language acquisition. The topic of this symposium is timely given the tremendous amount of emerging data that suggests the importance of this perception/language acquisition link.

**Fr3-56**

## Perceptual Constraints on Word Segmentation

**Jessica Hay**, Jenny Saffran
*University of Wisconsin, Madison, USA*

**Background and Aims:** In lieu of acoustical markers, infants use statistical information, namely transitional probability (TP) between syllable sequences, to locate word boundaries in continuous speech (Saffran, Aslin, & Newport, 1996). Natural speech, however, contains myriad acoustic characteristics that may either enhance or diminish infants' reliance on TP as a cue to word boundaries. The present study tested the hypothesis that infants, like adults, expect louder sounds to occur at word onsets and longer sounds to occur at word offsets, and asked whether these expectations act as perceptual constraints on segmentation.

**Method:** Four artificial languages were created by acoustically manipulating syllable intensity and duration in a language that contained 4 disyllabic statistical 'words', with internal TP's of 1.0 (Thiessen & Saffran, 2003). In the *Intensity Trochaic* (*IT*) and *Duration Iambic* (*DI*) languages (where words have louder initial syllables or longer final syllables, respectively), the statistics and the rhythmic groupings were **consistent** with one another, directing infants to the same word boundary location. In the *Intensity Iambic* (*II*) and *Duration Trochaic* (*DT*) languages (where words have louder final syllables or longer initial syllables, respectively) the statistics and the rhythmic groupings were **inconsistent**, and may direct infants to different boundary locations. Following familiarization, 9-month-olds' word segmentation was assessed using a headturn procedure.

**Results:** Infants successfully segmented the 'words' following both *IT* and *DI* ($p<.05$). Infants were unsuccessful at segmenting words from either *II* or *DT*. These results suggest that the conflicting acoustic and statistical cues disrupt segmentation.

**Conclusion:** Previous research on segmentation has largely ignored how specific acoustic cues impact statistical learning. This work provides an initial demonstration that intensity and duration have characteristic effects on rhythmic grouping, even in infancy. We suggest that this perceptual grouping bias may be language-independent, providing one possible perceptual constraint on statistical learning during word segmentation.

**Fr3-57**

## Auditory Biases in the Development of Language-Specific Speech Perception

**Jessica Maye**
*Northwestern University, Chicago, USA*

It is now well known that infants' ability to discriminate phonetic contrasts changes across the first year of life. However, the nature of this perceptual development is often mischaracterized as strictly one of pruning: infants are often said to be born with the ability to discriminate any phonetic contrast and lose sensitivity to any contrasts not used in the native language. This talk will discuss the wide variety of findings demonstrating that development in speech perception is better characterized as a more complex re-shaping of the perceptual landscape to match the phonetic system of the native language.

Eimas and colleagues (1971) were the first to demonstrate that infants are not born as blank slates with respect to phonetic perception; rather, certain voice-onset time values are easier for young infants to discriminate than others. Similar nonlinearities have been found in non-human animals' discrimination of speech sounds (e.g., Kuhl & Miller, 1975; Kuhl & Padden, 1982), suggesting that the mammalian auditory system is likely to be more sensitive to certain phonetic distinctions than others. From this perceptually biased starting point, the process of acquiring a language-specific pattern of perception involves both increases and decreases in sensitivity to particular phonetic contrasts. For contrasts that are initially easy to discriminate but do not support a meaning distinction in the infant's language, sensitivity decreases (e.g., Werker & Tees, 1984). Conversely, for contrasts that are initially difficult to discriminate but do support a meaning distinction in the infant's language, sensitivity increases (Polka et al., 2001; Kuhl et al., 2006; Tsao et al., 2006). And some changes in perception are perhaps best characterized as retuning, in which initial language-general biases (Polka & Bohn, 2002) morph into language-specific ones (Kuhl et al., 1992).

**Fr3-58**

### Infants' Use of Gender-Marked Determiners in Online Language Processing

**Marieke van Heugten**[1,2] Rushen Shi[1] Marilyn Cyr[1]

*1. Université du Québec à Montréal, Montreal, Canada; 2. University of Toronto, Toronto, Canada*

We focus on the hypothesis that perception of function word forms impacts early language learning. Although function words are often omitted in early production, infants recognize function words (e.g., Shady, 1996; Hoehle & Weissenborn, 2003; Shi et al., 2006) and use their forms to segment words (e.g., Shi & Lepage, in press) even at the preverbal stage. At 18 months of age, they use determiners to process nouns in online sentence comprehension (Kedar et al., 2006; Zangl & Fernald, in press). In some languages (e.g., French) nouns are divided into grammatical gender categories, and determiner forms agree in gender with the following noun. Since nouns are consistently preceded by function words in French, forms of gender-marked determiners may be salient to infants, and may influence their processing of nouns.

We tested French-learning 25-month-olds in a split-screen looking paradigm. Each trial presented two pictures, either same (e.g., *ballon*-masculine; *bateau*-masculine) or different (e.g., *ballon*-masculine; *banane*-feminine) in gender. Auditory stimuli instructed the infants to look at one of the two pictures. Target words were preceded by a correct determiner in the grammatical condition (*Regarde, le ballon!*), but by an incorrect determiner in the ungrammatical condition (*Regarde, la ballon!*).

As predicted, we found that the percentage of looking time to target was highest in the different-gender grammatical condition and lowest in the ungrammatical condition, while the same-gender grammatical condition fell in between. That is, while it seems demanding to recognize targets when gender information is not informative, it is even harder to overcome ungrammatical information in the determiner. Thus, French infants use forms of gender-marked determiners for processing gender-agreeing nouns at 25 months of age, consistent with evidence shown in older Dutch- (Johnson, 2005) and Spanish-learning (Lew-Williams & Fernald, 2007) children. We are currently testing whether this ability reflects more abstract syntactic knowledge.

## *Perceptual Development*

**Fr3-59**

### Rhythm Discrimination in the Visual and Auditory Modalities By 7-Month-Old Infants

**Melissa Brandon**, Jenny Saffran

*Dept. of Psychology, University of Wisconsin, Madison, USA*

**Background and Aims:** Rhythm is a property that can transcend modalities and unify sensory experiences. Previous research has demonstrated that for bimodal events, infants are capable of discriminating a change in rhythm unimodally when trained on the rhythm bimodally or cross-modally (Mendelson & Ferland, 1982; Pickens & Bahrick, 1995; Bahrick & Lickliter, 2000; Bahrick & Lickliter, 2004). To what extent are infants able to track purely visual rhythms, in a manner analogous to auditory rhythms? Seven-month-old infants were tested on unimodal rhythm discrimination, in either visual or auditory modalities. Notably, the stimuli contained numerous changes from presentation to presentation, such that rhythm was the only invariant property. Our goal was to assess infants' ability to track rhythms within each modality separately; future research will examine transfer across modalities.

**Methods:** Infants were exposed to a rhythm, in either the visual or auditory modality, for a fixed familiarization period. Unique to these experiments is the implementation of changes in multiple stimulus dimensions during familiarization while rhythm was held constant. At test, looking/listening times were recorded for matching versus non-matching rhythms (created by switching the positions of two events). The order of the test trials and the training rhythms were counterbalanced across subjects. The auditory stimuli were created using the timbres of brass instruments and the visual stimuli were colored shapes flashing left to right across the screen. Familiarization and test were in a single modality (between-subjects).

**Results:** Paired-sample t-tests revealed significant novelty preferences in both the visual [t (15)= 3.69, p= 0.002] and the auditory [t (15)= 2.25, p=0.04)] versions of the study. No effects of presentation order or trained rhythm (counterbalanced) were observed.

**Conclusion:** Infants succeeded in discriminating rhythms within modalities, whether the rhythm was presented in the visual or the auditory modality. The results suggest that rhythmic processing in the visual modality is robust, even in the absence of correlated auditory cues and amidst irrelevant variation across exemplars. We will discuss the implications for our understanding of rhythm as an invariant, amodal, property that may help infants to bind multimodal experiences together.

**Fr3-60**

### The Role of Rigid Motion in Newborns' Face Recognition

**Hermann Bulf**, **Chiara Turati**

*Dipt. di Psicologia dello Sviluppo, Università degli Studi di Padova, Padova, Italy*

A recent study provided evidence that newborns are able to recognize an unfamiliar face over changes in viewpoints, but fail to generalize the identity of a face when a profile pose is shown (Turati et al., in press). The present study was aimed at investigating if the use of a rigid head motion (where the head moved but the facial features were static) promotes newborns' ability to recognize the invariant aspects of a face conveyed by a profile pose. Previous studies with adults showed that rigidly moving faces can be recognized more accurately that static faces (Pike et al., 1997). Also, it has been shown that infants' object (e.g., Valenza et al., 2006) and face (e.g., Spencer et al., 2006) perception can benefit from the presence of motion information. Here, using a visual habituation technique, the effect of rigid motion on newborns' recognition of a profile pose of a face was tested in three different experiments. One-to-three-day-old infants were habituated to a set of images of a face with different degrees of rotation (60° sx, 30° sx, 0°, 30° dx, 60°dx). The face could undergo a rigid motion (Experiment 1), a random motion (Experiment 2), or could be shown as a series of static images from different viewpoints (multiple viewpoint condition) (Experiment 3). In all experiments, during the test phase newborns were presented with the familiar face in a profile pose paired with a novel face in the same profile pose. Results showed that newborns manifested a novelty preference only in the rigid motion condition (Exp. 1). In the random motion condition newborns looked longer at the familiar face (Exp. 2), while in the multiple viewpoint condition they did not show any preference (Exp. 3). Overall, these findings showed that rigid motion promotes newborns ability to recognize a profile pose of a face, suggesting that even at birth the recognition advantage found for moving faces is not simply a product of the different angles of view which are contained in a moving face, or an effect due to the presence

of motion per se. Instead, rigid motion appears to be an important source of information for newborns' face recognition, and probably aids in the derivation of a 3-D structure.

**Fr3-61**

### Auditory Influences on Low-Level Visual Processing Early in Development

**Vivian Ciaramitaro**[1] Karen Dobkins[2]

*1. UCSD/The Salk Institute, San Diego, USA; 2. UCSD, San Diego, USA*

Integrating sensory information across modalities allows us to create a meaningful, unified percept of events in the world. Although cross-modal integration has been studied previously in infants, most studies to date have focused on higher-level visual and auditory stimuli, or on the spatial and/or temporal constraints on integrating lower-level sensory stimuli to create a unified cross-modal percept. Here we investigate whether auditory cues can influence the ability to detect the presence of a near-threshold visual stimulus.

Using forced choice-preferential looking (FPL), we obtained contrast detection thresholds for a visual stimulus (a square subtending 11x11 degrees of visual angle, centered 15 degrees to the left or right of monitor center). The visual stimulus fluctuated in luminance at 1 Hz, under three different auditory conditions: (1) In-Phase (IP). The visual stimulus fluctuated in-phase with an auditory stimulus (white noise, presented bilaterally) fluctuating in loudness at 1 Hz, (2) Out-of-Phase (OP). The visual stimulus fluctuated out-of-phase with the same auditory stimulus, or (3) No Sound (NS). The visual stimulus was presented without a concurrent auditory stimulus. To obtain visual contrast thresholds, the visual stimulus was presented at one of five contrasts (3-100%), randomized across trials. Contrast threshold was defined as the contrast yielding 75% correct performance in the FPL task (where a correct response is defined as looking to the side of the monitor containing the visual stimulus). For each subject, visual contrast thresholds were obtained for two of the three conditions (IP, OP, NS). If synchronized auditory information enhances visual detection, we expect lower contrast thresholds for the IP versus the OP or NS condition. Conversely, if synchronized auditory information hinders visual detection, we expect higher contrast thresholds for the IP condition.

Preliminary data from 6-month-old infants show that the highest thresholds are in the IP condition, i.e., synchronized auditory information diminishes the detectability of a visual stimulus. These findings suggest that, at a low-level of sensory processing, infants are limited in their ability to attend to information in more than one sensory modality at a given time.

**Fr3-62**

### What is in the Face That Captures Infants' Attention From Birth?

Elisa Di Giorgio, Irene Leo, Francesca Simion

*DPSS-Università di Padova, Padova, Italy*

Two hypothesis have been proposed to explain face preference at birth (e.g., Johnson & Morton, 1991; Macchi Cassia et al., 2004): one maintains that newborns' attention is triggered by faces due to activation of a face-configuration detector, which selectively responds to face geometry that is to the correct disposition of the elements within a face or to the correct disposition of the eyes (Johnson, 2005); the other proposes that newborns' face preference arises from a number of general perceptual biases which drive newborns' attention toward certain structural properties of visual stimuli, as the presence of more elements in the upper part (i.e., up-down asymmetry; Simion et al., 2001). Furthermore, it has been demonstrated that the eyes play an important role to attract newborns' attention compared to others internal elements located in a face (e.g., Batki et al., 2000). A matter of dispute, concerns which of the properties embedded in a face attract newborns' attention: the position of the eyes, their orientation or their location in the natural arrangement in the face. In order to understand which of these perceptual cues make face so attractive at birth three experiments were carried out using a preferential looking technique. Three variables have been manipulated: the position (Experiment1) and the orientation (Experiment2) of the eyes and the natural arrangement of the internal features (Experiment3).Three groups of newborns were presented with three different pairs of photographs of faces: an upright face and an inverted face with the eyes correctly oriented but located in the lower part (Experiment1); two upright faces in which one presented with misoriented eyes (Experiment2); and two upright faces in which one scrambled but with the eyes correctly oriented and in the right position (Experiment3). Newborns showed a visual preference only when faces were contrasted with an inverted face with the eyes correctly oriented but located in the lower part (Experiment1). On the contrary, when faces were contrasted with an inverted face in which the eyes were misoriented (Experiment2) or a scrambled face but with the eyes correctly oriented and in the right position (Experiment3) newborns did not show any preference for the face. We interpret these results as evidence that face specificity is not prewired, but rather arises from general perceptual processes that, during development, become progressively tuned to the human face, as a result of extensive experience with this stimulus category.

**Fr3-63**

### Face Inversion Effects in Infants are Driven More by High than Low, Spatial Frequencies

**Karen Dobkins**, Vanitha Sampath

*University of California, San Diego, La Jolla, USA*

**Background:** The visual mechanisms underlying development of face processing have garnered much interest lately. One way this topic has been studied has been to employ faces that are spatial frequency (SF)-filtered into "low" and "high" SFs, with the notion that "low" and "high" tap different visual mechanisms. Using this approach, recent studies in infants (de Heering et al., 2007) and children (Deruelle et al., 2004) reported that face discrimination abilities are mediated by mechanisms selective for low SFs (see Johnson 2005 for a consistent view). Although intriguing, these previous findings are somewhat difficult to interpret since "low" and "high" SF-filtered faces were likely not equated in detectability, an issue that is especially problematic in young infants. In the current study, we investigated mechanisms underlying "face inversion effects " in infants, controlling for detectability.

**Methods:** Using forced-choice preferential looking, we obtained contrast detection thresholds for "low" and "high" SF-filtered faces, for both "upright" and "inverted" images (4 thresholds per subject). For each age tested, the "low" and "high" SF cutoffs were determined based on the published peaks in contrast sensitivity functions (e.g., Peterzell et al., 1995). (For example, for four-month-olds, whose peak is near 0.4 c/deg, "low" was < 0.3 and "high" was > 0.5 c/deg.) In the FPL paradigm, face stimuli (10.8 degrees wide) were presented centered 13.3 degrees to the left or right of monitor center, at one of five contrasts (from 6.13% to 95%), randomized across trials. Contrast threshold was defined as the contrast yielding 75% correct performance in the FPL task (correct is looking to the side of the monitor containing

the filtered face stimulus). For each subject, a threshold ratio was calculated: $Thr_{inverted}/Thr_{upright}$, separately for "low" and "high" SF-filtered faces, where values greater than 1.0 indicate a face inversion effect (FIE), i.e., lower thresholds (greater sensitivity) for "upright" faces.

**Results:** Preliminary data from four-month-olds show a significant FIE for "high" SF-filtered faces (ratio=1.91, p=0.013), but not "low" SF-filtered faces (ratio=1.10, p=NS).

**Conclusions:** The mechanisms underlying FIEs (i.e., greater sensitivity to upright faces) in infants appear to be selective for high spatial frequencies. The discrepancy with previous findings may be explained either by proposing that: 1) in previous developmental studies, the results are due to the "low" SF-filtered faces being more detectable than the "high" faces, or 2) FIEs (as in the current study) tap different mechanisms than face discrimination abilities (as in previous developmental studies).

**Fr3-64**

### Tracking Cortical Specialization for Music in Preverbal Infants

**Eswen Fava**, Heather Bortfeld, David Boas

*Texas A&M University, Department of Psychology, College Station, USA*

Recent investigations of music perception in infants and children have capitalized on techniques such as EEG and ERP to uncover a right hemisphere processing bias. Furthermore, this processing bias exists regardless of a child's musical training or ability. However, while electrophysiological methods are noteworthy for their temporal sensitivity, they are lacking in their ability to spatially localize regions of activation beyond the hemispheric level. Near-infrared spectroscopy (NIRS), an optical imaging technique that uses relative changes in total hemoglobin concentration and oxygenation as an indicator of neural activation, may be a viable alternative to electrophysiology for localizing event-related neural activation. The goal of the current study was to establish NIRS as a tool for dissociating regional activation associated with different forms of auditory processing. Specifically, we used NIRS to measure focal neural activity in the temporal cortices of preverbal infants (aged 6-9 months). Infants' cortical activity measured during exposure to classical music paired with visual stimuli was compared to the cortical activity measured during exposure to infant-directed speech paired with visual stimuli. Results revealed a dissociation of processing for language and music, such that music was preferentially processed by the right temporal cortex, and language was preferentially processed by the left temporal cortex. These lateralization data are consistent with findings using other psychophysiological techniques and highlight the utility of NIRS for studying the neural basis of auditory processing biases across the lifespan.

**Fr3-65**

### Faces attract infants' attention in complex displays

**Teodora Gliga**, Athina Andravizou, Mayada Ellsabbagh, Mark Johnson

*Birkbeck College, London, UK*

**Background:** Human infants' interest in faces has been documented repeatedly, through various experimental methods. Most of these studies measured visual preference using at most two stimuli presented side by side, these two stimuli being frequently variations of a face-like pattern. In the present study we used an eye-tracker to ask whether faces grab infant's attention, also when presented together with other objects.

**Methods:** Sixteen 6-months-old infants participated in this study, 10 girls and 6 boys. Infants were presented with 12 different slides containing 6 images placed in a circle: a face, a shoe, a bird, a car, an alarm clock and a mobile phone. A Tobii eye-tracker (17") was used to record the direction of the first saccade and the amount of time spent looking at each of the image categories.

**Results:** Infants first saccade was directed to the face more often than expected by chance (p<.001). Infants looked, on average, 4 times out of the 12 slides first at the face and 14/16 infants looked had a score of at least 3/12 (the chance level being 2/12). A t-test comparing the looking time to faces with the average looking times for the non-face categories also shows a significant difference (p<.001).

**Conclusion:** Faces captured 6 months-olds-infants' attention more often than the other objects and also maintained their attention focused for a longer time. This is to our knowledge the first evidence for attentional capture by faces, in a complex display, in infancy. Further studies will determine which properties drive this effect (e.g. the eyes, the face internal configuration)

**Fr3-66**

### The Perception of Biological Motion By Human Newborns

**Elenitsa Kitromilides-Salerio**, Christel Bidet-Ildei, Edouard Gentaz

*Université Pierre Mendès France, Grenoble, France*

**Background and Aims:** The movements of humans and other vertebrates, (i.e., biological motions) form a class of salient visual stimuli. This was first observed by Johansson with his famous "point-light" paradigm in which he attached small lights to the joints of actors and filmed them executing different activities (Johansson, 1973). The final movies showed a dozen of moving point-of-lights only, but adult participants quickly (about 200 ms only) recognize a person walking, dancing, or cycling. Although human infants aged 3 and 5 months preferred an upright point-light walker to the same pattern turned upside-down (Fox & McDaniel, 1982; Bertenthal, Proffitt, & Kramer, 1987) (or the same pattern with perturbed local rigidity or with scrambled spatial relations between the dots), the origins of this visual preference for biological motion (not found in 2-month-old infants) are currently debated (cf. Viviani, 2002). Does this ability emerge with the development or is it present at the start of life and dependent on inherent structures of the visual system?

**Methods:** We examined the visual preference for biological motion in 22 human full-term neonates. We tested 4-day-old newborns in a standard preferential looking paradigm (with a 1min 15s free-choice test). They were positioned in an adapted rigid seat, fixed on a trolley in front of a visual display. Two point-lights displays were presented simultaneously on LCD screens, one representing a sequence of biological motion (walking man) and the other non-biological motion (rigid motion).

**Results:** For each neonate we are interested in the gaze direction (right, left, elsewhere) over time. We observed that 4-day-old human neonates looked longer at biological motion (walking man) than at non-biological motion (rigid motion) [t(18)=1.71; p=0.05].

**Conclusion:** Because similar results were observed in inexperienced chicks (Vallortigara, Regolin, & Marconato, 2005), this means that the analysis of biological motion is an intrinsic feature of vertebrate's visual system.

**Fr3-67**

## Comparing Cats and Dogs: Infants' and Adults' Eye-Movements during Online Comparison

**Kristine Kovack-Lesh**, Bob McMurray, Lisa Oakes
*University of Iowa, Iowa City, USA*

**Background and Aims:** Work in infancy has examined overall looking time in infants as a measure of cognitive and perceptual processing. However, in recent years, the availability of automated eye-tracking has allowed researchers to pinpoint adults' and infants' point of gaze in some tasks (e.g., Hollingworth & Henderson, 2002) Johnson, Slemmer, & Amso, 2004; McMurray & Aslin, 2004). Yet we know virtually nothing about infant and adult eye-movements while actively comparing images. This study investigated this issue and will provide insight into how infants' active comparison in categorization studies may enhance their learning.

**Methods:** Four-month-old infants and adults were eye-tracked using remote computer-based eye-tracker while viewing pairs of stimuli on a large monitor. Participants saw a maximum of 48 pairs of animals for 10s each (Infants averaged completion of 25 trials; range 8-48 trials). We varied stimuli in terms of whether they were alignable or not (e.g., oriented in the same direction) and whether they were from the same category (e.g., two cats) or different categories (e.g., a dog and a cat). Eye-movements were coded frame-by-frame in terms five areas of interest: (1) left animal's body, (2) left animal's head, (3) right animal's body, (4) right animal's head, or (5) nothing/away.

**KeyResults:** All data has been collected to date and 8 infants' sessions have been completely coded. We calculated the average number of looks to each area of interest for each trial type. We conducted an ANOVA on infants' average number of looks with Look Side (Left, Right), Look Region (Body, Head), Condition (Same Direction, Different Direction), and Species (Dog, Cat, Both) as within-subjects factors. This analysis revealed that there was a main effect of look code ($p = .01$) and a significant interaction of look code and species, ($p < .05$). Infants had more looks to the body of the animals than to the heads and this difference was most pronounced when infants viewed items from different basic-level categories (i.e., a dog and a cat). Ongoing analyses are examining how the transitions between parts and animals are affected by these factors.

**Conclusions:** These results suggest that the type of comparison being made (between- vs. within-categories) can affect the active scanning of infants. This may provide a mechanism for differential learning effects seen in studies of categorization and comparison (e.g. Kovack-Lesh, Horst, & Oakes, in press; Quinn, Eimas, & Rosenkrantz, 1993).

**Fr3-68**

## Asymmetrical Use of Consonantal and Vocalic Information at the Lexical Level in 3-To-5-Year-Old Deaf Children with Cochlear Implant

Mélanie Havy, **Thierry Nazzi**, Josiane Bertoncini
*LPP, CNRS-Université Paris Descartes, Paris, France*

**Background and Aims:** Twenty-month-old infants have detailed phonetic representation of words (Mani & Plunkett, 2007). However, at this age, Nazzi (2005) noticed greater reliance on consonants than vowels in a word learning task, suggesting that infants give more weight to consonantal than vocalic information at the lexical level (Nespor et al., 1993). In the present study, we aim to define if 3-to-5-year-old deaf children having received a cochlear implant can (a) learn new words after just a few presentations, (b) use specific phonetic information (simultaneous acquisition of two words that different only by one feature), and (c) pay more attention to consonantal over vocalic information.

**Methods:** We tested 29 3-to-5-year-old deaf children with cochlear implant using a simplified version of the task of Nazzi (2005), and 35 age-matched normally hearing controls. Eight "maximal" trials involved two pseudowords differing by 2 or 3 phonetic features (4 in consonants, 4 in vowels), while eight "minimal" trials involved two words differing by 1 phonetic feature (4 in consonants, 4 in vowels). For each trial, we first presented two objects with different names ('puna'/'tuna'), then a third object named as one of the previous objects (e.g., 'tuna') and asked the child to give the other 'tuna'.

**Results:** The results on the maximal contrasts indicate that, like their controls, deaf children can rapidly learn new words already by 3 years of age (M = 64,1%, above 50% chance: $p = .01$). However, contrary to controls, their performance is at chance level up until 5 years of age when words only differ by one feature (M = 60.7%, $p = .06$). At that age, again unlike controls, they succeed with minimal vocalic contrasts (M = 64,3%, $p = .006$), but still fail with minimal consonantal contrasts (M = 57,1%, $p = .41$).

**Discussion:** This study shows that deaf children with cochlear implant can rapidly learn new words differing by 2 or more phonetic features by 3 years of age, but they do not process phonetic information with sufficient detail to learn words differing by one feature until 5 years of age. At 5 years, they show a use of vowel contrasts, suggesting that they give more weight to vowels than consonants at lexical level. This pattern can be explained by a greater transmission of vocalic information by cochlear implants. We will discuss effects of age at implant and duration of cochlear implantation on performance.

**Fr3-69**

## Babies' Responses to Natural and Man-Made Landscapes

**Megan Pickard**, Judy DeLoache
*University of Virginia, Charlottesville, USA*

Humans evolved in a landscape of living things, amid conspecifics, companion animals, predators, prey, and plants whose varied roles included habitat, equipment supply, food, and so on. According to the biophilia hypothesis, put forth by E.O. Wilson, humans thus possess an evolved affinity for living things. One way biophilia manifests itself today is in humans' appreciation for wild places and outdoor recreation. In fact, adults and even school-aged children explicitly prefer natural to built environments, and the therapeutic effects of experiencing nature are well established (e.g., Kaplan, 1987).

If such an appreciation for nature reflects an evolutionary predilection we would expect to see evidence among babies. In this study we examine babies' preferences for natural versus man-made landscapes.

Fourteen 6- to 12-month-olds, 7 girls and 7 boys, participated in a simple visual attention task in which they saw ten pairs of photographs of natural (i.e., savanna, forest, rainforest, and desert) and man-made (i.e., cityscapes, strip malls, factories, and neighborhoods) landscapes projected on a large screen for four seconds at a time. Of interest was whether babies spent more time looking at the natural or man-made landscapes.

Contrary to our expectations, we found a marked preference for man-made landscapes among boys, who looked nearly twice as long at the man-made landscapes than the natural ($p < .05$). We found no preference whatsoever among girls.

Such a preference for built environments among baby boys is counter to reports of adults' and older children's preferences for natural environments. However, other findings, for example that boys prefer to look at moving cars than smiling faces (Lutchmaya & Baron-Cohen, 2003), corroborate ours. Perhaps such findings reflect a low-level attunement among young boys for artifactual stimuli. Future research will explore this possibility.

**Fr3-70**

### An ERP Study of Intersensory Processing in 5-Month-Olds

Blake Jones[1] Daniel Hyde[2] **Chris Porter**[1] Mark Allen[1] Ross Flom[1] Cortney Evans[1]

*1. Brigham Young University, Provo, USA; 2. Harvard University, Boston, USA*

Young infants are sensitive to a variety of audio-visual intersensory relations including temporal synchrony, rhythm, and tempo (Flom & Bahrick, 2007). This sensitivity seems to work as a tool to promote the detection of more specific and embedded properties of objects, events, and even people (e.g., Bahrick, Hernandez-Reif & Flom, 2005). A growing body of research has addressed the neurophysiological bases of intersensory perception using animal models and human adults (e.g., Calvert et al., 1999; Fort, Delpuech, Pernier, Giard, 2002). Despite the central role intersensory perception plays in learning, little is known about the specific neural mechanisms important to intersensory perception early in life. This study was designed to fill this gap in the literature. In an attempt to better understand the neural processes involved in intersensory processing, we assessed 5-month-olds' electrophysiological response to synchronously presented pairs of audio and visual stimuli. To begin, each infant was presented with a learning phase consisting of either a large (10.5 cm), colored circle (green, blue, red) paired with a low-pitched tone and/or a small, colored (2.5 cm) circle paired with a high-pitched tone. Twenty pairs were presented for 1000ms followed by an inter-stimulus interval that also lasted for 1000 milliseconds. The learning phase was then followed by a test phase in which the same visual and auditory stimuli were presented in pairs that were either matched (large circle/low-pitched sound; small circle/high-pitched sound) or mismatched (large circle/high pitched sound; small circle/low-pitched sound) with the learning phase. While data collection is nearing completion, preliminary analyses (n = 14, 5 girls) suggests differential processing of matched and mismatched pairs with pairs of mismatched stimuli evoking greater potentials in both early and later components of the ERP waveform over both anterior and posterior scalp locations. Tentatively, we have also noted a polarity shift from occipital to frontal leads and greater positivities over temporal scalp regions to incongruous stimuli. These results suggest by 5-months of age, infants are able to learn pairings of synchronous audio and visual stimuli and distinguish the newly learned pairings from different pairings of the same stimuli. Furthermore, brain electrophysiology suggests the detection of mismatched pairs stimulates additional cognitive processing compared to that evoked by learned or matched pairs. We have also begun to examine whether this ability is dependent on congruent (large object/low frequency tone; small object/high frequency) or incongruent information (small object/low frequency tone; large object/high frequency tone) with information encountered during normative daily experiences.

**Fr3-71**

### Why do Infants Rely on Head Information to Categorize Cats versus Dogs? Evidence from Eye-Tracking

Matthew Doran, Jason Reiss, James Hoffman, **Paul Quinn**

*University of Delaware, Newark, USA*

**Background and Aims:** What stimulus attributes do infants use to form category representations? Identifying these attributes is part of a broader effort in the cognitive sciences to determine the properties that underlie concepts (Murphy, 2002; Smith & Medin, 1981). Previous looking-time studies have shown that infants use the heads of cat and dog images to form category representations for these animal classes (Quinn & Eimas, 1996; Spencer et al., 1997). The present research used an eye-tracking procedure to determine whether infant use of head information results from a pre-existing bias or on-line learning.

**Methods:** Six- to 7-month-olds were familiarized with cats or dogs in upright or inverted orientations and then tested with a novel cat and novel dog in the same orientation. On the assumption that stimulus regions used for categorization will be preferentially fixated over those not used, it can be reasoned that if the head preference results from a pre-existing biasing mechanism, then infants should fixate more on the heads than the bodies of the exemplars throughout the course of the familiarization portion of the categorization task. Alternatively, if the infants are learning that the head is the most diagnostic region of the stimuli, then the head preference should emerge during the course of the familiarization trials.

**Results:** In the upright orientation, when the relative size differences between the head and body regions were taken into consideration and the distribution of fixation time to the head versus the body per unit area was computed, the infants were shown to have a marked preference for fixating on the head that was present throughout familiarization. However, with inversion, no head preference was observed; fixations to the head were small when compared with fixations to the body.

**Conclusion:** Results support the notion that infants use the head to categorize cats versus dogs because of a pre-existing biasing mechanism that orients them to the head region of the stimulus images rather than an on-line learning mechanism that determines over the course of the trials that the head is diagnostic of the category distinction. Moreover, the difference in performance in the upright and inverted conditions suggests that the bias reflects a mechanism that attends to face information (Johnson & Morton, 1991) rather than a preference to attend to the most visible portion of the stimulus (Banks & Salapatek, 1981). Such a bias may assist infants in selecting from among various features that are potentially available in the input, and in this way set the concept acquisition system on a particular trajectory of learning.

**Fr3-72**

### Differences in Infant Scanning of Novel- and Familiar-Gender Faces

**Jennifer Rennels**, Andrew Cummings

*University of Nevada, Las Vegas, USA*

When infants with female primary caregivers see female and male faces paired together, they look longer at the female than male faces (Quinn, Yahr, Kuhn, Slater, & Pascalis, 2002), but when they see female faces only or male faces only, infants spend more time looking at male than female faces (Ramsey, Langlois, & Marti, 2005). Using eye-tracking equipment, we examined whether infants would spend more time

scanning the internal features of faces (when shown alone) that did not match their primary caregiver's gender relative to faces that did match. When novel-gender faces are shown alone, greater scanning of internal features may provide for deeper processing and learning about the faces as compared to when they see novel-gender faces paired with familiar-gender faces that compete for their attention.

Infants aged 9 to 10 (N = 22) months (7 females, 15 males) participated. Infants viewed 24 female and male faces presented individually from four racial/ethnic groups: African-American/Black; Asian-American/Asian; Caucasian; and Hispanic/Latino/Spanish. Using Applied Science Laboratories Model 504 Eye Tracking System, the software recorded the number of fixations and how long infants spent scanning internal and external regions of the faces. Parents provided information about the gender and race of the infant's primary caregiver.

We analyzed how scanning of internal or external features (facial zone) was influenced by the match between the gender of the face and the primary caregiver's gender. There was a significant two-way interaction between facial zone and gender match, $F(1,17) = 5.93$, $p = .03$. When scanning internal features, infants spent significantly more time looking at faces that did not match their primary caregiver's gender ($M = .82$, $SD = .29$) than at faces that did match their primary caregiver's gender ($M = .74$, $SD = .33$), $p = .008$.

The differences in perceptual scanning may reflect top-down processes. The novelty of novel-gender faces and lack of competition from familiar-gender faces may cause infants to spend more time scanning features that help them learn about novel-gender faces. We are currently examining 3- to 4-month-olds to determine if this scanning pattern is likely a top-down process that develops as a result of infants' differential experience with their primary caregiver.

**Fr3-73**

### The Perception of the Mother's Face in 3/4 Profile and Profile Poses: a Replication and an Extension

**Fatma Zohra Sai**

*Al ain, UAE*

Previous research demonstrated that newborn infants spend more time looking at faces when these are shown in full face (Sai,1990a, Bushnell, Sai & Mullin, 1989; Field, Cohen, Garcia & Greenberg,1985; Pascalis, de Schonen, Morton, Deruelle and Fabre-Grenet,1995; Walton, Bower and Bower,1992) but not when presented in 3/4 profile (Sai,1990a) or profile pose (Sai,1994). We replicated this finding by monitoring the presentation of the poses during testing, and using a rigorous control over the external features including the ears and the chin. Pairs of the mother and a female stranger showing the 3/4 profile pose (Experiment 1) or the profile pose (Experiment 2) as judged by two independent observers were presented to newborn infants (mean age 2 days 11hrs). The infants' failure to recognize the face of their mothers shown in 3/4 profile and profile orientations suggests that probably most of the newborn infants' cognitive abilities, like the perception of invariant aspects of faces and early representation of the mother's face, are confined to the full face pose. The results are discussed in relation to the hypothesis that newborn infants' abilities to form facial representations underlies their early responsiveness to voice-face associations, that is full face specific.

**Fr3-74**

### Preference for Impossible Figures in 4-Month-Old Infants

**Sarah Shuwairi**

*NYU Department of Psychology, New York, USA*

The visual system relies on pictorial depth information to infer three-dimensional (3D) structure from 2D depictions of objects. Adult observers readily classify 2D line-drawn figures as depicting "possible" or "impossible" 3D objects. However, the age at which infants respond to pictorial information, and the extent to which they use these cues to process global shape information, remains to be determined.

We previously showed that 4-month-old infants responded to the manipulation of a single pictorial depth cue involving the interposition of two overlapping bars, and that they used this information to discriminate between pictures of structurally possible and impossible cubes. Pictures of impossible cubes were constructed by reversing the local interposition cue of two overlapping edges of a possible cube. Infants looked reliably longer at the impossible relative to the possible cube, providing evidence of sensitivity to the pictorial depth cue of interposition. This finding also suggests an early capacity to detect structural inconsistencies in shape information.

The current study uses a preferential looking procedure with novel shapes containing several anomalous depth cues that include interposition of multiple overlapping bars, junctions and adjoining surfaces in a "critical region." In relation to all other parts of the figure, this region conveys information about global shape that defines the overall structure as possible or impossible. In Experiment 1, infants looked reliably longer at pictures of the impossible object. Experiments 2 and 3 tested whether the arrangement of lines in the interior region of the impossible figure contained more salient or interesting arrangements of lines may have been driving this discrimination. However, when the interior critical regions for both the possible and impossible cubes were presented in the absence of extended binding contours, infants showed no differences in looking time. These results suggest that 4-month-olds respond to an array of pictorial cues present in static 2D images and rely on depth information to detect contradictory spatial relations between parts that render a depicted object impossible as a real 3-D object.

General perceptual mechanisms for local and global shape processing develop early, enabling young infants to allocate attentional resources appropriately to represent local aspects of shape and interpret global coherence. These findings further clarify the development of mechanisms for processing depth cues that infants use to interpret 3D structure from 2D depictions of objects.

**Fr3-75**

### Partial Occlusion and Oscillatory Brain Activity in Infants

**Christina Thorpe**[1] Gergely Csibra[2] Mark Johnson[2] **Jordy Kaufman**[3]

*1. Department of Psychology, Memorial University of Newfoundland, St. Johns, Canada; 2. Centre for Brain and Cognitive Development, Birkbeck, University of London, London, UK; 3. Brain Sciences Institute, Swinburne University of Technology, Hawthorn, Australia*

**Background and Aims:** Recent developmental cognitive neuroscience work on object processing in infants has revealed a neural signature related to object memory. Kaufman et al. (2003) found that the infant brain responded to an occlusion event with a sustained burst of gamma oscillatory activity at the right-temporal cortex. This

activity was spatially and functionally similar to what is seen in the adult brain when adults are asked to keep a particular image in mind. A follow-up study (Kaufman et al., 2005) showed that this activity was related to a representation of the hidden object's continued existence and not simply a memory of what had disappeared. The aim of the present study was to examine gamma oscillatory further in infants by investigating how it reflects partial occlusion.

**Methods:** Sixteen six-month-old infants (aged 160-195 days, mean age 174.0 days) participated in this experiment. The computer-generated stimuli were based on the well-known "box-rod" studies (e.g., Kellman & Spelke, 1983). This was a within-subject study where each infant saw two events-types (Synchronous and Asynchronous) presented in random order and repeated throughout the study. All trials began with a box-like rectangle partially occluding a rod-like rectangle situated diagonally behind it. Following a short interval, in the Synchronous condition both the top and bottom visible parts moved together so that it appeared that a single rod moved behind the occluding box. In the Asynchronous condition, the two halves of the rod moved in opposite directions so that it appeared the rod was made up of two separate pieces. In both conditions the rod movement lasted for 600 ms and ended with the pieces(s) returning to their original position. EEG was recorded using a Geodesic Sensor Net comprised of 62 electrodes distributed evenly across the scalp.

**Results and Conclusions:** Independent t-tests revealed that gamma power at right-temporal cortex was significantly higher during the rod's movement during the Synchronous event than during the Asynchronous event ($p < .005$). Furthermore, gamma power increased in the synchronous event once the rod began to move when compared to the stationary rod ($p < .001$). These results suggest that right-temporal gamma activity is a signature of object representation even when there is a visible marker of the object's continued existence. These results have implications for an "object file" approach to thinking about object processing.

**Fr3-76**

## Infants' Categorization of Dynamic Emotional Expressions: Changes from 6 to 10 Months

**Emily Touchstone**, **Melanie Spence**, Kristin Atchison

*The University of Texas at Dallas, Dallas, USA*

This study examined categorization of dynamic facial expressions by 6- and 10-month-old infants. Many studies using static photographs of exaggerated expressions report categorization of facial emotions by 4- to 7- month-old infants (Gauthier & Nelson, 2001). Other results suggest that younger infants categorize expressions using isolated facial features but that it is not until 10 months that infants process configural information that specifies emotional expressions (Ludemann, 1991). Since motion affects infants' perception of other visual events and provides unique information about faces and expressions, then infants' processing of moving faces is particularly relevant to this debate. Motion may either facilitate or interfere with infants' categorization of positive (happy) and negative (disgust) expressions.

Six- and 10-month-old infants (n = 72; 35) participated in a fixed-trial familiarization procedure, whereby each infant viewed a series of 8 female faces portraying either happy or disgust emotional expressions, followed by 2 test trials. Dynamic face stimuli consisted of 3-s videos of naturalistic happy and disgust expressions. Each familiarization stimulus was presented contingent on infant fixation of an attention-getting visual stimulus and until infants looked a maximum of 30 s or looked away for 2 s. The first test trial introduced a novel face portraying the same emotional expression viewed during familiarization. The second test trial introduced a novel face portraying an expression different from those viewed during familiarization. Categorization was achieved when planned pairwise comparisons indicated a significant recovery to the novel emotion (test2) compared to the novel face displaying a familiar emotion (test1).

Results indicate that infants significantly decreased looking across familiarization trials (*Mdiff*= 5.842, *p*= 0.000). Pairwise comparisons revealed categorization of dynamic facial expressions at 10 months of age (*Mdiff*= -2.863, *p*= 0.000), but not at 6 months (*Mdiff*= -0.152, *p*= 0.823). These findings are of particular interest because for 6-month-olds, motion appears to complicate a task that could otherwise be achieved if static images are used. Motion facilitates 6-month-olds' perception of other events, suggesting that processing dynamic faces may require greater information-processing capacity than static faces and other visual events. Ten-month-olds, however, did use information afforded by dynamic faces to form categories of disgust and happy expressions, revealing an effect of age on infants' categorization of dynamic emotional expressions.

**Fr3-77**

## Stimulus Characteristics that Promote Infants' Sound Separation

**Lynne Werner**[1] Lori Leibold[2] Deborah Miller[3]

*1. University of Washington, Seattle, USA; 2. University of North Caorlina at Chapel Hill, Chapel Hill, USA; 3. Washington University, St. Louis, USA*

**Background and Aims:** Infants require a higher intensity than adults do to detect tones (Bargones et al., 1995), discriminate phonemes (Nozza et al., 1991), and recognize words (Newman, 2005) when competing sounds are present. Furthermore, infants' tone detection is affected by competing sounds that do not affect adults'tone detection. Two studies tested the hypothesis that immature sound source segregation, the process by which concurrently presented components of sound are grouped into separate auditory objects, makes it difficult for infants to separate competing sounds. Acoustic cues known to promote adults' sound source segregation were manipulated to determine whether those cues would facilitate infants' sound separation.

**Methods:** Infants and adults detected a 1000-Hz tone in a conditioned-response procedure. In each experiment, 20 7-9-month-old infants and 20 young adults were tested. Each listener was tested when the competing background was a standard 2-tone complex of the same duration as the target tone and when that background was modified. The background sound was repeated with a 50% duty cycle. The frequencies of the 2-tone complex were 581 and 2920 Hz, not expected to interfere with target detection for adults, but known to interfere with target detection for infants (Leibold and Werner, 2006). The target tone coincided with one presentation of the standard 2-tone complex. The tone was 71% detectable at the intensity presented in the standard condition. In each condition, 15 target trials and 15 no-target trials were presented. The dependent measure was d-prime. In one experiment, the modified background sound was a 2-noise-band-complex extending from 2920-2970 Hz and from 531-581 Hz. In a second experiment, the modified background sound was longer in duration than the target, coming on before and going off after the target tone.

**Results:** For infants, average target detection was better in the modified than in the standard background in both experiments. For adults, there was no improvement in target detection in the modified backgrounds.

**Conclusions:** That differences between a target and competing sounds in quality or duration facilitate infants' target detection is consistent with the hypothesis that infants' poorer detection of sounds in the presence of competing sounds is related to immature sound source segregation. Infants have difficulty separating sounds under conditions that do not challenge adults; however, infants and adults use the same acoustic information to segregate sounds.

## Poster Presentations, March 29 2008

### *Communication and Language*

Sa1-01

#### What Are They Looking At? Techniques in Preferential Looking

**Katie Alcock**[1] Sarah Watts[2]

*1. Lancaster University, Lancaster, UK; 2. City University, London, UK*

Cross-modal preferential looking is a widely-used technique in infant behavioural research. Some received wisdom in preferential looking however has not been empirically investigated. For example, whether caregivers see and hear testing sessions is not standard across laboratories.

In language development in particular, it is assumed that infants choose to look at images based on auditory input, rather than on other preferences. This latter assumption has been used in investigations of the Novel-Name-Nameless-Category (N3C) concept, which suggests that in the presence of an unfamiliar verbal label, infants will associate it with, and therefore look at, the image for which they have no label.

We carried out two studies to investigate 1) the influence of the caregiver seeing and hearing the testing session and 2) whether infants' looking at an image might be based on other preferences, rather than on auditory input. Both studies were based on a common paradigm: infants (total N=42, 17-19 mo) were presented with a pair of pictures and a single auditory stimulus ("Look! Look at the X!"), with known and unknown words/target pictures.

In study 1, condition A, caregivers could see and hear; in condition B they were blindfolded and wore headphones. In condition A infants looked more at target and less at non-target pictures, regardless of which they knew. In condition B however, infants only looked more at targets which they knew, with no difference between target and non-target looking when they did not know the name for the target.

In study 2, condition A, infants heard a standard verbal label stimulus ("Look! Look at the X!") whereas in condition B they heard a neutral verbal stimulus ("Look! Look at that!"). When infants heard a verbal label, they looked more overall at images. However, this did not increase looking time specifically to targets. Looking time to the image of a known word with a neutral stimulus was the same as looking time to the image of a target word with a verbal label.

We conclude that infants' looking towards labelled images for which a label was not previously known is not necessarily determined by their logical deduction based on the N3C principle, but may only appear in some conditions, and may depend on subtle input from caregivers. Likewise it is crucial to standardise caregiver as well as infant input across preferential looking studies.

Sa1-02

#### Statistical Language Learning in Infants and Toddlers with Williams Syndrome

**Cara Cashon**[1] Casey Allen[1] Katharine Estes[2] Jenny Saffran[3] Carolyn Mervis[1]

*1. University of Louisville, Louisville, USA; 2. University of California, Davis, USA; 3. University of Wisconsin-Madison, Madison, USA*

**Background and Aims:** Williams syndrome (WS) is a rare genetic disorder associated with mild to moderate mental retardation or learning difficulties. Although individuals with WS eventually develop relatively good language abilities and appear to acquire language in a similar pattern to typically developing (TD) children, language acquisition is clearly delayed (Mervis & Becerra, 2007). One of the early linguistic tasks of a young child is to discern where the word boundaries exist in his/her native linguistic environment. TD 8-month-olds are able to do so by attending to the statistical regularities in linguistic input (Saffran et al., 1996). The present study is the first to address the question of whether infants and toddlers with WS are also sensitive to these statistical properties.

**Methods:** Seven children with genetically-confirmed WS participated (mean age = 1.7 years; SD = .85; range 10 - 34 mos.). Using an experimental method and stimuli similar to that of Saffran et al. (1996), participants were familiarized to a 2-minute stream of speech of an artificial language. Subsequently, two types of test stimuli were presented: "word" and "part-word." "Word" test trials consisted of pairs of syllables that co-occurred statistically more often during familiarization than other pairs; "part-words" consisted of pairs of syllables that occurred equally often in the 2-minute speech stream as the "words," but not together.

**Results:** Participants' mean looking time during part-word test trials (M = 11.47 s, SD = 3.32) was significantly longer than during word test-trials (M = 8.46, SD = 3.48), paired t (6) = -3.34, p = .01. Importantly, the responses of all 7 children, including 3 who were <1 year of age, followed the same pattern.

**Conclusion:** Like TD 8-month-olds, infants and toddlers with WS are sensitive to the statistical regularities in the linguistic environment and can use this information to segment words from novel linguistic input. Saffran (2003) has hypothesized, that this learning mechanism likely plays an important role in language acquisition. This mechanism may be especially important for language acquisition for individuals with WS, as verbal working memory has been shown to be more closely related to language development for children with WS than for TD children (Robinson et al., 2003). Further research is warranted to determine if the statistical learning mechanism in infants and toddlers with WS is specific to linguistic information or represents a more domain-general learning mechanism, as is hypothesized for TD infants (Kirkham et al., 2002).

Sa1-03

#### Language Acts as an Invitation to Form Categories in 4-Month-Old Infants

**Alissa Ferry**[1] Susan Hespos[2] Sandra Waxman[2]

*1. Northwestern University, Chicago, USA; 2. Northwestern University, Evanston, USA*

**Background:** Previous research shows that naming words with a common label promotes object categorization in infants as young as 6 months (Fulkerson & Waxman, 2007). Linguistic stimuli promote successful categorization in infants but non-linguistic sounds (tones, mel-

odies, mechanical sounds, mouth sounds) do not (Balaban and Waxman, 1997; Fulkerson and Haaf, 2003, Woodward and Hoyne, 1999). We designed the current experiment to extend Fulkerson and Waxman (2007) to examine whether even younger infants are also able to use novel words an as invitation to form categories. Research with neonates shows that speech is special compared to other non-speech sounds. Newborns prefer to listen to human speech over non-speech analogues, suggesting that infants are born with a bias for listening to language (Vouloumanos & Werker, 2007). An early bias for listening to language suggests that infants even younger than 6-months-old may be able to use linguistic cues to categorize their world.

**Methods:** The current study examined the influence of words and tones on the categorization of objects in 3 and 4-month-old infants. In familiarization trials, infants saw eight exemplars of an object category (fish or dinosaurs) and each exemplar was accompanied by either a voice labeling the category with a novel word (e.g. Look at the toma! Do you see the toma?) or a series of tones. In test trials, the infants saw a new exemplar of the same category and an exemplar of a new category side by side. The dependent measure was the percentage of time infants looked at the novel and familiar stimuli.

**Results:** Four-month-old infants looked longer at the novel stimuli in the word but not the tone condition suggesting that they formed a category with words (but not with tones). In contrast the 3-month-old infants did not discriminate between test trials in either the word or tone condition.

**Conclusions:** The results with the 4-month-old infants support the idea that infants begin to use linguistic cues to organize the world around them well before they say their first words. The negative finding with the 3-month-olds suggests that it is around 4 months that linguistic cues become important for categorization. Further research is necessary to determine if 3-month-olds can use language to form categories under different conditions and the underlying mechanisms behind this developing ability.

**Sa1-04**

### Conditional Probabilities Cue Morphosyntactic Type: An Italian & Hungarian Corpus Study

**Judit Gervain**

*University of British Columbia, Vancouver, Canada*

**Background and Aims:** Transition probabilities (TPs) have been shown to help human and animal learners segment continuous linguistic input into its constituent words in artificial grammar learning experiments (Saffran et al 1996 and subsequent work). How TPs actually distribute in real linguistic input, especially in languages typologically different from English, has received much less attention (Brent and Cartwright 1996, Yang 2004, Swingley 2005). The current study investigates this question in infant-directed corpora of Italian (inflecting, V(erb)-O(bject) order) and Hungarian (agglutinating, mostly OV). Beyond evaluating the efficiency of TP-based segmentations cross-linguistically, the experiment also investigates the possibility that TP distributions might provide a cue to morphosyntactic type. If this is the case, statistics might act as a universal bootstrapping cue during the early acquisition of linguistic structure.

**Methods:** An Italian (51138 words, CHILDES subcorpora, MacWhinney 2000) and a Hungarian (54881 words, CHILDES subcorpora, MacWhinney 2000) corpus of infant-directed speech was phonologically transcribed and syllabified. Forward and backward TPs were calculated for every syllable transition (FWTP(AB)=F(AB)/F(A) and BWTP(AB)=F(AB)/F(B), respectively). An absolute threshold (Swingley 2005) and a relative threshold (Yang 2004) algorithm was used for segmentation with both FWTPs and BWTPs in the two languages. The accuracy and completeness scores of the resulting segmentations were computed in the usual way (acc=hits/hits+false alarms; comp=hits/hits+misses).

**Results:** Relatively good segmentation was achieved for all conditions. The lowest scores were obtained for Italian, using BWTPs with the absolute threshold algorithm (55% accuracy, 52% completeness), whereas the highest scores were obtained for Hungarian, using BWTPs with the absolute threshold algorithm (87% accuracy, 65% completeness). In general, BWTPs were always less efficient than FWTPs for Italian, while the opposite was found for Hungarian. Importantly, using the mathematical definitions of FWTPs and BWTPs, it can be shown that the cross-linguistic difference between the efficiency of FWTPs and BWTPs is related to the morphological type and word order of the languages. Specifically, frequent syllables (the denominators of the TP formula) are positioned phrase-finally (suffixes, postpositions etc.) in Hungarian, but phrase-initially (prepositions, few suffixes) in Italian.

**Conclusion:** The results suggest that conditional probabilities not only indicate segmentation boundaries in the linguistic input, but might also serve as cue to basic morphosyntactic properties, potentially helping young learners bootstrap into linguistic structure.

**Sa1-05**

### The Effect of Sentence Focus on 24-Month-Olds' Visual Attention

**Susanne Grassmann**, Michael Tomasello

*Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany*

Children's visual attention matches the words they hear (Swingley et al. 1998). However, since utterances contain both given and new information, the information conveyed by each single word is of different importance. Obviously, new information is the one of importance. In German as in many other languages new information is acoustically highlighted (stressed). In our studies we examined whether 24-month-olds know about the importance of stressed words and therefore focus their visual attention to a corresponding referent. We conducted an eye-tracking study and compared children's looking times to referents of stressed words (new information) and unstressed words (given information).

Children were presented with two successive pictures shown on a computer screen: A context picture containing a single element which served as the given element in the following target picture. The target picture showed two elements (the given and a new one). The context picture was visible for three seconds during which the experimenter labeled it twice (e.g., Look, there's a dog. Look, the dog). After the context picture had disappeared but before the target picture was presented, the experimenter described it with stress on the word corresponding to the new element (e.g., The dog has the BALL). Immediately after the sentence was finished, the target picture was presented for six seconds. In a second condition the givenness/newness of the elements in the target picture were reversed. In this condition the stressed word in the verbal description was in non-final position (e.g., The DOG has the ball). The results show that children looked longer at the new element (58.66 %, $p<0.05$, t-test) which corresponded to the stressed word than to the given referent of the unstressed word (41.34%).

An additional set of children participated in two control conditions. We established a Newness-Only Condition in which no verbal description of the target picture was given and a Stress-Only Condition where both elements in the target picture were equally new but only one

element was stressed in the verbal description. The results indicate neither an effect for stress alone (53.72% looking to stressed element) nor for the new element alone (55.84% looking to the new element). However, when analyzing the first two seconds of the target picture only, we found a clear newness-effect. As expected, 24-month-olds looked longer to the new element (62.99%, $p<0.05$, t-test).

The findings suggest that while an object's newness naturally attracts children's attention, stressed words for new information focus their attention on the corresponding referent.

**Sa1-06**

### Infants' Understanding of the Co-operative Nature of Imperatives

**Gerlind Hauser**[1] Tanya Behne[2] Malinda Carpenter[1] Michael Tomasello[1]

*1. Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany; 2. University of Manchester, Manchester, UK*

By 12 months of age infant's declarative communication is geared at sharing and cooperation (Liszkowski, 2004, 2005). For the imperative mode, it is still unclear whether the same motivations apply or whether infants in that case use the adult as a social tool to achieve their goal (Bates, 1976, Schatz&O'Reilly, 1990). Shwe and Markman (1996) showed in their study that 2-year-olds appreciate the mental impact of their imperative communication independently of obtaining their goal. The present study aims at finding a procedure applicable to younger children (18 and 24 months) and yielding more comprehensive evidence of infant's understanding of the cooperative nature of imperative communicative acts.

In our study, infants are playing a game with one of the experimenters (E2) and towards the end one important object is missing. Infants are encouraged to request this object from another experimenter (E1). E1 then reacts to this infant request according to one of 4 conditions (2x2 design): she either makes the requested object accessible first and expresses understanding/misunderstanding or she first makes the wrong object accessible and likewise expresses understanding/misunderstanding. The key conditions are (1) "Waiting": the wrong object is accessible first but the experimenter expresses understanding and passes the right object from a shelf after a delay of 5s and (2) "Shwe": the right object is accessible first but the experimenter expresses misunderstanding and gets ready to pass the wrong object from the shelf. In a within subject design each infant receives one trial of each condition.

If infants in the "Waiting" condition wait patiently until they get the requested object although they have been faced with the wrong object first this indicates their understanding of the power of successful communication. If infants in the "Shwe" condition repair the communication although they got what they wanted this shows their independent interest in successful communication. They not only want to obtain the object, they also want to be understood. Together the two key conditions provide good evidence for infants understanding of the cooperative nature of imperative communication.

Data collection is still under way. But preliminary results suggest that 24-month-old infants differentiate between understanding and misunderstanding in the two condition pairs independently of the access to the requested object. The behavioral responses differ as well for verbal rejections and reinforcements as for non-verbal means of repairing/acknowledging the success of the communicative act.

**Sa1-08**

### Linking Parent Input and Child Receptivity to Symbolic Gestures

**Jennifer Knight-Schwarz**[1] Rebecca Vallas[2] Laura Namy[1]

*1. Emory University, Atlanta, USA; 2. University of Virgina School of Law, Charlottesville, USA*

Young children frequently use symbolic gestures (e.g., a drinking motion for a cup) to refer to objects, actions, and events (Acredolo & Goodwyn, 1988). Early in development, children appear to interpret these gestures as serving the same communicative function as words (Namy & Waxman, 1998; Sheehan, Namy, & Mills, 2007). This study explored how parental input influences children's understanding of these gestures. Specifically, we examined the relation between parent gestural input and child receptivity to gestures as symbols. Previous research indicates that parents use symbolic gestures infrequently (Iverson, Capirci, Longobardi, & Caselli, 1999; Namy, Acredolo, & Goodwyn, 2000). However, parents' symbolic play with objects in hand (e.g., pretending to drink while holding a toy cup) is much more frequent. We investigated whether children's receptivity to symbolic gestures as a form of symbolic reference was linked with parents' own symbolic gestures as well as parents' pretend play with objects in hand, which may provide fodder for symbolic gesture on the part of the child without providing explicit modeling of gesture as a form of symbolic reference.

Thirty-one 16- to 22-month-olds and their parents participated in a 15-minute free play session, which was transcribed and coded for parents' verbal labeling, symbolic gesture production, and symbolic play production, as well as for children's spontaneous symbolic gesture production. Children also participated in a forced-choice novel gesture learning task in which they were taught a novel (arbitrary) symbolic gesture as an object name and were subsequently tested on their interpretation of the novel gesture. All parents also completed a gesture vocabulary checklist for their children. Thus, we employed three different measures of children's receptivity to symbolic gestures including spontaneous production during play, the forced-choice gesture learning task, and the gesture vocabulary checklist.

Parents' symbolic gestures were infrequent and unrelated to children's production of symbolic gestures. However, parents' symbolic play with objects in hand was predictive of both the frequency of children's (empty-handed) symbolic gestures for objects during play ($r = .43$, $p < .05$) and their object-name gesture vocabulary according to parental report ($r$'s = .44 and .48 for comprehension and production measures respectively, both $p$'s < .05). Parent symbolic play was unrelated to child performance on the forced-choice gesture learning task. These data suggest a strong link between parental input and children's symbolic gesture use. These findings also highlight the child's own role in transforming symbolic play behaviors that they observe into communicative signals.

**Sa1-09**

### The Relationship between Imageability of Words and Early Word Acquisition in Korean

Kwee-ock Lee, Hyoung-jai Kim

*Kyungsung University, Busan, Korea*

**Background and Aims:** The imageability of a word is the degree to which its referent can be perceived through the senses(Paivio, 1986). For example, 'tree' is a highly imageable word in that its meaning is

associated with many sensory properties(size, shape, etc.) whereas 'think' is low in imageability. Standard imageability ratings were considered as a reliable predictor of acquisition across languages(Ma, Golinkoff, Hirsh-Pasek, Song, Seaton, & Ballew, 2007). However, there has not been studied the early word acquisition in Korean in the aspects of imageability of words. The purpose of this study is to investigate the relationship between the imageability of words and the early word acquisition in Korean.

**Methods:** This study first collected the imageability data from 80 Korean-speaking adults in Busan. Measurement of imageability was consisted of words appearing in infants' vocabularies from 18 to 30 months(84 nouns and 84 verbs), and frequently used words in adults which don't appear in infants' vocabularies(84 nouns and 84 verbs). Also it was measured by not, moderately, and highly imageable grade, from 1 to 7 scales. The ratings of word acquisition according to each age were ratings of verbs acquisition(Lee, 1999) and nouns acquisition(Choi, 2000) witch each mother was asked to record on the checklist given the inflected words her child has produced. Then we analyzed correlation between the grades of imageability and the ratings of word acquisition by SPSS 12.0.

**KeyResults:** First, the ratings of verbs acquisition were significantly correlated to the imageability of all verbs; as 18 months(Pearson: .68, $p<.001$), 24 months(Pearson: .72, $p<.001$), and 30 months(Pearson: .77, $p<.001$), and the imageability of verbs appearing in infants' vocabularies; as 18 months(Pearson: .36, $p<.01$), 24 months(Pearson: .31, $p<.01$), 30 months(Pearson: .25, $p<.05$). Second, the ratings of nouns acquisition were significantly correlated to the imageability of all nouns; as 18 months(Pearson: .57, $p<.001$), 24 months(Pearson: .87, $p<.001$), and 30 months(Pearson: .96, $p<.001$), and the imageability of nouns appearing in infants' vocabularies; as 18 months(Pearson: .43, $p<.001$), 24 months(Pearson: .56, $p<.001$), 30 months(Pearson: .52, $p<.001$).

**Conclusion:** The results show that imageability is a reliable predictor of early words acquisition in Korean as well as English(e.g., Bird et al., 2002; Masterson et al., 1998; McDonough et al., 2006) and Chinese(e.g., Ma et al., 2007). The imageablility of a word could be a general factor having influence on word acquisition across grammatical system such as word order and languages.

**Sa1-10**

## The Association between Maternal Speech Input and Child Language Development

**Huei-mei Liu**[1] Feng-ming Tsao[2]

*1. Department of Special Education, National Taiwan Normal University, Taipei, Taiwan; 2. Department of Psychology, National Taiwan University, Taipei, Taiwan*

**Background and Aims:** The previous studies have shown that the clarity of infant-directed speech (IDS) is significantly associated with infant speech perception in the preverbal ages (Liu, Kuhl, & Tsao, 2003). It is assumed that infants engage in a learning environment in which ambient language input may play an important role in language development. The goal of this study was to explore the longitudinal links between the acoustic and linguistic features of IDS and the children's language abilities.

**Methods:** The maternal speech samples of 28 mother-child dyads were collected when mothers interacting with her child at two ages (6-12 months, 5 years) in a naturalistic face-to-face play session. The linguistic measures, such as the total amount of words, different types of words, type-token ratio (TTR), and the repetition rate of target words, were taken to index individual mothers' linguistic style. Two standardized language tests (PPVT-R & Expressive Language Test) were taken to indicate children's repetitive and expressive language abilities at 5-year-old.

**Results:** Compared to the speech directed to preverbal infants, mothers use more words, more different words, longer utterance and fewer targets word repetition to address their 5-yaear-olds. For the concurrent associations, the linguistic features of child-directed speech (CDS) were significantly correlated with children's language performance on PPVT (e.g., repetition rate of target words in CDS and PPVT, $r = -.45$, $p = .026$). However, there are no significant associations between acoustic features of CDS and child language performance. For the longitudinal associations, the different types of words measured in the mother-infant interaction at 6-12 months of child's age is significantly correlated with later child's performance on PPVT at the age of 5 ($r = .513$, $p = .021$). On the other hand, the repetition rate of target words used in IDS is negatively correlated with child's performance on PPVT ($r = -.566$, $p = .009$) and oral language expression ($r = -.390$, $p = .05$). It seems if mothers use a greater number of variant words in mother-infant interaction, the child's language outcome would be better. However, if mothers repeated the target words (all of them are nouns and objects) more frequently with fewer extension or expansion, then the child's language outcome would be negatively affected.

**Conclusion:** The linguistic inputs in 6-12 months of age is associated with the language performances of 5-year-old children, suggesting that early language input play important roles in long-term language development in children.

**Sa1-11**

## Infant Behaviors as Antecedents and Consequents of Mothers' Responsive and Directive Speech

**Elise Masur**[1] Valerie Flynn[2] Carrie Lloyd[1]

*1. Northern Illinois University, DeKalb, USA; 2. Aurora University, Aurora, USA*

**Introduction:** To investigate possible influences on and consequences of mothers' pragmatic speech styles, this study investigated specific infant behaviors preceding and following their mothers' responsive and directive utterances during naturally occurring dyadic interactions.

**Method:** Twenty infants (10 girls, 10 boys), aged 17 months, and their mothers were observed during free play. Maternal utterances from 8 minutes of transcribed videotapes had been previously coded for pragmatic intent, yielding Responsive Utterances, Supportive Behavioral Directives, Intrusive Behavioral Directives, and Intrusive Attentional Directives. Infant behaviors directly preceding and following 10 maternal utterances of each category, randomly selected, were coded from videotapes for: 1) antecedent Social Initiatives (mother-directed behaviors, including looks, vocalizations/words, gestures); 2) consequent Social Responses (mother-directed behaviors, including looks, vocalizations/words, gestures); 3) antecedent Locomotion, including whether or not the locomotion was appropriate to the ongoing activity; and 4) antecedent and consequent levels of Interest in the toys (low-active rejection or disengagement; medium-passive holding, touching, looking; or high-active play).

**KeyResults:** Analyses of variance revealed that infants' Social Initiatives were significantly more likely to precede responsive (M = 36%) than directive utterances (Ms = 12-19%), $F(3, 54) = 6.87$, $p = .001$. However, infants' Social Responses followed responsive and intrusive behavioral utterances (Ms = 36% and 37%) more often than supportive behavioral or intrusive attentional directives (Ms = 25% and 18%), $F(3, 54) = 5.77$, $p = .002$. Locomotion more often preceded intrusive

attentional or behavioral directives (Ms = 22 and 32%) than responsive or supportive directive utterances (Ms = 5% and 14%), F(3, 54) = 8.24, p < .001; inappropriate locomotion preceded intrusive attentional and behavioral directives (Ms = 20% and 24%) more than responsive or supportive directive speech (Ms = 2% and 7%), F(3, 54) = 10.73, p < .001.

Responsive utterances did not change infants' generally medium or high Interest in the toys, but supportive directives further increased infants' medium/high toy Interest, F(2, 36) = 26.53, p < .001. Infants' toy Interest increased modestly following intrusive behavioral directives, F(2,36) = 10.12, p < .001. In contrast, low levels of Interest in the toys (M = 81%) declined considerably following intrusive attentional directives (M = 23%), while medium levels rose substantially from before (M = 16%) to after (M = 63%), F(2,36) = 46.84, p < .001.

**Conclusion:** These findings suggest bi-directional dyadic influences on mothers' pragmatic responsive and directive speech styles and children's interactive behaviors.

**Sa1-12**

### Are 16-Month-Old Infants Aware of Allophony?

Nina Kazanina[1] **Rochelle Newman**[2]

*1. University of Bristol, Bristol, UK; 2. University of Maryland, College Park, USA*

12-month-old infants know segments/phones of their language (Werker&Tees, 1984; Kuhl et al., 1992), however it is still unclear whether they know which phonological contexts a particular phone can(not) occur in. The context information is especially relevant for cases of allophonic variation whereby a phoneme is realized differently depending on its environment, e.g. in English the velar stop *k* is 'palatal/soft' before front vowels (*k'*, as in *key* [k'i:]) and 'velar/hard' before back vowels (*k**, *cool* [k*u:l]). Our study aimed to establish whether 16-month-old American infants are aware of this allophonic rule of English.

The experiment used a head-turn preference paradigm and followed a 2(*phonemic/allophonic*) x 2(*licit/illicit*) design (4 trials per cell/participant). In the phonemic condition the licit variant contained English-like syllables, e.g. *shi* & *sho*, whereas syllables in the illicit variant started with a non-English consonant, e.g. *xi* & *xo*, *x* = a voiceless velar fricative. Given the prior literate on infant knowledge of their native phonemes, we expected infants to show significantly different listening times to these licit vs. illicit syllables. In the allophonic condition the licit variant contained combinations of *k* and a vowel that are legal in English, e.g. *k'i* & *k*u*, whereas the illicit variant included the same legal phones of English but combined in an illicit way, e.g. *k*i* & *k'u*.

Data collected so far (11 out of a future 16 participants) demonstrate a trend towards a novelty effect in the phonemic condition (mean listening times: licit=6.3 sec, illicit=8.6 sec, t(10)=2.0, p=.077), but lack of any effect in the allophonic condition (licit=7.6 sec, illicit=6.8 sec, t(10)=.8, p>.1). These results demonstrate that 16-month-olds accept sequences of phones as long as each of the sounds occurs in their language, regardless of whether the phones are combined in a phonologically licit way. Thus infants first form segmental categories, e.g. on the basis of distributional information in speech (Maye et al., 2002), and only subsequently verify their allophonic status, e.g. through a learning algorithm that combines statistical and possibly innate knowledge (Peperkamp et al., 2003; 2006). More generally, our results corroborate prior claims that segment-size categories are formed early in the development, whereas allophonic co-occurrence patterns appear to be defined later on the basis of segmental categories rather than holistically (Swingley, 2005). We discuss an apparent inconsistency between our results and previous findings of 9-month-old infants' sensitivity to their native language phonotactics (Friederici&Wessels, 1993; Jusczyk et al., 1993; 1994).

**Sa1-13**

### Do 2-year-old Children Use Functional Cues to Name Objects?

**Thien-kim Nguyen**[1] Yuriko Oshima-Takane[2]

*1. University of Toronto, Toronto, Canada; 2. McGill University, Montreal, Canada*

Previous studies have shown that 2-year-olds use functional rather than shape information to name artifacts, as long as they are allowed to play with these objects (e.g., Kemler Nelson, 1999). This finding suggests that prior manipulation of objects helps children understand the relation between the perceptual structure and function of these objects. The present study used the Intermodal Preferential Looking Paradigm to investigate whether 2-year-olds can name novel artifacts by function (a) when the novel name was taught by showing object exemplars that pitted shape against function and (b) without manipulation of the objects.

Eighty 2-year-olds were shown videos demonstrating functions of two object sets, *blick* and *cham*. In the teaching phase, two novel standard objects of similar shapes and the target function were shown along with the novel name. In the contrast phase, participants underwent the conflict or non-conflict condition in which they were taught that the novel nouns could not be extended to objects whose function was different from the target function. In the conflict condition, an exemplar of the target object with a shape dissimilar to the standard objects was contrasted with an exemplar of the non-target object with a similar shape. In the non-conflict condition, an exemplar of the target object with a similar shape was contrasted with an exemplar of the non-target object with a dissimilar shape. In the test phase, different target and non-target objects that pitted shape against function were presented with test questions. Participants' looking times were measured to determine whether they relied on function or shape when extending the novel names to the test objects.

Mean percentage of time looking at the matching screen (i.e., test object with *target function*) was (a) significantly higher than chance for the *blick* set in the conflict condition ($M$=0.59, $SD$=0.34; $t$(39) = 1.74, one-tailed, $p$ <.05), (b) significantly lower than chance for the *cham* set in the non-conflict condition ($M$=0.40, $SD$=0.30; $t$(39) = -2.18, one-tailed, $p$ < .05), and (c) not significant for the other test trials for both conditions.

The present study thus demonstrates that 2-year-olds *can* extend the novel names by function, even without manipulating the objects. Furthermore, the results showed that the conflict condition helped children rely on function, whereas the non-conflict condition did not. However, the advantage of the conflict condition depended on the type of exemplars shown in the contrast and the test phases.

**Sa1-14**

### The Role of Social Information For Category Learning at a Preverbal Age

**Sabina Pauen**

*University of Heidelberg, Heidelberg, Germany*

Category learning is typically interpreted in either the context of perceptual processing or preverbal concept formation. In both cases, only the infant-object relation is considered, whereas social influences are largely ignored. Since object categories are treated as precursors

of verbal concepts, it makes sense to assume that infants often learn about them in social situations when people look or point at objects. Consistent with this idea, recent studies show that visual object exploration can be influenced by the gaze of another person even in very young infants.

Based on this finding, a new paradigm has been developed to study category learning by referring to social information about eye gaze (Pauen & Schleicher, 2007). In Experiment 1, N = 22 12-month-olds were familiarized with 10 film scenes (20s), each showing a female agent directing her gaze to one of two objects (either an animal or a vehicle). The two objects presented in each scene changed on every trial but the target category remained the same throughout the familiarization phase (i.e. the experimenter would always look at the animal / vehicle). Left-right position of the target was counter balanced across familiarization trials. At test, the agent fixated the object of the contrasting category. Two independent coders analyzed infants' looking duration on each trial, and means of both coders served as data for further statistical analyses.

Results revealed a decrease throughout the familiarization phase and an increase at test. To clarify whether intention understanding or differences in object salience can account for this finding, the agent was replaced by a swivel desk lamp that first turned towards the target and then went on, thus flashing the target (Experiment 2). The desk lamp highlighted members of the same category across trials but was clearly a non-social agent. In this case, infants showed neither a familiarization response nor an increase in looking time at test. Findings of both experiments thus suggest that 12 month-olds use the gaze of other people to learn about object categories.

In the present study, two new samples of N = 22 7-month-olds, and N = 22 9-month-olds are being tested with the film stimuli of Experiment 1 (data collection under way). Based on recent work about gaze following we expect infants of both age groups to learn the categories. Results will of the complete series of experiments will be presented and discussed.

**Sa1-15**

### Foreign-Accented Word Segmentation in Infancy

**Rachel Schmale**, Amanda Seidl

*Purdue University, West Lafayette, USA*

Infants are equipped with an ability to cope with input variability. However, variability of affect and talker can both help and hinder word recognition (Houston & Jusczyk, 2000; Singh, Morgan, & White, 2005; Singh, 2007). One type of variability that has not been previously explored with infants is foreign-accented speech. Although infants raised in bilingual families hear not only two languages, but often two accents (e.g., English spoken with a Spanish accent and Spanish spoken with an English accent), infants in monolingual families often hear only one language and one accent, thus creating environments with different degrees of variability. It is unknown whether infants are able to accommodate different accents when processing speech, as there is a high degree of acoustic variability in the segmental and suprasegmental features of foreign-accented speech. Furthermore, it remains unclear how foreign-accented speech affects infants' abilities to segment, recognize and generalize words.

In 5 experiments using the Headturn Preference Procedure, we examined the effects of a Spanish accent on the word segmentation abilities of English-learning infants. In Experiment 1, 9-month-old infants segmented the speech stream when the same female Spanish-accented talker produced familiarization and test items ($p < .03$), but did not do so in Experiment 2 when test and familiarization items were produced by two distinct Spanish-accented talkers, who were rated to have highly similar voices in an adult listening experiment. Experiment 3 revealed that this was not due to an inability to segment words across different talkers, as they segmented the speech stream when test and familiarization items were produced by two distinct native speakers of English who were rated to have highly dissimilar voices ($p < .02$). Further, in Experiments 4 and 5, 13-, but not 9-month-olds, recognized a word produced across one Spanish-accented talker and one native English talker ($p < .02$).

These findings suggest that, although 9-month-olds have abstract phonological representations, these representations may not be flexible enough to accommodate the modifications of foreign-accented speech. Thus, it may be possible to separate voice similarity from accent similarity as infants at 9 months seem to be able to accommodate the former, but not the latter. Thirteen-month-olds, however, can deal with both kinds of variability, not only providing further evidence that they have established both flexible and abstract representations, but also providing some preliminary evidence suggesting that accentual differences may not significantly hinder word segmentation abilities.

**Sa1-16**

### Assessment of the Home Literacy Environment as a Predictor for Early Receptive Language

**Adrianne Simpson**, Margaret Friend, Ana Duenas

*San Diego State University, San Diego, USA*

**Background and Aims:** Infants' early linguistic competence is tapped by language comprehension. The present study examines the relationship between social-pragmatic factors in the context of the home literacy environment (HLE) and the acquisition of word comprehension in the second year of life. The elements that comprise the HLE emphasize time spent in communicative engagement. However, inconsistency persists regarding the relation between the HLE and receptive language in toddlers and preschoolers. Measurement issues contribute to this inconsistency. Specifically, differences in the conceptual scope of the HLE, the language measures employed, and the use of economically homogeneous samples makes comparability across studies difficult. We predict that a broadly defined HLE, including social-pragmatic factors in addition to specific book reading practices, will account for significant variance in receptive language. We have incorporated valid and reliable parent report and behavioral measures to assess receptive language and are collecting data from a more diverse sample than previously reported work. Because variability in the HLE exists across and within socio-economic groups, we hypothesize that the HLE will explain unique variance in receptive language beyond socio-economic status (SES). Data collection is in progress and we anticipate reporting findings on a sample of 40 infants from 16 to 21 months of age.

**Methods:** The current study utilizes a global HLE parent report measure (HLEQ), which combines questions regarding specific literacy practices with social-pragmatic factors, and a children's storybook title checklist (CTC). SES is measured with the Hollingshead Four-Factor Index of Social Status. Receptive language is assessed with the MacArthur-Bates Communicative Development Inventory: Words and Gestures (CDI: WG), a parent report measure, and the Computerized Comprehension Task (CCT), a behavioral measure.

**Results:** For our preliminary sample of 19 infants, the expected relation between the HLE and word comprehension was obtained for both the parent report and the behavioral measures. Correlations

between the HLEQ and CDI: WG and between the HLEQ and CCT are large and statistically significant, $r(15)=.762$, $p<.01$ and $r(16)=.588$, $p<.01$, respectively. In contrast, correlations between SES and word comprehension and between the CTC and word comprehension were small to medium and not statistically significant. A hierarchical multiple regression will be conducted on the full data set to further explore our hypotheses.

**Conclusion:** These results support our hypothesis that a broadly defined HLE incorporating social-pragmatic factors explains significant variance in receptive language. Furthermore, results suggest that the HLE will account for a significant increase after controlling for SES.

**Sa1-17**

### Children's Expectations of Conventionality Across Domains

**Casey Sullivan**[1] Lori Markson[1] Gil Diesendruck[2]

*1. Department of Psychology, University of California-Berkeley, Berkeley, USA; 2. Department of Psychology and Gonda Brain Research Center, Bar-Ilan University, Ramat-Gan, Israel*

Children appear to understand that words are conventions, shared by speakers of their language community. Do children have any expectations about conventionality in other domains, or is this assumption restricted to words? To address this question, we designed a more direct test of children's assumptions about the conventional nature of words, and then extended this method to investigate children's expectations about conventionality in the domains of functions and gestures.

In Study 1, 2- and 3-year-old children watched as a puppet removed familiar items (e.g., a cup) from a box and labeled the item correctly using it's conventional name (e.g., cup) or unconventionally, using an incorrect familiar label (e.g., hat) or a novel label (e.g., dax). After each labeling trial, children were asked a series of questions to assess whether the puppet's labeling behavior was expected/acceptable (e.g., "Is it okay that he called that a cup?"). The findings revealed that children expect speakers to use conventional labels for familiar objects and reject the use of unconventional names for things. However, 2-year-olds more readily accepted the use of a novel label for a familiar object compared to 3-year-olds, who were more adamant in their rejection of unconventional labels, regardless of whether the label was novel or familiar.

Study 2 used a similar procedure to test 2- and 3-year-old children's expectations about how an object should be used. Children watched as a puppet used an object (e.g., a hammer) in the conventional (familiar) way (e.g., pounding) or in an unconventional way (e.g., hair brushing). Following each function demonstration, children were asked a series of questions to assess whether the puppet's use of the object was expected/acceptable (e.g., "Is it okay that he used that to brush his hair?"). The results suggest that children have strong expectations about how objects should be used, consistent with findings from other laboratories.

A third study using the same procedure is currently investigating children's expectations about the use of communicative gestures. In the study, 3- and 4-year-old children watch a video of an actor using either a conventional gesture or an unconventional gesture to convey a specified meaning. Preliminary findings suggest that by three years of age, children expect people to use gestures in established, conventional ways.

Taken together, these studies provide a first step toward determining the scope of children's assumptions about conventionality.

**Sa1-18**

### Visual Speech Enhances Phoneme Discrimination and Learning in 6-Month-Old Infants

**Tuomas Teinonen**[1] Richard Aslin[2] Paavo Alku[3] Gergely Csibra[4]

*1. Cognitive Brain Research Unit, Department of Psychology, University of Helsinki, Helsinki, Finland; 2. Department of Brain and Cognitive Sciences, University of Rochester, Rochester, USA; 3. Laboratory of Acoustics and Audio Signal Processing, Helsinki University of Technology, Helsinki, Finland; 4. Centre for Brain and Cognitive Development, Birkbeck College, University of London, London, UK*

**Background and Aims:** Infants have been shown to match heard vowels to a face articulating these vowels (Kuhl & Meltzoff, 1982; Patterson & Werker, 1999). Additionally, they have been found to integrate seen and heard speech sounds (Rosenblum et al., 1997; Burnham & Dodd, 2004), even though integration is not always mandatory (Desjardins & Werker, 2004). Our aim was to determine whether seen articulations enhance phoneme discrimination, thereby playing a role in phonetic category learning.

**Methods:** Infants were assigned to two groups. The two-category visual group was exposed to speech sounds from a restricted range of a continuum between /ba/ and /da/. These tokens followed a unimodal frequency distribution centered at the category boundary. Simultaneously, a visual articulation of a canonical /ba/ or /da/ was presented in synchrony with the auditory token, and this display corresponded to the /ba/ or /da/ side of the midpoint of the continuum. Infants in the single-category visual group received the same unimodal distribution of speech sounds, but every token for a given infant was paired with either a visual /ba/ or a visual /da/. After the exposure phase, infants in both groups were tested for their discrimination of two tokens across the midpoint of the continuum as they viewed a neutral (bulls-eye) visual display. A stimulus-alternation preference procedure included both alternating (/ba/-/da/) and non-alternating test trials (Best & Jones, 1998).

**Results:** We hypothesized that the two-category visual group would show evidence of discriminating the /ba/-/da/ contrast while the one-category visual group would not. Infants in the two-category visual group looked longer during non-alternating (7.83 s) than during alternating (7.38 s) trials, and this difference was statistically significant ($t[23] = 2.477$, $P = .021$). In contrast, infants in the one-category visual group looked equally to the two trials (7.64 s vs. 7.72 s). A non-parametric test confirmed that significantly more infants in the two-category (19 of 24) than in the one-category visual group (10 of 24) showed longer average looking times for non-alternating test trials ($P < 0.017$, two-tailed Fisher's exact test).

**Conclusion:** These results not only show that visual information about speech articulation enhances phoneme discrimination, but more importantly that this enhancement during a learning phase carries over into an auditory-only post-test. Thus, contingent visual speech can override the statistical information embedded in auditory speech, and may contribute to the learning of phoneme boundaries in infancy.

**Sa1-19**

### Dynamic Infant-Directed Speech: Mothers Use Flexible Speech Strategies to Regulate Infants' Motor Behavior

**Tywanquila Walker**[1] Michael Goldstein[1] Lana Karasik[2] Catherine Tamis-Lemonda[2] Karen Adolph[2]

*1. Cornell University, Ithaca, USA; 2. New York University, New York, USA*

Compared to adult-directed speech (ADS), infant-directed speech (IDS) is characterized by exaggerated modulation of fundamental frequency, a slower rate of speech, and simpler speech. IDS communicates emotional messages (Fernald, 1985) and serves to organize infants' attention and facilitate associative learning (Kaplan et al., 2002). While previous work has described static categories of IDS (e.g. soothing, prohibition), mothers often switch rapidly between types of IDS. The present study investigated how mothers modify IDS in response to infants' behavior and task demands.

Thirteen mother-infant dyads participated in a social communication task in which mothers alternately encouraged and discouraged their infants to descend a sloping walkway. Infants were either 12-month-old crawlers (n= 6) or 18-month-old walkers (n=7). All infants were tested on slope angles that were safe (within infants' abilities), borderline (at the limits of infants' abilities), and risky (beyond infants' abilities). Maternal speech strategies (i.e., variations in pitch [F0] range, speech complexity [utterance length], and speech rate) were compared during Encourage and Discourage conditions and for each category of slope steepness. Speech to crawlers and walkers was also compared.

Mothers' speech characteristics were compared in 2 (Social condition: Encourage, Discourage) x 2 (Locomotion/age: crawlers, walkers) x 3 (Slope: safe, borderline, risky) mixed ANOVAs. We found a main effect of Social condition on pitch range, $F(1, 20) = 47.43$, $p < .001$. Mothers used a larger pitch range while encouraging than discouraging descent. We also found a main effect of Slope on utterance length, $F(2,16) = 5.12$, $p = .02$. Mothers used significantly less complex speech (shorter utterances) on borderline slopes than on risky slopes, Tukey's HSD, $p < .05$. There was a significant interaction between Locomotion and Slope on speech rate, $F(2, 20) = 5.54$, $p = .012$. For walkers, mothers spoke slower when their infants were approaching risky slopes than safe or borderline slopes, Tukey HSD, $p < .05$. Mothers of crawling infants did not modify speech rate across slope types.

In summary, mothers changed their IDS strategies in flexible ways, as a function of communicative task, slope angle, and their infants' age and locomotor ability (crawlers or walkers). Thus, mothers' use of IDS is dynamically attuned to infants' abilities and to task demands.

## *Motor and Sensorimotor*

**Sa1-20**

### Does Music Elicit or Reduce Body Movements of 3- to 4-Month-Old Infants?

**Mayumi Adachi**, Akio Akasaka, Shunsuke Kon-no

*Dept. of Psychology, Hokkaido University, Sapporo, Japan*

Adachi, Nakata, and Kotani (2002) played a set of music to each of the two Japanese infant girls 12 months of age during their spontaneous play at home. Even though these girls were growing up in completely different musical environments, both moved their bodies repetitively more often with music than without music while playing alone. Does music function as an elicitor of body movements from the beginning of infancy? The purpose of the present study was to answer to this question.

Sixteen healthy infants 3-4 months of age participated in a field experiment conducted at home. The mother of each infant placed her child in the most typical position when he or she spent private time at home. When the child looked comfortable, videotaping began. After 2.5-minute-long video-recording without music, a music CD was played on a stereo CD player in a comfortable level. The CD consisted of 10 excerpts of varying music, lasting approximately 10 minutes. The videotaping lasted 2.5 minutes after the CD ended. There were six CDs of the same set of music prepared in different orders; each infant was assigned randomly to one of the orders.

An effect of music on the infant's body movement was examined in the following manner. From each infant's video-recording, we selected 5-second-long video clips (n = 15) of the clearest and the most rigorous moving episodes: Five clips derived from the beginning 2.5 minutes (without music), another five from the first 2.5 minutes with music, and the rest from the last 2.5 minutes with music. Because some infants began crying after the CD ended, we decided not to use the 2.5-minute portion in the end. We played 15 video clips of each infant to a number of college students, who then judged how much the infant was moving for each clip on a 6-point scale. Prior to the judgment, we provided the standard video clips for the two extreme scores: 1 (not moving at all) and 6 (moving a lot).

The judgment study is still in progress. So far, music seems to have reduced movements of 3- to 4-month-old infants placed on the back during the experiment, whereas the effect seems to be reversed for those placed on the tummy (i.e., a push-up position). The function of music may change along with the motor development during infancy. The final results will be reported in the present poster.

**Sa1-21**

### Walkers on the Go, Crawlers in the Shadow: 12-Month-Old Infants' Locomotor Experience

**Daryaneh Badaly**, Karen Adolph

*New York University, New York, USA*

Balance and locomotion, like other skills, require practice to be perfected. Indeed, infants accumulate massive amounts of practice with balance and locomotion. For example, in 15 minutes of spontaneous, free play, the average 14-month-old accumulates 548 steps, travels 153 meters, and falls 4 times (Garciaguirre & Adolph, 2006). To further understand infants' locomotor experience, the current study examined the role of locomotor status by analyzing the frequency and content of 12-month-old crawling and walking infants' steps and falls. At 14 months, most infants have several weeks of walking experience. At 12 months, some infants are experienced crawlers, and others are novice walkers.

Twenty-five infants were tested: 14 experienced crawlers ($M = 96$ days of crawling experience) and 11 novice walkers ($M = 35$ days of walking experience and 155 days of crawling experience). Infants were videotaped as they engaged in a 20-minute play session in an indoor playroom. We counted the number of crawling and upright steps for both groups of infants because walkers sometimes revert to crawling and crawlers sometimes "cruise" upright holding onto furniture for support. We also assessed the accumulated distance infants traveled and counted the frequency of their falls.

Novice walkers took more steps and locomoted for longer durations than experienced crawlers, with differences driven by upright locomotion. That is, even though crawlers took more crawling steps, walkers amassed an astonishingly larger number of upright steps (Table 1). Novice walkers also traveled farther distances than experienced crawlers and fell more frequently (Table 1).

Overall, experienced crawlers accumulated less practice with balance and locomotion than novice walkers. Experienced crawlers also amassed fewer steps and less distance than experienced walkers (based on data from Garciaguirre & Adolph, 2006; Table 1). Perhaps infants are more driven to practice walking because all infants eventually walk and leave their crawling and cruising days behind.

Table 1: Steps, Distance, and Falls In 20 Minutes of Play

| | Experienced Crawlers | Novice Walkers | Experienced Walkers* |
|---|---|---|---|
| Crawling Steps | M = 211, SD = 130 | M = 102, SD = 121 | -- |
| Upright Steps | M = 74, SD = 70 | M = 610, SD = 274 | M = 731, SD = 343 |
| Distance (m) | M = 29, SD = 18 | M = 56, SD = 27 | M = 204, SD = 102 |
| Falls | M = 5, SD = 4 | M = 11, SD = 7 | M = 5, SD = 4 |

*Extrapolated data from 36 14-month-olds in Garciaguirre & Adolph, 2006.

**Sa1-22**

### Infant Exploration of Composite Substrates with Handled Objects

**Lee Carnes, Jeffrey Lockman**

*Tulane University, Department of Psychology, New Orleans, USA*

Adapting manual behaviors to the relation embodied between a handle-held object and a surface is an important element of skilled action, especially tool use. To study the perceptuomotor origins of this relational ability, we investigated how infants combine handle-held objects with surfaces differing in material composition.

Eight (N=24) and ten month-old (N=24) infants were presented a hammer-like object consisting of either a hard or soft cube attached to a handle; the object was placed on top of a composite tabletop surface that was half rigid and half flexible, divided at the infant's midline. Infants were presented three trial blocks, each consisting of two 45 second trials: on alternating trials within a block, each object was initially placed on top of the composite surface. Trials were videotaped and two independent observers scored how infants related the objects to the surfaces. Reliability averaged 0.94.

Of primary interest, we considered how infants related the objects to the composite surfaces, when holding the object's handle. Three relational behaviors were examined: banging, pressing and rubbing. Data were analyzed in separate 2 (Age: 8 or 10) x 3 (Trial Block: 1, 2, 3) x 2 (Mallet: hard or soft) x 2 (Surface: rigid or flexible) ANOVAs with repeated measures on the last three factors. Results indicated that infants related the objects to the two surfaces selectively, with some differential activity increasing with age. For banging, a three-way Age x Mallet x Surface interaction ($p < .05$) indicated that 10-month-old infants banged the hard mallet more on the rigid than flexible surface, but 8-month-old infants banged both mallets on each surface an equivalent amount. For pressing, a two-way Mallet x Surface interaction indicated that infants pressed the hard mallet more often into the flexible surface, but pressed the soft mallet more often into the rigid surface. Finally, for rubbing, a Surface main effect indicated that infants at both age levels rubbed both mallets more against the rigid than flexible surface, presumably because of the reduced friction afforded by the rigid surface.

Collectively the results suggest that by the middle of the second half year, infants evidence selectivity when relating handle-held objects to surfaces varying in material composition. Such differential activity may support early attempts at problem-solving and tool use in which parts of handle-held objects need to be related to parts of surfaces for instrumental ends.

**Sa1-23**

### Continuity in Toddlers' Skill in a Fine Motor Task

**Yuping Chen**[1] Rachel Keen[2]

*1. Department of Physical Therapy, California State University, Fresno, USA; 2. Department of Psychology, University of Virginia, Charlottesville, USA*

**Background and Aim:** Task demands affect reaching kinematics in adults, toddlers, and infants. In previous work toddlers showed a long deceleration when engaged in a precision task of building a block tower, compared to an imprecise task. Moreover, toddlers who could build tall towers (4+ blocks) had a significantly longer deceleration phase than toddlers who built low towers (2 or 3 blocks). The purpose of the current study was to determine whether the tall-tower group would maintain any kinematic differences in motor behavior compared to the low-tower group a year later when all children could build a tall block tower.

**Methods:** Sixteen children were first tested between 18 and 21 months and again between 30 and 37 months. Children were seated on their parent lap with the examiner across the table. In both sessions children were encouraged to grasp and throw the blocks into a container for the imprecise task and to grasp and put one block on the top of another to build a tower for the tower task. Reaches during the placement phase (defined as the time between grasping the block to releasing it on the top of the tower or into a container) were recorded using a Phoenix motion analysis system at 100 Hz. Two sensors were attached to each wrist of the child. Kinematic parameters (movement time, straightness ratio, peak velocity, the point in the reach where peak velocity occurred, and speed at the contact point) were computed. A mixed regression model was used to determine the statistical significance.

**KeyResults:** The reaches of the tall-tower group children were faster than those of the low-tower group at the follow-up visit. The lengthened deceleration phase in the tall-tower group observed at their first visit disappeared. As expected, all children reached slower, with less force, a longer deceleration phase, and lower speed at releasing the block in the tower task, compared to the imprecise task. All children at the follow-up visit also had straighter trajectories than in their first visit.

**Conclusion:** Toddlers with a higher skill level at 1 1/2 years of age still showed a difference in reaching kinematics a year later, but this was expressed differently. When first learning this fine motor skill, their mastery was shown in slowness when they approached the tower to place another block in this difficult task. A year later their more rapid movements when building a tower compared to low-tower children indicate a higher level of skill in this well-practiced task. As in the earlier session, all of these children adjusted their reaching kinematics when the precision requirements changed between tasks.

**Sa1-24**

### The Influence of a Barrier on A-Not-B Search

**Lisa-marie Collimore**[1] Mark Schmuckler[2]

*1. OISE/UT, Toronto, Canada; 2. University of Toronto at Scarborough, Toronto, Canada*

This experiment investigated the impact of motor constraints (e.g., a barrier) on infant's abilities to search for hidden objects in an A-not-B context. In the classic A-not-B task, infants repeatedly see a toy hidden in one of two locations (the A position), and then successfully recover the toy. Infants then see the toy hidden in a second (B) location and intriguingly, continue to search at the A location for this object; this search failure is called the A-not-B error. One explanation for this error is that infants get used to producing a particular motor action and it is this 'habit' that causes infants to make the old response (Munakata, 1997).

In this study, the nature of the motor movements necessary to recover the hidden objects in A and B locations were manipulated by placing a barrier in front of the A location, thereby forcing infants to produce a specific form of reaching behavior when searching. On B trials, the barrier was removed, thus modifying the type of motor movement required to reach for the A location. If infants are reaching to A out of some form of motor habit, then this old motor habit will no longer be in effect, and as such, might actually result in infants showing less error.

Two groups of 8- and 12-month-olds participated in this experiment. All infants received two blocks of trials - one with the barrier and one without. Within each block infants received up to 10 A trials, or until they reached a criterion of at least 5 correct searches; following the A trials, infants received a single B trial.

Comparison of percent correct search performance on A trials revealed that the presence of a barrier produced worse performance ($M$ = .44, $SD$ = .39) than when no barrier was present ($M$ =.75, $SD$ = .31), $F(1,28) = 12.50$, $p = .001$. Intriguingly, the presence versus absence of the barrier has had no effect on B trial performance ($Ms$ = .50 and .53, $SDs$ = .51 and .51, respectively), $F(1, 28) = .15$, *ns.*

Thus, although the presence of a barrier does significantly influence infants' abilities to retrieve a hidden object, changing the motor demands of the task fails to either facilitate or hinder search recovery on B trials. This finding undermines explanations for the A-not-B error that rely heavily on motor memory.

**Sa1-25**

### Early Sensorimotor Development Following Neonatal Brain Cooling in Infants who Sustained Perinatal Asphyxia

**Susan Duff**[1] Cynthia Morris[2] Christian Stanley[3,4] Marcy Gringlas[3,4] Susan Adeniyi-Jones[3,4] Vidula Damle[3,4] Shobhani Desai[3,4]

*1. Department of Physical Therapy, Thomas Jefferson University, Philadelphia, USA; 2. Occupational Therapy Department, Thomas Jefferson University Hospital, Philadelphia, USA; 3. Pediatrics Department, Thomas Jefferson University Hospital, Philadelphia, USA; 4. Nemours AI duPont Hospital for Children, Philadelphia, USA*

**Background and Aims:** Infants who experience perinatal asphyxia are at risk for sensorimotor dysfunction. Selective brain cooling has been found to increase survival and to be beneficial as a neuroprotective therapy in these infants (Gluckman et al. 2005; Lin et al. 2006). However, the influence of brain cooling on early sensorimotor development has not been established. Our first aim of this pilot study was to compare sensorimotor performance soon after brain cooling against performance at 3-4 months of age. The second aim was to examine the relationship between perinatal clinical variables and early sensorimotor outcome.

**Methods:** Fourteen term and near term infants were followed from birth to 4 months of age. Sensorimotor development was assessed using the Test of Infant Motor Performance (TIMP) (Campbell et al. 1995). Comparisons were made between performance on the TIMP in the neonatal period and at 3-4 months of age. The relationship between perinatal clinical measures taken before brain cooling (Apgars [1, 5]; pH; $pCO_2$; $pO_2$; base deficit; head circumference) and TIMP performance was examined.

**Results:** The mean Neonatal TIMP score (mean age 2 weeks) was 39 ±17 with 7/14 infants falling below the 5th percentile. The mean TIMP score at 3-4 months (mean age 14 weeks) was 93 ±16 with 13/14 infants scoring above the 25th percentile. Across all infants there were moderate correlations between Apgar at one minute and neonatal TIMP score (0.56, $p < 0.05$); and Apgar at five minutes and TIMP score at 3-4 months (0.60, $p<0.05$). The other clinical variables were not well correlated with TIMP scores.

**Conclusions:** Sensorimotor performance improved from the neonatal period to 3-4 months of age for most infants based on the TIMP and was associated with an improvement in Apgar score from one to five minutes. Sensorimotor performance in the neonatal period may reflect the residual impact of injury and the influence of medication while improvements at 3-4 months may represent early signs of neural recovery. As we continue to evaluate more infants the relationship between risk factors and behavioral outcomes may become more evident.

**Sa1-26**

### Skipping Crawling: Does it Predict Walking Attainment?

**Warren Eaton**, Samantha Lewycky, Amy De Jaeger

*University of Manitoba, Winnipeg, Canada*

In a major review of pre-walking locomotor movements Robson (1984) concluded that "The earliest walkers have no observable pre-walking locomotion -- they just stand up and walk". He estimated that 7% of infants fell into this stand-walk group and reported their mean age of walking to be 10 weeks earlier than for those who showed a typical pattern of pre-walking movements. Unfortunately Robson included little additional information about his sample or its characteristics. Here we test his claim that infants who show no pre-walking locomotion walk earlier than those who do not.

**Method**. Longitudinal daily parental diary recordings of motor milestones were available from 519 infants who were healthy at birth. As a time frame for considering pre-walking movements, we used the interval between when babies sat without support and when they pulled to a stand. 259 infants had diary data for that interval, and we then identified those who did not engage in any reported pre-walking locomotion, as well as those who did not hands-and-knees crawl, but who did display alternate forms of locomotion (e.g. inchworm crawl, bear walk).

**Results**. 95% of the infants hands-and-knees crawled, and 13% used alternate forms of locomotion. However, only 3 of the 259 infants (1%) neither crawled nor used some other form of pre-walking locomotion. We then used pre-walking locomotion status (no, yes) as a predictor in a survival analysis of age at walking. Survival analysis is ideally

suited for predicting when events will occur because information from dropouts is included (i.e., the information that a baby was not walking at the age of dropping out). Although other variables were predictive of age at first walking (e.g., gestational age), there was no significant ($\chi^2$=0.43) walking advancement for those who just 'stood and walked.' Indeed, their predicted age of walking was nearly 8 weeks later (62 vs 55 wks) than the age for pre-walking movers. When we applied the same analysis to hand-and-knees crawling (vs. its absence), we also found a non-significant difference.

**Conclusion**. Our results contradict Robson's claim. The incidence of no pre-walking locomotion was much rarer than his report of 7%, and the absence of pre-walking locomotion did not predict earlier walking (if anything, it predicted later walking). It is possible that our diary did not capture some relevant movements, but in our view, the lack of pre-walking locomotion is unlikely to accelerate the attainment of walking.

**Sa1-27**

### Movement and Autism Spectrum Disorder: Analysis of Gait during the Second Year of Life

**Gianluca Esposito**, Simona deFalco, Paola Venuti

*University of Trento, Rovereto (TN), Italy*

**Background and Aims:** Previous work has suggested that early identification of infants with autism spectrum disorders (ASD) is a critical aspect of their medical management and treatment (Rogers et al. 2007). Among the potential precursory signs, movement is the one that has gained much attention in the last decades. It has been considered a useful indicator of autism because movement does not depend on either social or linguistic development. Building upon this idea our study aims to verify, through observational methods, the possibility of distinguishing infants ASD from infants with typical development (TD) or with developmental delay (DD) by movement during the first two years of life.

**Methods:** Eshkol-Wachman Movement Analysis System (EWMN- Eshkol & Harris, 2001) and Walking Observation Scale (WOS- Esposito & Venuti) were applied to retrospective home videos of 46 children (ASD=16; TD=16; DD=10) after 6 months of independent walking (Age mean = 19,4 months). The EWMN analyses static and dynamical symmetry during gait and the WOS includes 11 items that analyze gait through three axes: foot movements; arm movements; global movements.

**Results:** Our results highlighted that after 6 months of independent walking, there are different patterns in gait among the groups. In particular, different ANOVAs have showed that children with autism scored significantly poorer ($p<.05$) then the TD and DD infants with both the EWMN and WOS analyses.

**Conclusion:** Movement disorders can be considered as a possible sign in early diagnosis of ASD. We suggest that different pattern of motor functioning probably relate to different pathways to ASD. We hypothesise that the deficits in gait in ASD children could be related to the loss of the Purkinje cells described in ASD (Welsh, 2002).

**Sa1-28**

### Intralimb Coordination as a Predictor of Motor Dysfunction in Premature Infants

**Linda Fetters**[1] Inbal Sapir[2] Yuping Chen[3]

*1. University of Southern California, Los Angeles, USA; 2. Boston University, Boston, USA; 3. California State University - Fresno, Fresno, USA*

We have previously reported that infants born prematurely with very low birth weight (VLBW) and white matter disorder (WMD) have atypical intralimb coordination patterns in kicking that can discriminate these infants from two comparison groups: infants born premature with VLBW and no WMD, and full-term (FT) infants (Fetters et al., 2004). Because VLBW prematurely born infants with WMD are at high risk to develop cerebral palsy (CP), this atypical coordination may be a hallmark of CP. In this study, we report the intralimb coordination of these three groups of infants at 5 months CA: 24 infants VLBW/WMD, 18 infants VLBW no WMD, and 12 FT infants. Atypical intralimb coordination, defined using kinematics and computing correlations between the three joint pairs in the legs, continue to be significantly different in the VLBW/WMD infants compared with the other groups (hip/knee $F(2, 516) = 7.154$, $p = 0.001$; hip/ankle $F(2, 516) = 7.846$, $p = 0.000$; knee/ankle $F(2, 516) = 4.656$, $p = 0.010$; with corresponding post hocs). Infants born VLBW/WMD maintain tight joint coupling evident through high correlations between joint pairs, whereas VLBW and FT infants have lower correlations, suggesting the decoupling of intralimb joints that would be expected at this age. The VLBW and FT infants decouple leg joints most remarkably at the distal joint pairs (hip/ankle and knee/ankle). The VLBW infants demonstrate the greatest amount of decoupled movement in at least one pair of joint couplings, with 89% of these infants kicking with both coupled and decoupled patterns, compared with 58% of the VLBW/WMD infants and 67% of the FT infants. These results suggest that atypical intralimb coordination patterns of infants with VLBW/WMD are sustained well past the developmental period during which intralimb leg movements should be characterized by the decoupling of joint pairs. The use of kinematic analysis of intralimb movements may provide the earliest evidence of a movement disorder including CP.

**Sa1-29**

### Efficacy of a Perceptual-Motor Intervention for Sitting Postural Control in Children with Moderate to Severe Cerebral Palsy Using Measures of Complexity

**Regina Harbourne**[1] Joan Deffeyes[2] Stacey DeJong[1] Anastasia Kyvelidou[2] Wayne Stuberg[1] Sandra Willett[1] Nicholas Stergiou[2]

*1. University of Nebraska Medical Center, Omaha, USA; 2. University of Nebraska at Omaha, Omaha, USA*

**Background and Aims:** For infants with moderate to severe cerebral palsy (CP), sitting independently is a major focus of therapy. The ability to sit and freely use the arms can provide the means to functional independence. However, responsiveness to intervention is difficult to measure in children who make subtle changes in postural control and take a longer time to reach movement goals. Our primary aim was to utilize measures of complexity to examine small changes in sitting postural control that indicate responsiveness to intervention.

**Methods:** We recruited 30 typically developing infants and 14 infants with moderate to severe CP, all of whom were just beginning to prop sit and were under 2 years. We calculated linear (range and RMS

[standard deviation]) and nonlinear variables (Approximate Entropy [ApEn] and Lyapunov Exponent [LyE])in both medial-lateral and anterior-posterior directions from 10 seconds of center of pressure (COP) time series of independent prop sitting on a force platform. Six trials were averaged for each infant from each testing session. Infants with CP were randomly assigned to receive a home program through a weekly physical therapy visit with for 8 weeks (N=7), or to receive a twice weekly perceptual motor intervention for 8 weeks (N=7). COP measures were taken pre-intervention, after 4 weeks, after 8 weeks, and at a 4 week follow-up session. Repeated measures mixed ANOVA (treatment x month) with post hoc analysis was performed on all variable group means.

**Results:** Significant differences between groups were noted for LyE medial-lateral (p=0.008). Post hoc testing revealed significant difference between only the home program group and the typical infants, indicating that the twice weekly group progressed toward typical values more than the home program group. There was an interaction effect (time x treatment) for LyE anterior-posterior (p=0.019) at follow-up testing, indicating that the twice weekly group increased complexity over the home program group. Specific contrasts for ApEn medial-lateral showed a significant difference (p=0.05) between the typical group and the home program group at follow-up.

**Conclusions:** The infants with twice weekly perceptual-motor intervention showed significant changes in complexity of the COP time series compared to the home program group. The linear measures of the COP were not sensitive to change, indicating nonlinear variables have greater sensitivity to small changes in postural control over time. This was consistent with previously unquantified clinical observations of qualitative postural changes over time.

**Sa1-30**

### Kinematics of Infant Manual Movements with Objects in Late Infancy

**Björn Kahrs**, Shubho Sarkar, Jeffrey Lockman
*Tulane University, New Orleans, USA*

Geerdink (1996) and Gasson & Piek (1997) have shown that movements of the lower extremities progress from being highly synchronized to less synchronized throughout the first months of life. This is thought to indicate a shift from reflexive movements to volitional control. Little is known, however, about the subsequent development of control of individual joints of the arm and the upper body to produce stable, effective movements, which is critical for using objects adaptively and linking movements to particular task demands.

To study the development of such control, eleven infants between 9-14 months of age were allowed to freely explore a tabletop surface. The infants were given a 1 inch cube to elicit banging behaviors for analysis. Detailed kinematic measures were recorded at 240 Hz using eight Qualisys ProReflex240 cameras synchronized with a Sony Handycam. One marker was placed on the chest and 5 on each arm at the following bony landmarks: Xyphoid Process (sternum), Acrimioclaviculare (shoulder), Lateral Epicondyle (elbow), Radial & Ulnar Styloids (wrist) and 3rd Metacarpal (knuckle). These markers were used to create three time series to represent different components of the banging movement: upper body tilt, elevation of the shoulder and extension of the elbow.

To analyze the degree of movement synchrony, Principal Component Analyses (PCA) were performed on the time series. Adult data for the same movement indicate that this movement is almost perfectly synchronous, with the first component accounting for almost all variability (93%). In contrast, the younger infants (9&10 Months) had great difficulty controlling the individual joints and producing synchronous movements (1st component = 58%) whereas older infants (14 Months) showed more advanced coordination (1st component = 75%) that was in between adult and young infant's patterns. A linear regression showed that the first component increased by 3.3% for each month between 9 and 14 months ($r^2 = .783$, $p < .01$).

To address control of movement amplitude, the median of difference scores in peak elevation from one strike to the next was analyzed. A linear regression resulted in a negative slope (b = -3.070), suggesting more stable movements with increasing age.

Both PCA and difference scores indicate that infants are developing the ability to control their upper extremities when using objects and begin to evidence stable and synchronized movements between 9-14 months of age. Maturational and experience-based accounts are considered to help understand this developmental increase in manual control.

**Sa1-31**

### Infants in Transition: the Development of Walking Changes Infants' Engagements with Objects

**Lana Karasik**, Catherine Tamis-LeMonda, Karen Adolph
*New York University, New York, USA*

Over the first two years of life, infants' motor skills undergo rapid and dramatic changes. New motor skills bring about new possibilities for discovering and learning about objects. This study examined how the transition from crawling to walking affects infants' engagements with objects. Specifically, we examined the effects of locomotor development on what objects infants chose to interact with and how infants shared objects with others.

Twenty-four mother-infant dyads were videotaped during 1-hour naturalistic interactions in their homes at two time points-when infants were 11 and 13 months old. At 11 months, all infants were crawling, and at 13 months, 11 had begun walking. The video data were subjected to intensive frame-by-frame behavioral coding. We examined the structure of object engagements including (a) duration of object manipulation while stationary and while transporting objects; (b) type of object that elicited interactions; and (c) whether objects were located at proximal versus distal locations. Second, infants' social engagements around objects were scored to determine whether (a) infants or mothers selected the target object; and (b) frequency of infants' social bids to mother (e.g., offering object to mother or traveling to mother with object).

Preliminary data from the crawling session indicated that 11-month-old crawling infants spent 25.4 min (M=42% of the hour) engaged with objects. They typically engage with objects while stationary (M=24.9 min) rather than while locomoting (M=.47 min). Most objects were in distal (65% of objects) rather than proximal locations (35% of objects). Infants rather than mothers were more likely to select objects for play (70% of engagements). Social bids with objects were frequent (21% of engagements). Eleven-month-olds tended to offer or give objects to their mothers while sitting (M=.89) rather than after traveling with an object (M=.11). Further analyses will describe changes in object engagements at 13 months when half of the sample was walking and half were still crawling.

In summary, this quasi-experimental study described psychological changes that accompany developing motor skills, and how motor skill acquisition facilitates changes in other developing domains. For example, changes in locomotor development allow new opportunities

for acquiring knowledge about objects as the transition to walking may afford more opportunities for travel and the hands may be freed for transporting objects. Moreover, changes in infants' engagements with objects and people set the stage for the development of social understanding.

**Sa1-32**

### Developmental Coordination Changes in Arm Movements with and Without a Toy Present Over the Pre-Reaching Period

**Hui Min Lee**[1] Anjana Bhat[2] James Galloway[1]

*1. University of Delaware, Newark, USA; 2. University of Connecticut, Storrs, USA*

**Background and Aims:** Our recent longitudinal work on the initial emergence of reaching identified a mosaic of developmental changes and consistencies within the hand and joint kinematics of pre-reaching arm movements up to reach onset. Little is known about pre-reaching coordination, that is, how the interrelationships between hand and joint kinematics change as infants learn to reach. The purpose of this study was to test hypotheses regarding pre-reaching coordination during movements with and without a toy present.

**Methods:** Principal component analysis (PCA) was conducted on hand, shoulder and elbow kinematic data from fifteen infants observed biweekly from 8 weeks of age through the week of reach onset. Separate PCAs were calculated for spatial variables and for velocity variables for the Early, Mid and Late phase of the pre-reaching period. From the PCA results, we constructed 'variance profiles' using all principal components to reflect the coordinative structure of the hand, shoulder and elbow. As PCA is new to the study of infant behavior, we used subgroup analysis, cross correlations, and adult data from flapping and reaching movements to strengthen PCA validation and interpretation. Comparing flapping and reaching data from adults suggested that specific changes in the variance profiles of infant data reflected more adult like reaching coordination.

**Results:** Results identified surprising consistencies and important developmental changes. First, over development, spatial and velocity coordination for both joints became increasingly adult-like during movements with and without a toy. In contrast, elbow spatial coordination became *less adult-like* during spontaneous movements. Within a developmental phase, movements with a toy present typically showed more adult like coordination as compared with movements without a toy present. Adult and infant data were surprisingly similar. Subgroup analysis suggested these findings were robust.

**Conclusions:** Coordination changes occur throughout much of the pre-reaching period. Joint coordination becomes increasingly adult like over this period with or without a toy present, with the noted exception of spontaneous elbow spatial coordination. From these findings and the similarity of adult and infant data, we propose distinct roles for the shoulder and elbow during early reaching, which in turn suggest specifics regarding type of control problems infant solve during the pre-reaching period. Lastly, our findings highlight the critical role of spontaneous arm movements in the emergence of reaching, and suggest that reaching coordination may be a fine tuning of the general coordination present in spontaneous movements.

**Sa1-33**

### Postural & Object-oriented Experiences Advance Infants' Reaching, Exploration, & Means-end Performance

**Michele Lobo**, James Galloway

*The University of Delaware, Newark, USA*

**Background and Aims:** Postural and movement experiences within a social context during the first months of life have been proposed to be important in the emergence of reaching (Bertenthal & von Hofsten, 1998; Fogel et al., 1999; Rochat, 1997). Our recent work suggested infants provided movement experiences reached earlier (Lobo et al., 2004). It is unclear whether advancing postural development or providing additional social interaction can advance reach onset. The purposes of this project were a) to compare the effects of enhanced social, postural, and object-oriented experiences on the emergence of reaching and b) to determine if infants able to interact with objects earlier would demonstrate advanced object exploration and means-end performance.

**Methods:** 8-11-week-old infants were randomly assigned to 1 of 3 groups with parents providing the respective experiences 15 minutes per day for 3 weeks: 1.) Social experience (SE), non-object-related talking and looking; 2.) Postural experience (PE), non-object-related activities to improve trunk, neck, and head control; or 3.) Object-oriented experience (OE), object-related reaching, manual and oral exploration. We visited infants in their homes for 6 visits over 12 weeks. At each visit, we assessed reaching ability (contact number and duration with a midline object), exploration ability (interaction with objects via mouthing and fingering), and means-end performance (learning in a paradigm requiring contact with 1 of 2 switches to activate a toy within view but out of reach).

**Key Results:** Postural and object-oriented experiences advanced reach onset by as much as 9 weeks. They also resulted in increased, earlier haptic exploration of objects. In addition, infants who had object-oriented experience demonstrated the best means-end performance and infants with postural experiences demonstrated better developing means-end performance than infants who received social experience.

**Conclusions:** The results suggest that the development of novel behaviors is dependent upon multiple subsystems and can be similarly advanced by addressing a variety of these subsystems. They also suggest that past experiences with active object exploration can facilitate early information processing and the development of early knowledge. These results on typically developing infants provide a foundation for the design of novel intervention strategies for families of infants born at risk for developmental delays.

**Sa1-34**

### Hand Dominance is not Stable in the Pre-Reaching Period

**Amy Lynch**, Hui-min Lee, Anjana Bhat, James Galloway

*University of Delaware, Newark, USA*

**Background and Aims:** Adult hand preference emerges from complex developmental changes in arm and hand use during childhood. Recent reports have highlighted the importance of understanding arm and hand use during the first year of life including the period before reach onset. (1) This longitudinal study tested the hypothesis that significant right-left differences exist in pre-reaching arm movements.

**Methods and Results:** We examined right and left hand kinematics from 13 healthy infants during trials with and without a toy present from 8 weeks of age through the week of reach onset. Significant right-left differences were found, however there was no clear pattern within a condition or across conditions. Without a toy present, the right hand moved faster, yet ended further from midline, and displayed more movements during the Late phase compared to other phases. With a toy present, the right hand moved longer lengths, yet ended movements further away from the toy. However, speed, length, and frequency of movements in the right hand did not predict "success" of right versus left hand in movement frequency to contact ratio at week of reach onset. Furthermore, when left and right hand kinematics were combined, previous findings of right hand kinematics alone were supported. Although infants begin adapting their pre-reaching kinematics many weeks before reach onset, we did not find evidence of a systematic right-left difference before reach onset in movements with or without a toy present.

**Conclusions:** Our results, coupled with other reports [2, 3, 4, 5] suggest hand asymmetries begin to emerge over the year following reach onset amid developmental changes both within the infant, and the physical and social environment. This emergence can be envisioned as an ongoing, dynamic interplay between constaints inherent in the infant and those related to the task of reaching. Implications for infants developing typically, as well as infants developing with special needs, will be presented.

1. Ronnqvist, L. & Domellof, E.. *Developmental Psychobiology*, 48(6):444-59, 2006.
2. Corbetta, D,, et al., *Developmental Psychobiology*, 48(6):460-71, 2006.
3. Michel, G.F., et al , *Developmental Psychobiology*, 40: 1-13, 2002.
4. Michel, G.F., et al , *Developmental Psychobiology*, 48:436-443, 2006.
5. Corbetta, D. & Thelen, E., *Developmental Psychobiology*, 34: 237 - 255, 1999.

**Sa1-35**

### Using Mu Rhythm Pertubations to Measure Mirror Neuron Activity in Infants

Pär Nyström, Therese Ljunghammar, Kerstin Rosander, Claes von Hofsten

*Dept. of Psychology, Uppsala, Sweden*

The discovery of a mirror neuron system (MNS) in monkeys (di Pellegrino et al., 1992; Gallese et al., 1996) provided the research community with an explanation of how the observed actions of others are matched to self-performed action. The role of mirror neurons as an execution/observation matching process has had impact in as diverse fields as cognitive neuroscience, psychology, neurophysiology and autism spectrum disorder research. Although speculative, mirror neurons have been suggested to play a role in many cognitive and social capabilities unique to humans, such as language and imitation learning, interpersonal communication, empathy and theory of mind. One reason for this uncertainty is that many of these social skills emerge already in infancy and there have been few direct measures of the infant MNS. This study is the first to measure MNS activity in infants using mu rhythm perturbations, which is a well documented EEG marker of mirror neuron activity in adults. The purpose of the present study was to examine if it is possible to detect and measure activation of the MNS in 8-month-old infants with high density EEG.

In total 34 normal, healthy 8-month-old infants observed a live actor perform actions within three different conditons, while their EEG was recorded using a 128-electrode geodesic EEG net. The actor altered his movements between a goal-directed action and a non-goal-directed action. A static condition was included as baseline. A wavelet time/frequency analysis of the data show a robust inhibition of the mu rhythm in 8-month-old infants when they observe a live goal-directed action but not when they observe a spatially similar non-goal-directed movement. A source localization analysis confirmed the anatomical location of dipoles to motor areas. We thereby provide direct evidence that the MNS is functioning in an adult-like manner at this age level, which is a new finding.

**Sa1-36**

### Effects of Prenatal SSRI Exposure on Infant Psychomotor Functioning

**Aimee Santucci**[1] Barbara Hanusa[2] Katherine Wisner[2]

*1. University of Pittsburgh, Division of General Internal Medicine, Center for Research on Health Care, Pittsburgh, USA; 2. University of Pittsburgh, Department of Psychiatry, Pittsburgh, USA*

**Background:** Previous studies have described the effects of in utero selective serotonergic reuptake inhibitor (SSRI) exposure on neonatal outcomes; however, little is known about the long-term effects of SSRI exposure on developmental outcomes throughout infancy. We examined the relative effects of both maternal depression and SSRI use during pregnancy on infant psychomotor, cognitive, and behavioural outcomes.

**Method:** Maternal depression status, based on whether the women met full criteria for major Depressive Disorder (MDD), was ascertained at the week 20 interview which included a SCID. Maternal interviews were completed at 20, 30 and 36 weeks gestation and 3, 6.5, and 12 months postpartum. The Bayley Scales of Infant Development second edition (BSID-II) were administered to infants at 3, 6.5 and 12 months of age. Items from the Mental Development Index (MDI) and Psychomotor Development Index (PDI) were administered individually to each infant.

**Results:** Growth curve models were used to estimate the effects of prenatal SSRI exposure on PDI and MDI scores from 177 infants with age of assessment as the time-dependent variable. Infant gender, prenatal alcohol use, delivery method, prenatal alcohol use, maternal education, and admission to a neonatal intensive care nursery (NICU) were used as main effect predictors in all analyses. Age of assessment was entered as an interaction with all main effect predictors. Preliminary analyses indicated that prenatal and postnatal MDD, gestational age, maternal age, and tobacco use were not significant predictors of PDI and MDI scores and were not used as predictors in subsequent analyses. PDI scores were lower overall with second trimester SSRI use [$F(1,121)=10.31, p=.0015$]. Both PDI and MDI decreased over time with prenatal alcohol use [$F(2,121)=4.07, p=.0184$; $F(2,121)=4.01, p=.02$].

**Conclusions:** These findings suggest that prenatal SSRI use is implicated in lower psychomotor functioning during infancy and prenatal SSRI use may have more far-reaching effects than short-term consequences for neonatal adaptation. However, few of these infants can be classified as "high risk" based on their PDI scores and these initial findings should be interpreted with caution.

**Sa1-37**

## LOVIS- Longitudinal Studies of Very Premature Infants: Development of Smooth Pursuit

**Dorota Stasiewicz**[1] Olga Kochukhova[1] Kerstin Rosander[1] Masaharu Kato[2]

*1. Uppsala university, Department of Psychology, Uppsala, Sweden; 2. Tokyo Women's Medical University, Dept. of Infants' Brain & Cognitive Development, Tokyo, Japan*

Infants born very preterm (VPT), i.e. before 32 weeks of gestational age, have an increased risk of developing neuromotor and perceptual disabilities. The current study is part of a longitudinal project, LOVIS, including 95% of all VPT infants born in Uppsala County (Sweden) during 2004-2007. At this point 101 infants are enrolled in the project. The general aim of the LOVIS project is early detection of impaired visual perception due to white matter injuries, intraventricular haemorrhage (IVH), and retinopathy of prematurity (ROP).

The ability to follow a moving object with smooth eye movements develops rapidly between 6-12 weeks of age in infants born at term (von Hofsten, Rosander 1996, 1997). The increase of smooth eye movements is closely connected to the development of motion perception. Smooth eye movements have been measured on the first 65 VTP infants in the LOVIS project while following a horizontally moving object. The results show that at 2 and 4 months of age the development of smooth eye movements is delayed. The amplitude of smooth pursuit is lower and increases less in the VPT infants between 2 and 4 months of age compared to controls. (Rosander et al. 2007, poster, CVRS London).

The aim of the current study was to measure the smooth pursuit of these infants at 10 months of age in order to see if the developmental delay continues to this age. The eye movements are measured with a Tobii T60 eye-tracker while the infant look at a horizontally moving object with either sinusoidal or triangular motion at different velocities. Our preliminary data suggest it has recovered in some infants and that it is still delayed in others.

**Sa1-38**

## Reliability of Body Sway Measurements during Infant Sitting Posture Development

Anastasia Kyvelidou[1] Regina Harbourne[2] Joan Deffeyes[1] Wayne Stuberg[2] Junfeng Sun[3] **Nicholas Stergiou**[1,4]

*1. HPER Biomechanics Laboratory, University of Nebraska at Omaha, Omaha, USA; 2. Munroe-Meyer Institute, University of Nebraska Medical Center, Omaha, USA; 3. Preventive and Societal Medicine, University of Nebraska Medical Center, Omaha, USA; 4. Department of Environmental, Agricultural and Occupational Health Sciences, College of Public Health, University of Nebraska Medical Center, Omaha, USA*

We determined the reliability of linear and nonlinear measures of body sway during sitting posture of typically developing infants. Twenty nine infants that scored above -0.5SD on the Peabody Developmental Scale came to the lab twice per month for four months. A physical therapist ranked sitting behavior at each visit according to three stages: 1) Prop sitting, 2) Variable, about 10 seconds of sitting, and 3) Sits upright all the time. Stage of sitting was considered the appropriate variable of development, because of the age variability which infants began to sit.

The first three trials of independent sitting of the first session that was identified at a specific stage were used to determine intra-session reliability. For the inter-session reliability, two sessions that were identified at the same stage of sitting were used. In each trial body sway, through center of pressure (COP) data, was acquired during sitting on a force plate. The COP data were analyzed using the linear tools of Root Mean Square (RMS) and Range for both the anteriorposterior (AP) and the mediolateral (ML) direction, as well as the nonlinear tools of the Approximate Entropy (ApEn) and the Lyapunov Exponent (LyE) for both directions. Reliability was quantified with ICC. An ICC of less than 0.4 indicates poor reproducibility, between 0.4 and 0.75 fair to good, and over 0.75 excellent.

For intra-session, ICCs for all parameters ranged between 0 and 0.74 for all stages indicating reproducibility between poor and fair to good. When the ICCs were averaged across stages, we only had fair to good results, except for the AP and ML LyE and AP Range, which had poor. However, even for these variables their maximum ICCs were fair to good.

For inter-session, ICCs for all parameters ranged between 0 and 0.81 for all stages indicating reproducibility between poor and excellent. When the ICCs were averaged across stages, we only had fair to good reproducibility, except for the AP and ML LyE that had poor. However, even for these variables their maximum ICCs were fair to good.

For both intra- and inter-session, ApEn had the higher ICC values, and the values for almost all parameters improved with more mature sitting. In conclusion, reproducibility of COP parameters during infant sitting showed similar results to standing. The reliability of COP measures in sitting is important for the evaluation of intervention targeting sitting postural control in infants with motor delays.

**Sa1-39**

## Resolving Degrees of Freedom in a Complex System Across Levels of Action: End-Point Behaviors, Kinematics, and Kinetics

**Caroline Teulier**, Beverly Ulrich

*Motor Development Lab, University of Michigan, Ann Arbor, USA*

**Introduction:** When humans produce functional tasks like walking, it is easy to assume the efficient orchestration of muscles, joints, and body segments is inevitable and emerges fairly well pre-formed. However, in previous work we documented that the emergence of rhythmic muscle activation requires months of practice (Chang et al., 2006). Here we examine stepping elicited prior to walking onset in infants born with typical development (TD) and infants born with myelomeningocele (MMC). We know that infants with MMC respond less frequently to attempts to elicit steps (Teulier et al, submitted) but we know little about the kinematics and kinetics underlying the overt patterns they produce. Here we a.) compare the frequency of alternating, single, parallel, and double steps in infants with TD and MMC when supported on a treadmill and b.) map leg segment kinematics and kinetics to step type.

**Method:** We tested 12 infants with TD and 12 with MMC at 1, 3, 6, 9, and 12 months by supporting them upright on a treadmill. We administered 10 trials at 5 speeds, 30s each. We used a 6-camera motion capture system and EMG on core gait muscles to collect kinematic and kinetic data and a digital camera to record and code step patterns.

**Results:** Both groups responded to this context by producing multiple step patterns. A 2 (Group) x 5 (Age) MANOVA w/repeated measures on Age for percent Alternating, Single, Parallel and Double steps showed that infants with TD produced more Alternating steps than infants with MMC ($p<.01$) who produced more Single ($p<.01$) and Parallel steps ($p<.05$). Results highlight an increase in percent Alternating

with age ($p<.01$) and decrease in percent Parallel steps ($p<.01$). We will present segmental angle time series showing the variation in leg motion and modal characteristics of muscle activity that underlie segmental rotations. For infants with TD variability in kinematic data tends to decrease across age while movements of infants with MMC remained highly variable in trajectory and muscle activation.

**Discussion:** We propose that infants with TD learn to manage their degrees of freedom by exploring their repertoire of options and perceiving better the consequences of each action pattern; increased persistent variability in infants with MMC arises from diminished neural pathways. In subsequent studies, with a higher sample size, we will examine, within infants with MMC, the relation between level of lesion and degree of variability in performance to test this proposal.

**Sa1-40**

### Vocalizations and Affect of Crawling and Pre-Crawling Infants

**Pamela Whitney**, James Green

*University of Connecticut, Storrs, USA*

Previous research, (Shirley, 1930) has found that plotting an infant's vocalizations by week indicates a steady increase in the number of utterances they will produce during the first year of life. Interestingly, Shirley showed this steady climb to be temporarily suspended in the few weeks before and after the onset of a new motor skill, such as reaching or crawling. This finding fits with newer ideas of a systems approach to developmental trajectories; however this relation of vocal development and motor development has not received much attention in the time since. The present study examined the relationship between vocalizations, affect and crawling in a sample of 8-month-old infants. We hypothesized that infants who had begun to crawl recently would show a different pattern of vocalizations and affect in different social contexts.

Video tapes of naturalistic interactions of 11 infants at home were viewed and five minute samples in three everyday contexts were examined: (1) free play, (2) meal time, and (3) playing with mother. Two types of vocalizations were analyzed: vocal play and negative vocalizations. Affect, judged from facial expressions, was coded as positive, negative or neutral. The onset and offset of each behavior was coded in each context. We used GSEQ to tally the number of seconds spent in the joint states of context and vocalization and of context and affect for each subject.

Log-linear analyses were performed on the 3-way tables of locomotor status, context and vocalizations or affect. There were 3-way interactions in both tables, inferred from the fact that the models with all 2-way interaction terms did not fit, $G^2(4)=226.01$, $p<.001$, $G^2(4)=320.20$, $p<.001$. Eight-month-olds who were not crawling produced less vocal play than expected in free play and more than expected with mother, whereas infants who could crawl showed the opposite trend. That is, crawling infants produced most of their vocal play when alone during free play and most of their negative vocalizations when playing with mother. A similar pattern was observed for facial expressions of affect; crawling infants showed the most negative affect with their mothers.

Current data collection is ongoing using a short-term longitudinal design, from 6 to 10 months, to track infants' vocalizations before, during and after the onset of crawling. Growth curve analyses will be done to model changes in vocalizations in infants who begin to crawl at different ages.

## *Theory, Methods and History*

**Sa1-41**

### Anatomical and Functional Magnetic Resonance Imaging (MRI) of Children From Birth Through 6-Years of Age

**C. Robert Almli**

*Washington University Medical School, St. Louis, USA*

**Background and Aims:** There are few magnetic resonance imaging (MRI) studies on anatomical (aMRI) and functional (fMRI) development of the human brain of healthy, normal infants, toddlers, and preschool age children. This lacking is related to the predominant use of medical patients as young subjects, where use of sedation to prevent distress and movement artifact can be justified. Recently, we have been establishing adaptation and training procedures to conduct MRI studies with healthy, normal subjects from birth through 6-years, without the use of sedation. Aim-1 determines adaptation and training procedures to accomplish aMRI and 'active'-fMRI (i.e., awake subject performs task, such as finger tapping, on command) with subjects 3-6 years of age. Aim-2 determines appropriate adaptation and training procedures to accomplish aMRI and 'passive'-fMRI (i.e., subject sleeping or resting quietly, low-level sensory stimulation presented, such as touching subject's fingers, mother's voice) with subjects from birth through 6-years of age.

**Methods:** Subjects underwent medical, neurological, developmental, and neuropsychological screening and testing to assess health history and status, and to acquire comprehensive behavioral performance measures (e.g., intelligence, motor, language, memory) for determining relationships among behavioral and brain (MRI) measures. Healthy subjects were adapted and trained in "play" and "mock" scanners, and by the parents at home, to 'hold still' and/or 'perform a task' on command. When comfortable with the scanning environment and procedures, the child was brain scanned (aMRI and fMRI) while sleeping, resting or awake.

**Results:** Awake subjects at 3-years of age and older had task-related fMRI (i.e., finger tapping) scans, and the BOLD signal showed primarily 'de-activations' during finger tapping periods, and a return to baseline during non-tapping periods. These de-activation BOLD signals were seen in small areas of the motor and somatic-sensory cortex, and broadly and diffusely in other cortical regions of the four hemispheric lobes. Similar results were also obtained from infants (6-12 months) in response to 'simulated finger tapping' stimulations. These preliminary results indicate that, based on fMRI analyses of active and passive tasks during waking and sleep, brain functional organization of infant and preschool children differs from that of the adult for the direction of the brain activity change (BOLD deactivation signal), and the brain loci of the activity changes.

**Conclusion:** The fMRI response patterns obtained from human infant and preschool subjects strongly differed from the response patterns of adults.

**Sa1-42**

## Deriving Timing-Based Contingencies with Event-Based Sequential Data Using the Limit of Phi

**Maximilian Bibok**, Raymond Koopman

*Simon Fraser University, Burnaby, Canada*

**Background and Aims:** This poster presents the limit of phi as a measure of sequential association for studying the timing of mother-infant contingent interaction that avoids the limitations of standard approaches to sequential association with event-based data. This methodological issue has significant implications for infant studies investigating social interaction. In research on mother-infant interaction (e.g., Bigelow, 1998), the analysis of sequential data plays an essential role in examining the influence of maternal contingent responding on infant development. Often the timing of maternal contingent responses is of theoretical importance. However, established methods for sequential analysis (Bakeman & Gottman, 1986), such as Yule's Q, are based upon event-based coding schemes that do not permit the timing of events to be incorporated into the determination of contingency - any behavioural code sequentially following another is considered contingent. Although time-based sequential analytic techniques have been proposed (Bakeman & Quera, 1995), such techniques use duration of behaviour rather than frequency of behaviour in the calculation of contingency. Consequently, time-based sequential analysis may not be appropriate when the timing of events is essential for addressing theoretical concerns, yet the duration of those events is of no theoretical or empirical importance. The limit of phi, as a measure of sequential association, is able to accommodate such situations.

**Method:** When the determination of contingency includes timing, a given behaviour can sequentially follow the preceding behaviour, yet not be considered contingent because the onset of that behaviour does not occur within a specified time window following the offset of the preceding behaviour. Such occurrences cannot be adequately reflected in a 2 X 2 contingency table. Recording the behaviour as non-contingent redistributes the cell frequencies in the contingency table in order to keep the total number of all observed behavioural events constant, and may result in negative cell frequencies. The limit of phi resolves this limitation, as it holds the total number of behavioural events constant by assigning it an infinitely large number. Consequently, recording sequential behaviours as non-contingent will not produce negative cell frequencies. The limit of phi, therefore, is equal to the value of phi when the value of cell D in a 2 X 2 contingency table is set to infinity.

**Conclusion:** Use of the limit of phi allows researchers to use the timing of behaviours in determining contingency without having to adopt duration as the unit of analysis.

**Sa1-43**

## Enacting the Dynamic Field Theory of Infant Perseveration

**Evelina Dineva**[1] Chritian Faubel[2] Yulia Sandamirskaya[2] John Spencer[1] Gregor Schöner[2]

*1. University of Iowa, Iowa City, USA; 2. Ruhr-Universität-Bochum, Bochum, Germany*

In Piaget's A not B paradigm, infants make a sensorimotor decision based on a visual cue and previous reaching experience. Theoretical models have accounted for selection through competition among dynamic neurons, for working memory through sustained activation, and for the dependence on experience through a memory trace (Thelen et al, 2001; Munakata, 1998). But do these models provide process accounts? Or do cognitive processes remain ungrounded such as the processes that underlie object recognition, autonomous action initiation, or the maintenance of correspondence across trials?

We demonstrate that the Dynamic Field Theory of perseverative reaching (Thelen et al., 2001) is a process account by implementing it on a simple autonomous robot. A video camera mounted on a small robotic vehicle serves as vision sensor. The number of pixels whose color value lies within a defined interval determines how much input each column of pixels contributes to a dynamic activation field. The field is defined over the heading direction of the vehicle. That direction is continuously estimated by integrating motor commands sent to the two wheels of the vehicle. Self-stabilized peaks in the field represent directions in the world in which visual targets lie. Such peaks provide inputs to a dynamical system of heading direction, which drives the vehicles motors and generates orienting responses. When visual targets are pushed sufficiently close to the vehicle, so that enough visual input is generated, the system autonomously initiates a response, selects color-coded visual target and orients toward it.

In a formalized A not B experiment on this robot, we demonstrate perseverative behavior. In particular, we show how "older" robots with stronger neuronal interaction tolerate longer delays between cue and movement initiation. A number of parametric effects such as the dependence of perseveration on the history of earlier responses and on the salience and symmetry of the visual targets are reproduced.

To explore which behavioral competences are provided by the dynamic field, we let the robot move around in the presence of targets and obstacles (sensed through a distance sensor). When "young" robots lose a target from view while avoiding an obstacle, they lose the target from "mind" as well. "Older" robots, in contrast, are capable of reaching targets even when these are temporarily out of view. Although the memory trace induces the A not B error, it actually helps "young" robots in this scenario, pushing their performance closer to that of "old" robots.

**Sa1-44**

## An Intensity-Specific Dyadic Approach to Analyzing Affect Attunement during Early Mother-Infant Interaction: A Methodological Comparison to Traditional Methods

**Lisa Greenwald**, **Pamela Rollins**

*School of Behavioral and Brain Sciences, University of Texas at Dallas, Dallas, USA*

**Background:** Researchers have measured infant's affect and caregiver-infant affect attunement to examine social-cognitive development, including CJA and language. Traditionally, infants and mothers have been examined separately, with few researchers using a dyadic measure of affect attunement. Further, affect has frequently been collapsed into one positive affect category regardless of the intensity (low, moderate, or high). Many researchers reference Stern's concept of affect attunement yet do not measure specific intensities or allow for the mapping of vitality contours. The current study compares traditional methods (non-dyadic infant affect and collapsed intensities) with an intensity-specific dyadic measure of affect attunement. Because the latter measure is the most labor-intensive, it is important to justify such an approach. The results of these differing approaches were contrasted in a predictive model examining the stability of infant's CJA skills.

**Methods:** Fifteen mothers-infant dyads participated in object-mediated free-play at 6, 9, and 12 months of age. Mother-infant interaction was captured utilizing split-screen video. Data was microanalytically coded for affect attunement at 6 and 9 months and CJA at 9 and 12 months. Affect attunement was measured utilizing affect-intensity matching (neutral, low-, moderate-, and high-positive intensity) occurring within a 2-second window during mutual-engagement time (ME-time). The comparison predictor measures were the percent of ME-time dyads demonstrated 1) low-, moderate-, and high-intensity affect matching (intensity-specific; dyadic), 2) positive affect matching (collapsed; dyadic), and 3) infant affect at each intensity (intensity-specific; non-dyadic), and 4) infant positive affect (collapsed; non-dyadic). The primary outcome measure was the mean length of CJA episodes at 12 months. CJA was measured utilizing a well-replicated coding scheme (Adamson, et al., 2004; Bakeman & Adamson, 1984; Carpenter et al., 1998).

**Results:** Comparing the dyadic approaches, the intensity-specific approach had a strong predictive relationship to CJA at 12 months ($R^2 = .604$, $p < .05$); whereas the collapsed approach had no effects at all. This is due to the opposing directions of the relationships of low versus moderate intensity (see other abstract). Comparing non-dyadic between dyadic approaches, the dyadic approach showed a strong predictive relationship; whereas the non-dyadic approach masked the strength of the relationship and was spurious.

**Conclusion:** The intensity-specific dyadic approach is preferred because the predictive relationships are evident and statistically sound. Analyzing unique contributions of differing intensities resulted in the identification of a predictor to CJA. Results suggest that an intensity-specific dyadic approach be considered when analyzing the role of affect attunement in social-cognitive development.

**Sa1-45**

### Construct Validity of the Comprehensive Developmental Inventory for Infants and Toddlers (CDIIT) for Four Age Groups

**Ai-wen Hwang**[1] Li-jen Weng[2] Hua-fang Liao[1]

*1. School and Graduate Institute of Physical Therapy, College of Medicine, National Taiwan University, Taipei, Taiwan; 2. Department and Graduate Institute of Psychology, National Taiwan University, Taipei, Taiwan*

**Background and Aims:** The purpose of this study was to investigate the construct validity of the Comprehensive Developmental Inventory for Infants and Toddlers (CDIIT) from infancy to preschool age.

**Methods:** This study has enrolled children with or without disability. The children were divided into four age groups, namely the infant group (6-11 months; N=309), 1-year-old group (12-23 months; N=193), 2-year-old group (24-35 months; N=184), and preschool age group (48-71 months; N=141). The CDIIT includes five domains (cognition, language, motor, social, and self-help), each composed of various subdomains. The Developmental Quotient (DQ) of every subdomain was used as the basic unit for factor analysis. Factor analysis was conducted by using the iterative principle factor method and promax rotation. Factorability of subdomains was confirmed by using the Bartlett's test of sphericity and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy. The range for the number of factors was decided based on multiple methods, the scree test, parallel analysis and eigenvalue greater than one. Root mean square residual (RMSR) was also calculated to check the solution of factor extraction.

**Results:** The KMO measure of sampling adequacy was over .8 with a significant Bartlett's test statistic (p<.001) for all the four age groups. The 2-factor (perceptual-motor and social-adaptive) solution in the infant and 1-year groups, 2- factor (perceptual-motor and social-adaptive) to 3-factor (motor, social-adaptive, and cognitive-language) solution in the 2-year group and preschool group provided superior factor structure in terms of interpretability and compatibility with existing child development theory. Further, the factors showed to be significantly intercorrelated (r=.34 ~.62, p<.01).

**Conclusion:** Although 5 domains was proposed in CDIIT according to the traditional developmental theory, 2 to 3 main constructs was established based on this empirical study.

**Sa1-46**

### Emergence and Stability of Pupil Responses in a Violation-Of-Expectations Task

**Sylvain Sirois**[1] Iain Jackson[2]

*1. The University of Manchester, Manchester, UK; 2. School of Psychological Sciences, The University of Manchester, Manchester, UK*

Looking time measures provide the main window into early cognitive abilities of infants (Aslin, 2007). However, suggestions of advanced cognitive skills in infants using Violation-of-Expectations (VOE) methods have been met with sustained criticism over the past decade (e.g., Bogartz et al., 1997; Haith, 1998; Sirois & Jackson, 2007). At the core of this criticism is the equivocal nature of relative looking durations to complex visual events (Cohen, 2004), as well as a failure to take into serious consideration infant learning dynamics (Houston-Price & Nakai, 2004). Recently, we have used pupil dilation data as a complement to looking time measures (Jackson & Sirois, submitted; Sirois & Jackson, 2007). Pupil dilation is an involuntary response to arousal and would be expected if and when infants are surprised by conceptually unusual events. Despite the growing availability of eye tracker systems in infancy labs (Aslin, 2007), use of pupil dilation had not been used with infants until our recent work (Karatekin, 2007). This paper examines the emergence and stability of pupil dilation data in a VOE task. 8-month-old infants (n = 24) were familiarised to video sequences showing a train going around a circular track on which there was a tunnel. During each of 6 familiarization trials, the wrong train impossibly emerges from the tunnel at the end of the dynamic sequence. There were 3 test trials manipulating the perceptual novelty and plausibility of events, followed by a tenth trial that duplicated familiarization events. We observe that dynamic pupil responses emerge over the first three trials and remain stable over the course of the experiment, despite a pronounced and significant linear decrease in overall looking time. These pupil data enrich the interpretation of looking data by providing a complementary picture of learning effects that remains unaffected by trial order effects at test.

**Sa1-47**

### A Method of Improving Avian Models of Human Attachment

**Tyler Wereha**, L. James Shapiro

*Dept. of Psychology, University of Manitoba, Winnipeg, Canada*

**Background and Aims:** Attachment Theory (Ainsworth & Bowlby, 1991) stands as one of the most influential contributions to the study of human attachment. John Bowlby, an early and significant contributer to human attachment theory, drew upon several seemingly disparate fields of inquiry to formulate the basic tenets of his theory. One of these fields was ethology, notably Konrad Lorenz's

(1935/1957) conception of "imprinting". Many problems exist with the traditional "imprinting" literature, however, that undermine its use as a developmental model of attachment (Shapiro, 1980). In particular, this research often focused exclusively on the role of the mother by using inanimate objects in the testing situation. In contrast, many studies looking at the influence of broodmates have found a pervasive attraction among ducklings (i.e. Dyer, Lickliter, & Gottlieb, 1989). Similarly, siblings and peers are important in the development of children (Furman & Buhrmester, 1992). Although animal models are very valuable in human research (Fossella & Casey, 2006), these models may be improved upon. A method of testing ducklings as a brood was devised. Testing ducklings in a more natural situation may allow researchers to more effectively elucidate the factors mediating attachment in avian and, ultimately, human attachment processes.

**Methods:** Two broods of 10 ducklings each were tested for their preferences in a simultaneous choice situation (see Shapiro, 1970) for a stimulus brood of three ducklings or no stimulus. Ducklings were tested in eight consecutive 15 min trials each day for seven days. The location of the stimulus brood was changed after every trial. Time spent in each quadrant was recorded. The results suggest that the broods consisting of 10 ducklings were attracted to the stimulus brood. The stimulus brood of three ducklings was preferred to a statistically significantly extent over the one week testing period.

**Conclusion:** This testing method presents a way of decreasing the artificiality of past avian attachment research and provides more valid findings. The results point to the influence of siblings/peers on the attachment process. The preferences of the broods for a group of ducklings may be driven by the underlying fitness benefits of group membership (Hamilton, 1964), and these benefits may similarly influence human attachment. Despite the different developmental trajectories among avian species and humans, these models may be useful for examining children's sibling and peer interactions up to adolescence when peer influence peaks.

## *Cognitive Development*

**Sa2-01**

### Infants' Eye Movements during Familiarization with Natural Object Categories

**Nadja Althaus**, Denis Mareschal

*Centre for Brain and Cognitive Development, Birkbeck, University of London, London, UK*

Previous research in infants' object categorization abilities has focussed on the types of category contrasts which infants at various stages in development are able to learn. A few studies also investigated how feature characteristics of familiarization exemplars influence infants' category formation (e.g., Mareschal, French, & Quinn, 2000; Oakes & Spalding, 1997). However, it remains an open question how these features are identified and processed by infants during familiarization.

We conducted two eye tracking studies with 12-month-olds to investigate how the learning process during familiarization with a natural object category is reflected in infants' eye movement patterns (e.g. considering fixations on spatially localized features such as object parts).

24 infants were familiarized with a sequence of eight different images of deer. Of these, 21 also completed the experiment with images of cars. Successful categorization was established in two paired test trials following the familiarization phase, which consisted of a novel item from the familiarization category and an exemplar from a contrasting category (horses and motorcycles, respectively). During the first test trial, subjects spent on average 59.4% of their looking time fixating on the novel category item after familiarization to deer stimuli ($t(23)=2.63$, $p<.05$), and 64.5% after familiarization to car stimuli ($t(20)=2.59$, $p<.05$).

In the more detailed analysis of the familiarization phase, we defined areas of interest representing spatially localized "object parts" such as head, antlers, and tail (deer) or wheels and headlights (cars).

Results indicate that infants systematically fixate areas corresponding to a certain object part for a number of trials, suggesting that their attention is focussed on this feature, before turning to other object parts. With the deer stimuli for instance, a decrease in the proportion of looking time spent fixating on the area corresponding to "head" is observable at the same time as looking at "antlers" increases. Similarly, subjects viewing car images initially focus on "wheels" before increasingly fixating "headlights".

The observed pattern suggests that infants extract features sequentially during category acquisition by directing their attention, as observable in eye movements, selectively to individual object parts for a certain period of time. These results will be discussed in terms of maximum information gain.

**Sa2-02**

### The Specificity of Object Knowledge in Infancy: What Erps Tell Us About the Association of Sight and Sound Information

**Lysett Babocsai**[1] Manuela Friedrich[2] Sabina Pauen[1]

*1. University of Heidelberg, Heidelberg, Germany; 2. Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany*

In order to acquire semantic knowledge about objects it is necessary to integrate information from different sensory modalities. Babocsai, Friedrich, and Pauen (2007) investigated the auditory-visual coordination of pictures and natural sounds in 12 month-old infants. Following a procedure developed by Friedrich and Friederici (2005), infants received sounds of animals and inanimate objects in matching (congruous) or non-matching (incongruous) picture contexts. Analyses of ERPs revealed a greater N400 in response to sounds that were incompatible with the picture content. Thus, the study provided first neurophysiological evidence for the integration of knowledge from different sensory modalities within global categories at 12 months of age. But how specific is this knowledge? Infants may have learned that animals do not make machine sounds and that artifacts do not make animal sounds. Alternatively, infants may have already acquired specific knowledge about visual-auditory associations. For example, seeing a dog may lead to the expectation that this object should bark (rather than meow). Based on this line of thought, one would expect similar N400 responses when the stimuli provide incongruity within a given global domain as they did when incongruity was between domains.

The aim of the current study is to test this idea. For that matter, the identical visual and auditory stimuli were used in the same intermodal picture-sound paradigm; only the picture-sound pairs in the incongruous condition changed. A total of N = 45 infants participated. During the experimental session, each infant received up to 116 picture-sound pairs which were presented sequentially. Pictures of animals and inanimate objects were shown for 2000 msec before a natural sound started to play for 1500 msec. Pictures remained visible during this time and continued to be in sight for another 500 msec after the

sound was turned off. The sounds were either congruous or incongruous to the picture content. Hence, half of the picture-sound pairs provided matching information; the other half provided non-matching information (i.e. a dog combined with a barking sound, or a dog combined with a meowing sound). Matching and non-matching pairs were presented in random order.

The data collection for this study is already completed and data analyses are in progress. To know whether infants apply specific knowledge or have more general expectations when integrating sights and sounds, will help us to better understand the beginnings of concept formation.

**Sa2-03**

### Mechanisms Underlying Developmental Transitions: Insights From Models of Implicit False Belief Tasks

**Vincent Berthiaume**, Kristine Onishi, Thomas Shultz

*Dept. of Psychology, McGill University, Montreal, Canada*

Developmental transitions or changes are ubiquitous in human development but their underlying mechanisms remain poorly understood. Using false belief (FB) tasks, two transitions in preschoolers' apparent understanding of mental representations in others have been found.

In a standard FB task, a child must predict where a protagonist will search for a hidden object. The protagonist has a false belief about the object's location when the object has moved without the protagonist's awareness. The first transition is when children begin to succeed at the "approach" version of this task (goal is to find the object) at about 3.5 years of age (e.g., Wellman, Cross, & Watson, 2001); the second is succeeding the "avoidance" version (goal is to avoid the object) at about 4 years (e.g., Leslie, German, & Polizzi, 2005). However, 15-month-olds can succeed at a non-verbal, implicit variant of the "approach" task (e.g., Onishi & Baillargeon, 2005), which raises questions about the existence of the previously discussed transitions.

Artificial neural networks are computer simulations that can model behaviour and suggest possible underlying mechanisms. Our model used a sibling-descendant cascade-correlation algorithm which was initialized with minimal computational power (hidden units) and recruited more computational units as it learned a task. Incremental learning can model longitudinal developmental transitions by testing networks after each recruited unit.

Training for the model included information about where an object started, where the object ended up, whether the protagonist was watching, and where the protagonist searched. Training information was stochastic, i.e., not consistently correct, to reflect everyday observations. The model was tested by providing information about where the object started, where it ended up, and whether the protagonist was watching, with the model predicting where the protagonist would search.

When the model was trained on twice as many true as false belief trials, networks went through two transitions: (1) from expecting protagonists to search where the object really was (omniscience) to success at the false-belief task and (2) from failure to success on the avoidance version of the task.

Thus, our model suggests that transition 1 may be due to receiving/perceiving more true-belief than false-belief based behaviour and that transition 2 may be due to avoidant goals being indicated by a greater variety of behaviours than approach goals (there are many ways to not find X, but only 1 way to find it). Implemented models are a rigorous way to explore the mechanisms that underlie developmental transitions.

**Sa2-04**

### The role of efficiency of action in infants' goal attribution

**Szilvia Biro**, Stephan Verschoor

*Leiden University, Leiden, The Netherlands*

Gergely et al. (1995) proposed that infants' goal-attribution is guided by the principle of efficient (rational) action. Thus, infants interpret an action as goal-directed ONLY if the action achieves the end-state in the most efficient way. However, Woodward (1998) suggested that infants' inferences about goals are initially based solely on their sensitivity to focus on the end-state of the action. In this study we investigated whether a non-efficient approach prevents infants from goal attribution, that is, from interpreting the end-state of the action as the goal.

We modified the study of Woodward & Sommerville (2000). Seven- and nine-months-olds were assigned to three conditions: (EF) Efficient Goal-approach (n=48), (NEF1) Non-efficient Goal-approach with Box (n=51), (NEF2) Non-efficient Goal-approach without Box (n=11, data under collection). In the EF condition infants were familiarized to two toys inside two closed transparent boxes. Infants saw a hand opening one of the boxes by removing the lid and grasping the toy *inside*. Then the boxes were removed and the positions of the toys were swapped. In the test events infants saw the hand either grasp the same toy as before in the new location or the other toy in the old location. The NEF1 condition was identical to the EF condition except that during familiarization the toys were not inside but *in front of* the boxes. In the NEF2 condition the boxes were not present, yet the hand performed (*'mimicked'*) the lid opening movement during familiarization before it grasped the toy.

We hypothesized that if infants use efficiency of the means, they will interpret he grasping of the toy as the goal during the familiarization and therefore will expect the hand to grasp the same toy in the changed circumstances only in the EF but not in the NEF1 or NEF2 conditions. An ANOVA on looking times in the two test events (old goal, new goal) showed a significant interaction of event and condition, [$F(1,105)=6,65$, $p<0.002$]. Separate t-tests showed that infants looked significantly longer in the new goal than in the old goal test event in the EF condition while in the NEF conditions no differences were found.

This finding indicates that infants do not only consider the end-state of the action when they attribute a goal. Therefore, our finding supports the idea that goal attribution takes place only if a well-formed teleological representation can be constructed that satisfies the principle of efficient action.

**Sa2-05**

### A Newfound Relation between Sitting Ability and Face Processing in 6-Month-Old Infants

**Cara Cashon**, Casey Allen, Pamela Healy, Amelia Barna

*University of Louisville, Louisville, USA*

**Background and Aims:** Whereas a number of studies show that relations exist between the development of locomotor skills and infants' perceptual, cognitive, and socio-emotional development (see Campos et al., 2000), fewer links have been found between sitting skills and

changes in other areas. However, recently it was hypothesized that infants' newfound ability to sit independently may be related to a brief period of regression found in face processing (Cashon & Cohen, 2004). The goal of the present study was to investigate this possible relation in 6-month-old infants.

**Methods:** Using an age-held constant design, 24 non-sitters (infants who were unable to sit without support) and 24 near-sitters (infants who were able to sit independently for more than 2, but less than 10 s) around 6 months of age were compared on a face-processing task. The visual habituation "switch" procedure, in which infants are habituated to two female faces and then tested on a familiar and combination test face, was used to test featural versus holistic face processing (Cashon & Cohen, 2004). The combination face consisted of the internal features (eyes, nose, and mouth) of one of the habituation faces and the external features (hair, forehead, eyebrows, chin, etc.) of the other. Holistic processing is inferred if infants look longer at the combination than familiar test face, whereas featural processing is inferred if no significant differences are found.

**Results:** A repeated-measures ANOVA of log10-transformed scores revealed a significant Sitting Stage X Test Trial interaction, $F(1, 46) = 5.32$, $p = .03$. Non-sitting infants were found to look significantly longer at the combination than familiar test faces, $F(1, 23) = 4.99$, $p = .04$, which indicates they processed faces holistically. In contrast, near-sitters did not look significantly differently, $F(1, 23) = 1.42$, $p = .25$, which suggests they processed faces featurally. Moreover, an independent t-test revealed that the groups did not differ significantly by age ($M = 24.48$ wks., $SD = 1.44$ and $M=25.02$, $SD = 1.14$).

**Conclusion:** The results of the present study indicate that a relation exists between sitting ability and face processing: 6-month-old infants who have no ability to sit autonomously process faces holistically, whereas infants who have marginal sitting abilities process faces featurally. We argue that infants who are learning to sit up experience an "information overload" that causes them to regress to a lower level of processing.

**Sa2-06**

### Developmental Limitations on Numerical Ordinal Abilities

**Sara Cordes**[1] Sumarga Suanda[2] Elizabeth Brannon[1]

*1. Duke University, Durham, USA; 2. Emory University, Atlanta, USA*

When habituated to repeating sequences of three stimuli involving sets which increase or decrease in numerosity (e.g., ascending stimuli: 1-2-4, 2-4-8, 4-8-16) and tested with stimuli with either the same or a reversal in ordinal direction, 11-month old infants look longer to the ordinal reversal while 9-month olds fail to do so (Brannon, 2002; Suanda, Tompson, & Brannon, 2007). This has been interpreted as evidence that an appreciation of ordinal numerical relationships develops sometime between 9 and 11 months of age. Here we investigate an alternative possibility that the limitations observed in the younger infants are a function of task variables related to the experimental design rather than a failure to detect changes in ordinality. We performed three experiments with 9- and 11-month old babies. In Experiment 1, we explored the role of the number of numerical exemplars in these tasks. Nine-month old infants saw four sets in each stimulus sequence (e.g., 1-2-4-8, 2-4-8-16) to see whether longer sequences would make the ordinal relationship more salient. In contrast, 11-month old infants were tested with only two-numerosity sequences to determine the necessary number of exemplars for success. Evidence suggests that although a minimum of three exemplars is necessary for success (i.e., 11 ms old infants failed to detect reversal with 2 numerosity sequences) in these ordinal tasks, additional exemplars do not increase the likelihood of success in 9-month olds. In Experiment 2, memory demands were greatly reduced by presenting two sets simultaneously, with the spatial configuration of the displays cuing ordinality (e.g., left set is smaller). Results mimicked previous findings - 11 month olds detected a change in ordinality, yet 9-month olds did not suggesting that memory demands were not an issue in the Brannon (2002) task. Lastly, the discriminability of sets within stimuli was increased in an attempt to make ordinal relationships more salient in Experiment 3. Thus, 9-month olds were presented sets in which set size increased or decreased three-fold (e.g., 1-3-9, 3-9-27). Again, these infants failed to detect the reversal in numerical ordinal direction. By ruling out the possible contributions of memory or set-size discriminability limitations, results of the current study support and extend previous findings that an appreciation of ordinal numerical relationships emerges sometime between 9- and 11-month olds of age.

**Sa2-07**

### Development of Melodic Categorization during the First Year of Life

**Eugenia Costa-Giomi**[1] Leslie Cohen[2] Ashley Brock[2] Danielle Solan[1]

*1. University of Texas, Center for Music Learning, Austin, USA; 2. University of Texas, Children's Research Laboratory, Austin, USA*

Infants are sensitive to timbre as reflected in their preferences for specific instruments and voices. Six- to nine-month-olds show a preference for their mother's voice over that of another female (Standley, 1990) and 8-month-olds indicate a preference for a single timbre rendition of a musical piece over its mutitimbre version (Ilari & Polka, 2006). Studies on word recognition have shown that, for infants, timbre is a salient feature in speech. Houston and Jusczyk (2000) found that 10.5 month olds could recognize words said by talkers of different sex but 7.5 month olds couldn't. The younger infants could only recognize the words if said by talkers of the same sex. In other words, when the timbres of the spoken words were different, the younger infants perceived the words as being different while the older ones were able to perceive them as being the same. These results showed developmental changes in the categorization of words with older infants being able to use a broader category than did the younger ones. The purpose of the study was to investigate the development of melodic categorization during the first year of life.

A habituation-novelty preference procedure was used in two series of experiments completed with 7- and 11-month olds (n=64 and n=56 respectively). In agreement with previous research, we found that 7- and 11-month olds can discriminate timbre and melody and that timbre is a very salient musical feature for them. We established that infants can recognize the sound of an instrument playing different melodies but cannot recognize a single melody played by different instruments. The results show that it is difficult for infants to habituate to renditions of a melody played by different instruments and that exposure to this type of stimuli may actually hinder their ability to discriminate between melodies. The findings that certain musical stimuli may be too complex for 7- and 11-month-olds to elicit categorization and discrimination of melody, led us to complete another series of experiments on infants' perception of timbre and melody. Initial findings suggest that 7- month-olds do not perceive the timbre and melody of a musical rendition as inseparable elements and confirm their difficulty in discriminating melodies played by different instruments.

**Sa2-08**

### The Impact of Labeling on 10-Month-Olds' Expectations About Internal Object Properties

**Kathryn Dewar**, Fei Xu

*University of British Columbia, Vancouver, Canada*

**Background:** It has been demonstrated that 9-month-olds expect objects differing in a kind relevant property (shape) to be marked by distinct count noun labels, but this expectation is not held for objects differing in a property unrelated to kind (color) (Dewar & Xu, 2007). Although shape is a cue for kind membership for adults and older children, it's possible that for infants, distinct labels refer to distinct shapes. One way to address this question is to ask whether infants expect objects that share kind membership to also share kind relevant properties. If labels refer to kinds, infants should expect the objects' internal properties (properties determined by kind membership, e.g., internally-generated sounds) to accord with the objects' label.

**Method:** A looking-time method was employed, featuring a between-subject design. During familiarization, infants were shown pairs of objects (half saw only identical objects, the other half saw only different-looking objects). Each object pair was demonstrated to make either identical sounds or different sounds. Infants were presented with one object pair that made identical sounds and one that made different sounds. Test trials followed the same procedure, except, before the sounds were demonstrated, the objects were labeled. For half the infants, object pairs were labeled with one repeated label and, for the other half, object pairs were labeled with two distinct labels. Infants' looking times to the object pairs were recorded. If internal properties, such as sound, are considered kind-relevant properties and labels refer to kinds, infants should expect same or different sounds from the object pairs by labeling, not by the appearance of the objects.

**Results:** A paired sample t-test revealed that infants who heard object pairs labeled with one repeated label looked significantly longer when the objects made different sounds (Mean = 9.30 s) than when they made identical sounds (Mean = 7.86 s, $t(31) = -2.11$, $p = .04$). Conversely, infants who heard object pairs labeled with two distinct labels looked significantly longer when the objects made identical sounds (Mean = 9.32 s) than when they made different sounds (Mean = 7.40 s, $t(31) = 2.09$, $p = .05$). No other significant effects were found.

**Conclusion:** These results indicate that 10-month-olds' expectations about object pairs' internal properties were driven by the number of distinct labels applied to the objects, as opposed to the object pairs' appearance. These findings provide evidence that infants expect distinct labels to refer to kinds.

**Sa2-09**

### Infants' Ability To Parse Continuous Actions

**Stacy Grossman**[1] Susan Hespos[1] Megan Saylor[2]

*1. Northwestern University, Evanston, USA; 2. Vanderbilt University, Nashville, USA*

**Background and Aims:** Though the ability to segment action is a critical first step to identifying others' goals and intentions, very little is known about the origins of this ability. How and when do infants successfully identify individual target actions in the continuous flow of human behavior? Previous work suggests that 9-month-old infants segment human behavior into action units that are akin to those identified by adults (Saylor et al., 2007). Our prediction was that in the first months of life, infants may learn to parse continuous human action by observing regularities in how objects behave and interact, and use this to create meaningful units necessary to parse action sequences. A first step in testing this hypothesis was to find out whether infants can detect familiar event categories embedded in continuous action sequences and whether certain portions of continuous action are more salient than others.

**Methods:** We used a habituation/dishabituation looking paradigm to test 32, 6- and 8-month-old infants in each experiment. In Experiment 1, half of the infants were habituated to a sequence of three events where a colorful ball was passed under a bridge, behind a screen and in a box. The other infants saw a colorful ball jump over a bridge, behind a screen and bounced on a pedestal. In the test trials, infants saw two events in alteration: a novel event and a familiar one. Experiment 2 was comparable to Experiment 1, except it tested whether infants could detect target actions that consisted of transitions between events. Habituation sequences were extended to incorporate two pairs of transitions (under/bounce/behind/down/on vs. under/slide/behind/up/on) and test trials consisted of a novel and familiar transition in alteration (bounce/up vs. slide/down). The between-subject habituation trials were designed so that the novel trial for one group was familiar for the other group, which controlled for interpretations based on low-level perceptual biases.

**KeyResults:** In Experiment 1, infants looked significantly longer at the novel compared to the familiar test events, however in Experiment 2 there was no significant difference for looking times at the novel and familiar transitions. There were no significant main effects for age or age by event interaction.

**Conclusions:** Together, these results indicate that 6- and 8-month-old infants can parse human action at units that correspond to event category boundaries and further that event categories are a privileged class that aid infants in creating boundaries to parse continuous human action.

**Sa2-10**

### False Belief Understanding about Contents in 2.5-year-olds in a Violation-of-Expectation Task

**Zijing He**, Matthias Bolz, Renee Baillargeon

*Department of Psychology, University of Illinois, Champaign, USA*

Some understanding of false belief has recently been observed in the second year of life in violation-of-expectation (VOE) tasks, and in the third year of life in anticipatory-looking tasks. Would children in the third year of life also succeed at VOE false-belief tasks? The present research examined 2.5-year-olds in a VOE false-belief task about objects' contents.

An experimenter sat at a window in the right wall of an apparatus, and another experimenter, called the agent, sat at a window in the back wall. In front of the agent were a small cheerios box and a small crayon box, both commercially available and easily recognizable.

Children in the false-belief condition first received a familiarization trial. While the agent was absent (her window was closed with a curtain), the experimenter switched the contents of the cheerios and crayon boxes. During test, the agent opened the curtain, said "I want to eat; I'll get the cheerios!", and then repeatedly pointed to the cheerios box (match event) or the crayon box (mismatch event), while saying "Here they are!". Children looked reliably longer at the mismatch than at the match event, suggesting that they understood that

the agent falsely believed that the cheerios box contained cheerios and the crayon box crayons.

Children in the true-belief condition received similar trials except that the agent was present during the familiarization trial. Children looked reliably longer at the match then at the mismatch event, suggesting that they understood that the agent realized that the boxes' contents had been switched.

Children in the modified-false-belief condition received the same familiarization trial as in the true-belief condition, followed by a second familiarization trial: while the agent was absent, the experimenter switched the boxes' contents again, thus restoring their original contents. Children looked reliably longer at the match than at the mismatch event, suggesting that they understood that the agent falsely believed that the cheerios box contained crayons and the crayon box cheerios.

In Experiment 2, the agent said "I want to color; I'll get the crayons!" during test. Results were as predicted, suggesting that children expected the agent to reach for the crayons where she believed they were.

The present results thus provide new evidence that some understanding of false belief is present in the third year, and support the view that the understanding of false belief revealed in VOE tasks in infants is continuous with that observed in older children.

**Sa2-11**

### Perception of Social Causality in Infants and Adults

**Shoji Itakura**[1] Tomoyo Morita[2] Yusuke Morito[2] Kayako Nakagawa[3] Norihiro Sadato[4]

*1. Kyoto University, Kyoto, Japan; 2. Japan Science and Technology Agency, Kyoto, Japan; 3. Osaka University, Osaka, Japan; 4. National Institute for Physiological Sciences, Okazaki, Japan*

**Background and Aims:** Adults detect social causality in dynamic visual events involving abstract entities interacting at a distance. Furthermore, they tend to interpret the moving entities as persons, with specific personality traits and intentions. Previous studies had shown the developmental change in perception of dynamic information that specifies social and intentional events for adults. Infants showed the sensitivity to the movements that specify chase events of two disks on the computer screen by the age of (Rochat et al., 1997). Using a habituation paradigm, they also showed that by the age of 8-10-month, which is a key developmental stage in social cognition; infants begin to infer social causality in abstract dynamic entities (Rochat et al., 2004). However, it is not clear that 8-10-month-old infants could perceive social causality in the same way as adults do. To address this issue, we recorded eye movements while viewing two abstract discs chasing each other between 5-month-old infants, 9-month-old infants, and adults.

**Method:** The participants were 12 5-month-olds, 12 9-month-olds, and 12 adults. Using a remote eye-tracking device, we measured the eye movements while the participants were shown the video clips in which a pair of discs moving in systematic interaction on the computer screen, one chasing the other but never actually contacting one another (chase condition) or moving either independently (random condition).

**Results:** In the chase condition, 5-month-old infants spent significantly more time fixating the chaser compared to the chasee ($p<0.001$), and 9-month-old infants also showed the similar tendency but not significant difference. In contrast, adults spent significantly more time fixating the chasee compared to the chaser ($p<0.05$).

**Discussion:** These results, such a remarkable difference in looking behavior between infants and adults, suggested that cognitive process accompanied with the perception of social causality in moving discs event was different. One possible explanation for the fixation bias to the chasee observed in adults is that adults might tend to empathize with the chasee and to infer about plans and intentions attached to the chasee.

**Sa2-12**

### Deference to Testimony about a Physical Event

**Vikram Jaswal**

*University of Virginia, Charlottesville, USA*

**Background and Aims:** Personal observation is not only insufficient to account for much of our knowledge, but it can sometimes lead us astray. In our day-to-day experience, the earth looks flat, not round, and eels look like snakes, not fish. How do we acquire knowledge that lies outside of, or even conflicts with, personal observation? The answer, of course, is that much of what we know is learned from what other people tell us--from their testimony.

Young children are largely deferential to testimony about what things are called or the category to which they belong--sometimes even when that testimony conflicts with their expectations (e.g., Gelman & Markman, 1986). In this study, we asked whether 30-month-olds would be similarly deferential to testimony about the physical world, even when that testimony conflicted with an event they had just witnessed.

**Procedure:** We used a chimney apparatus modeled after Hood (1995), and consisting of three chimneys affixed atop three cups. Each chimney was connected to a non-adjacent cup using a clear tube. On each of six experimental trials, 30-month-olds ($N = 18$) watched as a ball dropped through one of the chimneys traveled down a clear tube and landed in a particular cup. The experimenter asked children where the ball had landed, and then asserted that it had landed in a different, incorrect location. Finally, children were invited to search for the ball. We also included six baseline trials, which were similar to the experimental ones, except the experimenter provided neutral (rather than misleading) testimony.

**Results:** Before the experimenter's testimony, children indicated the ball's correct location on 75% and 88% of experimental and baseline trials, respectively, more often than would be expected by chance of 33%, $ps < .001$. However, after hearing the misleading testimony, they searched in the correct location significantly less often than when they heard the neutral testimony (38% vs. 83%, $p < .001$). Most searches following misleading testimony were to the incorrect location indicated by the experimenter (55%). Further, children were as likely to defer to the misleading testimony on the last of six trials as on the first (70% vs. 60%).

**Conclusion:** Toddlers were surprisingly willing to trust the testimony of an adult even though it conflicted with a physical event they had just witnessed. Of course, adults usually provide children with accurate information about an often unintuitive world, and so a default deferential stance may serve children well.

**Sa2-13**

### Infants' Representations of Causal and Intentional Agency

**Paul Muentener**, Susan Carey
*Harvard University, Cambridge, USA*

**Background and Aims:** The interventionist account of causal representations has suggested that intentional action may have special status in infants' causal representations (J. Woodward, 2007). One implication of this theory is that infants' initial causal representations may be limited to the effects of intentional actions. That is, infants may infer that only intended actions are capable of causing effects in the world. The current study tested this question by investigating infants' causal inferences of occluded state change events with intentional and unintentional actions.

**Method:** Eighty 8-month-old infants were habituated to an occluded state change event involving a situational agent (human hand) and a patient (a box that could break apart into several pieces). During habituation the hand entered the stage, passed behind a screen, after which the effect on a box, partially visible behind the screen, occurred. The actual interaction was occluded by a screen. During test trials, the screen was removed, and infants were shown, in alternation, two events: 1) the hand contacted the box (contact event) and 2) the hand stopped short of the box (gap event) before the effect occurred. In Condition 1, the hand performed actions that infants represent as unintentional (a backwards flop and a gloved hand that altered skin texture cues) (Woodward, 1999; Guajardo & Woodward, 2004). In Condition 2, the hand performed actions that were matched to the manner of motion in Condition 1, but that also could be interpreted as intentional. Following Ball (1963), if infants represent the habituation event as causal and expect contact in a causal event, then they should dishabituate to the gap event because the causal relationship between the entities has changed.

**Key Results:** Infants looked significantly longer at the gap test events only when the hand performed intentional actions ($p < .05$). An ANOVA on infants' looking times to test events also yielded a significant test event (contact vs. gap) X action type (intentional action vs. unintentional action) interaction ($p < .05$). Infants discriminated the occluded causal events involving intentional from those involving unintentional actions.

**Conclusions:** These results support the conclusion that infants distinguish intended and unintended causal actions. Furthermore, they suggest that infants' representations of causal agency and intentional agency may be confounded early in infancy. These results will also be discussed as they relate to follow-up studies further investigating infants' representations of causal agents and intentional agents.

**Sa2-14**

### What is He Going to Do? Infants Predict Action Goals by Observing the Way of Grasping a Tool

**Markus Paulus**, Sabine Hunnius, Harold Bekkering
*Radboud University Nijmegen, Nijmegen Institute for Cognition and Information, Nijmegen, The Netherlands*

Studies measuring proactive eye-movements have shown that, when observing somebody else's action, adults anticipate the goal of this action (Flanagan, & Johansson, 2003). Even when presented with several possible target objects, adult observers show visual anticipations of the correct action goal as soon as the goal can be predicted from the movement path (Rotman, Troje, Johansson, & Flanagan, 2006). Recent infant studies demonstrated that infants as young as 12 months anticipate the goal of a simple action they observe (putting balls into a bucket; Falck-Ytter, Gredebäck, & von Hofsten, 2006). When observing a person using everyday objects like a cup or a mobile phone, infants from 8 months of age on show anticipations of the goal location (Bekkering & Hunnius, 2007; Paulus, Hunnius, & Bekkering, 2007).

The present study investigates infants' anticipatory eye-movements during the observation of a person who was using a tool. In a series of short movies, infants saw two objects together with a novel tool which could be used in two different ways to elicit a salient action effect on each object. Only the way the tool was grasped was predictive of which of the two possible actions the person was going to carry out. The movement path itself was kept ambiguously within the first seconds, so that the goal target could not be extrapolated from the movements. Infants' eye movements were measured with an infrared eye-tracker. It was examined from which age on infants visually anticipated the correct target goal of the action just by observing the way the tool was initially grasped. Therefore the number of anticipations and the amount of looking time to the two target objects was analyzed during the time of the ambiguous movement.

Preliminary analyses suggest that infants from 11 months on anticipate the correct goal of a complex action. Interestingly, when compared to 16-month-old infants different learning sequence-plots are found: Whereas the younger infants need more learning trials to anticipate the correct action goal, the 16-month-old infants anticipate very early and show a strong decline after having watched some trials. The present study therefore suggests that infants have the ability to acquire knowledge of complex tools and sheds light upon infants' developing functional object knowledge. The present study therefore suggests that infants as young as 11 months of age have the ability to acquire knowledge about novel complex tools and sheds light upon infants' developing functional object knowledge.

**Sa2-15**

### Come Again: the Effects of Repetition on Toddlers' Imitation From Picture Books

**Gabrielle Simcock**[1] Judy DeLoache[2] Crystal Crawford[1]
*1. University of Queensland, Brisbane, Australia; 2. University of Virginia, Charlottesville, USA*

Joint picture-book reading is a prevalent activity in Western societies, and recent research has demonstrated that toddlers can learn about real-world objects and activities depicted in a picture book when reading with adults. Simcock and DeLoache (2006), for example, read 18- to 30-month-old children a book twice in succession that depicted and described how to make a toy rattle. The children learned from the book-reading how to construct the rattle: In the imitation test, they were more likely to successfully assemble the rattle than were the age-matched no-demonstration controls. However, the toddlers' imitative performance from the book was not stellar and varied as a function of the iconicity of the illustrations. For example, although the children imitated more with color photographs than with simple drawings, they consistently imitated less than children who observed a live demonstration of the target actions. It is possible that the toddlers formed a relatively impoverished memory representation from the book (relative to the live demonstration) and that repeated exposure to the book might improve their exploitation of the depicted information. Thus, in the present study, 18- and 24-month-olds (N=60) were read one of two picture books (illustrated with either photographs or

drawings) either twice in succession or four times in succession. The results showed that the children learned from the book reading: those who saw the book out-performed age-matched no-demonstration controls. However, amount of experience mattered: The toddlers who were shown the book four times imitated more than did the toddlers who were only exposed to the book twice. This positive effect of increased repetition occurred regardless of whether the toddlers were shown a picture book illustrated with photographs or with drawings. Thus, increased opportunities to encode the depicted information significantly improved the toddlers' ability to use it when presented with the corresponding real objects. The results are discussed empirically in relation to studies showing that repetition facilitates imitation, theoretically in relation to toddlers' emerging representational capacities, and practically in relation to young children's desire to re-read picture books over and over again.

**Sa2-16**

### Probability Triggers the Eye: Reasoning About Uncertain Events in 12-Month-Old Infants

**Erno Teglas**[1] Luca Bonatti[2]

*1. SISSA, Trieste, Italy; 2. Université de Nantes, Nantes, France*

The most widely accepted views hold that human probabilistic reasoning is affected by heuristics and biases, or it reduces to frequency sampling. A third view is that natural intuitions about possible future events ground elementary probabilistic reasoning. Here we propose that even 12 months olds have rational expectations relying on well-documented numerical abilities, which can be a functional base for expectancies about future events.

In order to test our hypothesis we generated 3D animations, where the geometry of the stimulus represented the information about likely and unlikely outcomes. A ball bounced inside a rectangular box with one hole in a wall and three in the opposite wall. Then an occluder completely hide the structure, and after a predefined time the ball exited from its right side. Afterwards, the occluder disappeared. Four test movies were presented, counterbalancing the right/left location of the 3-hole side. We collected both eye movements during the occlusion phase and looking time after the occlusion phase. We predicted that if infants expected the next outcome to be the most likely one, they would orient towards the 3-hole-side during occlusion (anticipation), but they would also look longer to one-hole (improbable) exits when the occluder was lifted (violation of expectation).

Indeed, without exposure to prior experiences, 12-month-old infants showed anticipatory saccades towards the 3-hole-side during the occlusion period, despite the fact that during that period they were simply looking at an uniform occluder. However, after the ball exited and the occluder was lifted, they looked significantly longer at the 1-hole (improbable) outcome. In short, they anticipated the probable and were surprised at the improbable.

These results show that anticipation of probable events and surprise at improbable events are both detectable in the same trials, and support the thesis that natural intuitions of probabilities guide expectations for future outcomes early in development.

**Sa2-17**

### Probability or Representativeness? Evidence From 8- and 12-Month-Old Infants

**Fei Xu, Vanessa Waechtler**

*University of British Columbia, Vancouver, Canada*

Are infants more surprised to see one white ball than one red ball come out of a box filled with mostly red and a few white balls (10:1)? Are they more surprised to see 4 red and 1 white balls (less probable) rather than 5 red balls come out of the same box? Our research asks whether 8- and 12-month-old infants can compute probabilities in a violation-of-expectation looking time procedure.

Previous research has shown that 8-month-olds expected a 4 red and 1 white sample to be drawn from a box filled with mostly red ping-pong balls; they found it unexpected if a 1 red and 4 white sample was drawn from the same box (Xu & Garcia, 2007). However, these studies left open the question whether infants had computed probabilities or had they simply expected a rough match in proportions between the sample and the population.

In the current study, sixteen 8- and sixteen 12-month-olds were presented with two probability tasks, counterbalanced in order. In the 1-ball task, half of the infants in each age group were familiarized with a box filled with mostly red and a few white balls (10:1), the other half to a box of mostly white balls. On alternate test trials, the experimenter closed her eyes and pulled out either a red ball or a white ball from the box; for the mostly red box, it would be less probable to pull out a white than red ball. After each ball had been placed into a small transparent container, looking time was recorded. In the 5-ball task, the infants were familiarized with the same box. On alternate test trials, the experimenter closed her eyes and pulled out either a sample of 5 red balls (5:0) or 4 red balls and 1 white one (4:1). The 5:0 sample was more probable than the 4:1 sample, whereas the 4:1 sample was more representative of the population (i.e., matches the proportions of the box). After all 5 balls had been placed into the container, looking time was recorded.

We found that 12-month-olds, but not 8-month-olds, looked reliably longer at the 4:1 than the 5:0 sample, suggesting that they computed probability and not just representativeness. Interestingly, neither 8- nor 12-month-old infants looked longer at the less probable samples in the 1-ball task. We conclude that 12-month-olds, but not 8-month-olds, may have developed a sense of probability.

**Sa2-18**

### Young Children Understand Normativity in Pretence

**Emily Wyman**, Hannes Rakoczy, Michael Tomasello

*Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany*

Children begin to engage in pretend play during their second year. Importantly, they inferentially elaborate on the pretend actions of others, for example, pretending to wipe up milk that a play partner has pretended to spill (Harris & Kavanaugh, 1993). This suggests some awareness of the implicit rules that exist in a pretend game, that is, that certain actions follow on appropriately from others. But do children view these rules as normative? If one were to act inappropriately, would children intervene? Although research into the development of children's understanding of normativity is in its infancy, it has been found that young children normatively protest in response to others' inappropriate actions during joint games (for example, Rakoczy,

Warneken & Tomasello, in press; Rakoczy, submitted). However, no research to date has examined whether young children understand the context-specificity of normative rules that apply to pretence games in contrast to reality.

We, therefore, tested 36-month-old children in an experimental and control condition. The common structure to both was this: The child, an experimenter (E), and a puppet engaged in a functional activity with a conventional object, such as drawing with a pen. The puppet then left and while he was absent, E and the child established a 'toothbrush game' in which they pretended the pen was a toothbrush. They then called the puppet back for his turn, explaining that they had played the 'toothbrush game' and the pen was now their toothbrush. In both conditions, the puppet then performed the functional activity, that is, he used the pen to draw with. However, in the experimental condition, before drawing he asked the child 'can I play with you?' and so joined the pretend game. By contrast, in the control condition he explained 'no, I don't like the toothbrush game, I prefer to draw' and so did not join the game. Thus, while he drew in both cases, in the experimental condition his drawing violated the rules implicit within the pretend game, while in the control condition no such violation occurred because the puppet had not joined the game in the first place.

Children spontaneously protested and intervened on 44% of experimental trials and only 2% of control trials, producing a significant difference between conditions (Wilcoxon test, $p<.0001$). This is, therefore, the first study to show that within the context of pretence, young children understand and enforce context-specific normative rules.

**Sa2-19**

### Assisted Imitation: How Infants Grasp that the Perceiving and Acting of the Self is "Like Others"

**Patricia Zukow-Goldring**
*UCLA, Los Angeles, USA*

How do infants come to know that the actions of others are analogous to those of the self? Many theoretical positions from a variety of disciplines attribute different sources to this understanding, including innate abilities (Meltzoff and Moore, 1995), identification (Hobson & Hobson, 2007), caregivers imitate infants (Barresi & Moore, 1996), cognitive precursors (Piaget, 1962; Heyes, 2005), socio-pragmatic knowledge (Tomasello et al, 1993), and simulation modelling (Hurley, 2005). Given infants know that the self and other are alike, it follows that infants learn new behaviours by spontaneously imitating the actions they have observed others performing. Is this assumption warranted? Perhaps not.

Byrne (2003) distinguished two uses of *imitation* : (1) the *transfer of skill problem* (how someone acquires novel, complex behavior by observing ); (2) the *correspondence problem* (how someone matches observed actions with self-executed actions).

This research first documents whether or not caregivers and/or infants spontaneously imitate one another. If spontaneous imitation is not a robust phenomenon, then a different kind of imitation might inform learning new actions. Consequently, this research examines the *transfer of skill problem* . While engaged in *assisted imitation*, we propose that caregiver gestures direct and educate infants' attention by linking the actions of self and other through the dynamic coupling of affordances (opportunities for action) and the body's work to reach a shared understanding.

**Method:** These results come from longitudinal data collected from five English-speaking, Euro-American middle-class and six Spanish-speaking, Latino working-class families with an infant of 6 months living in an urban center in the Western US. They participated from the pre-linguistic period through the end of the one-word period. We collected twenty-minute videos each month of naturalistic interaction at home, plus supporting documentation. We assessed the incidence of spontaneous and assisted imitation. We examined caregiver attention-directing gestures including embodying, showing, demonstrating, and pointing that occurred alone or accompanied by speech.

**Results:** Highly significant results indicated that spontaneous imitation occurred rarely. Multivariate frequency analyses examined culture, lexical level, caregiver gesture, and achieving a shared understanding.

**Discussion:** *Assisted imitation* accounted for 95% of imitative behaviour. The caregiver gestures that may promote a *transfer of skill* bracket ongoing actions, so that infants learn new bodily abilities and how to detect new opportunities for action. These gestures literally put infants in touch with both sides of the *correspondence problem* , documenting how infants grasp the relation between first and third person perceiving and acting - the correspondence between self and other.

## *Emotional Development*

**Sa2-20**

### Maternal and Paternal Sensitivity and Infant Responses during the Still-Face: Early Glances into Attachment Formation

**Julia Braungart-Rieker**, Shannon Zentall, Diane Lickenbrock, Naomi Ekas
*University of Notre Dame, Notre Dame, USA*

This study examined the extent to which parental sensitivity and infants' responses to the Still-Face (Tronick et al., 1978) are related to later attachment security. At least two previous studies have found evidence that affect and regulatory behaviors during the still-face at 4- (Braungart-Rieker et al., 2001) and 6-months (Cohn & Campbell, 1992) provide insight into the developing infant-mother attachment relationship. There has been little evidence to date, however, that infant responses during the still-face with fathers is predictive of the infant-father attachment relationship. This study extends previous research by examining infants, mothers, and fathers during the still-face over three time points: 3, 5, and 7 months--a time during which the attachment relationship is rapidly developing.

This longitudinal study involved 135 families who visited the laboratory when infants were 3, 5, 7, months of age. Each parent participated separately in the Still-Face Paradigm with their infant, which involves three 90 s episodes: play, still-face (no parental interaction), play-resume; parent order was counterbalanced at each visit. Parental sensitivity and intrusiveness were coded during the play and play-resume episodes; infants' positive affect, negative affect, parent looks, and object looks were coded during the still-face episode. Infants also participated in the Ainsworth's Strange Situation at 12 months with mothers and at 14 months with fathers; infant attachment was coded separately for each dyad into one of three attachment categories: Insecure-Avoidant (A), Insecure-Resistant (C), and Secure (B).

Repeated measures ANOVAs indicated that mothers of infants who later developed an avoidant or resistant relationship with them were significantly less sensitive and more intrusive with their infants during play and play-resume episodes. Fathers whose infants became As were also significantly less sensitive and more intrusive than those who became Bs or Cs. Similar to previous studies, infants who later became Cs with mothers showed more negative affect during the still-

face compared to those who became Bs or As. Infants who became Cs with fathers, however, showed significantly less negative affect during the infant-father still-face, compared to those who became As or Bs. Subsequent analyses will be conducted involving visual behaviors. Results suggest that responses during the still-face might reflect different processes in the development of the infant-mother vs. infant-father attachment relationship.

**Sa2-21**

### The Relationship Between Toddler Temperament and Emotion Regulation in Preschool: the Moderating Role of Mother and Father Behavior

**Elizabeth Cipriano**, **Jessica Dollar**, Cynthia Stifter

*Pennsylvania State University, University Park, USA*

There is a dearth of research exploring how temperament is modified by parenting to predict later developmental outcomes. Parents of inhibited children who used warm and responsive behaviors have been linked to greater compliance in children whereas punitive or harsh parenting was associated with poorer outcomes in children (e.g. Kochanska, 1995, 1997). For inhibited children, parents who used gentle discipline was sssociated with greater compliance in children whereas punitive discipline was related to poor compliance and social reticence (e.g. Rubin et al., 2003). However, little is known how parenting behaviors differentially impact children's emotion regulation development depending on their temperament. The goal of the current study was to examine whether mother and father behavior moderated the relationship between toddler temperament and preschooler's emotion regulation.

At 2 years, sixty-eight toddlers were classified into inhibited, exuberant, and low reactive temperament groups based on a series of high and low intensity tasks assessing approach-withdrawal behavior, negative affect, and positive affect (Putnam & Stifter, 2005). In addition, parent-child shared positive affect and parental maintenance and redirection of attention was coded in a structured play task with both mothers and fathers at 2 years. Children's regulatory behavior was coded in the Lock Box task at 4.5 years. A principal components analysis of emotion regulation strategies produced five factors: avoidance, lack of persistence, venting, autonomous, and goal directed behaviors.

Results revealed significant temperament X parenting interactions. Inhibited children whose mothers displayed more shared positive affect had children who showed more avoidance, $t(6, 48) = 2.919$, $p < .01$, but less avoidance when fathers displayed more shared positive affect while interacting with their inhibited children, $t(6, 48) = -2.027$, $p < .05$. Inhibited children whose mothers used more maintenance had children who showed more lack of persistence, $t(6, 48) = -2.555$, $p < .05$. When mothers and fathers of inhibited children displayed more redirection, their children showed more lack of persistence, $t(6, 48) = 2.472$, $p < .05$ and $t(6, 48) = 2.297$, $p < .05$, respectively. Mothers of inhibited toddlers who displayed more redirection had children who showed less goal-directed behavior, $t(6, 48) = -2.03$, $p < .05$. These results contribute to existing research by demonstrating that certain mother and father behaviors are associated with the development of children's emotion regulation abilities depending on children's temperament.

**Sa2-22**

### Facial Emotion Processing in 10-Month-Old Infants: Happy versus Disgust

Joseph McCleery[1] **Karen Dobkins**[2] Sara Geal-Touhy[2] **Leslie Carver**[2]

*1. Children's Hospital Boston, Harvard Medical School, Boston, USA; 2. University of California, San Diego, La Jolla, USA*

**Background and Aims:** Previous work with infants indicates that an event-related potential (ERP) component recorded from electrodes over frontal cortex (Nc) discriminates the processing of positive and negative facial expressions of emotion. Specifically, this component has been found to be of larger amplitude in response to negative facial expressions, perhaps reflecting greater allocation of neural resources to attention-grabbing stimuli. More recently, a study of happy and fearful face processing found that an earlier component recorded from electrodes over occipito-temporal cortex (P400) also discriminates the processing of these facial expressions. This finding suggests increased allocation of neural resources to negative facial expressions at the level of visuo-perceptual processing. In the current study we are examining the neural correlates of happy versus disgust processing in infants.

**Methods:** Event-related potentials were recorded from a high-density electroencephalography sensor net while fifteen 10-month-old infants viewed a female face posed in happy and disgust expressions, in a within-subjects design.

**Results:** A pairwise t-test conducted on the amplitude of the P400 component revealed a significant difference between happy and disgust faces whereby P400 responses were of larger amplitude in response to disgust faces (20.44 mV) relative to happy faces (17.22 mV; $p<0.05$, 1-tailed). A two factor (facial expression, hemisphere) analysis of variance (ANOVA) conducted on the amplitude of the Nc component revealed a marginally significant interaction among facial expression and hemisphere whereby responses to happy expressions were of larger amplitude over the right hemisphere (-17.31 mV) than the left (-14.57 mV) whereas responses to disgust expressions were of equal amplitude over the left (-17.32 mV) and right (-16.87 mV) hemispheres ($p=0.078$).

**Conclusions:** These preliminary data provide further support for the hypothesis that the neural systems underlying the differential processing of positive and negative facial expressions are functional early in life. Although the current results are consistent with a generic positive versus negative facial expression mechanism at the level of visuo-perceptual processing in infancy, the interaction among facial expression and hemisphere in the amplitude of the Nc component suggest unique patterns of frontal / attention-related activity for this particular pairing of positive and negative expressions. This difference may reflect the differential involvement of specific neural systems, such as the insular cortex, for discriminating disgusted and happy facial expressions as compared to other positive and negative emotions. Adult ERP data, which may further our understanding of this finding, will also be presented.

**Sa2-23**

## Toddlers' Salivary Alpha-Amylase and Emotions: Effects of Context, Gender and Cortisol

**Amy Dribin**, Kristin Buss, Christine Fortunato, Douglas Granger
*The Pennsylvania State University, University Park, USA*

There has been a recent surge in the number of developmental studies incorporating salivary α-amylase(sAA). A surrogate biomarker of sympathetic activity, sAA is released by the salivary glands during stressors (Natar, 2004). Studies have demonstrated associations between sAA and insecure attachment (Hill et al., in press), anger during frustration tasks (Spinrad, 2007), and externalizing behaviors (Gordis et al., 2006). However, the specific role of sAA in emotional development remains largely unknown. This study investigates how context, cortisol, and gender may interact with toddlers' sAA and emotions during novel tasks. The context in which emotional behavior is expressed appears to predict problematic outcomes like baseline sympathetic reactivity (Buss et al., 2004) and peer aggression (Calkins et al., 2007). Cortisol is differentially related to behavior depending on context. Moderating influences of gender have been found, with girls' basal cortisol associated with PTSD (Carrion et al., 2003) and boys' sAA reactivity related to emotionality (Spinrad, 2007).

Eighty-seven, 24-month-olds completed 12 tasks (e.g. clown interaction) which were videotaped and coded for toddlers' positive affect, distress, shyness, and boldness. Toddlers' saliva samples collected before, after, and 20min after the visit were assayed for cortisol and sAA.

Preliminary analyses found context-specific relationships between baseline sAA and positive affect and boldness during a stranger interaction (β=.349, $p$<.05), while playing with a clown (β=.282, $p$=.059), and being approached by a remote spider (β=.264, $p$<.05). There was also evidence that context-specific behaviors were associated with post-task sAA, in particular distress during a puppet show(β=.408, $p$<.01), the clown interaction(β=.330, $p$<.05), and free play(β=.380, $p$=.005). These findings suggest that context matters in understanding relationships between sAA and behavior.

We found a three-way interaction for sAA, cortisol, and gender in predicting distress. Interactions between sAA and cortisol were associated with context-specific emotions only for toddlers' whose baseline cortisol was at least .5sd below the mean ($n$=23). For boys in the low-cortisol group, baseline sAA was related to distress with an unfamiliar female in the room (β=-.675, $p$<.02) and boldness during a clown interaction (β=.838, $p$<.001). Baseline sAA was associated with shyness during a puppet show (β=-.532, $p$=.075) for girls in the low-cortisol group. Additional analyses will examine how baseline sAA and task behaviors jointly predict post-visit sAA. While further work is needed to elucidate the nuanced relationships among sAA, cortisol, and behavior, our findings suggest that toddlers with low-cortisol and high sAA are more likely to show approach related behaviors.

**Sa2-24**

## What to Do About Sleep? a Survey of Parents' Experiences with Infant Sleep and Popular Advice

**Macall Gordon**[1] Sheri Hill[2]
*1. Antioch University, Seattle, USA; 2. Early Childhood Policy Specialist, Seattle, USA*

**Background:** At one time, sleep deprivation was synonymous with early parenting. Today, however, "sleeping through the night" has grown in importance and urgency. While parents increasingly turn to popular media for information and guidance (Simpson, 1997), such sources can be inconsistent and even inaccurate in matters concerning health and development (Impicciatore et al., 1997). In fact, an examination of parenting books and magazines on infant sleep reveal stark differences in reported sleep milestones, appropriate age for starting, and amount of crying to allow. Further, advice content stresses the critical importance of extended sleep for both brain and behavioral development. It is not surprising, then, that parents may be stressed and anxious about sleep. This survey aims to assess how popular advice influences what parents know and do about infant sleep, and whether there are differences in experience based on their chosen approach.

**Methods:** First-time parents of infants under 12 months were recruited via targeted email and search engine ads. The survey includes questions about the infant's current sleep behavior, parental use of sleep advice, and implementation of the intervention. Parents' perceived levels of infant sleep difficulties, as well as worry or conflict around sleep were also assessed. Based on answers to key questions, respondents currently addressing their infant's sleep were placed into one of three groups: Crying approaches, No Cry approaches, or Cosleeping. Descriptive statistics for the sample as a whole were calculated. Intervention subgroups were compared for differences in parental perceptions of advice, implementation and experience.

**Preliminary Results:** Survey respondents (N=185) are predominantly white, married, well-educated mothers. 29.7% (N=51) were classified as Crying, 18.6% (N=45) as No Crying, and 51.8% (N=89) as Cosleeping. Preliminary data analysis revealed no significant differences between groups in use of sleep advice, knowledge of infant sleep development or the infant's current sleep behavior. Significant differences, however, were found in the level of worry about managing sleep $F$(2, 169)=21.58, $p$<.01), the goodness of fit with their parenting values $F$(2, 111=27.54, $p$<.01), and assessment of the approach's effectiveness $F$(2, 111)=6.698, $p$<.01).

**Conclusion:** While infant nightwaking is a known stressor for parents, it appears that sleep interventions themselves—especially those that necessitate crying—may also be a source of increased worry and stress for parents.

**Sa2-25**

## Toddlers' Emotion Regulation: Relations to Child Temperament and Maternal Personality

Whitney Hendricks, Marianne Idol, Katherine McCalla, Anne Hungerford
*University of North Carolina Wilmington, Wilmington, USA*

Research on individual differences in emotion regulation indicates relations between young children's behavior ("strategies") and their distress during tasks designed to elicit frustration. In general, behaviors that focus attention away from the source of frustration (e.g., distraction) are related to less distress, while behaviors that focus attention on the source of frustration are related to greater distress (e.g., Grolnick et al., 2006). In addition, aggressive behavior that accompanies distress ("venting") is also associated with greater distress (Calkins, 2002). Given that the strategies that children use may be differentially effective, it is important to understand the origins of such strategies. The current study examines relations between toddlers' temperament, maternal personality, and children's distress and strategies during a frustrating activity. Although previous research has linked temperament to children's emotion regulation skills, studies have not examined maternal personality and its relation to toddlers'

emotion regulation. Maternal personality may relate to emotion regulation by influencing socialization practices or through associations with child temperament; therefore, it is a potentially important influence on children's emotion regulation.

The participants included approximately 65 mothers and their 22- to 26-month-old children. Mothers completed questionnaires assessing maternal personality (the NEO Five Factor Inventory) and toddler temperament (the Toddler Behavior Assessment Questionnaire). As part of a larger laboratory assessment, mother-child dyads participated in a task designed to elicit child frustration (unattainable treat). Children's distress was rated on a 7-point scale every 5 seconds, and child strategies were coded in the same 5-second intervals. Child strategies included distraction, focusing on the unattainable treat, and venting.

Preliminary analyses (N = 40) indicated that children's average distress was positively related to venting and focusing on the treat and negatively related to distraction. Children's temperamental pleasure and interest/persistence were negatively associated with distress. In addition, interest/persistence was positively associated with children's use of distraction. Maternal personality was related to children's strategy use but not directly to their average distress. Specifically, maternal agreeableness, a personality factor reflecting cooperation and compassion, was positively related to children's distraction and negatively related to their focus on the treat, while maternal neuroticism was positively associated with children's focus on the treat. Child temperament and maternal personality were also related. The potential mechanisms linking maternal personality and children's emotion regulation will be considered. The implications of these findings for understanding the multiple interactive influences on early emotion regulation and the limitations of the study will also be discussed.

**Sa2-26**

### Maternal Child-Rearing Attitudes and Toddlers' Emotion Regulation

Marianne Idol, Whitney Hendricks, Katherine McCalla, Anne Hungerford
*University of North Carolina Wilmington, Wilmington, USA*

Research on individual differences in young children's emotion regulation skills indicates that maternal behavior is related to children's behavior in frustrating situations. In general, child or maternal behaviors ("strategies") that focus attention away from the source of frustration (e.g., distraction) are related to less child distress, while behaviors that focus attention on the source of frustration are related to greater distress (e.g., Grolnick et al., 2006). The present study examines associations between child-rearing attitudes and maternal and child behavior during a frustrating task. The goal of the present study is to understand how parental socialization of emotion regulation is related to broader beliefs about child-rearing.

Participants included approximately 60 mothers and their 22- to 26-month-old children. Mothers completed the Parental Modernity Scale (Schaefer & Edgerton, 1985), a questionnaire assessing child-rearing attitudes ranging from more traditional, authoritarian beliefs to more child-centered beliefs. Dyads were observed during a frustration task (inaccessible treat). For the first 3 minutes of the 6-minute task, mothers were asked not to initiate interaction with their children and to respond to children's bids as briefly as possible (mother-uninvolved condition), while in the remaining 3 minutes they interacted as they normally would without giving the child the treat (mother-involved condition). Children's level of distress and behavioral strategies were coded in 5-second intervals during the mother-uninvolved condition; these strategies included focusing on the treat, distracting, and engaging mother. Maternal strategies were coded in 5-second intervals during the mother-involved condition and included focusing the child's attention on the treat, distracting, soothing, and observing (no interaction).

Preliminary analyses (N = 40) indicated that maternal soothing was positively related and maternal observation was negatively related to children's distress during the mother-uninvolved condition. Children's use of distraction was negatively related to distress and engaging the mother was positively related to distress in this condition. Mothers who endorsed more traditional child-rearing attitudes had children who showed less distress during the mother-uninvolved condition. In addition, traditional child-rearing attitudes were associated with less engagement of mother and more distraction during the mother-uninvolved condition. Finally, mothers who endorsed traditional child-rearing attitudes soothed their children less than mothers endorsing more progressive attitudes. Discussion will consider the study's limitations (direction of effects, ecological validity) as well as the potential implications for understanding the socialization of emotion regulation in the context of broader parental beliefs and goals.

**Sa2-27**

### Breastfed Infants Demonstrate Enhanced Socio-Emotional Interactive Responses

Nancy Jones
*Florida Atlantic University, Jupiter, USA*

**Background and Aims:** Breastfeeding has been shown to provide infants with optimal nutrition (Newman, 1995) and social-interactive experiences (Kuzela, Stifter, & Worobey, 1990), however, the effects of breastfeeding on the interaction patterns of infants of depressed mothers have been investigated less often. Breastfed newborns have been deemed as more irritable (DiPietro, Larson, & Porges, 1987) yet breastfed infants demonstrate more positive infant temperament by 6-months (VanDiver, 1997). Are these patterns similar for infants of depressed mothers? The aim of the present study was to examine the association between feeding practices, maternal perceptions of infant temperament, and mother-infant socio-emotional interaction in depressed and non-depressed dyads during the first 3 months of life.

**Method:** 113 mothers (30 dep. and 83 non-dep.) and their infants participated at 1-month and 81 (19 dep. and 62 non-dep.) returned at 3 months of age. All infants were healthy and their mothers were primarily adult (M age = 31.05 years, SD=4.73), middle- to upper-middle class women (M = 2.61 on Hollinghead scale, SD=0.96), with 85.0% Caucasian, 9% Black, 4% Hispanic and 2% Asian. Mothers were interviewed about their feeding patterns, including quality and duration of breastfeeding. Maternal perceptions of temperament were reported on the IBQ and dyads participated in a face-to-face interaction. Interactions were coded for affective valence and quality of interactive responses. Inter-rater reliabilities were good (Kappas=.85 to .88)

**Results:** ANOVAs showed that perceptions of infant temperament differed as a result of mood and feeding method, $F(3,77)=3.48$, $p<.05$. In general, infant behaviors increased across age. At 1-month, the depressed groups were perceived to have more distress and the breastfeeding groups showed greater soothing and orienting. At 3-months, the breastfeeding groups were perceived as more interactive (with higher scores on activity, smiling, distress, and orienting) and there were fewer differences between the depressed- breastfeeding group and the non-depressed groups compared to the depressed-bottle feeding group, all p values<.05. Correlations between quality and duration of breastfeeding and temperament were also uncovered, with greater breastfeeding associated with more infant activity r=.55,

more distress in the depressed group r=.61 and less distress in the non-depressed group r=-.22, more orientation in the depressed group, r=.43 and greater dyadic interactive behaviors across groups, r=.38, p values <.05.

**Conclusions:** Ultimately, maternal mood and feeding patterns influence maternal-perceptions of infant temperament and mother-infant interactive behaviors. The findings support the advantage of breastfeeding for enhancing the mother-infant emotional relationship, even for depressed mothers. A discussion about the role of breastfeeding within socio-emotional development will be presented.

**Sa2-28**

### Roots of Smile: A Preterm Neonates' Study

**Kiyobumi Kawakami**[1] Kiyoko Takai-Kawakami[2] Fumito Kawakami[3] Masaki Tomonaga[4] Makoto Suzuki[5] Yukiko Shimizu[5]

*1. University of the Sacred Heart, Tokyo, Japan; 2. Japan Women's University, Tokyo, Japan; 3. Tokyo Institute of Techonology, Tokyo, Japan; 4. Primate Research Institute,Kyoto University, Aichi, Japan; 5. Kameda Medical Center, Chiba, Japan*

**Background and Aims:** To investigate the roots of smile, Kurjak (2004) used 4D sonography to observe fetal behavioral movements. But, even now it is difficult to code 4D smiling by our strict criteria. Wolff (1987), and Emde et al. (1971) observed spontaneous smiles in preterm neonates. But we can use more detailed data by digital videos. Recently, Dondi et al. (2004) observed Duchenne smiles in preterm neonate infants just as an exploratory study. The purposes of this study were 1 ) to present the digital data of spontaneous smiles in preterm neonates, and 2 ) to consider the roots of smile by the data.

**Methods:** Twenty-two preterm neonates were observed 1 hour per neonate in the NICU. They were born 1) under 280 gestational days, and 2) under 2500g birth weight, but 3) they were healthy enough. We adapted strict criteria for identifying spontaneous smiles as follows: 1) lip corner raising ( AU12 in FACS and Code 52 in MAX ); 2) during irregular sleep, drowsiness; 3) without known external or systematically demonstrable internal causes ( Wolff,1961 ); 4) continuing more than 1 s; 5) smiles continued within 1/6 s are combined.

**Results:** Ninety-five spontaneous smiles were recorded. Younger and smaller neonates showed more and longer spontaneous smiles than older and bigger. The youngest neonate, she was 200 observational day calculated by gestational day and her body weight was 511g, showed spontaneous smiles.

**Conclusion:** There is a possibility that younger neonates than our youngest show spontaneous smiles. The roots of spontaneous smile may be earlier. We can not find the true roots of smiling, so we should continue the survey to find them.

**Sa2-29**

### Mother-Infant Co-Regulation and Socioemotional Development at 4 Years

**Hui-chin Hsu**, Emmy Maddix, **Marina Klimenko**, **Jihyun Sung**

*University of Georgia, Athens, USA*

Moment-to-moment interaction between mother and infant demonstrates a pattern of bidirectional influences between the two partners. Mother and infant alter their actions with respect to the ongoing actions of their partner. This dynamic mother-infant interdependence is termed co-regulation (e.g., Fogel et al., 2006). Stable co-regulation patterns emerge from repeated interaction experience between mother and infant. Different co-regulation patterns observed in mother-infant dyads may have important developmental consequences. The present study investigated the developmental sequelaes of mother-infant co-regulation focusing on social (i.e., attachment) and emotional (i.e., emotion understanding) outcomes at preschool age.

Fifty mothers and their first-born infants participated in a larger longitudinal study. At 12 months, mothers and their infants engaged in floor play for 3 minutes. Based on physical orientation, attentional focus, and level of mutual involvement, holistic qualitative evaluations were made second by second with respect to the ongoing mother-infant interaction. Four different dyadic patterns were identified, namely symmetrical co-regulation (mutual engagement by both mother and infant), asymmetrical co-regulation with passive infant (infant passively observing mother), asymmetrical co-regulation with passive mother (mother passively observing infant), and unilateral co-regulation (mother actively engaging disengaged infant). At 4 years, the Separation Anxiety Test was administered to evaluate preschoolers' attachment to parents. Children's attachment was assessed on four dimensions: attachment (feelings of vulnerability about separations), self-reliance (self-confidence about handling separations), avoidance (avoidance of the discussion of separations), and emotional opening (openness in discussing emotional experience about separations). The emotion understanding task was also administered to assess children's understanding of four different emotions: happiness, anger, sadness, and fear.

Based on the duration of mother-infant engagement in different patterns of co-regulation, cluster analysis was first performed to classify mother-infant dyads into groups to reveal their preferential patterns. Four groups of mother-infant dyads were identified: Symmetrical dyads, Asymmetrical dyads with passive mother, Asymmetrical dyads with passive infant, and Unilateral dyads. Two separate one-way MANOVAs were then conducted to examine group differences in 4-year-olds' attachment and emotion understanding. Results showed that children of Symmetrical Dyads scored highest on emotional openness and understanding of happiness and fear, children of Unilateral Dyads scored lower on both, and children of Asymmetrical Dyads (passive infant or mother) scored the lowest.

As Bretherton (1990) suggests, secure relationships between parents and their young children are expected to be characterized by open and coherent discourse about their relationship. Thus, discourse about sensitive relational issues (e.g., separation) is likely to be more emotionally open for children who experienced a history of symmetrical co-regulation with their parents as infants. Symmetrical co-regulation characterized by shared affect and coordinated interaction may also promote children's understanding about feeling states, particularly those associated with separation and reunion.

**Sa2-30**

### Mother-Toddler Emotional Discourse & Emotion Understanding

**Marina Klimenko**, Hui-chin Hsu

*University of Georgia, Athens, USA*

Emotion understanding has been found to be linked to young children's social adjustment and emotional well-being (e.g., Cassidy, Werner, Rourke, Zubernis, Balaraman, 2003). Evidence also suggests that the quality of mother-child verbal discourse about emotions during toddlerhood is related to later child's emotion understanding. Although maternal elaborative discourse style has been found to be concurrently related to better understanding of emotions in children, longitudinal results have been mixed (e.g., Ontai & Thompson, 2002). Book reading presents an opportunity for toddlers and their moth-

ers to talk about emotions and causes of emotions. Thus, this study examined the longitudinal association of mother-toddler discourse during book-reading with later children's development in emotion understanding at preschool age.

Twenty-three mothers and their 2,5-year-olds participated in the present study. They read two wordless picture books for about 10 minutes at a laboratory playroom. The book-reading interaction was videotaped. The focus of this study was on the discourse between mother and toddler when they were looking at the book pages that have an implicit negative emotional theme (e.g., mother put a misbehaved boy in time out). Emotion-related utterances by mothers were transcribed and coded: (1) frequency of references to emotion, and (2) elaboration of causes of emotions, which was further categorized as emotional (e.g., "boy was sad because mom was mad"), cognitive (e.g., "she understands that he did not mean to do that"), situational (e.g., "mom was mad because boy made a mess"), desire/wish (e.g., "boy was sad because he did not want to go to his room"), or unclear (e.g., "mom is sad because we get on to kids"). At four years, the emotion understanding task was administered. The experimenter presented children with 20 vignettes describing situations in which the protagonist felt happy, sad, scared, or mad. At the end of each story, children were asked about how the protagonist felt. Higher scores in this task indicated higher levels of understanding about emotions.

Our results replicated previous findings that mothers talk about emotions and causes of emotions with their toddlers. Furthermore, individual differences in maternal discourse style were related to children's performance at the emotion understanding task. Better emotion understanding at 4 years was associated with frequent maternal elaboration of causes of emotions, but not with their frequent references to emotions. In addition, children whose mothers used more emotional and desire/wish explanations performed better at the emotion understanding task.

Taken together, the results demonstrate a developmental link between mother-toddler discourse and later children's emotional knowledge. Furthermore, although maternal elaboration of causes of emotions contributes to the development of emotion understanding, not all elaborative discourse styles are equally effective. Elaborative explanation focusing on emotional and desire causes appears to be the most effective in promoting children's understanding of different feeling states.

**Sa2-31**

### The Quality of Mother-Child Interactions and the Continuation of Breastfeeding

**Marie Lacombe**[1] **Bell Bell**[2] **Marie Hatem**[3]

*1. Université du Québec à Rimouski, Campus de Lévis, rivière-du-Loup, Canade; 2. Université de Sherbrooke, Sherbrooke, Canada; 3. Université de Montréal, Montréal, Canada*

This study was conducted within an international movement that promotes and supports breastfeeding. The general objective was to examine the influence of mother-infant interactions, postnatal depression, and the child's temperament on continuing breastfeeding. The study's hypotheses were: 1] mothers with high levels of depression were less likely to continue breastfeeding up to six months; 2] mothers that perceived their child as having a difficult temperament were less likely to continue breastfeeding up to six months and 3] the type of mother-child interaction would influence breastfeeding continuation up to six months.

This study is based on data from a large longitudinal study conducted in the Child Development Unit of the Children's Hospital Boston. Sample recruitment took place in the maternity wards affiliated with Harvard University in Boston. The sample study was composed of 75 mother-child dyads, with the mother breastfeeding at two months. To be included in the study, mothers and infants had to meet low sociodemographic risk criteria, except for depressive symptoms, which were present in more than 25% of mothers. Recruited mothers completed self-administered questionnaires and were observed with their child, in their own home, when the child was 3 months old.

The quality of the mutual regulation process was observed, based on the theoretical model developed by Tronick and Cohn (1989), in two types of interactions: 1] synchrony, or the parent's and child's ability to adjust their own behavior and affect to the other's; and 2] matching, where the mother-child dyad's affective or behavioral states are the same.

A correlational study design was used to study these variables in breastfeeding continuation. Bivariate analyses and a stepwise logistic regression analysis were used to examine the study's hypotheses.

Our first hypothesis was not supported in this study. However, it is interesting to note the changes in depressive symptoms in our sample. The number of mothers presenting depressive symptoms declined by 14 between the second and third month. The second hypothesis was neither confirmed not rejected since the mothers in the study had a positive perception of their child. The last hypothesis was confirmed. Results suggest that matching between positive maternal affect and the child's affect predicts the continuation of breastfeeding up to six months of the child's life. Thus, mothers and children that can regulate their interactions so they can have fun together are more likely to become close partners in the development of their relationship via breastfeeding.

**Sa2-32**

### The Effects of Parenting and Marital Functioning on Infant Affect during the Still-Face

**Diane Lickenbrock**, Naomi Ekas, Shannon Zentall, Julia Braungart-Rieker

*Department of Psychology, University of Notre Dame, Notre Dame, USA*

Previous studies involving pre-school and school-aged children have found that marital conflict negatively impacts children's socio-emotional development (Cummings & Davies, 2002). Additionally, studies have found that parental sensitivity predicts a number of outcomes during infancy and childhood such as positive and negative affect (Braungart-Rieker, Garwood, Powers, & Notaro, 1998, Spinrad & Stifter, 2002). While there is research to support that marital functioning can affect the parent-child relationship (Cummings, Davies, & Campbell, 2000), there is no research on how the combination of marital functioning and parenting could affect infant affect. Furthermore, few studies have assessed father-infant interactions during the Still-Face Paradigm. Building on previous research, the present study focused on how maternal and paternal parenting and marital functioning is related to infant affect and change in infant affect during the Still-Face over time.

This longitudinal study involved infants (N=135) at 3, 5, and 7 months and their parents. At each visit parents filled out questionnaires which assessed their level of marital adjustment and aggression. Additionally, parents participated separately in the Still-Face with their infant at all three visits. The Still-Face consisted of three 90-second episodes: a play interaction, no parent interaction, and a second play interaction.

Parental sensitivity and intrusiveness were coded for each parent during both play interactions. Infant affect was rated during all three episodes.

Correlations suggested differences between mothers and fathers in the effects of marital functioning on parenting and infant affect. For example, when infants were 7 months, fathers' marital adjustment were found to be positively related to their level of sensitivity during the play period (r=.20, p=.04). Additionally, it was found that paternal sensitivity was related to positive infant affect during the same play period (r=.27, p=.01). However, a different pattern was found for mothers at the same time-point. More specifically, maternal sensitivity was found to be related to positive infant affect during the play period (r=.20, p=.02). However mother's marital adjustment was not significantly related to sensitivity during play period. Subsequent analyses will use HLM and SEM as ways of assessing associations and changes in marital functioning, parenting and infant affect over time. Furthermore, similarities and differences in the patterns of change in marital functioning and parenting for mothers and fathers will be examined.

**Sa2-33**

### A Hidden Markov Model for the Study of Mother-Infant Interactions

**Siwei Liu**, Katerina Sinclair, Michael Rovine, Peter Molenaar, Cynthia Stifter

*The Pennsylvania State University, University Park, USA*

**Background:** The ability to regulate emotions is present in an immature form in newborn infants and is thought to evolve as a function of the infants' temperaments and the caregiving styles to which they are exposed (Cassidy, 1994). Caregiving styles are particularly salient in early infancy when infants lack the resources to successfully regulate their emotions, particularly in extremely stressful situations. Researchers agree that soothing by primary caregivers not only alleviates immediate stress in infants but also helps infants develop emotional self-regulation (Kopp, 1989). Through soothing, caregivers model emotion-regulation strategies by demonstrating effective behaviors for reducing stress. In theory, infants whose caregivers engage in appropriate and effective regulatory strategies will become better self-regulators than infants who experience less effective external regulation. Past research has failed to account for the dynamic relationship between mother and infant and failed to analyze changes in mothers' soothing strategies over time. The model we present provides a means for analysis.

**Methods:** The data from 131 mother-infant pairs come from the Infant and Child Temperament Study (Jahromi, Stifter, & Putnam, 2004; Stifter & Braungart, 1995). A Hidden Markov approach is used to model mother-infant interactions in a stressful situation, in this case where the infant receives a scheduled inoculation. The statistical method that is being used is based on the approach described by Rabiner (1989) and implemented by Visser (2005).

**Results:** We present the results of a six-state model estimated for the entire group, which was established as the optimal model using comparative fit indices. We found high stability among states, as evidenced by the transition matrix. Inspection of behavioral probabilities of each state resulted in the following characterizations of the states: a caretaking state, a distraction and pacifying state, a feeding and pacifying state, a heavy crying state, a medium crying state, and a light to no crying state. The last three states included high maternal behaviors of holding, rocking, touching, affection, and vocalizing.

**Conclusion:** The attributes of these states provide us with a means to evaluate which strategies are more effective, which states provide optimal environments for learning emotional self-regulation, and which mothers change strategies over time. We suggest both limitations of this common model and some necessary extensions to expand the scope of the analytic procedure.

**Sa2-34**

### What Do Infants Look the Most to, to Regulate Their Behavior?

**Reiko Matsunaka**[1] Kazuo Hiraki[2]

*1. University of Tokyo, Sagamihara, Japan; 2. University of Tokyo, Komaba, Japan*

**Background and Aims:** Previous work has suggested that infants older than 12-month-old can use emotional information to regulate their behaviors even in televised scenario (Mumme & Fernald, 2003). It is not clear, however, that in the televised stimuli which part of the image infants are looking to utilize emotional information. This study investigated how 13- to 15-month-old infants utilize the televised emotional information and aims clarifying the relationships between infants' looking behaviors and regulatory behaviors.

**Methods:** Participants were 26 full-term, healthy 13- to 15-month-old infants. In this study we prepared video stimuli in which an actress expressed neutral, positive or negative emotional affect toward one of two objects in front of her. Infants were shown the video clip (for 25-seconds) followed by the object play period (for 30-seconds) for which infants were presented the same pair of objects used in the video within their reach. In the video presentation period, an eye-tracking system (Tobii 1750) measured infants' looking behaviors, and infants' behaviors (e.g. touch) were analyzed by an experimenter on offline videotapes in the object play period. The video presentation and object play period were consisted of a trial, and we conducted two trials to each infant. The first is "Neutral baseline trial", and the second is "Emotion test trial". By the difference of the imposed emotional valence in "Emotion test trial", we set two conditions. One is NN condition (Neutral baseline to Negative Emotion test), the other is NP condition (Neutral baseline to Positive Emotion test). Infants were randomly assigned either NN or NP conditions. Target object and target object location (left or right) were counterbalanced.

**KeyResults:** In all video presentation periods, infants were looking the actress's face the most, and looking the target longer than the distracter object regardless of the imposed emotional valence. We compared emotion test trials with neutral baseline trials in each condition, looking time toward the distracter object increased in NN condition. We also did the same comparison in the object play period and found that infants didn't touch less the target but touched more the distracter object in NN condition, previous work showed, however, that infants touched less the target in NN condition.

**Conclusion:** The new finding is looking time toward the distracter object increased while infants were looking negative emotional scenario. This increase looking time toward the distracter might lead infants to touch the distracter more.

**Sa2-35**

### Suppression of Emotion Regulation and Respiratory Sinus Arrhythmia: Maternal Physiological Reactivity during the Still-Face Paradigm

**Julia Oppenheimer**, Jennifer Ablow, Jeffrey Measelle

*University of Oregon, Eugene, USA*

Studies have examined the role of respiratory sinus arrhythmia (RSA) in emotional reactivity and regulation; however, its role in interpersonal interactions remains unclear. Researchers have suggested that high

levels of resting RSA are indicative of physiological flexibility, predisposing an individual to adaptive emotional responsivity. Conversely, individuals with low RSA have been shown to exhibit emotional dysregulation, a pattern particularly characteristic of depressed individuals. Studies looking at suppression of emotion as a form of regulation have found that, while suppression involves a decrease in emotion behavior, individuals experience an increase in physiological reactivity as well as an increase in psychopathology. Given the link between suppression as a regulatory style and development of psychopathology, we studied women who met criteria for depression in order to determine whether they experienced increased physiological reactivity while suppressing emotion. Using a sample of mothers asked to suppress emotion behavior during the Still-Face paradigm, we examined patterns of physiological reactivity in response to their distressed infants. Our goal was to compare how well depressed women versus non-depressed women regulate arousal when asked to suppress in response to their own infant's distress.

Data were collected on 95 high-risk mothers of 5-month infants during the Still-Face paradigm. During this task, we would expect to see a stress-induced initial decrease in RSA across the sample. Since women with low levels of resting RSA - i.e. depressed women - are already at a state of relatively high arousal, we would predict a more restricted pattern of physiological reactivity and recovery in depressed women than in controls. Specifically, in depressed mothers we would expect to see minimal effects of suppression on RSA reactivity, since the behavioral and physiological results of suppression may be masked by the limited reactivity associated with depression. In contrast, non-depressed women would be predicted to show a substantial increase in their physiological response to a distressing stimulus while suppressing, demonstrating the more flexible and healthy physiological activation associated with sensitive caregiving and positive child outcomes. Preliminary results suggest that, as expected, depressed mothers show less decrease in RSA levels in response to infant distress, and generally exhibit the restricted range of reactivity associated with dysregulation.

The Still-Face is meant to mimic maternal depression, thus by studying physiological reactivity of women with and without depression in this paradigm we can better understand the effects of suppression as a regulatory strategy on maternal well-being and psychopathology, and also on infant outcome.

**Sa2-36**

## Does Infants' Bradycardia at the Onset of Maternal Arm-Restraint Predict Emotional Reactivity during Restraint?

**Chris Porter**, Blake Jones, Ashley Church
*Brigham Young University, Provo, USA*

Alterations in cardiac patterns to challenging events are predictive of on-going affective adjustment and social engagement in infants (e.g., Bazhenova, Plonskaia, & Porges, 2001). Brief detrending heart rate, bradycardia, has been linked to orienting responses in both animals and humans and is thought to reflect coactivation of attentional properties from both sympathetic and parasympathetic inputs (e.g., Hayne, Richardson, & Campbell, 2004). In this study, we examined whether a bradycardiac event at the onset of arm-restraint would predict differences in behavioral organization during restraint. We suspected that infants who demonstrated an initial bradycardia at the onset of arm-restraint would exhibit greater emotional reactivity during restraint. Complete behavioral and physiological data was obtained on 78 6-month-old infants. At the beginning of the arm-restraint protocol mothers were instructed to hold infants arms for 90 seconds and then asked to release the infant for an additional 90 seconds while maintaining a still face. Episodes were videotaped and infants' behavior was coded for several behaviors including latency to first negative vocalization, intensity and duration of cry behaviors, escape attempts, and attention to mother. EKG was also collected during arm-restraint and was visually inspected using MXedit software (Delta-Biometrics, Inc.). A total of 44 infants were found to demonstrate a brief bradycardia at the onset of restraint (mean heart period at onset = 391.76, ,$SD$ = 33.07, lowest heart period at trough = 453.39, $SD$ = 51.97, average duration of bradycardia = 6.87 sec., $SD$ = 3.96 sec). We next compared mean differences on arm-restraint measures between infants. Bradycardiac infants had a shorter latency to initial cry ($M$ = 14. 58 sec., $SD$ = 20.30 compared to $M$ = 20.55 sec., $SD$ = 38.19, t = -2.24, $p$ < .05), demonstrated less frequent attention to mothers ($M$ = 4.16 , $SD$ = 3.22 compared to $M$ = 8.34 , $SD$ = 7.45, t = -3.35, $p$ < .001) and exhibited more escape attempts during restraint ($M$ = 16.09 , $SD$ = 6.96 compared to $M$ = 13.13 , $SD$ = 5.45, t = 2.01, $p$ < .05). Additionally, infants displaying bradycardia cried longer during arm release ($M$ = 32.20 sec., $SD$ = 22.55 compared to $M$ = 23.21 sec., $SD$ = 18.14, t = 1.89, $p$ < .06) and cried more intensely during arm release ($M$ = 9.87, $SD$ = 5.63 compared to $M$ = 7.18, $SD$ = 5.28, t = 2.12, $p$ < .05). Together these findings suggest that brief bradycardia may signal infants' emotional lability or perhaps suggests that those infants who do exhibit bradycardia to arm-restraint find the protocol more novel and thus more emotionally distressing.

**Sa2-37**

## The Effect of Maternal Depressed Mood on Type of Smile By Infnat and Mother during Play Interactions

**Nadja Reissland**
*University of Durham, Durham, UK*

**Background and Aims:** The purpose of this study is to examine the claim that an infant's ability to respond appropriately to an emotional situation varies according to the emotional state of the mother. It is argued that the emotional state of the mother might not be obvious to a casual observer (Frankel & Harmon, 1996) and that in spite of the apparent similarity in facial expression, infant responses to mothers with and without depressive symptoms vary. Following research by Fogel & Nelson-Groens, (2000) four different types of smile expressed by mother and infant were coded in order to identify whether maternal mood state influences not only the smile type she shows but also her infant's smile type.

**Methods:** Forty infants matched on age and gender (mean age 6.8 months, range 3-11 months; 18 boys)and their mothers were videotaped in their homes while playing with a Jack-in-the-box. The second instance of pushing the button of the Jack-in-the-box , which was expected to elicit pleasure rather than surprise was coded. The 10-item Edinburgh Postnatal Depression Scale (EPDS; Cox et al, 1987) was used to assess the overall mood state of mothers. Maternal and infant type of smile, facial expressions of fear and surprise, as well as gaze direction and touch behaviours were coded.

**Results:** Pushing the button of the Jack-in-the-box the second time elicited pleasure rather than surprise in infants. A comparison of surprise and play smiles showed that none of the infants of depressed mothers showed play smiles or surprise. In contrast,infants of non-depressed mothers showed play smiles rather than surprise. Nondepressed mothers showed significantly more Duchenne smiles. There was a significant correlation of Duchenne smiles by both mother and baby when they gazed at the other person, expressing according

to Fogel et al (2000) enjoyment of participation in the game. Hence, nondepressed compared with depressed mothers, seemed to express more enjoyment and readiness to take the game forward. Play smiles occurring in both adults and infants during intense laughter (Nwokah & Fogel, 1993) were shown by infants of non-depressed mothers significantly more often than by infants of depressed mothers.

**Conclusion:** Maternal and infant expression of enjoyment in the game was dependent on maternal mood. Although both depressed and non-depressed mothers smiled during the play interaction, the type of smile differed for depressed and non-depressed mothers and their infants.

**Sa2-38**

### Emotional Expressiveness in the Family and Toddlers Social Adaptation Outside the Home

**Meagan Taylor**[1] Regina Kuersten-Hogan[2] James McHale[1]

*1. University of South Florida, St. Petersburg, USA; 2. Assumption College, Worcester, USA*

Toddlers who demonstrate early difficulties with social anxiety, withdrawal, and isolation are at greater risk to develop later, related problems than children who do not show early difficulties (Rubin & Coplan, 2004). Family factors linked to early social reticence include overcontrolling (Belsky et al., 1984) and overprotective parenting styles (Coplan et al, 2001). In recent years, emotional expressiveness in the family has become a greater focus of study. Morris and colleagues (2007) outline both direct and indirect mechanisms whereby emotional expression in the family may exert its effects. These include direct attitudes, coaching, and expressiveness of mothers and fathers when engaging with children, and effects traceable to parents' treatment of one another while coparenting in the child's presence. Each kind of influence is operative during whole family interactions, which help reveal underlying family structure and process in ways not usually possible from dyadic parent-child assessments.

This report examines relationships between the quality of mothers' and fathers' emotional expressiveness toward one another, and toward their 30-month-old child, as the family negotiated a series of play and teaching tasks together. We also assessed each parents' attitudes toward emotions, hypothesizing that these meta-emotion attitudes (Katz et al., 1998) would affect parents' behavior toward the child but not one another. We predicted that toddlers whose parents behaved in an emotionally open and expressive manner both toward them and toward one another when engaging together would be less prone to disengage socially and emotionally from other children in daycare situations.

101 families participated in videotaped, 20-minute play and teaching sessions. Mothers and fathers helped children negotiate a competitive game, share a family meal together, play a game of horseshoes, and explore a novel toy box. Trained coders evaluated each parent's positive and negative expressiveness toward one another and toward the child; high-scoring parents expressively conveyed not just joy and positive emotions, but also surprise, consternation, and disapproval where warranted. Each parent also completed the Katz et al. meta-emotion interview, coded for emotion coaching behavior. The children's preschool teachers completed the Child Adaptive Behavior Inventory, describing the children' social isolation and their overt, symptomatic behavior (anxious/depressed symptoms and externalizing behavior).

Fathers but not mothers emotion coaching (beliefs that children deserve help expressing emotions) was associated with more emotional openness toward children during play interactions, but not with interparental openness. This is relevant, because emotional openness by both mothers and fathers toward one another was of consequence; children were significantly less likely to be rated by teachers as socially isolated if parents were expressively open when engaging with each other during family interactions. Emotional openness with children had direct effects; more emotionally open fathers had toddlers who showed lower teacher-rated anxiety. Isolation, linked to interparental openness, was not significantly associated with either mothers' or fathers' openness with the toddler. Finally, greater negative expressiveness in the family, not surprisingly, was associated with more externalizing behavior problems.

**Sa2-39**

### Physiological Responses to a Social Challenge in Full-term and Preterm Infants

**Karla Vega**[1] David Haley[1] Jean Lowe[2] Peggy Maclean[2] Crystal Aragon[2] Ayesha Ali[1] Immaculate Antony[1]

*1. University of Toronto, Toronto, Canada; 2. University of New Mexico, Albuerque, USA*

The purpose of this study was to evaluate emotional and physiological responses to a social challenge in full-term and preterm infants. Heart rate and emotional responses were measured from 30 full term and 50 preterm 6-month old infants during a modified version of Tronick's face-to-face still-face paradigm, a standardized experimental procedure used to study social emotional development, which is a mild stressor for young infants. The modified version of the still-face procedure used in the current study consisted of a repeated face-to-face still-face sequence. Infants were videotaped during the experimental procedure. It was hypothesized that preterm infants would show greater levels of negative affect and heart rate than full-term infants during the still-face and reunion episodes. Results indicated that preterm infants had greater increases in heart rate in response to the final episodes of the procedure compared to full-term infants. Preterm and full-term infants, however, did not differ in their emotional response to the procedure. The results of the study are discussed.

**Sa2-40**

### Predicting Infant-Mother and Infant-Father Attachment: Associations with Expectations of Infant Temperament and Pre-birth Marital Relations

**Maria Wong**[1] Sarah Mangelsdorf[1] Geoffrey Brown[1] Cynthia Neff[1] Sarah Schoppe-Sullivan[2]

*1. Dept. of Psychology, University of Illinois, Urbana-Champaign, Champaign, USA; 2. Human Development and Family Science, Ohio State University, Columbus, USA*

**Introduction:** What happens in the family before the arrival of a new baby may have important implications for the parents' future relationships with their infant (Paley et al., 2005). The purpose of this investigation is to examine how pre-birth factors including parents' expectations of their infants' temperament and the quality of their marital relationship may predict later infant-caregiver attachment security. Because fathers play an important role in children's social and emotional development (Parke, 1996), we examine both mother-infant *and* father-infant relationships and identify predictors specific to each relationship. Further, we also examine how parents' expectations of

infant difficult temperament interact with the quality of their pre-birth marital relationship to predict infant attachment security.

**Method:** Results reported here are based on data from 64 mothers, 55 fathers, and their 1-year-old infants. During the last trimester of pregnancy expectant parents completed questionnaires about their marital adjustment (DAS; Spanier, 1976), and observed couple interaction was coded for marital conflict (Frosch et al., 1998). A composite was created by combining parents' and observers' reports. Expectant parents also completed questionnaires about their expectations of their infants' temperamental characteristics (modified ICQ; Bates et al., 1979). At 12 and 13 months, the Strange Situation (Ainsworth et al., 1978) was conducted to assess infants' attachment security with mothers and fathers, respectively. Following Owen and Cox (1997) we created a 6-point continuous scale to reflect infants' security (e.g., B3 = 6 *most secure*, to D = 1 *least secure*).

**Results:** Two hierarchical regression models were tested, with infant security to mothers and fathers as the dependent variables, respectively. For each model, mothers' or fathers' expectations of infant difficult temperament, pre-birth marital conflict and maladjustment, and an interaction between expectations of temperament X marital conflict and maladjustment were entered. Both models were significant and accounted for 21% and 28% of the variance in mother-infant and father-infant attachment, respectively. Results indicated that infant-mother security was predicted by lower levels of pre-birth marital conflict and maladjustment ($\beta = -.35$, $p < .01$), and lower maternal expectations of difficult temperament ($\beta = -.25$, $p < .05$). Moreover, the interaction between expected temperament and pre-birth marital conflict and maladjustment was significant in predicting attachments security to fathers ($\beta = .26$, $p < .05$). More specifically, infants were more likely to be secure with fathers when parents had lower levels of marital conflict and maladjustment pre-birth and had lower paternal expectations of difficult temperament.

**Conclusions:** These results highlight the importance of examining *pre-birth* factors that may influence subsequent infant-caregiver attachment relationships. In addition, this investigation adds to the relatively scant literature on the predictors of infant-father relationships and suggests that the pattern of pre-birth predictors may differ for infant-mother and infant-father relationships.

**Sa2-41**

### Longitudinal Assessment of Sleep-Wake Regulation and Attachment Security with Parents

**Shannon Zentall**, Naomi Ekas, Diane Lickenbrock, Julia Braungart-Rieker
*University of Notre Dame, Notre Dame, USA*

Until recently, sleep-wake regulation was considered to be and individual (infant) difference, however, sleep-wake regulation, like emotion regulation, is associated with the parent-child relationship (Anders, Halpern & Hua, 1992). This study examines the relation between infant night wakings and attachment to mothers and fathers. Infant-mother attachment has been found to relate to an objective assessment of night wakings, but not maternal ratings of night wakings (Scher, 2001). There is no research, to date, investigating infant night wakings relating to father attachment, and very little longitudinal research. The current study measures infant night wakings at three time points and assesses attachment to both mothers and fathers.

This study investigates 46 families at three times when infants were 7, 12, and 14 months of age. Prior to laboratory visits, parents completed the Sleeping and Eating Measure in which parents were asked to describe a typical day of eating and sleeping, including the number of times the infant woke that night and whom if anyone responded to them. Infants also participated in Ainsworth's Strange Situation at 12 months with mothers and at 14 months with fathers. Infant attachment was coded independently into one of four attachment categories: Insecure-Avoidant (A), Insecure-Resistant (C), Secure (B) and Disorganized (D) and then collapsed into Secure (B) and Insecure (A, C, D) to increase power for this study.

A repeated measures ANOVA found a significant difference between secure and insecure attachments to mothers. T-tests determined that the differences between the number of night wakings for secure and insecure infants at 7 months was not significant, however at 12 months, secure infants had significantly fewer night wakings than insecure infants; this difference remained significant at 14 months. In other words, the number of night wakings for insecure infants remained relatively stable over time whereas night wakings tended to decrease in secure infants.

Attachment to fathers was not significantly related to night wakings. This may be at least in part because mothers got up with their infants more than fathers at each of the three times, although of the infants that awoke during the night, 30%, 28%, and 36% of fathers (at 7, 12, and 14 months respectively) got up with their infants at least once on the reported nights.

## *Perceptual Development*

**Sa2-42**

### Disruption of Six-Month-Olds' Infant-Directed Speech Categorization in the Presence of Faces

**Kristin Atchison**, Melanie Spence, Emily Touchstone
*University of Texas at Dallas, Richardson, USA*

**Background and Aims:** Six-month-olds, but not 4-month-olds, categorize approving and comforting infant-directed speech (IDS) while viewing a checkerboard (Spence & Moore, 2003). However, 4-month-olds categorize approving and comforting IDS when viewing a static female face (Atchison and Spence, 2007; Spence, Chuang & Sokolsky, 2004). Faces have also been shown to aid infants' discrimination of vocal affect (Walker-Andrews & Lennon, 1991; D'Entremont & Muir, 1999). We hypothesized that a female face provides social context that would also enhance 6-month-olds' IDS categorization.

**Methods:** In Experiment 1, six-month-olds (*N*=54) heard either approving or comforting IDS during an infant-controlled habituation procedure contingent on fixation to a static female face. Approving utterances, relative to comforting utterances, are higher in frequency and have ascending rather than falling, frequency contours. Habituation occurred when looking time for 3 consecutive trials decreased 50% of looking time for the first 3 trials. Four test trials were then presented; during control test trials T1 and T2, two new utterances from the IDS category heard during habituation were presented, while test trials T3 and T4 presented two new utterances from the novel IDS category. For Experiment 2, after habituation, infants (*N*=25) were presented with either two new utterances from the same category as habituation (control test) or two new utterances from the novel category (experimental test) in a between-participants design. Experiment 3 (*N*=30) used the within-participants design of Experiment 1 but replaced the picture of a static face with two pictures of the same static face, a visual display more similar to the original study (Spence & Moore, 2003). In Experiment 4 (*N*=36) identical methods were used as

in Experiments 1 and 3, but the static female face(s) was replaced with a silent video of the same woman talking and smiling.

**Results:** No categorization effects were found. Six-month-olds in all experiments failed to significantly recover looking to novel experimental test trials (T3, T4) relative to control test trials (T1, T2) or to habituation criterion trials (all *F*s <2 and non-significant).

**Conclusion:** A female static face and a silent asynchronous video of a face seem to disrupt 6-month-olds' categorization of approving and comforting IDS. If infants become more proficient at matching faces and voices between 4 and 6 months, then asynchronous facial and vocal stimuli may interrupt 6-month-olds' attention to the category boundaries of IDS. These findings have implications for understanding how visual stimuli impact infants' processing of IDS.

**Sa2-43**

### Infants' Perception of Harmony and Meter

**Tonya Bergeson**, James Malenkos

*Indiana University School of Medicine, Indianapolis, USA*

**Background and Aims:** Two important components underlying musical compositions include harmony and meter. However, relatively little is known about the development of harmony and meter perception abilities in young infants. Previous studies have shown that infants may have some understanding of harmonic and tonal structure in music (Bergeson & Trehub, 2006; Hannon & Trehub, 2005). Meter in these studies was defined by either temporal cues or implicit harmonic cues. Nevertheless, more direct evidence is necessary to determine whether infants can discern the differences between duple and triple meter. Additionally, it is likely that explicit harmonic cues would be a stronger cue to meter compared to explicit cues. The purpose of the present study was to determine whether infants can discriminate duple and triple meter based on implicit or explicit harmonic cues.

**Methods:** We collected data from 17 normal-hearing 6- to 9-month-old infants. Using the visual habituation procedure, infants were placed on their caregiver's lap while facing a television screen. In the habituation phase, we presented infants with a series of melodies in either duple or triple meter in two conditions: implicit harmony and explicit harmony. In the test phase, we presented one old trial (e.g., duple if they heard duple meter during habituation) and one novel trial (e.g., triple if they heard duple meter during habituation). Infants' looking times to a red-and-white checkerboard pattern during each of these conditions were measured.

**Results:** A repeated-measures ANOVA revealed a significant main effect of Condition (implicit versus explicit harmony), $F(1, 14) = 5.36$, $p = .036$, but no main effect of Test (novel versus old meter), $F(1, 14) = .354$, n.s. We also found a significant interaction between Condition and Test, $F(1, 14) = 4.658$, $p = .049$. Post-hoc one-tailed t-tests revealed a marginally significant difference between novel and old trials in the implicit harmony condition, $t(8) = 1.625$, $p = .07$, but not in the explicit harmony condition.

**Conclusion:** Preliminary results indicate that normal-hearing infants show increased looking times for the novel meter in the test phase, but only in the implicit harmony condition. Contrary to our expectations, infants did not discriminate duple and triple meter in the explicit harmony condition. It could be the case that the explicit harmony condition provided complex information that precluded infants from focusing on the meter-relevant information.

**Sa2-44**

### Infant Perception of Object-Context Relations

**Marc Bornstein**[1] Martha Arterberry[2] Clay Mash[1]

*1. NICHD, Bethesda, USA; 2. Colby College, Waterville, USA*

**Background and Aims:** Our perceptions of objects always occur in context; indeed, context informs perception and cognition. For example, retention is improved when the contexts of encoding and retrieval are similar. The effects of context on infant perception have received little attention. We therefore examined the role of external context in infant object perception.

Objects of certain kinds naturally occur in certain kinds of contexts: Animals are more likely to appear in fields, and vehicles are more likely to be found on roadways. Part of acquiring knowledge about objects is learning about the contexts in which they appear. As infants learn about objects, they also learn about objects' typical or congruent contexts. To explore the role of the context in infant object perception, we recorded infants' eye movements in object-context relations that were congruent, natural, and expected and in object-context relations that were incongruent, unnatural, and unexpected.

**Method:** We used an eye tracking paradigm and color photographs of nine animals and nine vehicles. We developed 4 sets of stimuli to correspond to 4 conditions: (1) natural congruent scenes (images of animals and vehicles photographed where they naturally occur - animals in fields and vehicles on roads), (2) "natural" congruent scenes (animal and vehicle images placed in new natural contexts), (3) incongruent scenes (animal and vehicle images placed in unnatural contexts - animals on roads, vehicles in fields), and (4) object only, homogeneous context scenes. We measured the number of fixations and duration of fixation to the object and its context.

**Results:** Analyses of number of fixations and fixation duration were similar. When inspecting animal stimuli, infants looked significantly more to the object than the context when the two were congruent, but they looked equally to the object and context when the two were incongruent. For the vehicle stimuli, infants looked significantly more to the objects than the contexts in the congruent and incongruent conditions. Infants' greater looking at "street" than "nature" backgrounds in the incongruent condition does not reflect a baseline preference as it was not apparent in the congruent condition.

**Discussion and Conclusions:** Object-context relations play a role in infant perception. When infants inspect objects in their naturally occurring contexts, they pay more attention to the target object. A functional implication of these findings may be that the match of object and context saves cognitive resources.

**Sa2-45**

### Young Infants' Perception of the Continuity of Horizontal, Vertical, and Oblique Object Trajectories

**Gavin Bremner**[1] Alan Slater[2] Scott Johnson[3] Uschi Mason[1] Jo Spring[1]

*1. Lancaster University, Lancaster, UK; 2. University of Exeter, Exeter, UK; 3. UCLA, Los Angeles, USA*

**Background and Aims:** Four-month-olds do not perceive continuity of an oblique object trajectory when it passes behind a vertically oriented occluder, but succeed when the occluder has occluding edges perpendicular to the trajectory (Bremner et al. 2007. Developmental Science, 10, 613-624). This could indicate difficulty perceiving oblique trajectories, difficulty perceiving occlusion when the occlud-

ing edges are not perpendicular to the trajectory, or both. In this study we investigated infants' perception of a horizontal trajectory when the occluder had oblique edges. We also investigated their perception of vertical trajectories, with an occluder with horizontal or oblique edges. Finally, because the oblique trajectory in previous work was only 18 degrees from horizontal, we tested their perception of a 45-degree perpendicular trajectory, when the occluder's edges were vertical or oblique.

**Method:** Groups of 12 four-month-olds were habituated to a 6.7 cm ball moving across the display screen, passing behind a 12 cm wide occluder in the middle of its trajectory, and were then shown test trials without the occluder, with the ball moving either on a continuous trajectory or a discontinuous one with a gap where the occluder had been. If infants perceive the habituation display as a continuous trajectory, they should show a novelty preference for the discontinuous test display. The horizontal trajectory group were habituated to a horizontal trajectory with an oblique occluder, the vertical trajectory groups were habituated to vertical trajectories with either horizontal or oblique occluder, and the oblique trajectory groups were habituated to an oblique trajectory with either vertical or oblique occluder. All received six test trials alternating between continuous and discontinuous with the trajectory orientation used in habituation.

**Results:** Infants looked longer at the discontinuous test display in the horizontal trajectory group, $F(1,10) = 19.51$, $p = .001$, and in the vertical trajectory groups for both the horizontal, $F(1,10) = 14.16$, $p = .004$, and oblique occluder, $F(1,10) = 13.09$, $p = .005$. The oblique trajectory groups showed no preference for either test display, whether the occluder was vertical, $F(1,10) = .96$, $p = .35$, or oblique, $F(1.10) = 1.76$, $p = .21$.

**Conclusion:** Only infants presented with oblique trajectories failed to perceive trajectory continuity, and unlike previous work this result was unaffected by orienting the occluding edges perpendicular to the trajectory, probably because a more extreme oblique trajectory was used in this study. Possible reasons for infants' difficulty with oblique trajectories are discussed.

**Sa2-46**

### Discovering the Limits of Superior Spatial Ability in Children with Autism Spectrum Disorders in a Complex Visual Search Task

**Kelly Dickerson**[1] Kimberly Kraebel[2] Peter Gerhardstein[1]

*1. Dept. of Psychology, Binghamton University, Binghamton, USA; 2. Dept. of Psychology, SUNY Cortland, Cortland, USA*

Children diagnosed with autism spectrum disorders appear to possess certain spatial abilities superior to those of their developmentally-normal peers (O'Riordan & Plaisted, 2001). That is, in visual search tasks using simple stimuli, for children with autism, reaction time to locate a target stimulus is uninfluenced when the number of distractors is increased. In contrast, increasing the number of distractors typically slows down performance of developmentally-normal children. The extent of this superior ability is a point of interest for the current study, that is; does the performance of the autistic children become more similar to the performance of developmentally-normal children in the context of a complex visual search task? Using a standard touch screen apparatus, developmentally-normal children and children with autism spectrum disorders (ages 3 to 5 years) received six practice trials to learn to locate a target stimulus amongst a field of distractor stimuli. At test, their reaction times were measured as they responded to arrays that consisted of a target presented with either 2, 4, or 8 distractor objects. Each child was presented with two different complex target objects, each composed of multiple 3-dimensional volumes, such that one resembled a horse, and the other resembled a bird. Targets and distractors differed in terms of either their component parts and/or their spatial organization. As with previous studies, the results showed an overall superior performance by the children with autism: Children with autism showed significantly faster reactions times than their developmentally-normal peers. The results also showed, however, that for both groups of children reaction time did slow down as the number of distractors was increased. The findings of the current study suggest that increasing task difficulty by using more complex targets and distractors reduces the inherent advantage typically shown by children with autism in visual search tasks, suggesting certain limitations to autistic children's superiority in spatial tasks.

**Sa2-47**

### Infants Show a Preference for Typical versus Attractive Male Bodies

**Michelle Heron**, Olivier Pascalis

*University of Sheffield, Sheffield, UK*

**Background and Aims:** Previous research shows that newborn infants prefer to look at photographs of attractive faces than unattractive faces, as rated by adults (Slater et al., 1998). This finding has been interpreted in terms of infants' precocious face-processing skills. Attractive faces are most prototypical or face-like, and thus more closely match the infants' face template. As adults, we categorize others' bodies as attractive and unattractive on a daily basis. Previous research indicates that knowledge about the overall shape of the human body is late developing in infancy (Slaughter & Heron, 2004). We investigated if infants, like adults, would categorize bodies as attractive and unattractive. Consistent with this, one would not expect infants to look longer at attractive or unattractive bodies.

**Methods:** 3.5-, 6- and 9-month-old infants were shown pairs of photographs of males (30 cm in height): one had a typical body and the other an attractive body ($N = 18$ per age group). Each pair of males had an identical face, only the bodies differed. The attractive bodies had greater muscle definition and were slightly thinner than the typical bodies. Skin colour was fairly similar. Photographs were presented until the infant had viewed each pair for 10 cumulative seconds.

**Results:** Paired t-tests indicated that all age groups looked significantly longer at the typical males, as compared with the attractive males (all $t$'s $> 2.13$, all $p$'s $< .05$). Collapsed across age, average looking time was 45% for the attractive bodies and 55% for the typical bodies.

**Conclusion:** Infants preferred to look at typical bodies, as compared with attractive bodies. This may be due to a preference for body shapes which are most familiar to the infant. However, as the attractive males were naturally taller, they were adjusted to be the same height as the typical males. This resulted in the attractive men having slightly smaller heads (3.5 mm less in diameter) than the typical men. Thus it remains a possibility that infants prefer a body where the head is large in proportion to the rest of the body. A follow-up study which controls for head-size is currently under way. Further studies will also examine which aspects of attractiveness, if any, are used by infants to discriminate attractive and typical bodies (e.g. BMI, muscle tone).

**Sa2-48**

### Maturation of Fetal Response to Maternal Voice

**Barbara Kisilevsky**, Sylvia Hains
*Queen's University, Kingston, Canada*

**Background and Aims:** By 37 weeks gestational age (GA), healthy fetuses in uneventful pregnancies respond to their mother's voice with a heart rate (HR) increase but not to that of a female stranger (Kisilevsky et al., 2003), suggesting recognition (i.e., learning) of the mother's voice before birth. To date, however, the onset of responding to the mother's voice and the maturational changes in the response as the fetus matures have not been characterized and are the focus of this study.

**Methods:** Fetal heart rate response to a recording of the mother reading a children's story was obtained for 120 fetuses during a standard protocol: 2 min no voice, 2 min voice, 2 min no voice period. The mother's voice was recorded and played back on a computer using Praat software at an average of 93 dB (A) through a speaker placed about 10cm above the mother's abdomen. Fetal HR responses were analysed for three age groups: 31-34 weeks GA [n=26, M(±SD) = 33.6 (1.06)], 35-37 weeks GA [n=51, M(±SD) = 35.9 (.55)], and > 37 weeks GA [n=43, M(±SD) = 37.9(.77)].

**Results:** Below 35 weeks GA, fetuses showed no reliable change in HR following the onset of their mother's voice. Fetuses between 35 and 37 weeks GA showed a linear increase in HR of 7.8 bpm while hearing their mothers voice ($F(117,5733) = 3.37$, $p < .01$); fetuses >37 weeks GA showed an increase in HR over the first 20 s of 4.5 bpm ($F(19,798) = 1.98$, $p = .03$) that was maintained for the rest of the period.

**Conclusion:** The onset of fetal response to the mother's voice is observed around 35 weeks GA as a linear HR increase across the whole period. As the fetus matures, the HR response is more immediate and is maintained at the same level throughout the period. If the fetus learns the characteristics of the mother's voice (a ubiquitous stimulus) over gestation, then the fetal HR increase may represent a novelty response to a different location or a different quality of the mother's voice presented less directly via a loudspeaker through the abdominal wall and amniotic fluid than received from bone conduction through skull vibration and fluid conduction from the cranial cavity to the inner ear.

**Sa2-49**

### Developmental Narrowing of Intersensory Perception in Human Infants: Exploring the Separate Roles of Intersensory and Unisensory Processing Mechanisms

**David Lewkowicz**, Ryan Sowinski, Silvia Place
*Florida Atlantic University, Boca Raton, USA*

**Background and Aims:** Lewkowicz & Ghazanfar (2006) reported that intersensory matching of nonnative faces and vocalizations declines during infancy. Specifically, when infants watched side-by-side faces of the same monkey making a coo and a grunt vocalization and also heard one of these vocalizations, 4- and 6-month-old looked longer at the matching face whereas 8- and 10-month-old did not. Here, we conducted two experiments to investigate whether audio-visual synchrony mediated the intersensory matching in the younger infants and whether the older infants' failure to match was due to an inability to perceive the visible and/or the audible vocalizations.

**Methods:** We used a paired-preference procedure in Experiment 1 and tested 4-6 month-old (n = 48) and 8-10 month-old (n = 40) infants. During the first 2 trials infants watched side-by-side faces of the same monkey repeatedly producing the silent versions of the two vocalizations whereas during the last two trials infants saw the same faces but this time also heard the audible coo or grunt. To determine whether intersensory synchrony contributed to successful intersensory matching in the Lewkowicz & Ghazanfar study, we desynchronized the visual and auditory information by presenting the audible vocalizations 660 ms. prior to the visible vocalizations during the last two in-sound trials. In Experiment 2 we used a habituation/test procedure and habituated sixteen 8-10 month-old infants to an auditory-only coo or grunt and then tested for discrimination by presenting the other vocalization.

**Results:** Experiment 1 showed that both age groups showed a preference for the visual coo in the silent trials (4-6 month, $t(47) = 3.27$, $p < .01$; 8-10 month, $t(39) = 1.99$, $p = .05$) but that they did not exhibit intersensory matching. Experiment 2 showed that the 8-10 month-old infants discriminated the two vocalizations, $t(15) = 3.27$, $p < .01$.

**Conclusion:** The finding that 4-6 month-old infants did not exhibit intersensory matching when the auditory and visual information was desynchronized indicates that audio-visual synchrony underlies the matching effect found earlier by Lewkowicz & Ghazanfar (2006). The finding that older 8-10 month-old infants discriminated the visible as well as the audible vocalizations shows that the older infants' failure to make intersensory matches in the original study was not due to a failure to perceive the information in each modality. Overall, these findings indicate that the developmental narrowing reported by Lewkowicz & Ghazanfar (2006) reflect processes at the intersensory rather than the unisensory levels.

**Sa2-50**

### The Face Inversion Effect in Infancy: Is it Really Face Specific?

**Dana Kuefner**, Elena Vescovo, **Viola Macchi Cassia**
*Università degli studi di Milano Bicocca, Milano, Italy*

**Background and Aims:** The face inversion effect (FIE) refers to the disproportionate impairment in face recognition as compared to object recognition that accompanies stimulus inversion. The FIE is thought to reflect the inability to access in inverted faces the configural/featural cues that are necessary for face recognition. The FIE has been shown to emerge within the first year of life. However, the degree to which this effect is actually face specific in infancy is still unknown. To our knowledge, no studies have tested infants' discrimination of non-face stimuli in both the upright an inverted conditions.

It has been shown that one perceptual property that characterize upright faces, top-heaviness, is capable of attracting infants' attention at birth, and modulating neural responses in infancy and adulthood. Therefore, we hypothesized that the attentional bias present at birth for top-heavy stimuli may cause infants to develop sensitivity to configural information embedded in any top-heavy stimulus, not only faces. This would be reflected by an inversion effect that is not specific to faces, but present also for other categories of top-heavy stimuli.

**Methods:** Using an infant-control habituation paradigm, we tested recognition abilities for upright and inverted canonical and scrambled faces in two groups of 6- and 9-month-old infants. We used the same top-heavy (upright) canonical and scrambled faces used by Macchi Cassia et al. (2004), for which newborns were shown to manifest preferences over the inverted versions of the same stimuli. Infants were habituated to a single face, and then presented with a visual paired

comparison task in which the familiar face appeared together with a novel face of the same nature (canonical or scrambled).

**Results and Conclusion:** Preliminary data reveal that both 6- and 9-month-old infants discriminate the natural faces in the upright but not the inverted conditions, thus manifesting a FIE. Interestingly, the data indicate a directional change of the infants' preference from familiarity at 6 months (mean novelty preference score: 43.36%, [t(6) = 2.51, p = .046]) to novelty at 9 months (57.12%, [t(9) = 3.21, p = .011]). Data collection with the scrambled faces is in initial stages, but is expected to provide insight to the face-specificity of the inversion effect observed in infancy.

**Sa2-51**

### Children's Detection and Use of Cues to Infer Object Displacement

**Diane Marie Mangalindan**[1] Mark Schmuckler[2]

*1. University of Toronto, Scarborough, Canada; 2. University of Toronto, Toronto, Canada*

Investigating children's abilities to search for a hidden toy has been of perennial interest to developmental psychologists. In one instantiation of this question, toddlers observe a ball roll down a ramp, come to rest behind one of two doors, and are then asked to retrieve this hidden toy. Previous research using this paradigm has revealed that continuous tracking of the ball is critical for successful retrievals (Keen, 2003), and that cues such as the top of a barrier that would stop the ball are ignored. Such findings are explainable by assuming that attention towards the object spreads in a gradient-like fashion within the object itself, and is influenced by proximity relations and object boundaries. (Shutts, Keen, and Spelke, 2006). As evidence for this hypothesis, Shutts et al. (2006) found that 24-month-olds were more successful in search when a target object had a short cue (i.e., close to the car's center) attached to its roof than when the cue was longer (i.e., far from the car's center).

If attention truly spreads in a gradient-like fashion within the object, this suggests that the spatial relation between the cue and target is unimportant, with attention flowing from proximally to distally within the object regardless of the direction of flow. Intriguingly, such a claim contradicts the idea that horizontal and vertical alignments are privileged early in life (McGurk, 1970; Quinn & Bhatt, 1998), which would imply that attention between object and cue should be better when the two are aligned vertically/horizontally, as opposed to obliquely.

The present study examined this hypothesis, within the experimental context described earlier. Specifically, 24-, 30-, and 36- month-olds saw a hidden object containing an obliquely attached short or long cue hidden behind one of two doors, and then had to retrieve this toy. Supporting Shutts et al. (2006), short cues led to more successful retrieval and increased visual tracking. Conflicting with Shutts et al. (2006), however, overall performance was worse than that observed by these earlier authors, particularly for the 24-month-olds. Instead, it was not until 30 months that children can made better use of short, relative to long, obliquely oriented cues. These findings indicate that the spatial relation between cue and target, along with object boundaries and proximity, are important elements in modulating the spread of attention, as well as supporting the notion of a privileged status for vertical object orientations.

**Sa2-52**

### An ERP Study of Early Word Segmentation By French-Learning 12-Month-Olds

Louise Goyet, **Thierry Nazzi**

*LPP, CNRS-Université Paris Descartes, Paris, France*

**Background and Aims:** Previous behavioral (HPP) research first found a delay in the onset of segmentation in French (Nazzi et al., 2006) compared to English (Jusczyk et al., 1999). Second, that research showed that French 12-month-olds segment syllabic units rather than whole words, a result providing support to the rhythmic segmentation bootstrapping hypothesis. Given the potential implications of these results, and to determine whether the delay found for French is due to procedural difficulties, we used ERPs to re-evaluate both the delay and the syllable-based issues. This study will also allow an extension of the only ERP study so far (Kooijman et al., 2005) from Dutch to French.

**Methods:** High-density ERPs were used to record the cortical activity of 20 French-learning 12-month-olds. In our paradigm (see also Kooijman et al., 2005), infants were presented with up to 20 experimental blocks. In each block, they first heard 10 repetitions of a bisyllabic word, and then heard 6 sentences containing that target word and 6 sentences containing a "control" bisyllabic word presented in random order. For the test phase, mean ERPs were calculated on various 150 ms long time-windows for target and control words, for both the first and second syllables.

**Results:** For the first syllable, an ANOVA with the main factors of familiarity, quadrant and electrode on mean amplitude for the 350-500 ms window found a significant effect of familiarity, $F(1, 16) = 8.03$, $p = .01$, mean amplitude being more negative for target than for control words. This effect emerged between 250-400 and 300-450 ms, and was more prominent for the left temporo-parietal and the right fronto-central quadrants. A similar analysis on the second syllable revealed no significant effects or interactions.

**Conclusion:** The present study confirms Kooijman et al. (2005) ERP study in showing that increased negativity for target words signals early word segmentation. Our effects however showed earlier and more wide-spread activity than in Dutch, which might derive from age, linguistic and minor protocol differences between both studies. The fact that a segmentation effect was only found for the first syllable (a pattern different from that found with HPP) suggests that either ERPs allow to observe more advanced segmentation effects than HPP, or that segmentation of the second syllable was masked by the reaction to the first syllable, a possibility currently evaluated by familiarizing infants with the isolated final syllables.

**Sa2-53**

### Perceptual Grouping Transfers Across Organizational Principles in 6-to 7-Month-Old Infants

**Paul Quinn**[1] Ramesh Bhatt[2]

*1. University of Delaware, Newark, USA; 2. University of Kentucky, Lexington, USA*

**Background and Aims:** Research with infants in the first half-year of life indicates that a number of organizational principles by which small elements are grouped to form larger perceptual units are functional by 6 months of age, including lightness similarity (Quinn, Burke, & Rush, 1993), form similarity (Quinn, Bhatt, Brush, Grimes, & Sharpnack, 2002), good continuation (Quinn & Bhatt, 2005), and common motion

(Spelke, 1982). In the present research, we began an inquiry into the flexibility of the principles. Could an organization learned when elements are grouped in accord with one principle transfer and direct a subsequent visual preference for a novel organization produced by grouping of elements in accord with another principle?

**Methods:** Sixteen 6- to 7-month-olds were familiarized with arrays of elements that could be organized into columns or rows based on the lightness similarity of the elements (dark vs. light squares). The infants were then given a novelty preference test that paired arrays of elements that could be organized into columns or rows based on the form similarity of the elements (Xs vs. Os). If the infants can group the familiarized elements by lightness similarity, and use the resulting column or row organization as a basis for selecting among the column and row organizations achieved by grouping the test elements in accord with form similarity, then they should display a preference for the test stimulus depicting the novel organization of elements.

**Results:** Each infant's looking time to the stimulus with the novel organization was divided by the looking time to both test stimuli and converted to a percentage score. The mean preference for the novel organization was 67.20%, SD = 11.26, a value that was reliably different from chance, $t(15) = 6.11$, $p < 01$. In addition, 15 of the 16 infants displayed a preference for the novel organization above 50%, $p = .0005$.

**Conclusion:** The results suggest that infants can group elements by lightness similarity and transfer the represented organization (i.e., columns) to direct a preference for a novel organization (i.e., rows) produced by grouping of elements via form similarity. Prior research had suggested that there was flexibility in early perceptual grouping in that perceptual units formed by applying a particular grouping principle could be generalized to novel patterns organized by the same grouping principle (Bhatt, Hayden, & Quinn, 2007). However, the current findings are the first to suggest that perceptual units formed from application of one grouping principle can be transferred to process a visual pattern organized by a different grouping principle.

**Sa2-54**

### Between-Hand Transfer of Shape and Texture Object in Newborn Infants

**Coralie Sann, Arlette Streri**

*Laboratory "Psychology for Perception", University Paris-Descartes, Paris, France*

**Purpose:** Tactile information can be perceived shortly after birth. Newborn infants can gather and process information about object properties tactually. Previous works have revealed (a) discrepancies of performances between shape and texture in a cross-modal transfer task between vision and touch in newborn infants (Sann & Streri, 2007) and (b) development of between-hand transfer of shape information from 2- to 6-month-old infants (Streri et al., in press). The present study assessed the newborn's ability to process and exchange information about texture (granular/ smooth) (Exp.1) or shape (cylinder/ prism) (Exp.2) between the two hands. We aimed to determine whether inter-manual transfer of tactile information is possible at birth, despite the immaturity of the corpus callosum, and if so, whether discrepancies of performances between shape and texture are evidenced as in cross-modal transfer.

**Method:** Using habituation-reaction to novelty procedure, 48 newborns (24 per experiment) received a haptic habituation either with their right or left hand without visual control. An object is repeatly put in the infant's hand until a significant decreasing of the duration of holding. Then, a haptic discrimination test is performed in the opposite hand. The familiar object and the novel object (varying in texture or in shape) are presented in alternation.

**Results:** Experiment 1 showed that after habituation to a texture in one hand, newborns held longer the novel texture ($F(1, 20) = 6.06$, $p = .023$). This novelty preference was taken as evidence of inter-manual transfer of texture. Experiment 2 showed that after habituation to a shape in one hand, the familiar shape was hold for longer in the opposite hand ($F(1, 20) = 16.17$, $p < .001$). Even though no reaction to novelty was found, the finding of the prefence for the familiar shape indicated some transfer of shape information between the two hands.

**Conclusions:** These findings suggest that inter-manual transfer of information is possible from birth, despite the immaturity of the corpus callosum, but it depends on object characteristics. Discrepancies of performances between shape and texture revealed in our study are (1) in line with those obtained in a cross-modal transfer task between vision and touch and (2) support the neuroimaging studies which suggest a functional separation in cortical processing of shape and texture (Merabet et al., 2004; Peltier et al., 2007; Roland et al., 1998). Shape and texture processing seem to take different pathways in the newborn's brain as in the adult's brain.

**Sa2-55**

### Do Young Infants Hear Virtual Pitch?

Chao He, Lisa Hotson, **Laurel Trainor**

*Department of Psychology, Behaviour, & Neuroscience, McMaster University, Hamilton, Canada*

**Background:** Adults hear periodic complex sounds such as musical tones and vowels as single sounds although they are composed of a set of harmonics whose frequencies are at integer multiples of the fundamental or lowest frequency, f0. The pitch normally corresponds to the frequency of f0. However, when the fundamental is removed, the pitch is unaffected, although the timbre does change. This is called virtual pitch because the frequency of the perceived pitch is not actually present in the sound. Virtual pitch is derived in secondary auditory cortex from the frequency pattern of the remaining harmonics (Schneider et al., 2005; Bendor and Wang, 2005). In infants, however, the auditory cortex is not fully mature. Previous studies (Clarkson et al., 1995) showed that infants as young as 7 months of age can hear virtual pitch but infants at younger ages have not been studied because it is hard to test them with behavioural techniques.

**Methods:** Adults and infants of 3, 4 and 7 months were tested. Pairs of complex tones were created such that the frequencies of all harmonics, and the perceived pitch, went up from the first to the second tone. These were presented in random order. Occasionally a deviant stimulus was presented where the harmonics of the second tone lined up to create a virtual pitch that was lower than the first tone. We recorded Electroencephalogram (EEG) responses with 124-channel Geodesic® Nets. In adults, we expected to see a Mismatch negativity (MMN) component around 150-200 ms after the onset of the deviant tones. MMN occurs in response to occasional changes in a repeating auditory stimulus; it reflects automatic processes in auditory cortex of memory updating (Näätänen, 2000). We have shown that an MMN-like negative component also occurs in infants as young as 3 month (He, Hotson, &Trainor, 2007, He, Hotson, & Trainor, under review). Presence of MMN in infants would indicate that they hear virtual pitch.

**Results:** The adult data showed typical MMN responses. An MMN-like negativity was also prominent in 7-month-olds, consistent with previous behavior results. At 4 months, the MMN-like negativity was still

significant, although smaller in amplitude and later in time compare to 7-month-olds. At 3 months, there was no significant MMN.

**Conclusion:** Infants as young as 4 month of age can hear virtual pitch. Three-month-olds are likely not able to perceive virtual pitch, at least not at the cortical level.

**Sa2-56**

## An Intermodal Representation of Race and Language in Six-Month-Old Infants

**Lesley Uttley**[1] Kang Lee[2] Paul Quinn[3] Alan Slater[4] Olivier Pascalis[1]

*1. The University of Sheffield, Sheffield, UK; 2. The University of Toronto, Toronto, Canada; 3. University of Delaware, Delaware, USA; 4. The University of Exeter, Exeter, UK*

Infants are sensitive to events that are bimodally specified. This sensitivity implies that infants integrate information from two sense modalities into a single percept. Using such information, young infants are able to correctly match sound and vision to identify the appropriate moving object (Spelke, 1979), the gender of the speaker (Lewkowicz, 1996), as well as the age of the speaker (Bahrick et al, 1998) and also to discriminate between emotions (Walker-Andrews et al., 1991). Bonatti et al., 2002 suggested that infants have a representation and an expectation about humans. How precise is the human representation? Does it extend to language and culture? Ethnicity and language are examples of naturally occurring categories; we differ both in face morphology, skin tone and speech. Will infants expect an own-race face to speak their native language and an other-race face to speak a non-native language?

In this study infants were presented with static images of either Caucasian faces or Chinese faces paired with either an English-speaking soundtrack or a Chinese-speaking soundtrack. 36 six-month-old infants were tested. One group of 18 infants was presented with Caucasian faces and English language and Chinese faces and Chinese language (congruent condition) The other group of 18 infants was presented with Caucasian faces and Chinese language and Chinese faces with English language (incongruent condition).

Only infants from monolingual, English-speaking, Caucasian families were tested. Based on previous intermodal infancy research, it was hypothesised that infants would look longer to correctly matched intermodal pairs for the English face-voice, but we were however uncertain of their reaction to Chinese faces speaking English. It is indeed unlikely that those infants had encountered Chinese faces speaking Chinese in their environment.

The results showed that six-month-old Caucasian infants correctly matched Caucasian faces to English language and Chinese faces to Chinese language. Infants who viewed the "correctly matching" pairs of faces and voices looked significantly longer than infants who viewed "mismatching pairs" for both Caucasian and Chinese faces. There were no significant differences in overall looking time between Chinese and Caucasian faces, regardless of whether they were presented with a matching soundtrack or not. These results demonstrate that 6-month-old infants have a cross-modal representation of both their own race and native language. We are currently conducting controls and investigating whether this ability is present in infants who are younger than six months old.

**Sa2-57**

## Five-Month-Olds' Responsiveness to Pictorial Depth Cues in Preferential-Reaching Studies: a Meta-Analysis

**Albert Yonas**[1] Michael Kavšek[2] Carl Granrud[3]

*1. University of Minnesota, Minneapolis, USA; 2. University of Bonn, Bonn, Germany; 3. University of Northern Colorado, Greeley, USA*

This meta-analytical study is motivated by a striking inconsistency within research on infants' sensitivity to pictorial cues to depth. On the one hand, according to most preferential-reaching-studies, the ability to respond to pictorial depth emerges between 5 and 7 months of age (e.g., Yonas & Granrud, 2006). On the other hand, more recent habituation-dishabituation experiments provide evidence that infants as young as 3-4 months are able to extract spatial layout from pictorial depth cues (e.g., Bertin & Bhatt, 2006).

One theoretical solution to this discrepancy between preferential-reaching and habituation-dishabituation studies is to assume that it follows from differential processing modes triggered by the experimental methods. Especially for younger babies, it might be easier to generate a perceptual (habituation-dishabituation) response than a motor (preferential-reaching) response towards pictorial depth cues.

We tested the hypothesis that some sensitivity to pictorial depth is present even in younger infants, but that this sensitivity is still too small to evoke significant statistical effects in single preferential-reaching studies. We therefore combined the data for the 5-month-olds who participated in the existing preferential-reaching studies.

In total, the results from 15 samples consisting of 424 infants 5-5 months of age were integrated. For these samples, the *t*-statistics as well as one-tailed levels of significance *p* were reconstructed. Unfortunately, although most studies employed a repeated measures design, only *t*-tests for unpaired samples could be computed because insufficient data were available. Nevertheless, the values of *t* for unpaired samples can be considered approximately conservative estimations of the values of *t* for paired samples. The probabilities, *p*, were translated into the standard normal deviates, *Z*, which were then added by means of the Stouffer method (see Rosenthal, 1984). For the resulting overall *Z*, a corresponding significance *p* was determined. This *p* was the main outcome of the meta-analysis.

According to the results, the overall *p* was highly significant (< .001). Indeed, most studies found a tendency of their participants to respond to pictorial depth. On the other hand, effect size was relatively low ($r = .13$). Overall, the findings confirm our hypothesis that a weak sensitivity to pictorial depth cues is already present in 5-month-old infants. Furthermore, after about 5 months of age, the ability to manually react to pictorial depth improves substantially. There were large differences between studies in level of significance. These differential effects will be discussed.

**Sa2-58**

## Discrimination of Word-Medial and Word-Final Contrasts

**Tania Zamuner**[1] **Laurel Fais**[2] **Suzanne Curtin**[3] **Janet Werker**[2]

*1. Radboud University Nijmegen, The Netherlands; 2. University of British Columbia, Vancouver, Canada; 3. University of Calgary, Calgary, Canada*

**Background and Aims:** Many studies have focused on infants' perceptual abilities in word-initial position. However, to fully understand the development of speech perception, we also need to understand how infants perceive speech in different positions within words. A

growing body of research has begun to document differences in infants' knowledge of word-initial versus word-final position (Swingley, 2005; Zamuner, 2006). Moreover, conflicting results have been found for infants' ability to perceive contrasts in word-final position. These studies have employed various methodologies, and as a consequence, some research has examined infants' discrimination of word-final contrasts in running speech and others have examined infants' discrimination of word-final contrasts in isolation. This is an important factor to consider, because research in adult-speech processing has shown that perception varies according to position within an utterance (Pickett et al., 1995). Segments have different acoustic and articulatory realizations in running speech than in isolation (Repp, 1978, 1983; Chitoran et al., 2000), and this has consequences for how segments are perceived. As a starting point for examining the role of position in speech discrimination, we compared infants' perception of contrasts presented in isolation in word-medial versus word-final position.

**Methods:** 20-month-old English-learning infants completed a discrimination task (Werker et al., 1998). Infants were tested on a /p-k/ contrast, presented in either word-medial position (apta~akta as in words such as captain and doctor) or in word-final position (ap~ak as in words such as tap and tack). There was one within-subjects factor (Trial Type: Same or Switch) and one between-subjects factor (Position: Medial or Final).

**Results:** There was a significant effect of Trial Type ($F(1,12) = 6.49$, $p = .03$). Infants looked significantly longer to Switch trials (M = 8.63s, SD = 4.31s) than to Same trials (M = 6.46s, SD = 4.64s). There were no other significant effects.

**Conclusions:** This is one of the first studies to focus on infants' perception in word-medial versus word-final position. The results indicate that 20-month-old infants can discriminate /p/ and /k/ regardless of whether this contrast occurs word-medially or word-finally. Although adult speech perception and production varies according to position, the current results show that infants are equally capable of discriminating contrasts in either position. Follow-up studies are needed to determine whether there are developmental patterns in children's perception in word-medial versus word-final position.

## *Cognitive Development*

**Sa2-59**

### Racial Categorization of Human Faces by 6-Month-Olds

**Gizelle Anzures**[1] Shaoying Liu[2] Liezhong Ge[2] Paul Quinn[3] Olivier Pascalis[4] Alan Slater[5] Kang Lee[1]

*1. University of Toronto, Toronto, Canada; 2. Zhejiang Sci-Tech University, Zhejiang, China; 3. University of Delaware, Delaware, USA; 4. University of Sheffield, Sheffield, UK; 5. University of Exeter, Exeter, UK*

Infants' ability to discriminate between own-race and other-race faces (Bar-Haim et al., 2006; Kelly et al., 2005; 2007) coupled with their ability to categorize human facial expressions (Bornstein & Arterberry, 2003; Caron et al., 1982; Ludemann & Nelson, 1988; Ludemann, 1991; Nelson & Dolgin, 1985; Nelson et al., 1979; Serrano et al., 1992; 1995), and gender (Leinbach & Fagot, 1993, Younger & Fearing, 1999) suggests that they might also be able to categorize human faces based on race. The present study, therefore, examined 6-month-old Caucasians' ability to categorize Caucasian and East Asian female faces. Six-month-olds were specifically chosen because existing evidence suggests that an emerging ability to form subordinate-level categories (i.e., more defined categorization of exemplars from the same general category) is present at this age (Quinn, 2004).

We tested 27 Caucasian 6-month-olds (M = 198.19 days, 17 males). Infants were familiarized with either 8 Caucasian female faces or 8 East Asian female faces paired with different objects. Familiarization was then followed by successive presentations of 2 novel female faces from the novel race category paired with 2 novel objects. Racial categorization of human faces by 6-month-olds would be inferred if looking time at the 2 novel faces from the novel race category is greater relative to looking at faces of the familiarized race during the last two trials of familiarization.

Paired-samples t-tests were used to compare looking at the faces during the last 2 familiarization trials versus looking at the 2 faces from the novel race. Six-month-olds familiarized with East Asian faces showed a significant increase in looking ($p < .05$) at the novel Caucasian faces, suggesting that they had formed a category of East Asian faces that excluded Caucasian faces. However, six-month-olds familiarized with Caucasian faces showed no significant increase in looking ($p > .05$) at the novel East Asian faces, suggesting that they had not formed separate categories for Caucasian and East Asian faces. This asymmetry in categorization may be a reflection of a spontaneous preference for looking at own-race faces (Kelly et al., 2005, 2007). Such asymmetry in categorization is consistent with previous findings examining infants' ability to categorize facial expressions (Caron et al., 1982; Ludemann & Nelson, 1988; Nelson & Dolgin, 1985; Nelson et al., 1979) and gender (Quinn et al., 2002).

Chinese 6-month-olds are currently being tested in China. We expect to replicate the asymmetry in categorization found with the Caucasian infants (i.e., Chinese infants should show an increase in looking at the novel own-race/East Asian faces after familiarization with other-race/Caucasian faces, but they should show no change in looking at the novel Caucasian faces after familiarization with East Asian faces). An additional study is also being conducted to verify that 6-month-olds are able to discriminate between the Caucasian faces, as well as between the East Asian faces, used as stimuli.

**Sa2-60**

### Words Go Together But Not Pictures: Early Semantic Priming Effects

**Natalia Arias-Trejo**, Kim Plunkett

*University of Oxford, Oxford, UK*

Exposure to prior related words facilitates subsequent word processing in school-age children and adults: they are both faster and more accurate if the preceding word is related to the subsequent word (Nation & Snowling, 1999; Neely, 1991). An attempt has been made to extend these findings to the development of infants' word associations (Styles & Plunkett, 2007). These authors presented related word-pair and unrelated word-pair associations finding that infants looked more at target images in the related word-pair condition than in the unrelated-pair condition. However, their design did not allow clarification of whether infants were responding on the basis of word knowledge or picture knowledge. In the current study, we introduce a procedure that permits an evaluation of whether infants are using word-word knowledge.

Participants: 56 21-month-olds from monolingual English-speaking families.

An adaptation of the preferential looking task (Golinkoff et al., 1987) was used. Children were presented with twelve image pairs. We introduced four conditions in which we manipulated the relationship between word pairs: 1) Prime-Target ('dog'-'cat'), 2) Neutral-Target ('bib'-

'cat'), 3) Prime-Look ('dog'-'look') and 4) Neutral-Look ('bib'-'look'). At the beginning of each trial, infants heard the prime or neutral word at the end of a carrier phrase. 200ms after offset, the target word or 'look' was played. 200ms after the onset of this word, the two images appeared simultaneously and remained visible for 2500ms.

Infants looked significantly above chance at the target picture in the Prime-Target condition ($t(55) = 3.52$, $p < .01$). Furthermore, they looked longer at the target picture in the Prime-Target condition than in the Prime-Look condition ($F(1, 109) = 7.58$, $p < .01$). An analysis of variance with the factors Prior word (Prime vs. Neutral) and Subsequent word (Target vs. Look) revealed a significant interaction between the two factors, confirming that the manipulations produced significantly greater target looking in the condition in which the prime and target words were semantically related.

These data indicate that words are associated in the early lexicon. Infants as early as 21 months of age establish a word-word relationship between semantically related concepts. Furthermore, prior neutral linguistic input seems to inhibit word-word associations.

Golinkoff, R. M., Hirsch-Pasek, K., Cauley, K. M., & Gordon, L. (1987). The eyes have it: Lexical and syntactic comprehension in a new paradigm. Journal of Child Language, 14(1), 23-45.

Nation, K., & Snowling, M. J. (1999). Developmental differences in sensitivity to semantic relations among good and poor comprehenders: Evidence from semantic priming. Cognition, 70(1), B1-B13.

Neely, J. H. (1991). Semantic priming effects in visual word recognition: A selective review of current findings and theories. In D. Besner & G. W. Humphreys (Eds.), Basic processes in reading: Visual word recognition (pp. 264-336). Hillsdale, NJ: Erlbaum.

Styles, S., & Plunkett, K. (2007, March 29-April 1). Word-pairs prime picture-looking in the second year. Paper presented at the Society for Research in Child Development, Boston.

**Sa2-61**

## Conceptual Information about Animacy Influences Object Learning in 18-Month-Old Infants

**Ashley Brock**, Leslie Cohen

*University of Texas at Austin, Austin, USA*

**Background and Aims:** Research by Booth, Waxman, & Huang (2005) indicates that 18-month-old infants exhibit a texture bias when learning about animate objects in a novel word learning task. Infants in their study differentially extended the novel labels on the basis of texture for animate, but not inanimate, objects. The infants also showed a shape bias for both animate and inanimate objects, but the texture bias was found only for the animate objects. The current study is an attempt to replicate and extend this line of research. Although the Booth, Waxman, & Huang study used a word learning task in which infants learned about a new object and its label through presentation of a vignette, the current study employed animated videos to familiarize the infants with the target object. Half of the infants heard a voice labeling the object, but the other half watched the videos in silence. Thus, the current study also examined the effect of labeling on the texture bias.

**Method:** Infants were randomly assigned to one of four conditions: animate label (n=14), animate silent (n=14), inanimate label (n=13), or inanimate silent (n=11). Each infant was habituated to an animated video of the target object in which the object's animacy (animate or inanimate) was portrayed by its type of motion. In the label conditions, a female voice labeled the object in infant-directed speech. The infants were then presented with a familiar shape/familiar texture object, a novel shape/familiar texture object, a familiar shape/novel texture object, and a novel shape/novel texture object. Looking times were recorded during each test trial.

**Results:** All groups of infants looked significantly longer at a novel shape than at a familiar shape; $F(1,44) = 22.551$, $p = .0001$. Infants in the animate condition also looked significantly longer during the familiar shape/novel texture trial than infants in the inanimate condition. Another ANOVA revealed a significant interaction between animacy condition and trial type on the key test trials (novel shape/familiar texture vs. familiar shape/novel texture); $F(1, 44) = 4.037$, $p = .042$. However, no effect was found for label; $F(1, 44) = .112$, $p = .739$.

**Conclusion:** These results indicate that 18-month-old infants consider texture cues to be more relevant to animate objects than to inanimate objects. However, infants exhibit this texture bias when learning about a novel animate object regardless of whether or not the object is given a label.

**Sa2-62**

## Infant's Understanding of Emotional Expressions: Using Information for Oneself and to Predict Actions of Others

**Sarah Gerson**[1] Jacqueline Leventon[1] Amrisha Vaish[2] Amanda Woodward[1]

*1. University of Maryland, College Park, College Park, USA; 2. Max Planck Institute, Leipzig, Germany*

Emotional expressions provide critical information about the world and about the person expressing them. Much research has documented infants' emerging sensitivity to the former: by the end of the first year of life infants' social referencing behavior shows that they use emotional information to inform their responses to the environment (Moses, Baldwin, Rosicky, & Tidball, 2001; Repacholi, 1998; Sorce, Embe, Campos, & Klinnert, 1985). However, less is known about infants' use of emotion information to reason about the emoter. By 3 years of age this kind of reasoning is evident in children's explicit theory of mind. In the current study, we addressed this gap in the literature, asking whether 18-month-old infants would predict a person's actions based on her emotional expressions.

**Method:** Eighteen-month-old (mean age=17.96) infants'action predictions were assessed in a looking time paradigm. Infants viewed events in which an produced a fearful or happy expression in response to an object, and then either approached or avoided the object. Infants were familiarized to an actress expressing happiness (n=11) or fear (n=14) toward an ambiguous object. After four familiarization trials, the actress expressed the same emotion and then alternately leaned toward or away from the toy. A longer looking time at an inconsistent event (i.e., leaning away from the toy after expressing happiness) demonstrates an understanding of the relation between emoter and action. In addition, to provide a point of contact with prior social referencing studies, after the looking time procedure, each infants' own responses to the ambiguous object were evaluated.

**Results:** A paired samples t-test found a significant difference between for fear ($t(13)=2.35$, $p=.035$), but not for happiness ($t(10)=.953$, $p=.363$). Thus, infants in the fear condition looked longer on trials when the actress leaned toward the toy than when she leaned away from the toy. Infants' own responses to the object mirrored their looking time responses. A chi-square test indicated that infants in the two conditions behaved differently toward the object ($\chi^2$ (1, 25)=11.5 $p=.001$). Infants in the fear condition were less likely to touch the experimental toy (1/14) than infants in the happy condition (8 /11).

These findings suggest that in some cases, infants can derive information about the person, as well as the world, from an emotional expression. Infants predicted that a person would avoid an object following a fearful response to it, and, as expected based on the social referencing literature, infants themselves avoided that object.

**Sa2-63**

### Young Infants Prefer Prosocial Over Antisocial Actors

**J. Kiley Hamlin**, Karen Wynn
*Yale University, New Haven, USA*

Recent findings suggest that young infants prefer helpful individuals over those who hinder others in attaining their goals (Hamlin, Wynn, and Bloom, in press, 2007), suggesting that the capacity for social evaluation emerges early in development. The breadth of this capacity, however, is not known. The experiments reported here ask whether this capacity extends to (a) new helping & hindering actions (the original studies employed a single helping/hindering scenario), and (b) prosocial and antisocial actions other than helping/hindering (i.e. giving/taking a preferred object). Infant subjects were 3 - to 9-month-olds as specified below. No age differences were obtained so results are reported here collapsed across age groups.

In Experiment 1, 5- and 9-month-olds saw a puppet try, and fail, to lift a heavy lid off a box. Following this, infants alternately saw one puppet help the Trier to open the lid, and another puppet prevent the Trier from doing so. Infants preferred (reached for) the puppet who previously helped the Trier achieve his goal (binomial probability test, $p<.05$).

In Experiment 2, 3- and 8-month-olds saw a puppet playing with a ball. During each trial, the "Bouncer" dropped and picked up the ball twice. On the third drop, the ball rolled toward one of two puppets, a "Giver" who returned the ball the the Bouncer, and a "Taker" who left with the ball. Infants preferred (older infants via reaching, younger infants via preferential looking) the Giver over the Taker ($p<.06$).

Taken together, results from these two studies suggest that social evaluation processes are not only engaged early in development, but are also broad in scope. They apply across a broad range of social scenarios including not only a variety of helping and hindering behaviors but other kinds of prosocial and antisocial actions as well.

**Sa2-64**

### False Belief Understanding about Number in 19-Month-Old Infants

**Zijing He**, Renee Baillargeon
*Department of Psychology, University of Illinois, Champaign, USA*

Recent research suggests that infants in the second year of life already understand that an agent may hold a false belief about the location, identity, or contents of an object. The present research sought to extend these findings and examined whether 19-month-olds understand that an agent may hold a false belief about the number of objects hidden in a location.

Infants received four familiarization trials. In the first trial, an agent sat at a window in the back wall of an apparatus. In front of the agent were two identical placemats; two blocks rested on the left placemat, and one block on the right placemat. As the agent looked on, a gloved hand lowered identical covers over the placemats to hide the blocks. The agent then lifted a large cloth to close her window and sang a song. Next, she lowered the cloth, grasped the left cover, and paused until the trial ended. The following familiarization trials were similar except that different blocks were used and the locations of the placemats with one and two blocks were counterbalanced; in addition, the one block was sometimes larger and sometimes smaller than the two blocks combined. In all familiarization trials, the agent always selected the cover with two blocks.

Next, the infants received two test trials similar to the first familiarization trial, with one exception: while the agent was singing behind the cloth, the gloved hand surreptitiously transferred a block from the left to the right cover. When the agent returned, she selected either the left cover (which she falsely believed hid two blocks; left-cover event), or the right cover (which actually hid two blocks; right-cover event). Infants in a true-belief condition received similar trials except that the agent lifted the cloth only half-way and thus witnessed the transfer of the block to the right cover.

Infants in the false-belief condition looked reliably longer at the right- than at the left-cover event, whereas those in the true-belief condition showed the reverse pattern. Together, these results suggest that infants (1) attributed to the agent a preference for the cover that hid two as opposed to one block; and (2) expected the agent to select the cover which she believed—either truly or falsely—hid two blocks.

These results thus suggest that infants' understanding of false belief is broad and flexible and encompasses false belief about number as well as location, identity, and contents.

**Sa2-65**

### Why Do Names Guide Infants' Inductive Inferences About Nonobvious Object Properties?

**Jeany Keates**, Susan Graham
*University of Calgary, Calgary, Canada*

**Background and Aims:** Naming objects plays a critical role in guiding infants' inductive generalizations about nonobvious object properties. Research to date, however, has not fully explicated why infants attend to shared names when making inductive inferences. In this study, we examined the conditions under which 16- to 17-month-old infants will rely on shared names to guide their inductions about nonobvious object properties.

**Methods:** One-hundred and fourteen infants were presented with novel target objects with a nonobvious property, followed by test objects that varied in shape similarity (i.e., high, and low) relative to the target. Target and test objects were introduced by the experimenter in one of the following ways: a) with a general attentional phrase (e.g., "Look at this one"); b) highlighted with a flashlight and a general attentional phrase; c) via an audio-taped voice that named the objects using a naming phrase (e.g., "This is a blick"); d) with a count noun embedded within a naming phrase (e.g., "This is a blick"), e) with a count noun without using a naming phrase (e.g., "Look! Blick"), f) with an adjective (e.g., "This is blickish").

**Results and Conclusions:** When objects were not labelled or were highlighted with a flashlight, infants generalized the nonobvious property to high-similarity objects only. Thus, merely drawing infants' attention to objects does not facilitate infants' inductive inferences when objects share minimal perceptual similarity. When objects were labelled nonreferentially (i.e., by an audiotape), infants again generalized the nonobvious property only to highly similar objects. In contrast, when objects were labelled with a novel count noun in a referential context, infants generalized the nonobvious property to high- and low-similarity objects. Thus, infants view names as having inductive

potential only when they are presented in a referential context. When objects were labelled with names that were not embedded within an intentional naming phrase, infants generalized the nonobvious property to high-similarity objects only, indicating that infants do not rely on labels to guide their inductions when labels are presented in isolation. Finally, the naming effect was specific to count nouns. When objects were labelled with a novel adjective rather than with a count noun, infants generalized the nonobvious property only to perceptually similar objects. Together, these findings suggest that infants rely on labels to guide their inductions when the labels are presented with an appropriate referential form and when they are embedded within an intentional labeling phrase.

**Sa2-66**

### Parental Symbolic Behaviors in Picture Book Reading

**Nobuko Komori**[1] Yohko Shimada[1] Michiteru Kitazaki[2] Shoji Itakura[1]

*1. Kyoto University, Kyoto, Japan; 2. Toyohashi University of Technology, Toyohashi, Japan*

**Background and Aims:** Picture books were usually consisting of pictures and words. Many studies concerning picture book were focused about language development and interaction between parent and children. The past studies insisted that parental support was important for children's language development. However, very few studies have dealt with the relationship between children's understanding of picture and parental support. Callaghan, Rochat, MacGillivray, & MacLellan(2004) investigated parental supports of symbolic understanding. Experimenter (adult) demonstrated contemplative (pointed to picture of rattle) or manipulative (shook the picture of rattle) stance toward pictures. For pictures, 12, 15, 18-months-olds emulated the adults' actions. Those findings indicated that parental support has an influence on infant's picture understandings but it is not clear whether the behaviors seen in their study occur in everyday life of infants. The purpose of present study was to observe whether the parents show such behaviors in natural settings and interaction between parents and infants.

**Methods:** Fifty-three infants (13 9-months olds, 17 12-months olds, 13 15-mohts olds, and 10 18-months olds) and their mothers participated. We made two picture books contain five familiar fruits and cover page. One book constructed of color photographs and the other constructed monochrome line drawings. Infants sat on their parents' lap and were shown the picture books. Each picture was shown for approximately 15 s. The order of books and pictures were counterbalanced.

**Results and Discussion:** We defined two types of parents'behaviors: pointing and symbolic behavior (pretend eating or feeding). We also defined three types of infant's behaviors: banking or manual investigation (Deloache, 2004), pointing to the picture and pretending to the picture. Some parents showed symbolic behavior, but they did not show manipulative behavior (Callaghan et al, 2004). Numbers of symbolic behavior by parents increased with infant's age. However, pointing was the most frequent at all of the ages. This result indicated that symbolic behavior took supportive role in picture book reading.

In infants, number of pointing was increased in month; Number of manual behavior was decreased in month. Pretending behavior did not show in nine month, 18-months showed pretending behavior. In only 15-month-olds, infants whose parents showed symbolic behavior, tend to do symbolic behavior. Parents coordinate their reading behavior according to infant's responses. (This Study was supported by Nissan Science Foundation)

**Sa2-67**

### A Nonverbal Change-Of-Contents False Belief Test For Children and Chimpanzees

**Carla Krachun**[1,2] Malinda Carpenter[1] Josep Call[1] Michael Tomasello[1]

*1. Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany; 2. Carleton University, Ottawa, Canada*

A small number of nonverbal false belief tests have been developed, most of them adaptations on Wimmer and Perner's (1983) standard verbal change-of-location task (e.g., Call & Tomasello, 1999; Onishi & Baillargeon, 2005; Southgate et al., 2007). A greater variety of paradigms is needed. We present a new nonverbal test more comparable to the classic 'Smarties' task (Perner et al., 1987) because it involves false beliefs about the contents rather than location of a target item.

Five chimpanzees and 72 children (3-, 4-, and 4-year-olds) participated. We first taught participants two unique hiding locations (the left or right side of an apparatus) for two different types of reward (stickers or rubber stamps for children; grapes or banana slices for chimpanzees). During training, an experimenter (E1) placed one type of reward in a closed container and hid the container in the appropriate location for that reward. Once participants could consistently search in the correct location, they received the false belief test. E1 again placed one type of reward into a closed container but then put the container down and left the area, whereupon a second experimenter (E2) switched the reward for the other type. When E1 returned, participants had to predict she would hide the container in the wrong location, due to her false belief about its contents. In a true belief control test, E1 witnessed the switch and thus hid the container in the correct location.

As expected, there was a clear developmental trend in children's false belief performance: 3-year-olds were worse than chance (Wilcoxon test: $z$=2.18, $p$=0.03), 4-year-olds were at chance ($z$=0.73, $p$=0.47), and 4-year-olds were better than chance ($z$=2.32, $p$=0.02). However, all age groups performed significantly better than the proportion of incorrect true belief trials ($TB_{complement}$) (all $z$'s>2.22, all $p$'s<0.03), indicating that they behaved differently in the true and false belief conditions. Children's performance also correlated positively with a standard verbal false belief task. In contrast to children, chimpanzees' false belief performance was worse than chance ($z$=-2.03, $p$=0.04) and not different from $TB_{complement}$ ($z$=-0.41, $p$=0.69), although they did perform better than chance in the true belief control test ($z$=-2.04, $p$=0.04).

The results of this new nonverbal test accord well with results from previous studies comparing children's and chimpanzees' performance on other verbal and nonverbal false belief tasks. This new paradigm thus provides a much-needed additional method for testing further animal species, younger children, and other nonverbal populations.

**Sa2-68**

### Infants Extend Category Knowledge to Adapt Actions on Novel Objects

**Clay Mash**

*National Institute of Child Health and Human Development, Bethesda, USA*

**Introduction:** The early development of object categorization has been examined in manual object-exploration tasks that support infants' responding through the use of familiar categories, unmediated access to stimuli, and the modeling of response actions (e.g., Mandler, 2000). Less is known about the functional utility of infants' category knowledge under less structured conditions. To investigate, infants

participated in an object-exploration categorization task while the movement of their arms was measured.

**Method:** Eighty 10- to 14- month-olds participated. An electromagnetic motion-analysis system was used to measure infants' actions during their exploration of novel objects. Infants were serially familiarized with eight objects from two different novel categories whose exemplars differed between categories both in shape and weight. Infants were then presented consecutively with two novel test items - one from each shape category - whose shape/weight correspondence was reversed. Throughout each trial, the 3D coordinate position of infants' wrists was recorded at 100 Hz. All pertinent stimulus factors were counterbalanced.

**Rationale:** Because the familiarization objects of one category weigh considerably more than those of the other, they require different amounts of force to handle effectively. To prepare actions adaptively for the categories' discrepant handling requirements, infants must learn the correspondence between their shape and weight. If infants acquire relevant category knowledge during the familiarization phase, they may also be able to extend category-specific action plans to completely novel test exemplars. Actions prepared for a given weight level should yield efficient control when the object's actual weight is concordant, but erratic control when it is not. Thus, for infants generalizing categorical knowledge, lift outcomes should differ between objects whose shape/weight correspondence differs (e.g., a familiar member of the light category vs. the light test object whose visual shape resembles members of the heavy category).

**Results:** Arm movement measures were compared between the final familiarization trial and the test trial for each weight level. Significant differences were observed in the displacement, straightness, and latency to upward peak acceleration in infants' handling of light objects, and in the displacement and latency to downward peak acceleration in their handling of heavy objects ($ps < .05$). Control findings indicate that that infants' baseline handling did not differ between shapes or weight levels, and that infants could discriminate among exemplars within the same shape category.

**Conclusion:** Infants from 10 months of age acquired and extended category knowledge to selectively adapt their actions for objects that they had never previously encountered.

**Sa2-69**

### The Emergence of Stable Goal Representations in Means-End Problem Solving

**Daniel McCall**, **Lauren DeBrouse**, **Hannah Kane**

*Gettysburg College, Gettysburg, USA*

Two experiments explored 12-18 month-old infants' ability to remember a goal-oriented action - searching for a hidden toy under an appropriate location - when confronted with an intervening step in the problem (pulling down a transparent screen). In experiment 1, 12-, 15-, and 18-month-olds (n=13/group), were tested on two versions of a multi-step search task, each requiring identical motor responses, but differing in the manner in which the goal object was occluded. On "action" trials (n=8), a toy was placed between two small boxes, set behind a rotating transparent panel. As infants pulled the panel down, the target was visibly displaced left or right, disappearing inside one of the boxes (the toy's motion was rigged to the rotating panel). On "observe" trials (n=8), the experimenter first activated a mechanism that caused the toy to slide left or right into one of the boxes, while infants watched through the raised transparent panel. Infants were then allowed to pull down the panel and search for the toy under one of the boxes. "Observe" trials therefore demanded that infants remember the target location while executing the intervening response of lowering the panel. Twelve-month-olds searched near chance on 'observe' trials (M=.57, SD=.20), but were significantly above chance on 'action' trials (M=.86, SD=.17). Fifteen-month-olds were able to find the toy on the majority of trials in both conditions, but still made errors ('observe' trials M=.70, SD=.29; 'action' trials M=.78, SD=.31). By 18 months most infants searched correctly (M=.81, SD=.16; M=.85,SD=.07). Follow-up analyses of visual attention and solving time indicated that 12-month-olds' difficulty with 'observe' trials was not due to a failure to attend to the hiding event, but was likely due to an inability to remember the appropriate location when the intervening action of lowering the screen was required.

Experiment 2 examined whether the action of lowering the screen was in itself enough to disrupt infants' representations of the target's location. Twelve-, 15-, and 18-month-old infants were again tested on "observe" trials, but on half of the trials the experimenter lowered the transparent panel for the infant before allowing the infant to search under one of the hiding locations, thereby eliminating the need for the infant to generate this intervening action. Performance improved on these trials, especially for the 12-months-olds, who searched at chance levels on the standard "observe" trials (M=.47, SD=.19) but searched significantly above chance on trials when the experimenter had first lowered the panel (M=.71, SD=.19). This result suggests that on standard "observe" trials, the sub-goal action of lowering the panel disrupted younger infants' representation of the toy. Data support the idea that the ability to resist this kind of self-generated goal disruption underlies improvements in planning observed between 15-18 months.

**Sa2-70**

### Infants Process Action for Gist

**Eric Olofson**, Dare Baldwin

*University of Oregon, Eugene, USA*

**Introduction:** A burgeoning literature has shed light on developments in young infants' ability to interpret human action. The bulk of studies in this literature focus on infants' understanding of object-directed grasps (e.g., Woodward, 1998) and motion toward an endstate (e.g., Sodian, Schoeppner, & Metz, 2004). However, the goal of human behavior often involves manipulating objects once they are grasped and little research has investigated infants' understanding of object manipulation. The current study addressed this issue by investigating infants' understanding of the push/pull distinction. In question was whether infants utilize abstract, extra-perceptual information (i.e., the functional affordance or *gist* of the action, c.f. Fillenbaum, 1966) to categorize perceptually-dissimilar exemplars of pushing and pulling an object.

**Method:** Sixteen 5-7-month-olds and sixteen 10-12-month-olds were habituated to a videotaped presentation of an actor either pushing or pulling a glass. At test, all infants saw (1) a "push-contact" action, where the actor placed her palm on the near side of the glass as if to propel it forward (i.e., gist = *push*); and (2) a "pull-contact" test event, where the actor placed her palm on the far side of the glass as if to propel the glass toward herself (i.e., gist = *pull*). The actor's hand configuration in each test video was noticeably distinct from the ambiguous hand configuration in habituation, and neither test video depicted the woman moving the glass.

**Results:** A 2 (habituation condition) x 2 (gist) repeated measures ANOVA was performed on the older infants' looking time to the first trial pair. The predicted habituation condition by gist interaction was significant, $F(1, 14) = 6.23$, $p < .05$, showing that infants who were habituated to a pushing event looked longer at the first presentation of pull-contact test actions ($M = 12.02$) than push-contact actions ($M = 4.92$), whereas infants habituated to a pulling event looked longer at the first presentation of push-contact actions ($M = 8.58$) than pull-contact actions ($M = 5.73$). No significant effects emerged in the younger group.

**Conclusion:** The current study suggests that 10-12-month-olds, but not 5-7-month-olds, are able to interpret pushing and pulling actions for gist and recognize which of two perceptually novel actions is consistent and which is inconsistent with a familiar gist. We will discuss these findings vis-à-vis strategies for action categorization and will raise the question of whether this developmental progression emerges concurrently with gist processing of other action categories.

**Sa2-71**

### Complex Object Recognition in Preschool Aged Children

**Georgianna Reilly**, Kelly Dickerson, Peter Gerhardstein
*Binghamton University, Binghamton, USA*

Several leading theories of object recognition propose that an object is represented through the integration of two separate sets of information; the constituent parts of an object and their spatial relations (Biederman, 1987; Pentland, 1994). One of the simplest ways to study this separate-processesing theory is through visual search tasks; tasks during which a participant searches for a target object amongst distracter objects.

Arguin and Sauimer (2004) investigated the respective and combined effects of parts and configuration sharing between a target object and its distractors using visual search. Target objects were shown among a varying number of distractors. Target objects were composed of four simple parts and were presented in one of three general shapes. Targets and distracters shared either a combination of parts , a configuration, both, or neither. Reaction times were fastest when neither parts or spatial configuration were shared. Reaction times were affected equally when either parts or configuration alone was shared. Critically, parts sharing and configuration sharing were shown to contribute additively to reaction times, making reaction times for this condition the slowest. This suggests that adults had parsed objects into constituent parts and their spatial configuration, evidence for the existence of separate processing mechanisms.

The current study investigated this separation of processing in children ages 3-5 using the same stimuli and conditions as the original study by Arguin and Sauimer (2004). The experiment was adapted to use a touch screen in order to eliminate the need for complex instructions: Participants were told to touch the object when they saw it. Participants were familiarized with the target objects (horse, bird or factory) during 6 practice trials. During the test phase of the experiment the target and its distractors (2,4,or 8 distractors) were show in either a circular or random array on the screen for 36 trials.

We report data suggesting that separate processing mechanisms for parts-sharing and configuration-sharing may be present in children as young as 3-5, and that the type of display (circular, random) used in a touch-screen visual search task may elicit specific search strategies in older children and in adults. Implications of both of these findings are discussed.

**Sa2-72**

### Domain-General Categorization in 12-Month-Old Infants

**Kristin Rostad**, Diane Poulin-Dubois, Amanda Guay, Julie Coutya
*Concordia University, Montreal, Canada*

Studies that have used the object-examination task have yielded results indicating that infants as young as 7 months can categorize objects at the global level (Mandler & McDonough, 1993; 1998; Oakes, Coppage, & Dingel, 1997). The question of whether infants recognize that the various global categories that they discriminate (e.g., animals vs. people, or vehicles vs. furniture) can be combined into broader domains, that is, animates and inanimates, has yet to be examined. The current study investigated whether infants can form categories as broad as the animate and inanimate domains using an object examination task.

In Study 1, infants aged 12 months (N = 31) were presented with a series of toy models from one of the domain-general categories. Specifically, the animate category consisted of two people and two animals, and the inanimate category consisted of two vehicles and two pieces of furniture. During the test phase, the infants were then presented with a new exemplar from the familiar domain-general category (e.g., a new animal or person exemplar if familiarized with people and animals) and an exemplar from the contrasting domain (e.g., vehicle or furniture). The infants examined the contrasting category exemplar longer than the familiar category exemplar during the test phase. This suggests that infants may have been forming a domain-general category (animates) during the familiarization phase. However, the possibility still remains that the infants could have been grouping the items into two distinct superordinate-level subcategories (animals and people).

In Study 2, infants aged 13 months (N = 14) were familiarized with two superordinate-level categories that did not belong to the same domain (e.g., animals and vehicles). During the test phase, they were then presented with a new exemplar from one of the familiar superordinate-level categories (e.g., a new animal exemplar) and an exemplar from a novel superordinate-level category which belonged to one of the familiarized categories at the domain-general level (e.g., a piece of furniture). The infants did not examine the novel superordinate-level category item longer than the familiar superordinate-level category item. These preliminary results suggest that the infants considered the novel superordinate-level category item as belonging to one of the familiarized categories (i.e., furniture and vehicles both belong to the inanimate domain). This also lends support to the interpretation that the infants in Study 1 were not subcategorizing during familiarization, and that 12-month-old infants possess knowledge about domain-general categories.

**Sa2-73**

### Development of Spatial Classification

**Adam Sheya**, Linda Smith
*Indiana University, Bloomington, USA*

**Background and Aims:** For the last 40 years, developmental researchers have used the sequential touching procedure to measure categorical knowledge. This measure relies on the robust tendency of infants to produce sequences of touches to objects from the same adult category longer than expected by chance. However, almost no research has been done on the behavior itself. The current research

considers the behavioral, real-time processes which generate this spontaneous behavior and how these processes change between 12 and 18 months of age.

**Methods:** The traditional sequential procedure was used with the exception that objects were fixed to a peg board by springs, in order to examine both the influence of object similarity and location on the reaching patterns of infants. Seventy-two infants (twenty-six 12-month-olds, twenty-three 15-month-olds, twenty-three 18-month-olds) were presented with 3 boards. Each board had three objects of one type (target set) and five objects of a second type (contrast set). The location of the two of the target set objects varied across trial. The influence of object similarity on sequential reaching was measured by a log odds ratio calculated from 2x2 contingency table of transitions within and between target and contrast sets. The relative frequency of reaches back to same location was used as one measure of spatial dependence.

**Results:** A 2-way ANOVA, with Layout as a within subject factor and Age between, was run on the log odds measure. There was a main effect of age, $F(2,69) = 5.43$, $p = 0.0064$, but no other significant effects. The 18-month-olds ($M = 0.17$; $SD = 1.28$) were more likely to reach to a object the same as last reached to then the 15-month-olds ($M = -0.28$; $SD = 1.33$) and the 12-month-olds ($M = -0.65$; $SD = 1.09$). A second ANOVA was run on the relative frequency to reach back to the same location. There was only a main effect of age, $F(2,69) = 4.16$, $p = 0.02$. The 15-month-olds ($M = 0.20$; $SD = 0.13$) where more likely to reach back to a location just reached to then the 18-month-olds ($M = 0.14$; $SD = 0.11$) and the 12-month-olds ($M = 0.16$; $SD = 0.12$).

**Conclusions:** The results reveal that at each age there exists a systematic pattern of reaching, which depends on space and similarity and that differences across developmental time can be explained by changes in these dependencies. A developmental model, as well as, the role this behavior plays in the development of spatial classification will be considered.

**Sa2-74**

### Toddlers' Discrimination of Correct versus Incorrect Counting

**Virginia Slaughter**[1] Michael Siegal[2]

*1. University of Queensland, Brisbane, Australia; 2. University of Trieste & University of Sheffield, Trieste, Italy*

Gelman & Gallistel (1978) proposed that acquisition of verbal counting relies on toddlers' implicit understanding of nonverbal counting principles. These are (a) one-to-one correspondence between count words and objects being counted, (b) stable ordering of the count words and (c) the last count word in a sequence represents the total number counted. There is debate about whether these principles of counting are innate (Gelman & Gallistel, 1978) or learned (Carey, 2004).

When asked to count, toddlers from the age of 2 adhere to the counting principles under some circumstances. However there are performance constraints on toddlers' production of counting, which are difficult to untangle from their understanding of the counting principles. We began testing pre-counting infants' comprehension of one of the counting principles, one-to-one correspondence, by showing them videos of accurate (principle-consistent) and inaccurate (principle-inconsistent) count sequences. If infants implicitly understand the one-to-one principle, then they should visually discriminate between principle-consistent and principle-inconsistent count sequences.

Twelve and eighteen-month-olds were presented with a video display in which six coloured fish were shown on a white background while a hand with index finger outstretched moved from one fish to the other and voice recited the count words from "one" to "six." In the accurate count condition, the finger pointed to each fish in turn to count all six correctly. In the inaccurate count condition, the finger pointed to the first five fish but then doubled back and pointed to an already-counted fish when the voice pronounced "six." Different hand/voice pairings were used for the accurate and inaccurate count conditions, so that from the adult perspective, there appeared to be a correct and an incorrect counter. The complete display showed the correct and incorrect counts each repeated twice so that there were three blocks of accurate and inaccurate count sequences presented. Preliminary results from16 twelve month olds and 9 eighteen month olds indicated that the 12 month olds showed no looking preferences. The 18 month olds looked significantly longer at the incorrect (Mean = 8.31 seconds; SD= 1.91seconds) than correct (Mean = 7.18 seconds, SD = 2.59 seconds) count, $t(8)=2.63$, $p=.03$, on the third presentation block. This pattern suggests that the older infants developed expectations about which counters (hand/voice pairings) were correct and incorrect. These preliminary data also suggest that at least one of Gelman and Gallistel's counting principles is present before infants have mastered the count routine.

**Sa2-75**

### Infants' Social Information Gathering from Video: A Second Look

**Gabrielle Strouse**[1] Brian Verdine[1] Allison Milam[2] Georgene Troseth[1]

*1. Vanderbilt University, Nashville, USA; 2. Duke University, Durham, USA*

Starting at around one year of age, infants use social cues offered by others (e.g., eye gaze, facial and vocal expressions) to help guide their behavior (Hornik, Risenoover, & Gunnar, 1987; Walden & Ogan, 1988; Moses, Baldwin, Rosicky, & Tidball, 2001). In at least one study, social cues presented by an adult in a pre-recorded video appeared to guide 12-month-old infants' behavior with toys present in the children's environment. In Mumme and Fernald's (2003) study, infants saw a video of an experimenter commenting about toys while the real toys were in view directly below the TV screen, allowing the infants to simultaneously reference the real toys, something that every participant did at least once.

In our study, we examined whether infants could use social information regarding an object presented on video in the absence of the real object. Infants watched as an adult commented positively or negatively about one of two toys. In the live condition the two toys appeared with the adult in a puppet stage window; in the video condition the toys appeared with the adult on a TV screen that filled the window. The experimenter then lowered a blind over the window/TV screen, placed the toys on a tray, and pushed the tray through a curtain below the puppet stage, toward the child. Infants in the live condition played with the negatively referenced object significantly less than with the other object, $t(14) =2.78$, $p = .015$. Infants in the video condition played an equal amount of time with both objects, $t(14) = 1.07$, $p = .30$. Thus, when the real objects were not visible in the environment during the video, infants did not appear to be influenced by the emotional message from the on-screen person. (As it typical in "social referencing" research, positive messages did not have a significant impact on children's play with one object over the other in either condition).

Our results indicate that infants may have trouble encoding emotional information about objects on video and later applying it to real objects. Given the fact that objects featured on videos are unlikely to always be present in the environment during TV viewing, this research

suggests limitations to the usefulness of infants' social information gathering from video. Additionally, this research demonstrates subtle differences in how even young infants respond to information presented by real social partners versus people on TV.

**Sa2-76**

### The Influence of Neighbourhood Cohesion, Maternal Depression, and Parenting on Children's Outcomes at 36 Months

**Jennifer Timer**, Carla Merkel, Janet Kidd, Susan Dahinten, Laurie Ford
*University of British Columbia, Vancouver, Canada*

**Background:** A substantial body of literature exists showing that children, from infancy to adolescence, are at increased risk for poor developmental outcomes in response to maternal depression (Downey & Coyne, 1990; Cummings, Keller, & Davies, 2005; Somers & Willms, 2002). Maternal depression has been linked with providing a less stimulating home environment, decreased sensitivity and responsiveness to child cues, and inconsistent and more punitive parenting (Downey & Coyne; Kohen, Leventhal, Dahinten, & McIntosh, in press), suggesting that parenting behaviours mediate the effects of maternal depression on children's outcomes. Evidence exists regarding associations between neighbourhood characteristics and both maternal depression (Kohen et al.) and child development (Chase-Lansdale, Gordan, Brooks-Gunn, & Klebanov, 1997), suggesting that neighbourhood characteristics may influence children's outcomes through their effect on maternal depression and/or parenting behaviours.

**Objectives and Hypotheses:** The present study examined the relationships between neighbourhood cohesion, maternal depression, parenting behaviours and children's cognitive, language, and behavioural outcomes at 36 months. There were three hypotheses: (1) that neighbourhood cohesion is inversely associated with maternal depression, after accounting for family SES; (2) that maternal depression is inversely associated with positive and consistent parenting behaviours and positively associated with harsh/ineffective parenting behaviours; (3) that maternal depression has indirect, detrimental effects on child development, mediated by parenting behaviours, after accounting for child gender, family SES, and mothers' perceptions of neighbourhood cohesion.

**Methods:** The sample consisted of 204 children aged 36-42 months (M = 39, SD = 1.9) who were part of a larger study on developmental screening conducted across several communities near Vancouver, British Columbia. Children's cognitive, language, and behavioural outcomes were assessed with the *Stanford-Binet Scales of Intelligence: Fifth Edition* (M = 101.2, SD = 13.7); *Peabody Picture Vocabulary Test - Third Edition* (M = 103.4, SD = 14.4); *Behavior Assessment for Children - Parent Rating Scale* (M = 50.3, SD = 9.3); and *Devereux Early Childhood Assessment* (protective factors M = 49.9, SD = 9.1; behavior concerns M = 55.7, SD = 9.6). Measures of neighbourhood cohesion, maternal depression, and parenting (positive, consistent, and harsh) were drawn from the Canadian National Longitudinal Survey of Children and Youth. Child gender and family socioeconomic status (maternal education and household income) were controlled for in the analyses. A series of hierarchical multiple regression analyses were conducted for each of the child outcome variables.

**Results:** Results will be presented showing the direct, indirect, and mediating effects of the explanatory variables under study.

**Sa1-77**

### Functional Cuing of Event Components in an Imitation Task

**Laura Wagner**, Anna Yocom
*OSU, Columbus, USA*

Directed Motion (DM) events have multiple components, including at least a Manner of motion and a Goal to which the motion is directed. They are a critical organizing force in language (Talmy 1985) and are important in cognition more generally. This study asks, How do infants decide which component of a DM event to focus on?

Previous work (Carpenter et al. 2005) showed that 18-month-old infants preferentially imitated the goal of a DM event at the expense of the manner component. Wagner (2006) similarly found that 20-month-old infants were typically able to imitate only a single component in a DM event; however, she also found no bias towards any single component. One possible reason that Carpenter et al's subjects were goal biased was the fact that the goals in that study were socio-functionally rich items (houses). By contrast, Wagner used simple boxes and bowls. This study tests the hypothesis that infants preferentially imitate the functionally salient event components.

Twenty-five infants (mean age 20 months) participated in an imitation task. The experimenter modeled a DM event consisting of a manner of motion (hopping or swimming) to a goal object. The events were acted out with a toy animal on a board; following the model, the board and toy were passed to the child who was told it was their "turn." In the Functional-Goal condition, the goal objects were associated with familiar activities (a bed to sleep in; a bowl containing a spoon). In the Functional-Manner condition, the goal objects were a simple bowl and box; however, the function of the manners was highlighted by putting a depiction of water on half the board (i.e., only the swimming manner is functionally associated with water). Coders were blind to the model, and imitations were coded for presence and quality of the manner and goal components.

Coding and reliability for both conditions is still ongoing. Preliminary analyses suggest that (1) in the Functional-Goal condition, infants are unbiased, imitating the Goal and Manner components approximately equally often; (2) in the Functional-Manner condition, infants are slightly biased towards imitating the Manner component; and more strikingly, (3) the quality of the Manner component imitation (how well the manner was enacted) is greater in the Functional-Manner condition. These results suggest that infants can represent and imitate both components of a DM event, and that their performance is guided by the specific functional structure of the event.

**Sa2-78**

### Parallel Enumeration of Multiple Spatially-Overlapping Sets in Infancy

**Jennifer Zosh**, Lisa Feigenson, Justin Halberda
*Johns Hopkins University, Baltimore, USA*

The ability to nonverbally approximate large numbers of items (e.g., estimate the presence of 40 dots) is seemingly contradictory to the limit of 3-4 individual objects that can be stored in tasks of attention and working memory (e.g., Luck & Vogel, 1997). Recent work addressed this paradox by showing that adults can enumerate up to 3 *sets* of objects (e.g., the total number of dots in an array plus up to 2 color subsets- i.e., the number of red dots, the number of green dots, and the total number of dots) in parallel (Halberda, Sires & Feigenson, 2006). To date, the developmental origins of this ability to enumerate

multiple sets remain unclear. By 6 months, infants can enumerate at least 1 *set* of items (Xu & Spelke, 2000). And by 10 months, they can track up to 3 *individual objects* in parallel (Feigenson & Carey 2003, 2005). Can infants, like adults, enumerate multiple sets at once? If so, do working memory limits constrain the number of enumerations they can perform?

In Experiments 1-3, 9-month old infants were habituated to arrays containing 2, 3, or 4 sets of spatially intermixed colored dots (e.g., red/blue/yellow dots with 4 - 20 dots per set). Infants were then tested with Discriminable arrays, in which only one of the colored subsets changed its numerosity, versus Non-Discriminable arrays, in which all of the subsets changed their numerosities but by an amount known to be undetectable by 9-month olds. This equated the change in total number of dots across test trial types. Longer looking at Discriminable arrays would implicate the ability to enumerate multiple sets simultaneously, since which colored subset changed its number was randomly determined.

We found that infants detected a numerical change to arrays containing 2 subsets, but not 3 or 4 subsets. Further experiments demonstrated that infants also notice a change to the superset of all dots. Hence infants, like adults, can enumerate 2 subsets plus the superset (a total of 3 simultaneous enumerations). These findings combine to reveal that 1) infants, like adults, can perform multiple parallel enumerations, and 2) working memory limits constrain the number of enumerations they can perform, just as they constrain the number of individual objects they can represent.

## *Communication and Language*

**Sa3-01**

### Infants' Perception of Language Specific Phonotactics

**Stephanie Archer**, Suzanne Curtin

*University of Calgary, Calgary, Canada*

**Background and Aims:** Between six and nine months, infants develop the capability to discriminate between legal and illegal speech sound patterns of their native language (Jusczyk et al. (1993)). Nine-month-olds not only prefer non-words that conform to their native language phonotactics (Friederici and Wessels (1993)) but also non-words with high probability phonotactics over those with low probability phonotactics (Jusczyk, Luce and Charles-Luce (1994)).

In English, all onset clusters of the type stop-liquid are legal except for those that feature two coronals (ie. tl and dl). Studies based upon this gap have shown that adults shift their perception of these illegal clusters to ones that conform to the phonology of their language (Halle et al. (1998)). The aim of this study is to compare infant perceptions of attested stop-liquid clusters in onset versus the unattested clusters tl/dl, as well as other illegal onset clusters.

**Methods:** Sixteen six-month-olds were presented with six test lists of non-words varying in their onsets. Three lists contained attested stop-liquid onsets of high, medium, or low frequency in English and three of unattested onsets: tl/dl, other clusters found only across syllable boundaries, and word-final clusters (i.e. pt). As each list played, a checkerboard appeared on the screen and looking times were frame-by-frame coded off-line.

**Results:** Significant differences in looking times were obtained for high frequency attested onset clusters and word-final clusters, $t(15) = -2.18$, $p < .05$, and for tl/dl clusters and word-final clusters, $t(15) = -2.26$, $p < .05$. Among the attested onset lists, there was a trend for infants to look longer when the low frequency lists were playing than when either of the high or medium frequency lists were presented. The unattested lists show that tl/dl and other clusters found across a syllable boundary had shorter looking times than those with word final clusters in onset. However, there were no differences between the tl/dl clusters and attested ones. This finding likely reflects both novelty and familiarity preferences and another round of testing is currently underway which separates attested and unattested lists.

**Conclusion:** The results from this study support our hypothesis that six-month-old infants are sensitive to frequency in phonotactics and they attend to word-final clusters, such as pt, appearing in the onset position. These results suggest that young infants are not only quite sensitive to the co-occurrences of sound sequences, but also the positions in which these sequences can occur.

**Sa3-02**

### How Babies Look at Faces: Changes in Gaze Patterns For Talking Faces From 6 to 14 Months

**Megan Blossom**[1] James Morgan[2]

*1. University of Kansas, Lawrence, USA; 2. Brown University, Providence, USA*

**Background and Aims:** The presence of a talking face provides a rich set of cues for speech perception. Faces can convey information about talker affect, providing social cues as well as important information about the speech sounds being produced (Walker-Andrews, 1997; Kuhl and Meltzoff, 1984). Being able to identify and use these cues are important parts of both social and language development. Previous research has shown that sensitivities to these audiovisual cues begin to develop early in infancy (Rosenblum, Schmuckler, and Johnson 1997).

Determining what babies look at when they are presented with talking faces will help us to understand how these audiovisual sensitivities develop. Haith, Bergman and Moore (1977) found that from 3-11 weeks, infants fixate on the eyes of the speaker, possibly establishing a vital social connection between infant and caregiver. More recently, Hunnius and Gueze (2004) found that from 1.5 to 6.5 months infants divide their fixations between eyes and mouth, with gaze towards the mouth increasing with age. In the current study, we extended these earlier findings to older infants.

**Methods and Results:** Six-, 10-, and 14-month-olds were presented with 2-minute videos of naturalistic infant-directed speech; eye movements were tracked with a remote camera system. At 6 months, infants looked predominantly at upper parts of the face. At 10 months, there was some convergence of gaze direction, but looking to the upper parts of the face still outweighed looking to the mouth. At 14 months, however, this pattern reversed: infants at this age showed a strong preference for looking at the mouth region over other areas of the face.

**Conclusion:** Combined with previous work, these findings indicate that infants attend to faces in different ways across development. Our results suggest that during the time when most infants begin to utter their first words, their gaze patterns shift from the eyes towards the mouth, consistent with a developing sensitivity to linguistic cues available in talking faces. We are currently testing older infants to examine how conversational gaze develops during the second year of life.

**References:**

Haith, M. M., Bergman, T., and Marshall, H. (1977). Eye contact and face scanning in early infancy. Science, 198, 853-855.

Hunnius, S. and Geuze, R. H. (2004). Developmental changes in visual scanning of dynamic faces and abstract stimuli in infants: A longitudinal study. Infancy, 6, 231-255.

Kuhl, P. K. and Meltzoff, A. N. (1984). The intermodal representation of speech in infants. Infant Behavior and Development, 7, 361-381.

Rosenblum, L. D., Schmuckler, M. A., and Johnson, J. A. (1997). The McGurk effect in infants. Perception & Psychophysic, 59 , 347-357.

Walker-Andrews , A. S. (1997). Infants' perception of expressive behaviors: Differentiation of multimodal information. Psychological Bulletin, 121, 437-456.

**Sa3-03**

## The Influence of Maternal Sensitivity and Maternal Mind-Mindedness on Children's Language Development

**Stéphanie Bordeleau**, Jessica Laranjo, Annie Bernier

*University of Montreal, Montreal, Canada*

**Background:** Over the past decades, research has documented a relation between early mother-child interactions and children's cognitive and language development (Hebert et al., 2004; Kelly et al., 1996; van Bakel & Riksen-Walraven, 2002). Maternal behaviors which have been found to relate to children's language development include maternal responsiveness (Tamis-LeMonda et al., 2001), mothers' maintaining of children's interest (Landry et al., 2000) and maternal sensitivity (Paavola et al., 2006). Maternal mind-mindedness, defined as "the mother's proclivity to comment appropriately on her infant's mental states" (Meins et al., 2002, p. 1722), has been associated with children's theory of mind (Meins et al., 2002) and linguistic acquisitional style (Meins et al., 1999), but has never been investigated specifically in relation to child language development. The goal of this paper is to examine the combined contributions of maternal sensitivity and maternal mind-mindedness to children's early expressive vocabulary.

**Methods:** 49 mother-infant dyads (27 girls) participated in this study, taking part in two visits, at 12 and 18 months. Maternal sensitivity (i.e., the quality of mothers' behaviors during interactions with their infants) was rated at 12 months with the Maternal Behavior Q-Sort (MBQS: Pederson et al., 1990) based on observations performed throughout a 1.5 hour home visit. Maternal mind-mindedness was assessed at 12 months also, based on a 10-minute videotaped free-play sequence between mother and infant (coded using Meins et al.'s (2001) coding system). At 18 months, mothers completed the MacArthur Communicative Development Inventory (Fenson et al., 1993) to evaluate children's expressive vocabulary.

**Results:** Results indicate that both maternal sensitivity and maternal mind-mindedness are significantly related to children's language development ($r = .25$, $p < .05$; $r = .40$, $p < .01$). A multiple regression analysis suggests that maternal sensitivity and maternal mind-mindedness contribute independently to child language ($\beta = 0.35$, $p < .01$; $\beta = 0.42$, $p < .01$), explaining a total of 28 % of the variance in expressive vocabulary.

**Conclusion:** The findings of this paper suggest that different aspects of mother-child interactions contribute to child language. Given that language development is related to future outcomes such as academic competence (Dieterich et al., 2006) and emotional-behavioral problems (Gilliam & De Mesquita, 2000), these results highlight the importance of enhancing children's language development through interventions focusing on maternal behaviors such as maternal sensitivity and mind-mindedness.

**Sa3-04**

## Responses to Prelinguistic Object-Directed Vocalizations Facilitate Word Learning in 11-Month-Olds

Jacquelyn Briesch, Jennifer Schwade, Michael Goldstein

*Cornell University, Ithaca, USA*

**Background and Aims:** When infants babble while looking at or touching objects, caregivers often respond by labeling the objects (e.g., Bruner, 1983). These prelinguistic "object-directed vocalizations" create opportunities for infant learning. For example, the type of maternal response to 9-month-olds' object-directed vocalizations predicts infants' vocabulary size at 15 months. Infants also learn more about the perceptual features of objects at which they vocalize than of other objects (Goldstein, Schwade, & Syal, 2007). Babbling may thus signal a state of increased interest and attention to the environment. Contingent responses to babbling may facilitate learning. The present study examined the effects of responding to an object-directed vocalization with an object label on the formation of word-object associations.

**Method:** Eleven-month-old infants were assigned to the Vocalization Condition (VC; n=19) or Silent Look Condition (SLC; n=19). After a ten-minute warm-up period, infants interacted with two novel objects, a target and a distracter. An experimenter labeled the target object with a novel word (e.g., "Look at the koobie!") either after the infant vocalized at the object (VC) or after the infant silently looked at the object (SLC). The experimenter presented the distracter without a label (e.g., "Oh, look at that!"). The timing of labels for SLC infants was yoked to that of VC infants. Infants' learning of the word-object association was tested in a two-trial preferential looking task. Paired pictures of the target and distracter objects were presented while the label played on a speaker (e.g., "Look at the koobie! Can you find it?"). Infants' eye gaze was coded from videotapes.

**Results:** In Trial 1 of the test, VC infants looked at the target significantly more than chance after the instruction "Can you find it?", $t(12) = 2.29$, $p < .05$. In Trial 2, VC infants looked at the target more than chance, $t(12) = 2.86$, $p < .02$, and more than SLC infants, $t(22) = -2.92$, $p < .01$, after hearing "Can you find it?". SLC infants did not look at the target more than chance on either trial.

**Conclusion:** VC infants learned the word-object association, while SLC infants did not. The findings suggest that labeling a new object after an infant's object-directed vocalization facilitates word learning. Thus we propose that babbling signals a state of increased attention and interest, and contingent social responses during this state can facilitate word learning.

**Sa3-05**

## People or Objects? Monolingual and Bilingual Children's Performance in a Mutual Exclusivity Task

**Chandra Brojde**, Eliana Colunga

*University of Colorado at Boulder, Boulder, USA*

**Background:** Research has demonstrated that children are biased in their word learning. For example, they will often only accept one label for an object (Markman & Wachtel, 1988). However, bilingual children are less likely to show this bias by accepting more than one label for an object. Researchers have recently proposed that this bias is weaker in bilingual children because they are more sensitive to pragmatic cues (e.g. whether the other speaker knows two languages) (Diesen-

druck, 2005). The present study addresses an alternative explanation that bilingual children are less biased because they attend less to conflicting object properties that clearly suggest that two labels should not be attached to the same category. To test this account, two novel labels were associated with different object properties (shape vs. material). Children were then tested on their sensitivity to these property cues when attaching the second label to a new object.

**Method:** Two-year-old monolingual (n=32) and bilingual children (n=15) were taught two novel labels. The first label (e.g. "Lep") was given to a category of objects that all shared the same property (P1) (i.e. U-shape). The second label (e.g. "Poma") was used to name an object that had a distinctive property on a different dimension (P2) (i.e. rough texture). The children were then tested in one of two types of trials where they were asked to get the referent of the second novel label. In the High-Conflict trials, one object choice matched only in P1 and one object matched only in P2. In the Low-Conflict Trials, one object choice matched only in P1 and one object did not match either property.

**Results:** A main-effect of type of trial, $F(1,39)=6.75$, $p<.05$, showed that children chose the P1 object more in the Low-conflict condition ($M=2.70$) than in the High-conflict condition ($M=2.13$). However, an interaction between trial type and language group, $F(1,39)=3.75$, $p=.06$, showed that only monolingual children, $t(31)=4.45$, $p<.01$, but not bilingual children, $t(14)=.32$, $p=.76$, were sensitive to the conflicting property information between the Low-Conflict and High-conflict conditions.

**Conclusion:** These results suggest that monolingual children are influenced more by conflicting object property information than bilingual children when extending a learned novel label to a new object. While bilingual children may be moved by the pragmatic situation more than monolingual children, they may also, at the same time, be less influenced by conflicting property information when two labels are applied to one object category.

**Sa3-06**

## The Effects of Accent Related Variation on Speech Perception in 5 and 7 Month Olds

**Joseph Butler**, Jennifer Metz, Caroline Floccia

*University of Plymouth, Plymouth, UK*

Little is known about what very young infants know about regional accents in the speech signal that they attend to. Previous research has suggested that American infants at 5 months are able to discriminate between American and British accented English (Nazzi et al, 2000). Other research has shown that American infants at 6 months are able to discriminate between American and Australian accented English, while Australian infants are not able to do this at 6 months but are able to perform this discrimination at 3 months (Kitamura et al, 2006). In order to examine whether these capabilities are due to early learning of accent-specific features, or to general abilities to distinguish between any type of accent, this study aims to investigate whether British infants at 5 months are able to discriminate between their home accent (Plymouth) and other regional variations of English (i.e. Welsh), and whether they are able to discriminate between two regional variations of English that are not their home accent (Welsh versus Scottish).

Infants were tested using the Headturn Preference Procedure (HPP), where they were habituated to either Plymouth, Welsh or Scottish accented sentences and then exposed to an alternation of the familiarisation accent plus a new one in the test phase. Average looking times for each accent were computed and analysed to look for a difference in looking times between the accents. Preliminary data from 7 infants that have been tested so far were analysed using a repeated measures ANOVA, and these results suggest that British infants are able to discriminate between their home accent and another regional variation of English (Welsh), $F(1,6) = 7.737$, $p < .05$, partial $\eta 2 = .563$.

In order to examine the role of accent familiarity in these early capacities, further data will be collected to determine whether infants are able to discriminate between two regional variations of English that are not their home accent (Welsh and Scottish). If early accent discrimination is based on the recognition of a familiar accent, then no discrimination should occur between Welsh and Scottish accent. If on the contrary this ability relies on a general sensitivity to prosodic (and phonetic) differences, discrimination should be obtained as well. Infants will also be tested at 7 months to see whether they are still able to perform these discriminations, as Kitamura et al's results suggest that this ability might be lost after 6 months of age.

**References:**

Kitamura, C., Panneton, R., Deihl, M. & Notley, A. (2006). Attuning to the native dialect: When more means less. In Proceedings of the Eleventh Australian International Conference on Speech Science & Technology, Auckland, December 6-8, pp. 124-129.

Nazzi, T., Jusczyk, P. W., & Johnson, E. K. (2000). Language discrimination by English-learning 5-month-olds: Effects of rhythm and familiarity. Journal of Memory and Language, 43, 1-19.

**Sa3-07**

## Language Discrimination and Preference in Newborns with Prenatal Bilingual Exposure

**Krista Byers-Heinlein**[1] Tracey Burns[2] Janet Werker[1]

*1. University of British Columbia, Vancouver, Canada; 2. Organisation for Economic Co-operation and Development, Paris, France*

**Background and Aims:** Language learning begins even before birth. Newborns show a preference for listening to the language spoken by their mother during pregnancy (Moon, Cooper, & Fifer, 1993), and can discriminate a variety of language pairs (Mehler et al., 1988; Nazzi, Bertoncini, & Mehler, 1998). For infants learning two languages, language discrimination has been shown from 4-months of age (Bosch & Sebastián-Gallés 1997; 2001). Here, we consider for the first time the role of prenatal bilingual exposure by asking 1) Does bilingual exposure affect newborns' ability to discriminate their languages from each other? and 2) Do bilingually-exposed newborns show a preference for one of their two languages?

**Methods:** Participants were healthy, full-term monolingual (born to mothers who spoke only English while pregnant) and bilingual (born to mothers who spoke English and Tagalog regularly while pregnant) newborns. Stimuli were English and Tagalog sentences, low-pass filtered to a cutoff of 400Hz. A High Amplitude Sucking paradigm was used, such that each stimulus was presented contingently to the infant delivering a high amplitude suck to a pacifier. Number of high amplitude sucks/minute was the dependent variable.

Study 1: Discrimination. Sixteen monolingual and 14 bilingual infants participated in the experimental condition, and (to date) 9 monolinguals participated as controls. Infants heard one language until the number of sucks declined to a habituation criterion, and then 4 minutes of novel test sentences were played in either the same (control) or a different (experimental) language.

Study 2: Preference. Eight monolingual and 16 bilingual infants participated. Infants were tested for 10 minutes, with alternating minutes of English and Tagalog sentences.

**Results:**

Study 1. Infants' sucking in the last two habituation minutes was compared to sucking in the 4 test minutes. The control group showed a non-significant decrease in sucking to the test sentences, t(8)= -1.06, p=.319, while sucking at test increased in both the monolingual experimental group, t(15)=2.07, p=.06, and the bilingual experimental group t(13)=2.32, p=.04.

Study 2: Trials were collapsed across language. English infants sucked significantly more to hear English than to hear Tagalog, t(7)=2.4, p<.05, while bilingual infants showed no preference, t(15)= -.93, p=.37.

**Conclusion:** Infants with bilingual prenatal exposure not only maintain the ability to discriminate their two languages but also show an adaptive listening preference to attend equally to both. The results suggest that infants growing up bilingual lay the foundations for successful dual language learning from the earliest stages.

**Sa3-08**

### Joint Engagement with Language Tutors Predicts Brain and Behavioral Responses to Second-Language Phonetic Stimuli

**Barbara Conboy**, Rechele Brooks, Miranda Taylor, Andrew Meltzoff, Patricia Kuhl

*University of Washington, Seattle, USA*

**Background and Aims:** Previous research has shown that 10-month-old infants can learn to discriminate nonnative phonetic contrasts given naturalistic language input, but that this input must be live rather than from a video, suggesting an important role for social interaction in language acquisition. The present study investigated whether discrimination of a second-language (nonnative) phonetic contrast was linked to levels of joint engagement (JE) with language tutors during play sessions over the previous month.

**Methods:** Twenty infants from monolingual English homes participated in twelve 25-minute Spanish sessions from 9.5 - 10.5 months. Native Spanish-speaking "tutors" showed infants pictures and toys labeled by /d/- and /t/-initial Spanish words. A parent sat silently behind the infant to help maintain face-to-face contact between the infant and tutor. Two 6-minute segments of play were analyzed for each infant. JE behaviors were identified based on infants' eye gaze during the 30s following presentation of a new toy by the tutor. A gaze shift proportion score (GS) was calculated based on whether the infant shifted gaze between the toy and tutor's face each time the tutor presented a new toy (Mean GS = 0.51, SD 0.13).

Two tests assessed discrimination of a Spanish /ta/-/da/ contrast: a conditioned head turn (HT) behavioral task administered within one week of the last Spanish exposure session and an Event-Related Potentials (ERP) oddball paradigm administered one week later. For HT, a d-prime score was calculated based on false alarms and hit rates to the target /da/. Seven infants with d-prime scores < 0 were excluded. For ERP, a mismatch response (MMR) was calculated by subtracting peak amplitude measurements from 250-500 ms to the standards (/ta/) preceding deviants from those to the Spanish deviant (/da/). One infant refused to cooperate and two were excluded due to excessive artifact.

**Results and Conclusion:** The GS proportion score was negatively correlated with the Spanish MMR, r = -.59, p = .01 (more negative MMRs indicate higher levels of discrimination) and marginally positively correlated with the Spanish HT score, r = .52, p = .07. Infants with GS scores > .50 showed larger MMRs, t(15) = -1.97, p < .05 and a trend for higher HT scores, t(11) = 1.56, p < .07. These results provide the first evidence that higher rates of joint engagement with adults speaking in a second (nonnative) language may facilitate acquisition of a phonetic contrast in that language.

**Sa3-09**

### Learning About Cross-Category Word Use: the Role of Prosodic Cues

**Erin Conwell**, James Morgan

*Brown University, Providence, USA*

To become productive language users, learners must assign words to grammatical categories - noun, verb, adjective, etc. This supports linguistic productivity as newly learned items inherit the syntactic properties of their categories. However, in many languages, some words may appear in multiple grammatical categories. This ambicategoricality could cause children to conflate lexical categories and is a linchpin in arguments against distribution-based grammatical category learning (e.g., Pinker, 1987).

Recent work using habituation, however, indicates that infants can distinguish noun and verb tokens of the same word (Conwell & Morgan, 2007). That study did not address which cues infants detect or the overall availability of such cues in child-directed speech. In adult-directed speech, noun tokens of words are reliably longer than verb tokens (Sorenson, et al., 1978). Furthermore, nouns appear phrase-finally more often than verbs and should therefore be more likely to have intonational properties associated with phrase-final position. Given the exaggerated prosody of child-directed speech (Fernald et al., 1989; Fisher & Tokura, 1996), these cues may well be available to language learners.

This study examined the reliability of several prosodic cues to grammatical category in natural child-directed speech from four mothers in the Demuth Providence Corpus (Demuth, et al., 2006). Tokens of words with at least 10 noun and 10 verb uses were extracted from corpus recordings. Using PRAAT, each token was measured on six dimensions: duration, vowel duration, mean pitch, minimum pitch, maximum pitch, and pitch range.

For over 70% of the words examined, at least one prosodic property was significantly different for nouns and verbs. Two mothers reliably distinguished noun tokens from verbs using token duration. The other two mothers used duration to cue lexical category for some words and pitch for others. Nevertheless, within each word type, noun tokens were distinct from verbs along at least one dimension. Moreover, a multi-dimensional discriminant analysis showed that the set of measures, taken collectively, predicts category membership with over 75% accuracy, compared to a chance accuracy of 50%.

These results, together with research showing that infants discriminate noun and verb tokens of the same word, suggest that the ambicategoricality problem need not pose difficulty for learning grammatical categories. Learners may use these prosodic cues to learn two distinct forms, one appearing in noun contexts and one appearing in verb contexts. Armed with this distinction, children may learn grammatical categories from distributional evidence, even in cases of ambicategoricality.

Sa3-10

## Mother-Infant Person- and Object-Directed Behaviors: A Comparison of Latin Americans, Latino Immigrants, and European Americans in the United States

**Linda Cote**, Marc Bornstein, O. Haynes
*Child & Family Research, NICHD, NIH, DHHS, Bethesda, USA*

**Introduction:** Person- and object-directed mother-infant interactions are universal and developmentally significant, however their prevalence differs across cultures. Latino families socialize children to be *bien educado*, which includes an emphasis on interpersonal skills and acting respectfully toward others (Harwood et al., 2002) and is embodied in person-directed interactions (Bornstein et al., 1999; Posada et al., 2002; Valenzuela, 1997), whereas European American mothers socialize children to be autonomous (Bugental & Grusec, 2006) and thus engage in object-directed activities that allow their children to gain control over the environment. To better understand acculturating families, a comparative approach to acculturation was utilized by comparing South American Latina immigrants' (n=33) person- and object-directed behaviors (and their infants' behaviors) to mother-infant dyads in the cultures of origin (nonmigrant Latinos in South America, n=48) and destination (European Americans in the U.S., n=40).

**Method:** Mothers and their 5-month-olds were videorecorded for 50 min in naturalistic interaction at home. Mothers' person-directed (encourages attention to herself) and object-directed (encourages attention to objects) mutually exclusive behaviors were coded, as were two mutually exclusive infant behaviors (infant looks at mother or object). Interrater reliabilities, computed separately by group, were acceptable (κs≥.64). The proportions of time that mothers and infants engaged in person- and object-directed behaviors were computed.

**Results:** Four 3 (Culture) x 2 (Gender) AN(C)OVAs were performed, one for each DV, followed by Bonferroni-adjusted t-tests ($p<.05$). Nonmigrant Latina mothers (M=.13, SD=.08) engaged in person-directed behavior longer than Latina immigrant (M=.07, SD=.05) or European American (M=.05, SD=.05) mothers, $F(2,115)=17.60$, $p<.001$, $\eta^2p=.23$. Nonmigrant Latino infants (M=.12, SD=.06) engaged in person-directed behavior longer than Latino immigrant (M=.06, SD=.06) or European American (M=.08, SD=.05) infants, $F(2,115)=12.26$, $p<.001$, $\eta^2p=.18$. Nonmigrant Latina mothers (M=.15, SD=.09) engaged in object-directed behavior longer than European American mothers (M=.09, SD=.08), $F(2,115)=3.84$, $p<.05$, $\eta^2p=.06$. Latino immigrant infants (M=.40, SD=.10) engaged in object-directed behavior longer than nonmigrant Latino infants (M=.32, SD=.10), $F(2,115)=4.68$, $p<.05$, $\eta^2p=.08$.

**Conclusion:** Results for person-directed behavior suggest that Latino families instill interpersonal skills in their children (person-directed behavior) and suggest that first-generation immigrants' parenting behaviors acculturate quickly. Perhaps because object-directed behavior is a relatively new skill for 5-month infants (Bakeman & Adamson, 1984), cultural differences in mothers' object-directed behaviors did not emerge. However, Latino immigrant infants engaged in more object-directed exchanges than nonmigrant Latinos.

Sa3-11

## Do Six-Month-Old Infants Follow Pointing Gestures? A Naturalistic Study

**Gedeon Deák**, Jordan Danly, Jacqueline Acuña
*University of California, San Diego, La Jolla, USA*

Previous work has examined infants' gaze- and point-following (critical early attention-sharing skills) within laboratory studies. These show that 9- to 18-month-olds are responsive to adults' gaze-shifts, but more responsive to pointing gestures (Butterworth & Jarrett, 1991). However, these responses emerge around 6- to 9-months, possibly with large individual differences (Morales et al, 2000) and sensitivity to contextual factors (Flom et al, 2003). It is unclear how they emerge around this time. A complication in evidence (Deák et al, 2007) that even 1-year-olds might not respond to adults' gaze shifts in distracting or cluttered environments. Perhaps, then, 6-9-month-olds use point-following to bootstrap gaze-following, but perhaps they cannot point-follow in naturally distracting settings.

We examined point-following in 6-month-olds, improving ecological validity by testing infants at home. In a semi-scripted paradigm, parents pointed to targets in front of, peripheral to, and behind infants' visual field.

From a longitudinal study of shared attention (N = 32), currently n = 10 infants' 6-month data is coded; 2 were excluded for fussiness. In the semi-scripted paradigm, targets and locations were controlled in homes: colorful toys were placed 110 cm from the infant at 45°, 90°, and 135° from midline. Parents were not instructed when and how to point, but to get their baby interested in the target. Parents produced means of 6.5 (SD = 2.5), 7.2 (2.5) and 5.7 (1.8) points to front, peripheral, and back targets, respectively. Behaviors were captured by 3 mini-DV cameras. Timing of parents' cues, and infants' looking responses, were coded every .1 sec using Mangold Interact.

Infants responded to means of 38.6% (SD = 28.7) of points to front targets, 47.7% of points to peripheral target (31.1), and 13.8% to back targets (16.7). The front vs. back difference was significant, within-subject $t(7) = 2.8$, $p = .026$ (2-tailed). The peripheral vs. back difference also was reliable, $t(7) = 3.9$, $p = .006$. Thus, infants followed to locations within their visual field but, as in laboratory studies (Butterworth & Cochran, 1980), not to targets behind them.

Trends suggest large individual differences that fit mixed results from prior studies of 6-month-olds. Point-following rates to the three locations were correlated: front and periphery, r = .50, front and back, r = .50, and periphery and back, r = .62.

**Conclusion:** Even in distracting environments, 6-month-olds respond to points to targets within their visual field-possibly bootstrapping harder attention-following routines. Perhaps motor immaturity at 6 months discourages infants from turning to back targets; motor data will address this. Regardless, 25% of 6-month-olds never respond to pointing in naturalistic interactions.

Sa3-12

## Acquisition of Local and Non-Adjacent Syntactic Dependencies in 7- and 16-Month-Old Infants

Barbara Höhle[1] **Tom Fritzsche**[1] W. Fitch[2]
*1. University of Potsdam, Berlin, Germany; 2. University of St Andrews, St Andrews, UK*

Infants are able to learn local as well as non-adjacent dependencies presented in an artificial language (Saffran, Aslin & Newport 1996,

Gómez 2002). The capacity of learning local dependencies is sufficient for acquiring a finite state grammar (FSG) whereas the second should enable infants to learn a simple phrase structure grammar (PSG). We examined if infants are capable of learning these two types of grammars. In contrast to previous studies and closer to natural grammars, the dependencies existed between *categories* of different syllables, requiring an abstraction from specific syllables.

We tested 7- and 16-month olds using the head-turn preference paradigm. In the first experiment infants were familiarised for 2 min with strings from the FSG (N=54) or the PSG (N=55) followed by 14 test-trials with strings from both grammars. In a second experiment, 7-month olds (N=25) were tested without familiarisation to control for preferences existing prior to the experiment. The vocabulary for the artificial languages consisted of 16 CV-syllables, each belonging to one of two categories. Category membership was either coded by the speaker's voice as in Fitch & Hauser (2004) or by vowel identity. Strings were generated by combining 4 or 6 syllables according to the rules of the grammars.

Both age groups present different patterns of behaviour. The 7-month-old infants in the FSG-familiarisation group showed no preferences [$t(35)<1$, n.s.], whereas in the PSG-familiarisation group they preferred the strings from the familiar grammar [$t(38)=2.24$, $p<.05$]. For the 16-month-old infants a trend for the reversed pattern was observed with a marginal novelty-preference for PSG-strings after the FSG familiarisation [$t(17)=1.78$, $p=.093$] and no effect after the PSG-familiarisation [$t(15)<1$, n.s.]. No preference [$t(24)<1$, n.s.] for one of the string-types was found in the experiment without familiarisation. The kind of category-cue (voice or vowel) had no effect on the performance.

The preference for familiar strings after familiarisation with the PSG found in the 7-month olds suggests that the infants have learnt some characteristics of the grammar. This is supported by the fact that the experiment without familiarisation did not yield the same effect. However, this conclusion seems to conflict with the missing effect after FSG-familiarisation and the results of the 16-month olds. We will argue that our findings indicate that the preference-pattern is not only influenced by string-novelty but by string-complexity as well as age of the infants. This is in line with the multifactor-model of infant-preferences by Hunter & Ames (1988).

**Sa3-13**

### Non-Native Speech Facilitates Categorization in Infants Too.

**Micah Goldwater**, Catharine Echols

*University of Texas at Austin, Austin, USA*

One of the general cognitive skills important for language learning is categorization: Words-whether referring to objects, action, properties or aspects of an event-typically refer to categories rather than individual entities. This observation raises the question of whether words map only onto preexisting categories or whether labels may help to promote categorization. Several studies suggest that labeling promotes object category learning (e.g., Balaban & Waxman, 1997). Recent work has focused on the categorization of motions (Goldwater, Brunt, & Echols 2006). Goldwater et al showed that labels facilitate the categorization of motions without reducing the infants' ability to discriminate them. An important issue is what sort of auditory stimulus will and what will not promote categorization. The answer will aid our understanding of the mechanism underlying the previous results. In Goldwater et al, the infants showed evidence of categorization when the visual stimuli were accompanied by a nonce English label, but not for music, and not in silence. This pattern helps to rule out an explanation that any auditory stimulus would heighten infants' attention and then promote categorization. One question that Goldwater et al leaves open is whether the speech sounds in the label would have to be familiar, that is, of the infants' (soon to be) native language. The current study addresses this question by presenting the motion stimuli accompanied by Hebrew labeling.

9 month- old infants (range 8.5 -9.5, N = 23) habituated to videos of a novel toy moving its arms in three different, but similar, ways. All could be described as falling within a flapping or waving category. At test infants saw one of the familiar motions again, a novel but highly similar motion (within category motion), and a novel arm motion that was different from the other four (out of category motion). The order of the familiar and novel within category motion was counterbalanced across participants. The hypothesis was that if infants formed a category of the motion during habituation, then they should treat the within category motion as familiar and look no longer at it than at the familiar motion. The infants did this in Goldwater et al when the motions were accompanied with English labeling, but did not when the motions were accompanied by music or without auditory stimulus. This hypothesis was supported, infants looked at the novel within category motion (M = 6.7 sec) no longer than the familiar motion (M = 7.1 sec).

**Sa3-14**

### 21-Month-Olds Understand the Co-operative Logic of Requests

**Gerlind Hauser**, Henrike Moll, Michael Tomasello

*Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany*

One of the most prominent ways in which humans communicate cooperatively is by requesting help. The ability to respond appropriately to requests requires an understanding of their logic and cooperative nature. Little is known about when and how an understanding of requests develops in ontogeny. In the present study we investigated 21-month-olds' understanding of one of the felicity conditions of requests, namely that people do not request things they can do without considerable effort.

In each of three experimental conditions (n = 16 per condition), infants were presented with an adult sitting at a table and directing an ambiguous request for an object to them. There were two candidate objects: one was located on the table directly in front of the adult (close object) while the other was located out of the adult's reach on another table at a distance of about 2m (distant object). Both objects were equidistant from the infant's position. In the Hands-Free Condition, the adult's hands were free so she could easily grasp the close object when she requested the infant to help her and give her 'the' object. In the Hands-Occupied Condition, the adult made the same ambiguous request, but her hands were occupied so that the close object was just as inaccessible for her as the distant one. In the Free-Choice Condition, the adult's hands were free, but instead of making a request for help, the adult asked the infant to choose an object for herself.

Independent-samples t-tests revealed that infants in the Hands-Free Condition (Mean = .5) chose the distant object significantly more often than infants in the Hands-Occupied Condition (Mean = .23, $t(30) = 2.36$, $p = .025$), and more often than infants in the Free-Choice Condition (Mean = .23, $t(30) = 2.91$, $p < .01$). Infants' choices in the Hands-Occupied and in the Free-Choice Condition did not differ significantly ($t(30) = .0$, $p = 1$). These two conditions revealed a strong general bias towards the object that was close to the adult.

These results suggest that 21-month-old infants understand that a person requesting help is unlikely to refer to something she can easily accomplish herself (here: reach for the close object). Instead, she must be referring to something she could not do without noticeable effort (here: fetch the distant object). Infants at this age thus already possess some basic understanding of the logic of requests including the underlying felicity conditions and the cooperative nature of requests. Consequences for the understanding of the three basic assumptions of communication - cooperativeness, rational agency and relevance - will be discussed.

**Sa3-15**

### Does Repetition Affect 12-month Olds' Ability to Learn Novel Grammatical Structures?

**Dan Hufnagle**[1] Suzanne Curtin[2]

*1. University of Calgary Department of Psychology, Calgary, Canada; 2. University of Calgary, Calgary, Canada*

**Background and Aims:** Young infants can generalize input to novel utterances when exposed to small, relatively simple artificial languages (see Gómez & Gerken, 2000 for a review). Speech input is perceived linearly and is processed through the accumulated context of prior experience. The structure of input therefore should affect acquisition (Newport, 1990), and repetition of utterances is one characteristic of this structure.

Can 12-month-olds, when exposed to a complex artificial language, use repetition in the input to influence learning? Hearing a sentence repeatedly, with intervening sentences, may allow that sentence to be processed multiple times throughout acquisition, encouraging reanalysis at several points in development. On the other hand, an equivalent number of unique sentences presents each word in more contexts, possibly reinforcing within-phrase dependencies.

**Methods:** Infants heard 280 sentences from a complex artificial language during 25 minutes of familiarization. One group (Unique; n = 15) heard 280 unique sentences, while the other (Repeated; n = 13) heard 40 sentences repeated 7 times. Distributional characteristics of familiarization were equated across groups. A test phase followed, using Sequential Looking Preference (Cooper & Aslin, 1990). Four counterbalanced trial types were tested: previously heard sentences, novel grammatical sentences, ungrammatical sentences violating transitivity, and ungrammatical sentences with initial and final phrases switched. Test trials included two sentences of a given type, repeated once (i.e., 1, 2, 1, 2). The test phase was identical across groups.

**Results:** Infants in the Repeated group looked longer to ungrammatical (7.0 seconds) than grammatical (5.7 seconds) sentences: $t(14) = 1.89$, $p = .08$). Infants in the Unique group did not distinguish between ungrammatical (6.9 seconds) and grammatical (7.1 seconds) sentences: $t(14) = .52$, $p = .61$.

**Conclusion:** As expected, infants differentiate between repeated and unique information. However, we expected better learning in the Unique group, mirroring findings in prior research with adults. We propose that infants' representations of new word forms and, therefore, relationships among words are less stable than those of adults, who can rely on more previously-acquired knowledge to help them support new word forms and learn patterns among those forms. Even when subsequent repetitions occur three minutes apart with 40 intervening sentences, hearing the same sentence multiple times serves to strengthen representations of new word forms enough to allow young children to learn complex systems over a brief period.

**Sa3-16**

### The Use of Cardiac Orienting Responses to Assess Phonemic Perception in 6-Month-Olds

**Julie Kable**[1] Claire Coles[1,2] Mary Ellen Lynch[2] Katrina Johnson[1,2]

*1. Marcus Institute, Atlanta, USA; 2. Emory University School of Medicine, Atlanta, USA*

**Background and Aims:** Tasks assessing habituation and response to novelty have produced new insights into the perceptual and cognitive development of infants and have moderately predicted performance on later intelligence tests. Cardiac deceleration has been recognized as a component of an orienting response (OR), which reflects the infant's attention to stimuli and have been found in response to the onset of visual and auditory stimuli and linked to later cognitive functioning. Cardiac ORs to phonemic stimuli presented in a habituation/dishabituation paradigm were collected to assess individual differences in phonemic perception and then related to cognitive functioning.

**Methods:** Participants were recruited for a longitudinal study of language development from two hospitals and then seen at 6- and 15-months. The sample was recruited to assess the impact of maternal smoking on language development but only participants who were nonsmokers (n=60) were used for this analysis. All infants had to pass the newborn hearing exam. At 6-months, infant cardiac ORs to phonemic stimuli were assessed by exposing them to 10 consecutive 12-sec trials of "ba" followed by 5 consecutive 12-sec trials of "da" to assess individual differences in initial encoding of the "ba" stimulus and then differences in the ability to differentiate "da" from "ba." Bayley Scales of Infant Development, 2nd edition (BSID-2) were also done at the follow-ups.

**Results:** A repeated measures analysis of variance was done on cardiac responses during the trough phase (sec 3-7) across the exposure trials. A significant multivariate effect for trial was found ($F(12, 48) = 4.10$, $p < .001$). Repeated measures contrasts suggested that there was a systematic linear decrement in response over trials up to the tenth trial, which was then disrupted by the presentation of the novel stimuli on the 11th trial. Although 6-month ORs were not related to cognitive performance at 6-months, by 15-months there was a negative linear relationship between average heart rate during the trough of the dishabituation trials and raw cognitive scores on the BSID-2 ($r = -.38$, $p < .005$).

**Conclusion:** These results suggest that cardiac OR to phonemic stimuli may be a useful tool in assessing infant phonemic perception skills as responses systematically diminished over 10 habituation trials and evidence of dishabituation to the novel phonemic stimulus was obtained. Discriminative ORs were also significantly related to later cognitive functioning suggesting that components of cognitive development may be influencing the discrimination of the phonemic stimuli.

**Sa3-17**

### Development of Different Modals of Request Behavior in 11-and 15-Month-Olds

**Aya Kutsuki**[1] Misa Kuroki[1] Sonoko Egami[2] Tamiko Ogura[3] Shoji Itakura[4]

*1. Japan Science and Technology, Kyoto, Japan; 2. Hokkaido University of Education, Hokkaido, Japan; 3. Kobe University, Kobe, Japan; 4. Kyoto University, Kyoto, Japan*

**Introduction:** Infants begin to make use of different modals of behaviors such as gaze, hand movement (gesture), facial affects and vocalization for communication and they increase and improve during the period between 9 and 15 months of age. Intentional communicative attempts by infants using gaze from an object to person start to increase during this period (Bakeman & Adamson, 1984; Masur,1983). There is also an increase in intentional vocalizations co-occurring with gesture (Bakeman & Adamson, 1986; Masur, 1983; Zinober & Martlew, 1985). Infants also begin to make use of different facial affects; 24-month-old infants coordinated their sad facial expressions with gazes to their mother to gain help (Buss & Kiel, 2004).

Our interest is to find out the development of request behaviors in different modals and how these different modals coordinate with each other to constitute more mature request behaviors. The current presentation includes preliminary analyses of some of the request behaviors and their combinations.

**Methods**: The current analysis is based on the twelve infants (7 males and 5 females) at the age of 11 and 15 months (longitudinal). Each infant was individually tested. A female experimenter showed a small wind-up toy and played with it. The experimenter put the toy in a bottle and closed the lid and handed to the infants. The procedure repeated twice. For the analyses, the frequencies of behaviors during the first 20 seconds of the two sessions (total:40 seconds) were used.

**Results and** Discussions: No statistical difference was found in the frequencies of the facial affects ( positive, anxious, angry and neutral ) following the request gaze movements (from toy to person). Due to the facial characteristics and expressions of the Japanese face, we almost never found the anxious affect with the eyebrows down, thus most non-positive expressions were coded as neutral. This may have affected the results. We will need to look into other sequence patterns involving facial affects with other modals. The frequency of vocalizations increased over age ($t(11)=3.07, p.(<.05)$. We will see if it coordinates better with other modals with an increasing age. The gaze to the toy did not change significantly but the coordinated gazes from the toy to the experimenter (request gaze movements) increased significantly ($t((11)=3.63, p.<.01)$. This demonstrates that at 11 months, the infants looked at the toy for their interest while at 15 months, their looks to the toy became more communicative, intending to others. We shall look into other possible coordinations in future.

**Sa3-18**

### Origins of Word Learning: People and Objects

**Dilys Leung**, D. Geoffrey Hall

*University of British Columbia, Vancouver, Canada*

A fundamental challenge in the study of language development is to understand how infants learn to assign words to different lexical categories, including count nouns (object kind words, like "ball") and proper names (individual object words, like "Fred").

One account invokes infants' use of word-meaning constraints. Infants should interpret words for novel objects as count nouns referring to whole object kinds (taxonomic and whole object assumptions); furthermore, they should assume each object has only one kind label (mutual exclusivity assumption). Count nouns should thus be easier to acquire than proper names, because learning proper names requires using the mutual exclusivity assumption to override the taxonomic assumption.

An alternative account appeals to differences between infants' intuitive conceptualizations of people and other objects. Infants' earliest proper names usually label people (e.g., "Mommy"); their initial count nouns typically label artifacts (e.g., "cup"). These facts suggest that infants may naturally construe people as individual objects but think of other objects as instances of their kind. Infants may thus interpret words for unfamiliar people as proper names and words for other kinds of unfamiliar objects (e.g., artifacts) as count nouns. Count nouns should thus be no easier to acquire than proper names.

The fact that infants' earliest lexicons contain both count nouns and proper names favors the alternative account. We sought experimental support. Sixteen- and seventeen-month-olds watched a video showing one unfamiliar object enter a scene. A recorded voice labelled it ("DAXY!"). A second object of the same kind then entered the scene. The voice requested a referent of a second word ("Find BLICKY!"). In the people condition, infants saw two unfamiliar women's faces; in the artifact condition, they saw two unfamiliar artifacts (hourglasses). If they adhere to word-meaning constraints, infants in both conditions should interpret the first word as a count noun applicable to both objects and show no preference for looking at either object when asked for the second word's referent. If object kinds influence interpretation, infants in the artifact condition should treat the first word as a count noun applicable to both artifacts and show no preference for looking at either artifact when asked for the second word's referent. However, infants in the people condition should treat the first word as a proper name for the first person and prefer looking at the second (unnamed) person as the second word's referent. Preliminary results (N = 16) provide support for the latter prediction.

**Sa3-19**

### Infants Produce Communicative Acts Based on the Common Ground They Have Shared with their Interlocutors

**Kristin Liebal**, Malinda Carpenter, Michael Tomasello

*Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany*

Many theoretical accounts emphasize the importance of common ground for successful communication (e.g., Clark, 1996), showing how interlocutors build their communication based on the experience they have previously shared. For example, only when two people have talked about a third person named Tom, can they then refer to Tom using the pronoun "he" because Tom has become part of their common ground.

We investigated whether 18-month-old infants, before they are fully competent with language, already rely on the experience they have shared with their interlocutors when they communicate. Infants shared one particular activity (e.g., a duck game) with one experimenter (E1), and then a second activity (e.g., a teddy game) with a second experimenter (E2). Afterwards, infants entered the test room either with E1 (E1 condition) or E2 (E2 condition). In the test room they faced two pictures: one that depicted an object from the activity they had shared with E1 (duck picture), and one that depicted an object

from the activity they had shared with E2 (teddy picture). We scored infants' communication about the pictures for the adult.

Results showed that infants communicated differently and appropriately in the two conditions: infants in the E1 condition pointed at the picture that represented the experience they had previously shared with E1, whereas infants in the E2 condition pointed at the picture that represented the experience they had previously shared with E2 (Fisher's exact test, $N$=24, $p$<.02). Infants' behavior in the E1 condition demonstrates particularly strongly that they really relied on shared experience because in order to communicate appropriately toward E1, they had to withdraw themselves from what they themselves had just done (teddy game with E2) and switch back to what they had shared with E1 before.

These results show that infants use the particular common ground, or experience they have shared with particular adults when they produce communicative acts for them. They are competent with this pragmatic skill even though they are not competent with language yet, suggesting an underlying socio-pragmatic skill prior to language that might help them later with the pragmatics of language use.

**Sa3-20**

### Do Verbal Cues Facilitate the Learning of Nouns?

**Marie Lippeveld**, Yuriko Oshima-Takane

*Psychology Department, McGill University, Montreal, Canada*

Previous research has shown that object manipulation is an important factor for young children to extend object names by function (Booth & Waxman, 2002; Kemler Nelson, 1999). Using the Intermodal Preferential Looking Paradigm (Hirsh-Pasek & Golinkoff, 1996), we investigated whether children under 3 years of age are able to extend the names of novel objects by function without prior object manipulation when they hear the verb form of the novel noun.

Twenty-seven 30- to 35-month-old French-speaking children were shown a video during which they were taught novel nouns (vop, dax, and ploun) for three different sets of unfamiliar kitchen utensils (bottle opener, cheese grater and pastry cutter). The children in the specific condition heard a novel noun as well as its verb form denoting the function of the object during the teaching trial (Look, she is vopping the bottle), while those in the non-specific condition heard a novel noun and a general-purpose verb (Look at what the vop can do to the bottle). In the teaching trial, the children were introduced to a novel object and its target function. They were then shown an object with a target function and one with a non-target function in the contrast trial. In the control trial, the children were shown two novel objects and their functions (one with the target function and one with the non-target function) with no linguistic stimuli. Finally in the test trial, the children were shown still frames of these two novel objects and asked to identify the one with the same name as the object in the teaching trial. The proportion of time the children looked at the target test object was measured to determine their choice.

The mean proportion score was significantly higher than chance (0.5) in the specific condition for all three object sets (vop: t(12) = 2.47; dax: t(12) = 1.99; ploun: t(11) = 3.93, one-tailed, ps <.05). No significant effects were found in the non-specific condition, indicating that only children in the specific condition were able to extend the novel name to a previously unseen object by function.

The results demonstrate that children under the age of 3 can generalize newly learned object names to a previously unseen object by function without prior experience manipulating the objects. The finding that this process is facilitated by hearing the verb form of the novel noun underscores the importance of semantic information in early word learning.

**Sa3-21**

### Statistical Computation and Rule-Learning in 18-Month-Olds: Evidence for Two Distinct Mechanisms

**Erika Marchetto**, Luca L. Bonatti

*Cognitive Neuroscience Sector, Trieste, Italy*

**Background and Aim:** Language acquisition requires both the ability to segment speech into words, and to extract its structural regularities. Peña, Bonatti, Nespor and Mehler (2002) proposed that at least two processes analyze speech input. One, relying on general-purpose statistical computations, is dedicated to breaking the continuous speech signal into its components (that is, words). The other mechanism can extract generalizations, but -crucially- only from previously segmented elements, whereas statistical computation operates also on continuous streams. We investigate whether both processes are also present in infants acquiring language.

**Method:** We tested 18-month-olds using a modified head-turn procedure (Kemler Nelson et al., 1995). Infants were exposed to artificial speech streams composed of tri-syllabic nonsense strings (henceforth, "words"). In each word, the first syllable predicted the third syllable, thus instantiating a long-distance dependency. The middle syllable, instead, varied. Infants were randomly assigned to two experimental groups: the continuous stream group (n=16) and the segmented stream group (n=16). Then, they were tested with part-words and rule-words. Part-words are strings of syllables that appeared in the stream, but spanned a word boundary. Thus, part-words are statistically weaker than words. Rule-words are novel strings respecting the aforementioned dependency between the first and the third syllable, but with a different middle syllable that appeared in the stream but never in the middle position.

**Results:** Paired t-tests revealed that infants assigned to the continuous stream group looked longer to rule-words than to part-words, $t(15) = 2.33$, $p = .03$, suggesting that they computed statistical relations over sequences appearing in the stream. In contrast, infants in the segmented stream group looked longer to part-words than to rule-words $t(15) = 2.71$, $p = .01$, suggesting that they generalized the dependency between the first and the third syllable over rule-words.

**Conclusion:** Results showed that infants exposed to a continuous stream could extract sequences using statistical computations, and looked longer when listening to novel sequences containing the dependency between the first and the third syllable. However, the presence of silent gaps between words induced the opposite looking time pattern. This difference may depend on the activation of two distinct mechanisms: one is statistical, and possibly serves word extraction; the other one might be involved in rule-learning, and can be triggered only if segmentation cues are contained in the stream. Our evidence is compatible with the hypothesis that statistical computation and generalization might rely on different mechanisms.

**Sa3-22**

## Six-Week Postpartum Maternal Self-Criticism and Dependency and 4-Month Mother-Infant Self- and Interactive Contingencies

Beatrice Beebe[1] Joseph Jaffe[1,2] Karen Buck[1,2] Henian Chen[1,2] Patricia Cohen[1,2] Sidney Blatt[3] Tammy Kaminer[4] Stanley Feldstein[5] Howard Andrews[1,2] **Sara Markese**[1,2]

*1. New York State Psychiatric Institute, New York, USA; 2. Columbia University, New York, USA; 3. Yale University, New Haven, USA; 4. The Bank Street College of Education, Private Practice, New York, USA; 5. University of Maryland, Baltimore, USA*

We investigated associations of 6-week postpartum maternal self-criticism and dependency with 4-month mother-infant self- and interactive contingencies during face-to-face play in 126 mother-infant dyads. Despite extensive investigation of maternal depressive symptoms, other forms of maternal distress, such as personality-based rather than symptom-based depressive vulnerability, remain under-studied. The Depressive Experiences Questionnaire (DEQ), a reliable self-report instrument, distinguished two personality profiles, "Self-Criticism," excessive concern with self-worth and achievement; and "Dependency," excessive concern with maintenance of interpersonal relatedness. Dependency and self-criticism differ in forms of defense (avoidant vs. counteractive), attachment styles (preoccupied vs. avoidant/dismissive), modes of cognition (concerns about people vs. objects; synthesis vs. critical analysis), and styles of affect regulation (labile/ expressive vs. over-controlled/distant). Using multi-level time-series modeling, we evaluated two dimensions of contingencies within the dyadic encounter: (1) within each individual's behavioral stream, "self-contingency" (autocorrelation); and (2) between the two partners' streams, "interactive contingency" (lagged cross-correlation). Different communication modalities can convey discordant information. We thus analyzed the separate modalities of infant and mother face, gaze, touch, and vocal quality, coded sec-by-sec from split-screen videotape. Findings for self-contingency: (1) More self-critical mothers showed primarily lowered self-contingency; their infants showed both lowered and heightened. (2) Infants of more dependent mothers showed primarily lowered self-contingency; findings were absent in mothers. Thus, with maternal distress, infant self-contingency was primarily lowered, interpreted as a pattern of self-destabilization. This was the most robust finding of the study. Interactive contingency: (1) More self-critical mothers showed lowered attention and emotion contingencies, interpreted as difficulty joining the infant's attention structure and in joining the infant's emotional shifts; but heightened contingent touch coordination with infant touch, interpreted as compensating by touch over-involvement. (2) More dependent mothers and their infants showed heightened facial/vocal interactive contingencies, a dyadic social vigilance, interpreted as excessive maternal concern about the infant's visual and emotional availability. Thus, maternal self-criticism and dependency have different effects on mother-infant communication.

**Sa3-23**

## Infant Speech Categories Do Not Encompass the Phonetic Space

**Bob McMurray**[1] Richard Aslin[2]

*1. University of Iowa, Iowa City, USA; 2. University of Rochester, Rochester, USA*

Phonological representations during infancy are typically described in terms of which phonological contrasts are discriminated (e.g. Werker & Tees, 1984; Eimas et al, 1971), emphasizing the location and nature of the phonetic boundary. However, adult speech categories are typically defined as a graded prototype defined by the location of the most typical values. Recent work suggests that infants may have the similarly graded speech categories (McMurray & Aslin, 2005) and that this may arise due to statistical learning (Maye, Werker & Gerken, 2002). However, it is not clear whether infant categories are defined by boundaries or prototypes.

One consequence of a prototype-defined category is that multiple categories along a dimension (e.g. voicing) are independent of each other. Thus, the voiced category, for example, could develop independently of the voiceless one. This is supported by recent modeling (McMurray, Toscano & Aslin, in press) which predicts that there may be regions of the input that are not categorized that all. That is, along a voice-onset-time continuum (VOT, a perceptual cue to voicing), some VOTs are neither /b/ nor /p/.

This was tested in a two-day experiment. On the first day, 8-month-old infants were exposed to 80 exemplars of beach, bear, bail and bomb. They were then tested using the head-turn-testing procedure on variants of these with VOTs of 5 ms (B), 17 ms (B*), and 40 ms (P). On the second day, the same infants were exposed to 80 exemplars of peach, pear, pail, and palm and tested on the same tokens. We predicted that on day 1 infants would listen longer to B* than B, but B* would be the same as P, indicating that the B* was "not B". On day 2, we predicted that infants would listen longer to B* than P, but similarly to B, indicating that B* was "not P".

Results were as predicted. On day 1, listening times to B* were significantly different from B (p=.003) and not from P. On day 2, B* was significantly different from P (p=.003), but not from B.

Thus, B* tokens did not appear to be categorized as either /b/ or /p/. This suggests that infant phonetic categories, even those on the same dimension, are independent of one another, in support of statistical learning models like McMurray et al (in press). It also suggests that simple discrimination and categorization are not isomorphic, raising questions about the interpretation of classic results.

**Sa3-24**

## Causal and Intentional Action: Are They One in the Same? Evidence From Language Acquisition

**Paul Muentener**, Laura Lakusta, Susan Carey

*Harvard University, Cambridge, USA*

**Background and Aims:** Recent research suggests that infants' representations of causal agency may be confounded with representations of intentional agency. Infants may expect that only intentional actions can be causal actions (Muentener & Carey, in prep). The current study explored this hypothesis by testing the causal and intentional language of 3-year-old children. Adults' use causal language to describe both intentional and non-intentional events; lexical causatives ("he broke the window") are used to describe intentional events, whereas periphrastic causatives are used to describe non-intentional events ("he made the window break") (Wolfe, 2003). Will this also be the case for children? If causality is linked to intentionality in early development, then children may restrict their use of causal language to causal events involving intentional actions. The findings shed light on conceptual representations in infancy as well as linguistic representations in childhood.

**Method:** 3.5- to 4-year-old children are presented with mediated causal events involving causal agents that are people, performing intentional and unintentional actions, and physical objects. In Condition 1, children are asked to produce descriptions of the events. In

Condition 2, children are asked to choose the best description for the events. Children's responses are coded as to whether they use/choose a lexical or periphrastic causative, or a noncausal description. Adults are also tested in order to provide benchmarks for adult performance.

**Key Results:** The findings revealed that for both production and comprehension, adults (n = 12) used lexical causatives for intentional events involving people and periphrastics for non-intentional events, suggesting that causal language is modulated by intentionality. Preliminary data suggest that children limit their use of causal language to events that involve actors performing intentional actions. For the remainder of the events, non-causal language is used.

**Conclusions:** Children's linguistic descriptions shed light on the underlying structure and origin of causal representations. While adults can represent any type of potential agent (person or object) and any type of action (intentional or unintentional) as causal, children's causal representations seem to be linked to distinct types of events - specifically those involving intentional actions. The results will be discussed in terms of early conceptual and linguistic development, specifically of whether causality is confounded with intentionality from early in development.

**Sa3-25**

## Gender Influence on Speech Sound Processing and Word-Learning of Pitch Accent

**Ryoko Mugitani**

*Japan Society for the Promotion of Science / NTT Communication Science Labs., Souraku-gun, Japan*

**Background and Aims:** It is often claimed that gender influences early language development, and specifically that girls acquire vocabulary faster than boys. This claim has often been supported by studies of vocabulary development in children's spontaneous speech production (Huttenlocher, 1991) and by vocabulary checklists based on caregivers' reports (Feldman, 2000). However, very little empirical research has been conducted to reveal the underlying mechanism that leads to this gender difference in relation to vocabulary acquisition. To address this issue, we reanalyzed the results of our previous discrimination and word-learning experiments with respect to Japanese lexical accents (Mugitani, 2006) to confirm the influence of gender on early language acquisition.

**Methods:** We tested infants' discrimination and word-learning abilities by using a habituation "switch" paradigm. The participants were 56 Japanese infants at 14 months of age, which is the age at which infants usually begin to learn word-object association. The infants were presented with a pair of nonsense words contrasted solely by their accent patterns (mOpo vs. mopO, Capitals represent accented syllables) as linguistic stimuli. In the discrimination task, the infants were first habituated to one word, and then tested for dishabituation to another word to determine whether they could differentiate these words. In the word-learning task, the infants were audiovisually habituated to two types of word-object combinations ("mOpo"-cutter and "mopO"-stapler), then tested for dishabituation to two switched combinations ("mOpo"-stapler and "mopO"-cutter) to determine whether they had learned the particular word-object combinations.

**Results:** In the discrimination task, only boys were significantly dishabituated to a novel word accent (boys: $t[15] = 4.951$, $p < 0.001$; girls: $t[15] = 0.372$, n.s.) In the word-learning task, only girls were significantly dishabituated to the switched combinations (boys, $t[11] = 0.624$, n.s.; girls, $t[11] = 2.520$, $p = 0.028$).

**Conclusions:** We found a distinct gender effect in the accent discrimination and word-learning tasks. Only boys were successful in the discrimination task whereas only girls were successful in the word-learning task. Interestingly, the word-learning task even made it easier for the girls to perceive the different accent patterns, which they failed to do in a simple discrimination task. Such advantageous word learning confined to girls might lead to a gender difference in vocabulary acquisition in early language development. Future experiments with phonetically varied stimuli and different age groups will help to untangle the origin and the mechanism of the gender difference in early language development.

**Sa3-26**

## What Characteristics of Social Interaction Facilitate Early Learning? Effects of Animacy and Contingency on Vocal Learning in Prelinguistic Infants

Angela Narayan, Michael Goldstein, Jennifer Schwade

*Cornell University, Ithaca, USA*

**Background and Aims:** Infants perceive and prefer contingency early in life (e.g. DeCasper & Carstens, 1981). Contingent interactions with caregivers facilitate vocal learning in 9-month-olds (Goldstein, King, & West, 2003). However, the characteristics of early interactions that influence infants' vocal development have not been isolated; the contingency of social interaction has not been separated from the animacy of the social partner. This study tested the hypothesis that a contingently-responding but non-animate partner facilitates vocal learning in 9-month-olds.

**Method:** Infants interacted with a remote-controlled car during two 30-minute sessions on consecutive days. Sessions took place in a playroom with the infant's caregiver. During Session 1, infants became familiarized to the car's movements. Session 2 consisted of three 10-minute periods (Baseline-1, Social Response [SR], and Baseline-2). Infants participated either in the Contingent Condition (n=22), in which the car contingently responded to their vocalizations during SR; or the Yoked-Control Condition (n=21) in which the car responded during SR according to a yoked schedule from a randomly-selected Contingent infant. Thus, Yoked-Control infants received the same amount of stimulation as Contingent infants, but it was not contingent on their vocalizations. Sessions were videorecorded and infants' vocalizations were counted and coded for changes in vocal quality (increased resonance and faster consonant-vowel articulation).

**Results:** Repeated-measures ANOVAs revealed changes in vocal quantity across the three periods only for Contingent Condition infants, $F(2, 42) = 7.05$, $p < .01$, with significant increases in number of vocalizations from Baseline-1 to SR and from Baseline-1 to Baseline-2, Tukey's HSD $p < .05$. Contingent infants showed significant changes in resonance, $F(2, 42) = 7.27$, $p < .01$, and proportion of canonical syllables, $F(2, 42) = 4.05$, $p < .05$. For the Contingent infants, post-hoc tests revealed significant increases in resonance from SR to Baseline-2 and from Baseline-1 to Baseline-2; canonical syllables increased from Baseline-1 to Baseline-2. Number of vocalizations during SR was positively correlated with improved vocal quality only for Contingent infants, $r(20) = .55$, $p < .01$.

**Conclusions:** The results suggest that contingent reinforcement facilitates vocal learning even when provided by a non-human partner. Infants show similar learning when interacting with contingent caregivers (Goldstein et al., 2003). Thus, regardless of animacy, infants only learn when the social partner is interacting contingently on babbling. Vocal learning is more sensitive to the temporal structure of social interaction than to the physical attributes of the interaction partner.

**Sa3-27**

## The Past was Just a Moment Ago: Past Morphology in the Speech of Young Children and their Mothers

**Anat Ninio**

*The Hebrew University, Jerusalem, Israel*

**Background and Aims:** A relatively unexplored aspect of the development of past morphology in children concerns the concept of past children may work with. Here we ask the most basic question, what is past tense for young children? When was the past? We examined the speech of three groups of Hebrew-speaking young children, 10, 18 and 26 months old, and their mothers' speech in conversation, looking for developmental trends in children's use of past morphology and age-related changes in mothers' use.

**Methods:** Twenty four mother-infant dyads were videotaped in their homes, engaged in activities of their choice. The observational sessions lasted 30 minutes. All mothers had at least postsecondary education. Half the infants in each age group were male, half female. All utterances containing a verb inflected for past tense were categorized according to the reference of the past tense, as Recent past -- the time immediately before speech -- or Distant past -- all others.

**Results:** At 10 months no child produced a tense-inflected verb. Comparison of children's pooled utterances at 18 and 26 months shows extreme age-related differences, when at 18 months all past tense referred to immediately recent past whereas at 26 months only 56% of verbs did so. Namely, children begin using past verb inflections exclusively for very recent events and only later on start referring to a more distant past. Examination of mothers' speech to the three age groups revealed that when addressing 10-month-olds, mothers almost exclusively referred to the immediately recent past (88%). This bias got relatively less pronounced when speaking to 18-month-olds (62%) and further reduced in speech to the 26-month-olds (42%). The differences in distribution are significant by Chi-square test both for children and for mothers.

**Conclusion:** Children's earliest concept of a linguistically encoded past event appears to be an occurrence that happened just a moment ago but does not happen any longer. This probably reflects infants' cognitive and linguistic limitations, with maternal fine-tuning to infants' abilities contributing to the conceptualization. The very recent past, however, consists mostly of events of punctual and telic character, accounting for the early achievement aspectual bias for past tense. The explanation for under-extension of the past to the immediately preceding moment is probably linguistic-pragmatic. It is almost impossible to establish distal joint reference by linguistic means for pre-linguistic and barely-verbal infants, whereas talk about the very recent past utilizes already-established joint attention to perceptually prominent events.

**Sa3-28**

## Once Upon a Time: Parents Talk Differently to Boys and Girls during Storybook Reading

**Julia Parish-Morris**[1] Kathy Hirsh-Pasek[1] Roberta Golinkoff[2]

*1. Temple University, Ambler, USA; 2. University of Delaware, Newark, USA*

**Background and Aims:** "Dialogic" storybook reading is an interactive, shared reading style that is an established predictor of preschoolers' language and later literacy (Fielding-Barnsley & Purdie, 2003; Heubner & Meltzoff, 2005; Zevenbergen & Whitehurst, 2003). Although parents read equally often to their sons and daughters (Karass et al., 2003), some research suggests that they read differently to boys versus girls by age four (Anderson et al., 2004). This study reports some new findings about parental talk when reading to preschool sons and daughters.

**Method:** 40 3-year-olds and 40 5-year-olds were videotaped reading either an electronic console storybook or a traditional storybook with their parents. Five minutes of the videotaped interactions were transcribed and extra-textual parental language was coded for utterances consistent with a dialogic reading style (Blewitt, 2007). Each utterance's *form* was coded (question or comment) as well as its content (either *story-related* (e.g., *"Caillou is sick!"*), *behavior-management* (e.g., *"Sit still"*), or *experience-related* (e.g., *"Remember when you were sick?"*)). The *experience-related* code was used when parents talked about events similar to - but outside of - the textual story.

**Results:** Preliminary analyses revealed no differences in parental talk by age, so further analyses were collapsed across this variable. A one-way ANOVA on the proportion of utterance type per minute by gender revealed that parents spoke significantly more about events that go beyond the story when reading to boys than when reading to girls ($F=6.6$, $p<.05$) but spoke equally often about the story and the child's behavior with both sexes ($ps>.05$). Furthermore, with respect to utterance form, parents asked boys more questions than girls ($F=6.03$, $p<.05$), and made more comments to girls than to boys ($F=5.83$, $p<.05$).

**Conclusion:** Since parents reading to boys ask more questions and are more likely to refer to events beyond the story than parents reading to girls, boys hear more dialogic speech during shared storybook reading. Prior research shows that dialogic reading leads to better literacy outcomes. However, girls still perform better on language and literacy tests in preschool than do boys (Denton & West, 2002; Justice et al., 2005) and maintain their superiority in grade school (U.S. Department of Education, 2007). These apparently contradictory findings demand continued research as the country struggles to help all children become proficient readers.

**Sa3-29**

## The Impact of Labelling on Categorization at 7- to 11 Months of Age

**Sabina Pauen**[1] Deise Desch[2]

*1. Psychology Department, University of Heidelberg, Heidelberg, Germany; 2. University of Heidelberg, Heidelberg, Germany*

Category formation at a preverbal age is often tested with the object examination task (OET). Using this technique, it has been shown that infants perform a global-to-basic-level shift during the second half of the first year of life. The present set of experiments investigates whether 7- and 11-month-olds vary their response pattern, depending upon the level of abstraction of (a) constrasts being presented, and (b) labels used to name the given stimuli.

A total of 105 7-, and N = 120 11-month-olds received 10 different exemplars from one category to play with sequentially for 20s each. At test, a new exemplar from the familiar category was presented, followed by a contrasting category member. Examination duration per trial was coded from video by two independent coders (r = .97). Further analyses were based on the means of both coders for any given trial. Category discrimination was defined by an increase in attention from the first to the second test trial. In Experiment 1 (animals vs. vehicles), 3 conditions were presented to 7- and 11-month-olds: No Label, Global Label, and Basic Label. In Experiment 2 (cars vs.

trucks), the No Label and the Basic-Label condition were presented to 11-month-olds only.

Since kind of label (global or basic) did not have any impact on the results in the global-level task, both subsamples were combined to form a „Label" group, and compared to data from the „No-Label" condition. Categorization effects were observed for both age-groups. For 7-month-olds, an interaction between group and test-trial was observed, $F(1,101)=39,85$; $p < .05$, resulting from stronger categorization in the Label condition. For 11-month-olds, a main effect Condition was observed, $F(1,72)=13,69$; $p < .05$, resulting form longer examination times at test for the Label group. In Experiment 2 (basic-level contrast), the No-Label group failed to categorize cars and trucks, whereas the Label group succeeded.

In sum, verbal labels improved categorization performance in a global-level task at 7 months of age. At 11 months, the impact of labels varied with the level of the contrast: In a global-level task, labels increased general attention to individual exemplars; in a basic-level task, labels improved categorization performance. Based on these findings we conclude that infants profit most from labelling when they are about to learn a given category. Once the category has been formed, labelling seems to increase attention to exemplars within that category, but does not change the general pattern of responding.

**Sa3-30**

## Where You're Going Trumps What You're Doing: Infants Prefer Paths Over Manners in Dynamic Displays

**Sarah Roseberry**[1] Tilbe Goksun[1] Kathy Hirsh-Pasek[1] Wendy Shallcross[1] Roberta Golinkoff[2]

*1. Temple University, Philadelphia, USA; 2. University of Delaware, Newark, USA*

**Background and Aims:** To learn relational terms like verbs and prepositions, infants must parse components of dynamic events (e.g., *paths* or the trajectory of a figure and *manners* or the way the figure moves). Research suggests that young children are able to abstract *paths* (e.g., over) before *manners* (e.g., twist; Pruden, 2006). Paths might be conceptually central to event perception, or paths might simply be more perceptually salient than manners. This study extends Pruden (2006) by systematically manipulating *manner* salience. Given the results from Pruden (2006) and infants' tendency to prefer familiarity in complex displays (Houston-Price & Nakai, 2004), we predict infants will continue to prefer familiar paths even when the manner of action is highlighted.

**Method:** Twenty 10-12- and eighteen 13-15-month-olds were tested in a non-linguistic Preferential Looking Paradigm (PLP) using an animated starfish. Manipulating the stimuli used in previous path and manner discrimination studies (Pruden, 2006), we stretched Starry by making his limbs half the original width and twice the length. This resulted in a relatively smaller path and a larger, more obvious manner. During familiarization, infants saw four 12-second trials of stretched Starry performing a single manner on a single path (e.g., *twist over* a ball). At test, on a split-screen, infants saw two scenes simultaneously: the same manner and a novel path (e.g., *twist* under the ball) and a novel manner with the same path (e.g., bend *over* the ball). In the second test trial, the originally proportioned Starry was shown with the same split-screen scenes. The dependent variable was looking time to each simultaneous display.

**Results:** All infants performed similarly in both test trials ($p > .05$), but younger children looked significantly longer toward the familiar path than older infants ($p < .05$). This suggests that only younger infants continue to notice familiar paths. Although this preference was not significantly different from chance ($p > .05$), large variability necessitated further examination. A nonparametric test revealed that 16 of 20 younger infants significantly preferred to watch the familiar path ($p = .01$). Older infants showed no preference toward either screen.

**Conclusions:** Parallel to Pruden (2006), the current study indicates that a shift from path preference toward manner preference occurs between 13 and 15 months of age. Young infants attend to the familiar path even when the stimulus parameters are made more salient, suggesting that path may indeed be a central component of events.

**Sa3-31**

## How Children Learn About Mental States

**Ted Ruffman**, Mele Taumoepeau

*University of Otago, Dunedin, New Zealand*

Recent research suggests that mothers scaffold their child's understanding of mental states (Taumoepeau & Ruffman, 2006; in press). We examined scaffolding by having mothers describe pictures to children at 9, 15, 21, or 27 months old (N=72), and then again six months later. There were three picture categories: negative emotions (e.g., angrily pushing food away), positive (e.g., smiling when receiving a gift), and reaching (e.g., for a rabbit). Mothers also rated their child's general language development using the MacArthur Communicative Development Inventory and their mental state language using an additional supplement (Taumoepeau and Ruffman, 2006). We examined mothers' use of three mental state terms ("want", "like" and "try"), hypothesizing that they would begin by using terms mainly in the most salient situation in need of explanation (negative emotion), and to avoid overwhelming children, would initially use a term to describe one rather than multiple categories.

Three findings were consistent with these hypotheses. First, at Time 1, mothers used "like" and "want" mainly with negative stimuli, $F(2,36) = 13.86$, $p < .001$.

Second, mothers' scaffolding was based on child ability levels; they used a given term (e.g., "want") to describe more than one situation (e.g., reaching and crying) only with older and more able children. There was a significant correlation between the child's age and mothers' use of a term in multiple contexts having accounted for potential confounds including mother education and all of the child's mental and non-mental state language, $pr = .27$, $p < .05$. Likewise, the more mental state terms the child used, the more likely mothers used a term in multiple contexts (having accounted for mother education, age, and child non-mental state language), $pr = .25$, $p < .05$, whereas children's non-mental state language didn't correlate with mothers using a term in multiple contexts, $pr = -.02$, n.s.

Third, it was only mothers' introduction of mental state terms with the negative affect pictures at Time 1 that correlated with Time 2 child mental state talk (having accounted for Time 1 child mental and non-mental state talk and mother education), $pr = .34$, $p < .05$, whereas the analogous analyses for positive affect pictures, $pr = .13$, $p = .46$, and reaching, $pr = -.05$, $p = .77$, were not significant.

In sum, there were three pieces of evidence for scaffolding: mothers introduced mental state terms mainly in the most salient situations (negative affect), they held off using a term in multiple contexts until the child was older and beginning to produce mental state terms, and only the introduction of terms to describe negative affect was correlated with children's later mental state understanding.

**Sa3-32**

## Look Who's Talking: Infant Attention and Activity Response to Adult and Child Speech

**Priya Shimpi**[1] Michael Goldstein[2] Meredith West[3]

*1. University of California, Santa Cruz, San Jose, USA; 2. Cornell University, Ithaca, USA; 3. Indiana University, Bloomington, Bloomington, USA*

**Background:** Maternal infant-directed speech (IDS) attracts infant attention compared to adult-directed speech (ADS) (Fernald, 1985). Young children also use IDS (Sachs & Devin, 1975), yet the influence of children's speech (CS) on infant behavior is unknown. A new paradigm examines infants' visual and behavioral responses to mothers' speech (MS) and CS and further explores the effects of infants' experience with CS on their responses to it.

**Method:** Eight-month-olds sat in a high chair and played with novel toys while a speaker, located 90 degrees to the right or left of midline, played ten 10-second speech trials of either ID or AD speech, separated by 10-second silent interstimulus intervals (ISIs). After the 10 trials, speech type (ID/AD) switched.

Forty infants heard MS. Eighty infants heard CS; 40 had siblings (CS-Sib) and 40 did not (CS-No Sib). Nineteen Control infants heard no speech. We measured (1) looking time to the speech source during each trial and (2) increase/decreases in activity level from the speech trials to the following ISIs.

**Results:** *Looking time*. We followed up significant omnibus ANOVAs with Bonferroni post-hoc tests. Regardless of speech type, infants listened longer to CS than to MS or no speech (corrected ps < .05). Furthermore, only CS-Sib participants habituated across the 10 trials, $t(39) = 3.154$, $p = .003$.

An ANOVA revealed that for CS-Sib infants, attention drops across the switch, $p<.01$. For CS NoSib infants, when CS switched from ID to AD, they decreased attention, $t(19) = 5.66$, $p < .001$. When speech switched to ID, there was no change.

Activity level: Based on significant omnibus ANOVAs, Bonferroni post-hoc tests showed that infants in MS and CS-Sib groups decreased activity on more speech trials than the CS-No Sib group and controls (corrected ps < .05). Controls and infants without sibling experience did not change their play activity.

**Conclusion:** We found that CS was more effective than MS in attracting infant attention, indicating that CS is a potent source of input. Furthermore, these data show that having a sibling predicts infant response to CS. By adding an activity level measure, we found that infants who have experience listening to the type of person speaking decreased their play with toys when listening to speech. Thus, children with siblings have learned that ID speech is predictive that something is about to happen. The discussion will address the learning opportunities afforded to infants by their older siblings.

**Sa3-33**

## Brain Correlates of Non-Verbal Communicative Comprehension in 20-24-Month-Olds

Janne Torkildsen[1] Rune Thormodsen[2] Gro Syversen[2] **Lars Smith**[3] Magnus Lindgren[4]

*1. Department of Linguistics and Nordic Studies, Oslo, Norway; 2. Department of Psychology, University of Oslo, Oslo, Norway; 3. The National Network for the Study of Infant Mental Health, Department of Psychology, University of Oslo, Oslo, Norway; 4. Department of Psychology, Lund University; Department of Psychology, University of Oslo, Oslo, Norway*

Early on, children learn to differentiate social signals not only when they are directed to the child, but also social signals between other people. Relatively little is known of the brain correlates of such social perception. We studied the EEG activation when toddlers observed two different types of non-verbal communication acts between two adults.

Several earlier studies have investigated the electrophysiological correlates of prelinguistic social communication skills in children (Henderson et al. 2002, Mundy et al. 2003). These have found a longitudinal association between the tendency to initiate and respond to joint attention and baseline EEG-indices of left frontal activity. These studies have, however, only investigated an indirect link between joint attention and electrophysiological activity by comparing baseline EEG at rest with behavioral data. In the present study, we wished to establish a direct measure of joint attention skills. Since recording EEG while the child is a participant in joint attention situations would yield too much artefact, we observed children's comprehension of joint attention in video-taped communication situations between two adult actors.

Forty-seven typically developing children aged 20-24 months participated. The children watched video clips illustrating two types of joint attention-related gestures; *protodeclaratives* and *protoimperatives*, as well as parallel play used as a contrasting condition. We hypothesized that the three conditions would cause different EEG activity. The EEG analysis was focused on power in two bands: 3.9 - 5.9 Hz and 5.9 - 8.3 Hz.

EEG power differed significantly between the three film types in both frequency bands. Further analysis by pair-wise comparisons showed that all three experimental conditions were significantly separated in both bands. We found no significant difference between the two age groups, indicating that participants did not change their responses to the three types of behaviors within this age interval.

The EEG data were related to language skills, derived from parental assessment. A correlation analysis showed a significant relation between the MacArthur CDI and the band power difference between the maximally activating proto declarative film clips and parallel play film clips ($r=.46$, $p<.005$).

These findings lend support to the hypothesis that children before the age of 2 are able to detect the moment when a nonverbal dialogue, going on between two other persons they are merely observing, shifts from one intentional stance to another. Early language acquisition may to a large extent be derived from such types of observational experiences. We discuss alternative interpretations of the results.

**Sa3-34**

## Infants Hear Faces and See Voices

**Sandra Trehub**[1] Jelena Brcic[2]

*1. University of Toronto, Mississauga, Canada; 2. University of British Columbia, Vancouver, Canada*

Adults are capable of matching the utterances of unfamiliar speakers with dynamic visual images from the same speakers. Specifically, when they hear an utterance followed by silent visual displays of two speakers, they match the correct video to the previously heard speaker at above chance levels (Kamachi et al., 2003). These findings indicate that identity-specific cues are available in dynamic facial and vocal signals and that these cues are independent of speaker familiarity.

The purpose of present study was to ascertain whether infants are also capable of linking dynamic auditory and visual cues from unfamiliar speakers. In one experiment, we exposed adults (n = 44) to 30-second samples of infant-directed speech, each of which was followed by two 7-second silent videos, one from the target speaker and the other from a different speaker. The silent videos were always derived from speech samples differing from those heard previously. The assignment of the target auditory stimulus for each pair of videos was counterbalanced across participants. Adults successfully matched the visual images to the previously heard voices at well above chance levels (69.9% correct), $t(43) = 5.73$, $p < .0001$.

In a second experiment, we exposed 6- to 8-month-old infants (n = 44, mean age = 7 months) to the same auditory and visual materials except that each infant heard only one speech sample followed by two silent videos in a preferential-looking procedure. Infants looked significantly longer at the videos of the previously heard speaker (M = 57.37%, SD=15.46) than would be expected by chance (50%), $t(43) = 3.16$, $p < .003$. In fact, 33 of 44 infants showed that pattern of performance. The results indicate that infants as well as adults recognize person-specific cues across modalities, even when the auditory and visual cues emanate from different utterances.

These findings go well beyond infants' documented ability to differentiate familiar from unfamiliar voices (e.g., Bahrick et al., 1998) and faces (e.g., Sai & Bushnell, 1988) and their ability to link facial and vocal expressions of happiness or anger (Soken & Pick, 1992). Infants' ability to link dynamic facial and vocal cues to the identity of unfamiliar persons implies that the encoding of such cues occurs automatically, requiring little experience or cognitive sophistication. In fact, such automatic encoding of dynamic vocal and facial features may underlie the rapidity with which newborns recognize their mother's voice and face (e.g., DeCasper & Prescott, 1980).

**Sa3-35**

### Cues Infants use to Visually Discriminate Languages

**Whitney Weikum**, Janet Werker

*University of British Columbia, Vancouver, Canada*

Recognizing and learning one's native language requires knowledge of the phonetic and rhythmical characteristics of the language. Numerous studies have examined the auditory phonetic and rhythmical cues infants' use, but far fewer address the rich phonological information available in a speaker's face. Recent research has shown that solely visual speech information permits language discrimination in both adults (Soto-Faraco et al., 2007) and infants (Weikum et al., 2007). Language experience plays an integral role in maintenance, as 4-month-olds can discriminate languages visually, but this ability declines by 8 months unless the infants are familiar with both languages. To better understand the developmental trajectory of visual language information, the following studies examined whether visual correlates of phonetic segments and rhythmical information are sufficient for visual language discrimination at 4 and 8 months.

Infants' sensitivity to non-native auditory phonetic segments declines toward the end of the first year of life (Werker & Tees, 1984). We tested whether a similar insensitivity to visual phonetic segmental information impairs language discrimination in 8-month-old monolingual English infants. Video clips of bilingual (French/English) speakers silently reciting sentences in both languages were manipulated. Each clip was cut into 200 msec chunks to isolate visual phonetic segments and then randomly reordered to create a scrambled clip that contains segmental information but disrupted rhythmical information. Infants were habituated to English or French scrambled clips, and then shown new scrambled sentences for six test trials. Half viewed test trials from the same language (control condition) and half from the other language (experimental condition). Infants used these cues to discriminate languages at 4 ($p<.05$), but not 8 ($p=.49$) months, supporting our hypothesis that a developing insensitivity to non-native visual phonetic information impairs language discrimination performance.

Mehler and colleagues (1988) showed how infants, using rhythmical speech information, can discriminate languages from different rhythmical classes when they are played forwards, but not backwards. We tested this effect with reversed visual speech. If visual speech information patterns similarly to auditory, we expected that infants would fail to discriminate the reversed languages. Instead, we found that 4- and 8-month-old infants could discriminate the reversed language clips ($p<.05$), suggesting that there is something unique about the reversed visual speech signal that conserves rhythmical differences. These findings parallel the auditory speech literature, but also diverge to highlight unique characteristics of visual speech and further enrich our understanding of how infants come to recognize and learn their native language(s).

**Sa3-36**

### Development of Abstract Grammatical Representation

**Katherine Yoshida**[1] John Iversen[2] Aniruddh Patel[2] Janet Werker[1]

*1. University of British Columbia, Vancouver, Canada; 2. Neurosciences Institute, San Diego, USA*

A fundamental task in language acquisition is segmentation of lexical units from the continuous speech stream. A key syntactic unit is the noun phrase: function + content word ("the soup"), the ordering of which differs cross-linguistically (in Japanese, "soup the"). Infants are sensitive to cues distinguishing word class, including perceptual stress (Shi & Werker, 2001) and relative frequency (Gervain et al., 2007), where functors are less stressed and more frequent. Recent work has revealed a culture-specific abstract noun phrase representation (Gervain et al., 2007). This artificial grammar-learning experiment presented alternating function (frequent) and content words (infrequent), and revealed that Japanese- and Italian-learning 8-month-olds displayed grouping preferences consistent with native noun phrase structure (i.e., for the Italians, [function-content] and the Japanese, [content-function]). We ask whether stress cues like duration are incorporated into the grammatical representation and probe the level of abstraction.

Previous work has revealed an analogous cultural difference in response to a nonlinguistic sequence of short and long tones: English infants and adults segment after the long tone (Trainor & Adams, 2000) while Japanese adults segment into [long-short] units (Iversen, Patel, & Ohgushi, 2007). If the tone segmentation preferences are shaped by an abstract linguistic mechanism, the timecourse of development should coincide with the development of stress-based linguistic segmentation. In previous work, it has been shown that infants of 8-months (Johnson & Jusczyk, 2001), but not younger (Thiessen & Saffran, 2003; but see Curtin et al., 2005) rely on stress cues for linguistic segmentation. The present study tests both older and younger infants on their tone segmentation strategies to ascertain whether a developmental shift will be observed in accordance with the transition found in language.

**Method:** Seven-to-8-month-old and 5-6-month-old English-learning infants (N=12 each) were familiarized to an alternating duration tone sequence in a head-turn preference paradigm. Two types of test trials

compared subsequent preference for sequences with a slight gap inserted after each long tone, or after each short tone, biasing perception towards either [short-long] or [long-short] groupings, respectively.

**Findings:** The younger infants showed no preference [t(11)=.070, ns], whereas the older infants displayed a novelty preference for [long-short] test trials [t(11)=3.50, p=.005], suggesting that they had grouped the familiarized sequence into [short-long] units. This indicates the emergence of segmentation in concert with linguistic abilities, documenting development of abstract grammatical representation, and extends the cues incorporated to stress, specifically duration. Future directions include expansion to Japanese-learning infants.

**Sa3-37**

### Language Differences in Lexical Structure: Evidence From Hungarian Child-Directed-Speech

**Tania Zamuner**[1] Judit Gervain[2]

*1. Radboud University Nijmegen, University of British Columbia, Vancouver, Canada; 2. University of British Columbia, Vancouver, Canada*

Previous research has shown that English children's early lexicons have a large proportion of lexical items that contrast in word-initial position (DeCara & Goswami, 2002; Zamuner, 2006). For example, children's lexicons tend to contain phonological neighbours such as 'pin' and 'bin'. One argument that has been made is that languages' vocabulary structures reflect the sequential temporal processing of speech. If speech is processed linearly, then vocabularies will develop to maximize contrasts at word-onsets because an abundance of words that begin with the same sounds would interfere with lexical retrieval. Cross-linguistic evidence to support this claim comes from other languages that also have a higher proportion of words that contrast in word-onset position (i.e. for German and French, Goswami, 2002). However, neighbourhood densities have been shown to vary according to word-length (Storkel, 2004) and by language (Vitevitch & Stamer, 2006). Further cross-linguistic work is needed to examine the structure of lexicons in languages with different phonological and morphological patterns.

This research examines the structure of phonological neighbourhoods in Hungarian child-directed-speech. Hungarian is a Finno-Ugric language, with different phonological and morphological patterns than found in English. For example, Hungarian has vowel harmony and it is an agglutinating language (Siptár & Törkenczy, 2000). If neighbourhoods reflect basic speech processing abilities, we would predict to find the same neighbourhood structure in phonologically and morphologically distinct languages.

Analyses of neighbourhood densities were done on a corpus of Hungarian child-directed-speech compiled from CHILDES (Gervain, 2007). Neighbours were analyzed to determine the proportion of rhyme neighbours (as in pin/bin), consonant neighbours (as in pin/pan/), and lead neighbours (as in pin/pit). Analyses were restricted to monosyllabic CVC words. For both type and token counts, the highest proportion of neighbours were with lead neighbours (type: .48, token: 60), then rhyme neighbours (type: .31, token: 25), followed by consonant neighbours (type: .21, token: 15).

Surprisingly, Hungarian patterned in the opposite direction as English: Hungarian has proportionally more lead neighbours. One possible account is that the vocabulary structure of Hungarian reflects it's rich system of morphological processes. These data illustrate that children's target lexical structure will vary greatly from language to language. This in turn has implications for the patterns we predict to see in early speech perception and production. Preliminary analyses on Hungarian production data indicate that children's vocabularies at the early stages of lexical development pattern with the Hungarian input, rather than reflecting patterns established in other languages.

## *Psychopathology and Developmental Delay*

**Sa3-38**

### Early Attention Shifting and Joint Attention Deficits in Infants at Risk for Autism

**Daniel Messinger**, Tricia Cassel, Lisa Ibañez, J. D. Haltigan, Susan Acosta, Kara Kelley

*University of Miami, Coral Gables, USA*

Children with Autism Spectrum Disorders (ASDs) are impaired in their ability to visually disengage attention from stimuli. Prospective studies have begun to identify disengagement deficits in the infant siblings of children with an ASD (ASD-sibs) as compared to the infant siblings of typically developing children (COMP-sibs). We investigated the development of patterns of visual attention (gazing) in ASD-sibs (n = 17) and COMP-sibs (n = 17) at six months during the Face-to-Face/Still-Face Protocol (FFSF) and during the examiner-administered Early Social Communication Scales (ESCS) at eight, ten, twelve, fifteen, and eighteen months of age. All ps < .05

In the FFSF, the mean duration of ASD-sibs' gazes away from their parents' faces was greater than those of COMP-sibs. In addition, ASD-sibs shifted their gaze to and from their parents' faces less frequently than COMP-sibs. The frequency of gaze shifts positively correlated with the mean of initiating joint attention behaviors in the ESCS between eight and eighteen months of age.

In the ESCS, ASD-sibs showed an overall reduction in initiating joint attention with the examiner (i.e., nonverbally offering and showing objects and events), with significant deficits evident at eight, ten, and fifteen months. ASD-sibs also showed an overall reduction in responding to the examiner's joint attention bids (i.e. less likely to orient to the examiner's points) with significant deficits evident at 15 and 18 months.

As early as six months, ASD-sibs had difficulty disengaging from non-face stimuli in the environment. Infants who shifted their gaze less frequently in the FFSF had apparent difficulties disengaging attention from events to initiate joint attention with an examiner. Deficits in both initiating and responding to joint attention may be a manifestation of the "sticky" attention thought to characterize older ASD children and infant ASD-sibs who later receive an ASD diagnosis.

**Sa3-39**

### Gesture, Vocalization, and Toy Play in 13-Month-Old Infant Siblings of Children with Autism

**Jana Iverson**[1] Stefanie Poulos-Hopkins[2] Robert Wozniak[2]

*1. University of Pittsburgh, Pittsburgh, USA; 2. Bryn Mawr College, Philadelphia, USA*

Atypical or delayed development in gestural/verbal communication and play, widely documented in older children with autism, may serve as infant predictors of later autism diagnosis. This study therefore analyzed vocalizations, gestures, and play style of infants at heightened biological risk of autism (the younger Infant Siblings of children with autism, ASD-Sibs, N=14) in relation to comparable data from

comparison sibling infants (COMP-Sibs, N=14). Observations were collected in home play sessions at 13 months of age with diagnostic follow-up provided at 36 months. Play style was assessed using a recently developed Brief Toy Play Scale (BTPS; Poulos-Hopkins, 2007) focusing on variables such as infant exploration of object characteristics, play with varied objects, spontaneous initiation of object play, and maintenance of active engagement in play situations. The BTPS demonstrated excellent internal consistency (alpha = .93) and inter-rater reliability (ICC = .97). Inter-rater reliabilities for vocalization and gesture coding were similarly high (both >90%). Coders were blind to group membership. Results indicated that relative to COMP-Sibs infants, ASD-Sibs produced significantly fewer vocalizations (p=.015), meaningful vocalizations (p=.02), and gestures (p=.03), particularly the later emerging gestures Show and Point (p=.003). ASD-Sibs also displayed less variety in deictic gesture types (p=.045) and received lower toy play ratings (p=.055). Of particular interest is the fact that two ASD-Sibs who received a clinical diagnosis of autism at 36 months were at the bottom of the distribution on all measures. Neither produced meaningful vocalizations. For both, the only gesture produced was Reach, the earliest gesture type to appear in development; and both received BTPS toy play ratings more than 1.5 standard deviations below the mean. These data are discussed in terms of the potential value of observing vocal and gestural communication and toy play in the early identification of autism.

**Sa3-40**

### Using Parental Diary Data to Detect Early Signs of Communicative Delays in Infants at Risk for ASD

Helen Tager-Flusberg, Alice Carter, Leah Casner, Nina Leezenbaum, Annmarie Zuluaga

*Boston University School of Medicine, Boston, USA*

Several prospective studies of infants at risk for autism have identified early signs of ASD at 12 months of age. Across all studies published thus far the most consistent findings are delays in language and communicative development. The primary goal of our ongoing study is to employ novel home-based methods for collecting frequent, detailed and rich behavioral data during the critical period between 6 and 12 months when initial signs of language delay or ASD may emerge. The study includes infants at risk for ASD, defined on the basis of an older sibling with a confirmed diagnosis, and control infants at low risk who have typically developing older siblings. At 6 and 12 months infants are tested in the laboratory on a battery of behavioral measures, including the Mullen Scales of Early Learning and the Communication and Symbolic Behavior Scales (12 months) and parents complete the MacArthur-Bates Communicative Development Inventory. Between these visits, parents complete a weekly web-based diary addressing several key questions about their infants' vocal, gestural and lexical development. Every other week, parents videotape their infants during structured interactions involving toy and social play. Before beginning these diaries parents complete a home visit with a research assistant who guides them through the methods of data collection. Thus far, we have analyzed the web-based diary entries from 12 families. In comparison to the control infants, the infants at high risk show delays in babbling milestones, are less vocally responsive to others, and use few communicative gestures. Implications of these findings for early screening of risk signs will be discussed.

**Sa3-41**

### Play and Emotional Availability in Infants with Down Syndrome

**Simona de Falco**[1] **Gianluca Esposito**[1] Paola Venuti[1] Marc Bornstein[2]

*1. University of Trento, Rovereto (TN), Italy; 2. Child and Family Research, National Institute of Child Health and Human Development, USA, Washington, USA*

**Background:** The aim of this study is to investigate mother-infant interaction and its associations with play in Down syndrome infants. There is consensus that mother-infant interaction during play represents an important determinant of typical infants' play development. Concerning Down syndrome infants, few studies have investigated mother-infant interaction -- in terms of the overall emotional quality of dyadic interaction -- and its effect on infant play. Specifically, this study aims to verify whether mother play affects Down syndrome infants' exploratory and symbolic play, and the interrelation between infants' level of play and dyadic emotional availability.

**Methods:** A sample of 28 Down syndrome infants (M developmental age = 21 months) and their mothers took part to this study. Two 10-min sessions were videorecorded, one of infant solitary and one of infant collaborative play with mother. A coding system for exploratory and symbolic play was applied to both sessions and emotional availability of the dyads was assessed with the Emotional Availability Scales (EAS, 3rd ed.; Biringen, Robinson & Emde, 1998).

**Results:** Down syndrome infants showed significantly more exploratory play during collaborative play with mothers than during solitary play. An increase of symbolic activity during collaborative play with respect to solitary play was also found, and it was higher in infants of highly sensitive mothers relative to infants whose mothers showed lower levels of sensitivity.

**Conclusion:** Dyadic emotional availability and infant play are significantly associated, consistent with the hypothesis that dyadic interactions based on an intense emotional involvement lead to enhanced cognitive functioning. The effectiveness of early intervention programmes for Down syndrome infants as well as infants' responsiveness to and involvement with mother may be enhanced by promoting maternal emotional availability.

**Sa3-42**

### Infant Risk Factors for Toddler Oppositional Behaviors: The Role of Infant Temperament and Maternal Factors

**Danielle Dorn**[1] David Perkins[2] Talia McKay[2] David Bridgett[3] Maria Gartstein[2] Erin Iddins[2] Anna Rittmueller[2] Jessica VanVleet[2] Lindsey Yake[2] Danielle Wald[2]

*1. Washington State University, Enumclaw, USA; 2. Washington State University, Pullman, USA; 3. Yale University, Child Study Center, New Haven, USA*

Oppositional behaviors emerging early in life are a risk factor for later conduct difficulties. Past research has identified temperament contributions to conduct difficulties (e.g., Frick & Morris, 2004). Temperament also has been linked to disruptive behavior disorders in general (Leve et al., 2005). Little research has specifically examined the contribution of temperament in the emergence of oppositional behaviors. The purpose of the current study is to examine the role of infant negative emotionality (NE) and regulatory capacity (RC), after accounting for family and maternal variables, in the emergence of oppositional behaviors at 24 months of age. It was anticipated that both infant NE and RC would make unique contributions to 24 month oppositional behaviors. Furthermore, it was anticipated that family SES, maternal

depression, maternal parenting stress, and maternal negative affect would predict early toddler oppositional behaviors.

One hundred fifty-four mothers of 4 month old infants from four states (Washington, Idaho, Montana, and Oregon) completed a demographics questionnaire, Beck Depression Inventory-II, Adult Temperament Questionnaire, and Parenting Stress Index when their infants were 4 months old and completed the IBQ-R, a measure of infant temperament, when their infants were 8, months of age. When toddlers were 24 months of age, mothers completed the CBCL, which has a scale measuring oppositional behaviors.

Multiple regression was utilized to analyze the data with maternal/family demographic variables entered in the first step, maternal depression and parenting stress in the second step, and 8 month infant negative emotionality and regulatory capacity entered in the final step of the equation. Two significant predictors of 24 month ODD symptoms emerged: maternal parenting stress when infants were 4 months of age (B = .63, t = 2.36, p < .05) and infant negative emotionality measured when infants were 8 months of age (B = .40, t = 2.32, p < .05; infant regulatory capacity did not make a significant contribution to the prediction of 24 month ODD symptoms). Furthermore, predictors accounted for a total of 26.3% of the variance in 24 month toddler ODD symptoms (Adj. R2 = .263).

Findings emphasize the importance of infant NE, after accounting for socioeconomic index and maternal variables (age, negative affect, depression, and parenting stress), in contributing to early emerging oppositional behaviors at 24 months of age. Discussion will focus on the role of potential early parenting focused interventions that may reduce risk for early oppositional and other disruptive behaviors in the toddler period.

**Sa3-43**

### Joint Attention Target Location as a Predictor of Subsequent Language Outcomes in High Risk Children

**Dolores Farhat**, **Shira Kolnik**, Marygrace Kaiser

*University of Miami, Coral Gables, USA*

Joint attention, a child's capacity to coordinate attention with a partner in relation to an object or an event, is a pre-linguistic skill associated with later language. Between 12 and 18 months, typically developing infants progress from responding to joint attention bids within their visual field (left and right) to objects outside of this field (behind) (Delgado et al., 2002; Deak, Flom and Pick, 2000). Delgado et al. (2002) found that individual differences in typically developing 15-month-old infants' ability to respond to joint attention outside of their visual field predicted expressive language at 24 months.

The present study examined whether individual differences in 12-month joint attention based on target location was predictive of subsequent language. Children in this study were enrolled in a birth to three intervention center for prenatal cocaine exposure and are at risk for language and cognitive delays due to numerous psychosocial risk factors. The sample was 73% African-American and 57% female. Responding to Joint Attention (RJA) refers to an infant's ability to follow the attention of a play partner, and was measured based on an infant's ability to correctly respond to pointing trials to the left, right and behind in the Early Social Communication Scales (ESCS; Mundy, Hogan & Doehring, 1996) RJA task. The Reynell Developmental Language Scale (RDLS; Reynell & Gruber, 1990) was used to measure language ability at two years.

Preliminary results revealed that as early as 12 months, infants respond significantly more to bids within their visual field ($M$= 43.75, $SD$ = 32.45) as compared to those outside of this field ($M$= 22.27, $SD$ = 34.83), $t(127) = 6.332$, $p < .001$. Correctly responding to Behind trials (β = -.231, $t(79) = -2.11$, $p < .05$) significantly predicted 24-month expressive language. There were only significant group differences based on birthweight for Left/Right trials ($F$ (1, 126) = 5.85, $p < .05$).

Consistent with theory, infants around 12-months were more responsive to RJA bids within their visual field. Similar to the Delgado et al. (2002) study, results showed that target location was not consistently predictive across receptive and expressive language, only predicting expressive language. Contrary to the expected hypothesis, target location negatively predicted expressive language, indicating a need for further study. This is particularly important in a language delayed population as it may help identify a specific precursor of expressive language that may be targeted for intervention.

**Sa3-44**

### Postpartum Depression: Effects on Infant Social Withdrawal

Bárbara Figueiredo, Raquel Costa

*Universidade do Minho, Braga, Portugal*

**Background:** Postpartum depression affects the quality of care and of mother-infant interaction with adverse effects on infant development and behaviour. Objective: In this study we intend to analyze whether 3 months-old infants of depressed mothers (EPDS≥12) show more social withdrawal compared with those of non-depressed mothers.

**Procedure:** The Alarm Distress Baby Scale (ADBB - Guedeney & Fermanian, 2001) and the Bayley Scales of Infant Development (BSID - Bayley, 1993) were administered to a sample of 130 three-month old infants. Their mothers filled out the Edinburgh Postnatal Depression Scale (EPDS, Cox, Holden, & Sagovsky, 1987).

**Results:** 3 months-old infants of depressed mothers presents more social withdrawal (X = 1.53; DP = 1.74) compared with infants of non-depressed mothers (X = .78; DP = 1.25) (t = 2.257; p = 0.05). Infants with high social withdrawal (ADBB> 5) show low scores in the mental (Z=2.098, p=0.051) and behavioural (Z=2.918, p=0.008) development Bayley Scales and in the total Bayley Scale (Z=2.514, p=0.022). To identify predictors of infant social withdrawal - infant and mother's socio-demographics (age, educational level, cohabiting with partner, professional status, parity and type of delivery) as well as mother's depression entered as independent variables in a linear regression analyse (Enter). The model does not predict infant social withdrawal (F=1.017, p=.439); nevertheless maternal depression is the only significant predictor of infant social withdrawal at (t=2.316, p=0.024).

**Conclusion:** Infant social withdrawal is associated to maternal depression and poor development and should be targeted as a sign of infant alarm distress.

**Sa3-45**

### Effect of Parenting Stress on Cognitive Development: a Twin Study

**Keiko Fujisawa**[1] Koken Ozaki[2] Yusuke Takahashi[3] Juko Ando[1] Shinji Yamagata[1]

*1. Faculty of Letters, Keio University, Tokyo, Japan; 2. JST Research Fellow, Tokyo, Japan; 3. The University of Tokyo, Tokyo, Japan*

**Background and Aims:** Previous studies using the behavioral genetic design have suggested that environments which produce the similarity of children growing up in a family (i.e., shared environment) are im-

portant for cognitive development during early childhood. However, few researches have been conducted to examine what environmental factors explain shared environmental variation. One of the possible environmental factors which explain shared environmental variance of children's cognitive ability is parenting stress (Feldman et al., 2004). Aims of this study were to examine: 1) the extent to which parenting stress accounted for the variation of cognitive ability independently from genetic and other environmental factors; 2) the age-related difference of the effect of parenting stress on cognitive ability.

**Methods:** Participants were a part of Tokyo Twin Cohort Project (ToTCoP; Ando et al., 2006); 45 pairs of 18-month-old twins (MZ= 18 pairs; DZ= 27 pairs), 45 pairs of 24-month-old twins (MZ= 25 pairs; DZ= 20 pairs), and their mothers. Children's cognitive ability was assessed by Bayley Mental Development Index (MDI; from Bayley Scales of Infant Development; Bayley, 1993). Mothers' parenting stress was assessed by Parenting Stress Inventory (PSI; Abidin et al., 1995). The total score of items for parent domain from PSI was used as shared environmental factors for analyses. Univariate genetic analyses were separately conducted for twins of 18-month-olds and for twins of 24-month-olds to assess the relative contribution of parenting stress, genetic and environmental factors other than parenting stress to the variation of cognitive ability.

**Results:** Shared environment accounted for 29% and 64% of the individual differences of MDI for 18-month-olds and for 24-month-olds, respectively. PSI accounted for 2.4% and 5.8% of shared environmental influences for 18-month-olds and for 24-month-olds. Influence of genetic factors was more substantial for 18-month-olds (52%) than for 24-months-olds (21%). Nonshared environmental influences accounted for 20% for 18-month-olds and 15% for 24-month-olds.

**Conclusion:** Although the effect of parenting stress as shared environment was not major on the whole, it increased during later toddlerhood. As the influence of shared environment was substantial, the effect of genetic factor was relatively weak for 24-month-olds compared to 18-month-olds. However, this age-related change should be interpreted with caution, because of small sample sizes and cross-sectional analysis. Thus the longitudinal analysis with larger sample size will be necessary. A possible mechanism in which parenting stress and other shared environmental factors affect children's cognitive development will be proposed.

**Sa3-46**

### Tonic Cardiac Rhythms and Regulation in Newborns of Depressed and Non-Depressed Mothers

**Nancy Jones**, Chantal Gagnon
*Florida Atlantic University, Jupiter, USA*

**Background and Aims:** Newborns of depressed mothers have exhibited dysregulated physiological and emotional responses compared to newborns of non-depressed mothers. Specifically newborns of depressed mothers show tonic EEG patterns manifesting hypoactivation of the left frontal region of the brain (Jones et al., 1997, 1999), lower heart rate variability (Field & Pickens, 1995), and fewer responses to facial and auditory presentations of emotion (Jones & McFall, 2004; Lundy et al., 1996). The purpose of the present study was to examine group differences in cardiac vagal regulation and the association between behavioral responses, behavioral regulation and the recovery of cardiovascular activity from negative emotions.

**Method:** 129 newborns were tested, 44 newborns of depressed and 85 of non-depressed mothers. All infants were healthy, full-term births, with 78% vaginal and 22% cesarean deliveries. Mothers were predominately adult (M age=28.64, SD =6.29), middle-class (M Hollingshead score=3.13, SD =1.01) women, with 71.3% Caucasian, 17.9% African American, 5.4% Hispanic and 5.4% Asian American. During an alert period, infants were presented with two, 4-min. sounds, a cry and a computer-simulated sound (a control measure). Second by second behavioral assessments (infant state, affect, gaze, and regulation) were coded. Inter-rater reliabilities for all measures were good (Kappas=.82 to .89). Heart rate was recorded in a subsample of 30 newborns (N=15 in each group). A digital camera recorded the infants' behavioral responses and ECG leads and a laptop computer recorded the infant's heart rate patterns (i.e., measures of vagal regulation and seconds for cardiac patterns to return to (recover) baseline).

**Results:** Multivariate ANOVAs were conducted on behaviors and cardiac activity with the depression and sound-type as grouping variables. Newborns of depressed mothers had lower tonic vagal regulation, $F(1,29)=8.13$, $p<.05$, M=2.15 versus M=4.05 and took longer to for cardiac recovery (M=15.6 versus 6.3 sec.). Infants of depressed mothers showed less distress during the cry sound (M=0.18) compared with the simulated sound (M=3.15) whereas infants of non-depressed mothers showed the expected patterns of distress, (M=6.42 for cry sound versus M=2.21 for the simulated sound), $F(3,125)=4.89$, $p<.05$. Newborns of depressed mothers made less use of self-regulatory strategies (M=26.51 versus M=33.69). Behavioral regulation and distress positively related to vagal control, $r(28)=.43$, $p<.05$ with a negative relation between regulation and cardiac activity in the depressed group, $r(13)=-.71$, $p<.05$.

**Conclusions:** These findings add to the empirical literature that newborns of depressed mothers demonstrate greater tonic and emotion-elicited behavioral and physiological dysregulation. The implications of these findings will be discussed within a bio-regulatory model.

**Sa3-47**

### Early Joint Attention and Relations to Preschool Socioemotional Competence in Infant Siblings of Children with Autism

**Erin Koterba**, Meaghan Parlade, Jana Iverson
*University of Pittsburgh, Pittsburgh, USA*

**Background and Aims:** Although links between early joint attention and later socioemotional competence are well established in typical development (Vaughan Van Hecke et al., 2007), little is known about this relationship in children who have an older sibling diagnosed with autism (ASD-sibs, themselves at enhanced biological risk for autism). This study focuses on the nature of the relationship between joint attention and socioemotional functioning in ASD-sibs and examines ways in which these variables differ between ASD-sibs who eventually do/do not themselves receive a diagnosis of autism.

**Methods:** Twenty ASD-sibs were videotaped at home during 12-, 18-, and 24-month administrations of the Early Social Communication Scales (ESCS; Mundy et al., 1996). The ESCS is a semi-structured assessment of children's initiating joint attention (IJA) and behavioral requests (IBR) through eye contact or conventional gestures and of their responding to joint attention bids from another (RJA). At 36 months, parents completed the Infant-Toddler Social & Emotional Assessment-Revised (ITSEA; Carter & Briggs-Gowan, 2000), which assesses children's internalizing and externalizing behaviors, social competence, and dysregulation; and children received an autism evaluation using the ADOS (Lord et al., 2000).

**Results:** While IBR, IJA, and RJA rates increased developmentally as expected, increase in IBR consisted primarily of increase in gestured requests (Mdn12 = .15, SD = .44; Mdn18 = .69, SD = .72; Mdn24 = .72, SD = .50) rather than in requests made via eye contact only. At 12 and 18 months, by contrast, almost all IJA involved eye contact only rather than gesture use (Mdn12 = 0, SD = .04; Mdn18 = 0, SD = .26; Mdn24 = .11, SD = .32). At 36 months, two of the 20 ASD-sibs received an autism diagnosis. Neither of these infants employed conventional gesture to initiate joint attention at any age and their response to joint attention was rare even at 24 months. Finally, large and significant negative correlations were obtained between 12-month IBR and 36-month ITSEA internalizing ($\rho$ = -.754); 12- and 18-month RJA and ITSEA dysregulation ($\rho$s = -.656 and -.718); and 12-month RJA and ITSEA externalizing scores ($\rho$ = -.648), with RJA at 18 months positively related to ITSEA competence ($\rho$ = .654).

**Conclusion:** Findings are interpreted in terms of the nature and degree of developmental delay in ASD-sibs as a group and the possibility of using ESCS measures as early indices for a later autism diagnosis.

**Sa3-48**

### Self-Perceptions on Parenting & Parental Stress:Relations with Maternal Depression

**Yeonsoo Kim**, **Keumjoo Kwak**, Soyeon Yoon, Jeeyeon Kim, Sunyoung Choi
*Seoul National University, Seoul, Korea*

**Background and Aims:** Maternal internal variables such as depression, anxiety and self concept play important roles in the child development and the interaction with infants (Kim & Kwak, 2003, 2004). Especially, maternal depression influences on touching and responsiveness during interaction with infants and also on infants' developmental outcome(Field, 2004; Kim & Kwak, 2004). Both personal characteristics and parenting result in aggravating maternal depression. Self-perception and parental stress impact on maternal depression differently by producing and organizing parental behavior and arbitrating the effect of parenting(Sigel & McGillicuddy-De Lisi, 2002). This study investigates (1) the relationship between maternal depression at 12months and self-perceptions on parenting and parental stress, and also (2) the impacts influenced on maternal depression after 6months(at 18months).

**Method:** 204 Korean mothers with 12months old infants were participated in this study. Maternal depression (BDI; Beck, Ward, Mendalson, Mock, & Ergaugh, 1961), Self-Perceptions of the Parental Role (SPPR; MacPhee, Benson, & Bullock, 1986), Parenting Stress(PSI: Parenting Stress Index, Abidin, 1990), Psychological wellbeing(PWBS: Ryff & Keyes, 1995) were tested at 12months. After 6months, when infants were 18months, testing BDI was repeated.

**Results:** Maternal depression at 12months was negatively correlated with self perception(r= -.19, p<.01) on the parenting role but was positively correlated with parental stress(r=.25, p<.01). In other words, as self-perception on parenting role was more positive and parenting stress was lower, maternal depression was higher. Also, maternal depression had significantly negative correlation with subjective well-being(r= -.15, p<.05). Repeated measures at 12 and 18 months on maternal depression showed that the maternal depression decreased as the infant's age increased (BDI: 12month M=29.97, 18month M=28.03), and it was statistically significant (F=29.00, p<.01). In addition, maternal depression at 12months were positively correlated with maternal depression at 18months(r=.59, p<.01), and self perception on parenting role was negatively correlated with maternal depression at 18months(r= -.17, p<.01). However, there was no significant relationship between parental stress at 12months and maternal subjective well-being.

**Discussion and Conclusions:** This study shows that maternal depression is constantly stable covering 12months through 18months. It shows that each variable is differently related to parenting. Maternal depression and self-perception on parenting role at 12months would expect maternal depression at 18months. However, parental stress and happiness do not impact on maternal depression at 18months. This result suggests that impact of parental stress at 12months is relatively higher than at 18months.

**Sa3-49**

### Evidence of Early Markers of Language Impairments in Infancy

**Nicole Magaldi**
*William Paterson University, Brooklyn, USA*

**Background and Aims:** Previous findings in the area of babbling and gesture development suggest that prelinguistic behaviors in infancy may be affected by language impairments to come (Stoel-Gammon, 1989; Thal, Tobias, and Morrison, 1991), and therefore may act as early markers of language impairment. To date there have been few studies that have directly examined the prelinguistic behaviors of infants later diagnosed with language impairments. In order to determine whether children with language impairments demonstrate differences in prelinguistic behaviors during infancy, this study compared the babbling and gesture use of ten infants, five who were later diagnosed with a moderate language impairment (LI) and five typically developing children (TD).

**Method:** Subjects were matched based on gender, socio-economic status, and ethnicity. Home videos of each child between the ages of six and 12 months were collected and analyzed in terms of rate and complexity of babbling and rate and type of gesture use. Videos were viewed and matched for context, so that the context was the same for all comparisons. Each vocalization made by the child was transcribed and coded as either a non-canonical vocalization or canonical babbling. Gestures were analyzed in terms of gesture type and frequency of use. The conversational context was also noted for each behavior, so that gestures and vocalizations were coded as being made spontaneously, in response, or in imitation. In order to analyze possible differences and changes in behaviors at different ages, data were separated into three intervals: 6-7 months, 8-9 months, and 10-12 months. Ten percent of all videos were coded by a second reviewer blind to the infant's diagnosis and interrater reliability was 90% for vocalizations and 92% for gestures.

**Results:** An independent samples t-test revealed that at 10 - 12 months of age the LI group had a significantly lower total rate of gesture use than the TD group (t= 2.59, p < .05, Mean (LI) = 1.79, Mean (TD) = 15.77). Although no statistically significant difference was noted in the two groups babbling rate, at the 8 - 9 month age range the TD infants had a mean rate of canonical babbling more than 6 times the rate of the LI infants (LI: 6.25, TD: 40.25). Additionally, the two groups demonstrated very different patterns of canonical babbling and gesture use across the 6 - 12 month age range.

**Conclusions/Discussion:** These results provide some of the first evidence of early markers of language impairments in infancy.

**Sa3-50**

## Development of Infant Negative Emotions and Early Risk for Emerging ADHD Symptoms

David Bridgett[1] **Talia McKay**[2] **Maria Gartstein**[3] David Perkins[2] Danielle Dorn[2] Erin Iddins[2] Anna Rittmueller[2] Kristin Ramsay[4] Lindsay Yake[2] Stephanie Kelley[2]

*1. Yale University, Child Study Center, Branford, USA; 2. Washington State University, Pullman, USA; 3. Washington State University, Moscow, USA; 4. Washington State University, Spokane, USA*

In addition to regulatory aspects of temperament, such as effortful control, demonstrating connections to ADHD symptoms (e.g. Martel & Nigg, 2006), negative emotionality (NE) and related constructs also have demonstrated connections with ADHD. Specific NE related constructs associated with increased symptoms of ADHD include anger, sadness, and irritability (e.g., Cukrowicz, et al., 2006; Braaten & Rosen, 2000; Nigg et al., 2004). Few previous studies have examined infant temperament and early emerging ADHD symptoms in toddlerhood. Furthermore, no studies have examined the impact of changes in temperament in the first year of life on subsequent toddler ADHD symptoms. In the current study, latent growth modeling was utilized to examine how infant NE intercept and slope factors are associated with emerging symptoms of ADHD when toddlers were 24 months of age. Controlling for maternal depression, we anticipated that initially high levels of infant NE and steeper slopes of infant NE would be positively associated with increased ADHD symptoms measured at 24 months of age.

One hundred fifty-four mothers of 4 month old infants from four states (Washington, Idaho, Montana, and Oregon) completed a demographics questionnaire and the BDI-II when their infants were 4 months old and completed the IBQ-R, a measure of infant temperament, when their infants were 4, 6, 8, 10, and 12 months of age. When toddlers were 24 months of age, mothers completed the CBCL, which provides an index of ADHD symptoms.

A linear spline model, utilizing MLE to handle missing data, with intercept and slope NE factors predicting 24 month ADHD symptoms was fit to the data. Results indicated a well fitting model ($X2$ (df = 14) = 32.46, $p < .01$; CFI = .98; AGFI = .93; RMSEA = .057; AIC = 4.46) with higher initial NE intercept ($z = 4.96$, $p < .01$) and steeper NE slope ($z = 1.91$, $p < .05$) factors significantly predicting toddler ADHD symptoms (23.7% of variance). Maternal depression did not account for interindividual differences in NE intercept and slope factors nor did it add significant variance to the prediction of toddler ADHD symptoms.

These findings indicate dual risk trajectories for early emerging ADHD symptoms. Infants rated as initially high in NE and/or infants who experience steeper/greater increases in NE in the first year of life are at risk for higher levels of ADHD symptoms. Implications for early identification of risk and early interventions to reduce risk will be discussed.

**Sa3-51**

## Toddler Inhibitory Control, Emotion, and Response to Novelty in the Risk for Externalizing Problems

**Emily Robinson**[1] Elizabeth Kiel[1] Kristin Buss[2]

*1. University of Missouri-Columbia, Columbia, USA; 2. The Pennsylvania State University, University Park, USA*

Emotionality (Eisenberg et al., 2001; Putnam & Stifter, 2005), nonfearful responses to novelty (Calkins et al., 2007), and inadequate regulation (e.g., inhibitory control [IC]; Eisenberg et al., 2001, 2007; Rubin et al., 2003) in early childhood have predicted later externalizing problems. Regrettably, interactions among these variables are infrequently investigated, and single measures of outcomes are often used. Given this, the current study examined how observed toddler positive and negative affect, fearful and bold responses to novelty, and IC predicted multiple kindergarten externalizing outcomes in interactive or additive ways. Interactions were also examined in trajectories of effortful control across early childhood as indicators of risk for externalizing problems. Since behavior problems develop differently for boys and girls (Keenan & Shaw, 1997), the current study examined gender as an additional moderator.

One hundred ten 24-month-olds and caregivers participated in a study of toddler temperament. Toddlers participated in IC and novelty tasks at a laboratory visit. Caregivers completed the Child Behavior Questionnaire (CBQ; Rothbart, 2000) when children were 3- (n=69), 4- (n=66), and 5-(expected n=90) years-old. Parent and teacher versions of the Health Behavior Questionnaire (HBQ; Armstrong et al, 2003) were completed at age 5. At an age 5 laboratory visit, children participated in novelty tasks and reported on their symptoms via the Berkeley Puppet Interview (BPI). Age 5 data collection is ongoing.

Analyses examined how interactions among toddler IC, emotionality, behavior towards novelty, and gender predicted Externalizing/ADHD scales of the parent and teacher HBQ and child BPI. An interaction among gender, IC, and positive affect predicted parent HBQ ($t=-1.82$, $p<.08$). For girls only, the relation between positive affect and Externalizing/ADHD was positive at lower levels of IC and negative at higher levels of IC. Toddler IC interacted with gender to predict BPI Externalizing/ADHD ($t=-1.81$, $p<.09$). Higher IC predicted externalizing problems in a negative direction (although non-significant) for girls but had no relation for boys. Toddler boldness in novelty tasks predicted higher BPI Externalizing/ADHD ($t=2.09$, $p<.05$). Growth models revealed an increase in CBQ Effortful Control from 3 to 5 years ($t=9.18$, $p<.001$) and that IC interacted with time to predict Effortful Control in various models involving other variables ($t$'s=1.79 to 2.00, all $p<.10$). Toddlers lower in IC demonstrated dampened growth in Effortful Control. Models will be re-investigated for interactive effects with the full sample.

**Sa3-52**

## Maternal-Fetal Attachment in Pregnant Women with SSRI-Treated and Non-Treated Major Depressive Disorder

**Amy Salisbury**[1] Julie McFarland[2] Barry Lester[1]

*1. Women & Infants Hospital, Brown University, Providence, USA; 2. Brown University, Providence, USA*

**Background and Aims:** Maternal-fetal attachment (MFA) represents women's cognitions, emotions, and adaptations to the pregnancy and the fetus and has been linked to postnatal attachment and relationship disturbances. MFA is often reported to be lower in women with Major Depressive Disorder (MDD), but it is not known if treatment of MDD also affects MFA. This study examined MFA in women with MDD and SSRI treatment.

**Methods:** As part of a larger study on the effects of SSRIs during pregnancy, 184 women were recruited between at 22-26 weeks gestational age (GA). The women were interviewed with the Semi-Structured Interview for the DSM-IV-R (SCID), completed the Beck Depression Inventory (BDI) and 110 of the women completed a modified version of Cranley's Maternal Fetal Attachment Scale (MFAS) at 26 and 36 weeks GA. Two (SSRI vs No-SSRI) by two (MDD vs No-MDD) ANCOVAs were used to examine the effect of SSRI treatment and MDD on MFAS scores at each GA. Potential confounders of socioeconomic status

(SES), parity, and maternal age were included in the ANCOVA. Linear regression analyses tested the relationship between level of depression on the BDI, length of SSRI treatment (Tx) and MFAS scores.

**Results:** There was no significant main effect for SSRI Tx on MFAS scores at either 26 or 36 weeks GA. However, women with MDD had significantly lower scores than non-MDD women at 36 weeks GA (4.13 (.07) vs (4.34 (.06), $F(1, 98)=4.63$, $p<.04$); this was due to women with MDD and no SSRI-Tx having a decrease in their MFAS scores at 36 weeks ($p<.03$), while women in the other groups remained the same or increased their scores. Depression symptom severity predicted MFAS scores at both 26 and 36 weeks ($F(1, 110)=11.01$, $p<.002$; $F(1, 110)=12.30$, $p<.001$). Amount of time with SSRI Tx was not significant in the model. Covariates of SES, parity, and maternal age were not significantly related to MFAS scores at either GA.

**Conclusion:** MDD diagnosis and symptom severity is related to lower MFA in pregnant women. The use of SSRIs in pregnancy did not affect MFAS scores. Women who were treated effectively with SSRIs and had remission of MDD symptoms had higher scores than those without effective treatment. This is an indication that treatment efficacy for MDD may also improve cognitive and emotional aspects related to maternal-fetal relationships. Future research will examine the prenatal to postnatal attachment relationships in depressed women and their infants.

**Sa3-53**

### Predicting Behavior Problems in Toddlerhood from Fearlessness in Infancy

**Jennifer Self**, **Katrinka Boyles**, Lisa Isberg
*Washington State University, Pullman, USA*

The present study sought to determine if fearlessness at 1 year of age was predictive of behavior problems in toddlerhood, constituting a risk factor for externalizing problems. Fear levels were assessed at 1 year using the Infant Behavior Questionnaire-Revised (IBQ-R; Gartstein & Rothbart, 2003), and a laboratory observation procedure based on the Prelocomotor version of the Laboratory Temperament Assessment Battery (LAB-TAB; Goldsmith & Rothbart, 1996). A multi-method construct consisting of the IBQ-R Fear scale and laboratory-based indices of fear was initially developed utilizing previously collected data from an independent sample of infants, and was subsequently replicated and utilized to address hypotheses of this study with the present sample. Thus, this investigation was aimed at discerning whether relatively "fearless" infants would be more likely than relatively "fearful" infants to display externalizing behavior problems in toddlerhood, as assessed by the Child Behavior Checklist for ages 1.5 to 5 (CBCL/1.5-5; Achenbach & Rescorla, 2000). Furthermore, each of the 3 potential predictors (IBQ-R Fear scale, laboratory-based composite, multi-method construct) was entered into a multiple regression to determine which accounted for the greatest amount of variance when child sex and concurrent temperament were controlled. Based on previous research with older children (e.g., Thorell, Bohlin, & Rydell, 2004; Fowles & Kochanska, 2000), it was hypothesized that more "fearless" infants would demonstrate more behavior problems in toddlerhood. It was also hypothesized that the new multi-method construct would be a better predictor than either parent-report or laboratory observation, alone. Analyses of relationships between infant fear at 1 year of age and toddler externalizing behavior problems did not produce statistically significant results, regardless of the measure used ($t = .282$, $p = .779$; $t = -.078$, $p = .938$; $t = -.350$, $p = .728$, for the IBQ-R Fear scale, the laboratory fear rating, and the new multi-method construct, respectively). Results of the investigation did not indicate superiority of the multi-method construct, in so far as it did not lead to statistically significant findings, similar to the single-measure indices. However, estimated effect sizes for regression equations suggested small effect sizes (ranging from .001 to .103), which would likely be undetectable with the size of the sample studied. Therefore, the present study lays the groundwork for future research into the relationship between fearlessness in temperament and later behavior problems, particularly using larger samples.

## *Cognitive Development*

**Sa4-01**

### Neophobia in Infancy Requires a Conceptual Food Category

**Steven Brown**, Gillian Harris
*University of Birmingham, Birmingham, UK*

**Introduction:** Neophobia is the fear of new foods, beginning between the ages of 18 months to 2 years (Cooke, Wardle & Gibson, 2003; Harper & Sanders, 1975). The child sees the food being offered as a non-food and therefore rejects it or, more likely, as a food, but one that is not recognised. The latter suggests infants have developed a conceptual food category.

A conceptual category is one not requiring a perceptual match between stimuli (Herrnstein, 1990) and as yet no research shows infants have developed this concept of food by the time neophobia begins. Awareness of a food concept is difficult to extrapolate from data using other stimuli. Some research suggests more understanding of artifacts than natural items in infancy (Mandler & McDonough, 1998; Mandler & McDonough, 2000) but attributes this to greater exposure to the artifacts. Food, while a natural item, is exposed on a daily basis and serves a biological advantage, so could appear early in category formation.

**Method:** This study used a sorting task with children aged between 15 and 28 months (mean = 21.3 months). 36 different toy foods/animals were presented and, after a period of play, the children were asked to "tidy-up" by placing the toy foods into one box and the toy animals into another box. The children were successful if they exhaustively grouped the items.

**Results:** The results showed that the mean age of the infants able to categorise the items correctly was 22.6 months and the mean age for failing the task was 19.5 months. An independent samples T-test showed that this difference was significant ($t = 3.326$, $df = 24$, $p = 0.001$, one-tailed).

**Discussion:** This study is the first to show that, around the time neophobia begins, infants have a clear understanding of a food category that is not based on visual perceptual qualities. It is suggested in this poster that a conceptual food category is likely to appear younger than demonstrated here and that visual perception and categorisation could play a part in a number of food rejections beginning around 18 to 24 months.

**Sa4-02**

## Cues to Object Persistence in Infancy: Tracking objects through occlusion vs. Implosion

**Erik Cheries**[1] Lisa Feigenson[2] Brian Scholl[3] Susan Carey[1]

*1. Harvard University, Cambridge, USA; 2. Johns Hopkins Univeristy, Baltimore, USA; 3. Yale University, New Haven, USA*

Objects in the real world frequently move in and out of view, as when they pass behind occluding surfaces. Even young infants are able to keep track of objects over time and motion in such situations, despite long occlusion intervals. What factors support and constrain this ability? Research on mid-level vision in adults suggests that persisting object representations are constrained by the precise manner of an item's disappearance at an occluding boundary. Here we explore the power of this cue, in a study of infants' numerical representations. Infants were habituated to dynamic displays of either 2 or 3 randomly moving identical items, which disappeared and reappeared from behind occluders. In the Occlusion condition, the items disappeared and reappeared gradually, via normal accretion and deletion cues along a single edge. In the Implosion condition, the items still disappeared and reappeared gradually (and at the same rate), but did so from all contours simultaneously -- 'imploding' out of existence and then 'exploding' into existence. In a test phase, which was identical across both conditions, infants' looking times were then assessed to 2 versus 3 moving objects without occluders. Infants in the Occlusion condition looked longer to test displays with a novel number of objects compared to habituation, but infants in the Implosion condition showed no such preference for the number of objects. A final Implosion Control condition showed that this effect was not due to a general disruption caused by the anomalous nature of the implosion/explosion display, per se. Infants who were habituated to the same implosion/explosion displays as before successfully dishabituated to a change in the shape of the objects (circles to squares or vice versa) at test when number was held constant. We conclude that the local manner in which an item disappears and reappears serves as a fundamental cue to the maintenance of numerical identity over time: occlusion is a cue that an object has gone out of sight, while implosion is a cue that an object has gone out of existence. More generally, these results are consistent with the idea that the same types of representations are being studied in adult mid-level vision and infant object cognition.

**Sa4-03**

## Development of Prosocial Responding: Helping, Sharing and Comforting in 18- and 24- Month Olds

**Kristen Dunfield**, Elizabeth Kelley, Valerie Kuhlmeier, Laura O'Connell

*Queen's University, Kingston, Canada*

**Background and Aims:** Recent research has shown that by 18-months of age infants readily provide instrumental aid to an experimenter (Warneken & Tomasello, 2006). However, instrumental aid is only one form that "helping" behaviour can take. The current study extends previous investigations by testing 18- and 24- month-old infants' ability to share, comfort, and provide instrumental aid.

**Method:** We gave twelve 18- and thirteen 24-month-old toddlers eight prosocial trials, four of which were non-verbal requests for aid and four of which served as controls to ensure that the children were responding to need and not simply the opportunity to interact with the experimenter. Like previous studies, toddlers could retrieve an out-of-reach object as well as overcome a physical obstacle, but in addition the toddlers were provided with novel opportunities to share food and provide comfort. If toddlers were sensitive to the multiple ways that help can be provided, they should have engaged in more prosocial responses in the experimental compared to control trials in all four tasks.

**Results:** Analyses revealed that both 18- ($t(11) = 2.80$, $p < .05$) and 24- ($t(12) = 4.38$, $p = .001$) month old toddlers were significantly more likely to retrieve an object that the experimenter dropped and reached for, than one that they simply placed on the floor. Twenty-four- ($t(11) = 2.74$, $p < .05$) but not 18- ($t(11) = 1.48$, $p = .16$) month olds were more likely to open a cupboard door for an experimenter whose hands were full and wanted into the cupboard than one whose hands were simply full. When given the opportunity to share food with an experimenter, the 24- ($t(12) = 1.90$, $p = .08$) but not the 18- ($t(11)=1.48$, $p=.17$) month olds tended to share more often when the experimenter had no food than when she and the child had an equal amount of food. Interestingly, although no infant responded to an experimenter who simply banged her knee on a table, all infants expressed concern when her reaction following the injury was distress. We will examine the correlations between all four measures of prosocial responding.

**Conclusions:** Toddler prosocial responding is not limited to simply providing instrumental help; toddlers are able to recognize need and respond appropriately to many bids for aid. Future research should examine the associated cognitive skills that may allow for such complex social behaviour.

**Sa4-04**

## Infants' Reasoning About a Collision Event Involving a Tool: an Example of an Early Understanding of Function

**Marissa Greif**[1] Amy Needham[2]

*1. Department of Psychology, Florida Atlantic University, Boca Raton, USA; 2. Department of Psychology & Neuroscience, Duke University, Durham, USA*

**Background and Aims:** Previous work has shown that infants have many sophisticated expectations about the basic physical behavior of objects. However, far less is known about their understanding of how these principles are embedded in the *functional* properties of objects. For example, infants understand certain elements of containment (Hespos & Baillargeon, 2001), and the support and cupping functions of spoons (Barrett et al., 2007; McCarty et al., 1999). To build on this literature, we examined twelve-month-olds' expectations about the function of a hammer-like tool. A hammer's function rests on its ability to make a direct physical connection, a collision, with a target object. If infants understand this relationship, then they should look longer at a display in which it is violated.

**Methods:** A modified violation-of-expectation procedure was used. In an initial pre-test phase, infants (N=12) watched a popular children's show for 60 seconds or until they looked away for 2 consecutive seconds. Then infants watched two alternating video events for a total of six test trials. In the "possible" event, a human hand lifted a toy hammer up and hit a wooden peg that was suspended inside a raised platform. The peg fell to a table top directly underneath the platform. In the "impossible" event, the hammer hit the table next to the platform but the peg still fell to the table. Test videos were looped to repeat continuously during each test trial and were presented under the same timing parameters as the pre-test. Half of the infants saw possible event first, and half saw the impossible event first.

**Results:** Looking times for each infant were aggregated over the three "possible" trials and three "impossible" trials respectively. On average, infants looked longer at the impossible trials in which the hammer hit the table (M=35.43 seconds, SD = 13.34 seconds) than at possible trials in which the hammer hit the peg (M=27.8 seconds, SD=10.62 seconds), t(11) = 2.43, p<.04. Neither presentation order nor gender yielded significant effects.

**Conclusion:** Twelve-month-old infants appear to understand that direct physical contact is necessary for a hammer to produce a transformation in a target object. That is, they understand that one functional component of a hammer involves a surface-to-surface collision between the hammer and its target. The results will be informed by a discussion about the possible components of functional reasoning in infancy.

**Sa4-05**

### Infant's Developing Concept of Weight: Does Training Matter?

**Petra Hauf**[1] Morgan Blackmore[1] Markus Paulus[2]

*1. St. Francis Xavier University, Antigonish, Canada; 2. Radboud University, Nijmegen, The Netherlands*

Previous studies have demonstrated that 9- and 11-month-old infants use their physical knowledge about compression to infer the weight of objects and that they prefer to reach for the lighter one (Hauf, Paulus, & Baillargeon, subm.). Recent studies have revealed developmental changes in the use of information about material to infer the weight of objects: 11- but not 9-month-olds took into account the material in order to remember the weight of objects. Nevertheless, they did not transfer this knowledge to the weight of new objects made of the same material (Paulus & Hauf, 2007). The aim of the following study was to investigate (1) whether slightly older infants (13-month-olds) are able to infer the weight of new objects due to the material and (2) whether 11-month-olds can be trained to transfer their knowledge about material and weight to new objects. Experiment 1 investigated 16 infants at 13 months of age. During the exploration phase, they successively felt two yellow boxes (200g and 2000g) made out of two different materials (sponge and Styrofoam). Afterwards the experimenter pushed two alternating pairs of differently shaped objects of the same material on a platform toward the infant. Infants were encouraged to reach for the objects in four trials. Infants' reaching preferences were coded. Preliminary analysis suggests that 13-month-olds transfer the information given by material to new objects with other shapes. Experiment 2 investigated 16 infants at 11 months of age by following the same procedure as in Experiment 1. The only difference was that during the exploration phase, differently shaped objects were presented. Half of the infants explored heavy objects made out of sponge and light objects made out of Styrofoam (2000g vs. 200g). For the other half of the infants, the combination of weight and material was reversed. The findings suggest that 11-month-olds can be trained to use the information given by material to infer the weight of differently shaped new objects. In sum, these experiments suggest, that the 13-month-olds have already built up a concept of the relationship between material and weight which helps them to successfully guide their own reaching behaviour. In contrast the 11-month-olds do not yet have such a stable concept; but they can be trained to focus on the combination of material and weight by a short exposure to different exemplars which facilitates their capacity to transfer specific knowledge about material to new objects.

**Sa4-06**

### The Development of Infants' Ability to Perceive the Goal-Directedness of Others' Pointing Actions: Evidence From Korean 6- and 9-Month-Old Infants

**Min-young Kim**, Hyun-joo Song

*Department of Psychology, Yonsei University, Seoul, Korea*

By 6 months, infants interpret others' actions in terms of goals (e.g., Woodward, 1998). Previous findings suggest that between 9 and 12 months, infants come to understand pointing gestures as goal-directed actions (Woodward & Guajardo, 2002). The aim of this study is to confirm the developmental course of pointing understanding during the first year of life, testing Korean infants.

In the present research, 6- and 9-month-old Korean infants first watched 6 familiarization events. During the familiarization events, two novel objects were on the apparatus floor, an actor sat centered between and behind the two objects, and the actor pointed to one of the two objects with her outstretched index finger. After familiarization, the positions of objects were switched. Then each infant received test events of two types: The actor pointed to the new goal object, now in the position formerly occupied by the old object (new-goal event) or the old goal object, now in the position formerly occupied by the new object (old-goal event).

Nine-month-olds looked significantly longer at the new-goal event than the old-goal event, indicating that they encoded the goal-directedness of the actor's pointing gesture. In contrast, 6-month-olds looked about equally during test, suggesting that they have failed to understand the goal of the actor's pointing gesture.

This and preliminary control results suggest that at least by 9 months of age, infants can encode the goal of others' pointing actions. Note that most of our Korean 9-month-olds did not produce pointing gestures yet according to parental reports, but they could still understand the goal of others' pointing gestures in our experimental situation. This result is contrasted with previous finding that 9-month-olds failed to interpret the goal of pointing action overall and only those who could produce their own goal-directed pointing could interpret others' pointing actions as goal-directed (Woodward & Guajardo, 2002). The results are discussed in terms of possible cultural and contextual factors that may help young infants to detect the goal-directedness of pointing gesture.

**Sa4-07**

### Infants Predict Robot and Human's Action

**Nobuko Komori**[1] Yohko Shimada[1] Tomoyo Morita[1] Michiteru Kitazaki[2] Shoji Itakura[1]

*1. Kyoto University, Kyoto, Japan; 2. Toyohashi University of Technology, Toyohashi, Japan*

**Background and Aims:** Modern worlds have new type of agent robot. How do infants perceive robots? The present study focused on infant's perception of a robot. Previous studies had shown that infants discriminate between human and non-human agent. Using habituation paradigm, Woodward (1998) showed that nine month old infants looked longer at non-human agent than at human agent in the test phase. Those studies indicated that 12 month olds might know the characteristics of human and non human agent. However, it is unknown whether infants perceive robots' action differentially from humans'. There are an enormous number of studies that infants can predict goals of other people's action (e.g. Falk-Ytter, Gredeback, & von Hofsten, 2006). Twelve-month -olds indicated goal-directed eye

movement only in human agent stimuli. In this study, we used robot stimuli, to explore infant's understanding of robot's action. When we predicated other's action, beginning of action had some information as well as the end of action. We will investigate predictive eye movement toward goal and start.

**Methods:** Six 12-month-olds and ten adults participated. Video clips of the two types of agent (human or robot) conveying three balls were shown. Participants were randomly assigned to one of the two agent conditions. Procedure followed Falk-Ytter et al.(2006). However, the some experimental setting (the bucket had a face and moved with sound) was removed. The infants' eye-movement was recorded by NAC eye-tracking system.

**Results & Discussion:** We defined two Areas of Interest (AOI); i) the starting position of the conveyance (Object AOI) ii) the goal area of the action (Goal AOI). The participants' gaze shifted from the Object AOI to the Goal AOI. How much time the gaze movement to AOIs preceded the arrival movement of the balls to the AOIs was timed. For both the adults and infants the length of the precedence was longer for the beginning of the action than the end of action. The reverse results in Falk-Ytter et al. (2006) might have been caused by due to their experimental setting. The stimuli where the agents convey the balls had end of action (bucket), the participants think the beginning of action was more important than the end of action. There was no time difference for different agents. The Robot used in this study had head and hand. Participant might give the same attributes both to agents (This Study was supported by Nissan Science Foundation).

**Sa4-08**

### Detection of Motion Direction in Point Light Walkers by 6-Month-Olds

**Valerie Kuhlmeier**, Niko Troje, Vivian Lee
*Queen's University, Kingston, Canada*

**Background and Aims:** Biological motion can be conveyed through capturing videos of humans walking with point lights attached to their major joints, thus eliminating the appearance of mass, depth, bodily features. Studies consistently show that adult observers immediately identify biological motion displays as a human walking (Johansson, 1973). Additionally, for adults, scrambled biological motion which is completely devoid of structural information not only retains information about the direction of a walking human, but also is subject to a pronounced inversion effect such that the direction of inverted walkers is difficult to determine (Troje & Westhoff, 2006). Infants as young as 3-months of age are also sensitive to biological motion (e.g, Bertenthal et al., 1984; 1985); we tested here whether they can also detect the direction of walking, and if this is subject to an inversion effect.

**Procedure:** 6-month-old infants were habituated to movies of an upright (Experiment 1) or inverted (Experiment 2) point-light walker who walked as if on a treadmill (i.e., there was no actual displacement across the screen). For half of the infants, the walk was to the right, and for half the walk was to the left. In test, infants saw the familiar direction of walking on one trial, and the new direction on a second, with order counterbalanced. Looking time to each display was recorded and analyzed.

**Results and Conclusions:** When presented with an upright walker, infants were sensitive to a switch in the direction of walking from habituation to test. Infants looked longer at the new direction than the old in test trials (familiar direction M=7.64s, new direction M=14.03s; $t(19)=2.86$, $p=.01$). In contrast, when the walker was inverted, infants did not seem to notice the switch in direction, and looking times were equal across both trials (familiar direction M=10.06s, new direction M=8.61s; $t(18)=.510$, $p=.616$). Thus, young infants not only seem to recognize the difference between upright and inverted walkers and visually prefer the former (Bertenthal et al., 1984), but they also can detect the direction of motion of upright walkers. The detection of direction does not, however, extend to inverted walkers, suggesting the existence of an inversion effect.

**Sa4-09**

### Relations Between Infants' Responses to Maternal Imitation and Their Later Lexical Development

**Janet Olson**, **Elise Masur**
*Northern Illinois University, DeKalb, USA*

**Background and Aims:** Mothers' imitation of infants' early vocalizations and words is positively associated with children's later vocabulary development. Infants' responses to their mothers' imitation may elucidate how maternal imitation predicts children's verbal development. Thus, this study examined relations between infants' behavioral responses to their mothers' vocal, verbal, and action imitation and the infants' subsequent lexical development.

**Methods:** Twenty mother-infant dyads were videotaped during free play and bathtime at 10, 13, 17, and 21 months. The first infant behavior(s) following maternal vocal/verbal and action imitations was coded into one of the following mutually exclusive, broad categories: No Reaction; Return Imitation; or Social Response, including responsive signals (laughter, smiles, vocalizations, gestures), responsive actions, and/or responsive words. Interrater reliability exceeded 93% (Kappa>.90). Proportions of each category were analyzed. Infants' total lexicons at 17 and 21 months were calculated by combining maternal reports and observations.

**KeyResults:** Infants' responses to maternal vocal/verbal imitation predicted their later vocabularies. Children whose language would accelerate most during the second year had the following characteristics: At 10 months, they were more likely to acknowledge imitation with any Social Response, $r = .62$, $p < .05$. At 13 months, they provided more socially responsive actions, $r > .54$, $p < .05$, and fewer socially responsive signals, $r < -.67$, $p < .01$. They were also more likely to produce Return Imitations, $r = .48$, $p < .05$. At 17 months, more lexically advanced children were less likely to have No Reaction to maternal matching, $r < -.52$, $p < .05$. In addition, by 17 and 21 months, the more advanced children had shifted from repetition alone to incorporating socially responsive but non-imitative words into their replies, $r > .46$, $p < .05$, with some providing socially responsive words to maternal action imitation as well. These responsive words add non-repetitive turns to discourse and may represent opportunities to learn and practice conversational competence.

**Conclusions:** The pattern of responses to maternal imitation by children whose language would increase most during the second year reveals a distinctive developmental trajectory. From a correlational study we cannot determine whether this changing response pattern exerted a causal influence on children's later language ability or was a consequence of it or of a related process. But even as index rather than influence, this sequence of infants' responses to maternal imitations may be informative for researchers and practitioners evaluating developmental progress.

**Sa4-10**

### Cognitions in Mothers of Infants in South Korea and the United States

**Diane Putnick**[1] Marc Bornstein[1] Keumjoo Kwak[2]

*1. NICHD, Bethesda, USA; 2. Seoul National University, Seoul, Korea*

**Background and Aims:** An emerging focus of parenting studies is cognitions-parents' beliefs, attitudes, goals, and knowledge-because they generate and shape parenting practices and afford organization and coherence to parenting tasks. The main purpose of this study was to compare parenting cognitions among mothers of infants from two contrasting cultures.

**Method:** We compared multiple domains of parenting cognitions in 74 South Korean and 75 U.S. mothers of 20-month-olds. Mothers completed questionnaires about: (a) self-perceptions of parenting, (b) self-reports of parenting behaviors, (c) parenting attributions, and (d) parenting knowledge. Measures were selected to be theoretically and age appropriate. We followed several steps to promote the validity, cultural appropriateness, and "adapted equivalence" (van de Vijver & Leung, 1997) of the measures across cultures (e.g., back-translation, pilot testing).

**Results:** Korean mothers rated themselves as more invested, and U.S. mothers rated themselves as more competent, satisfied, and role balanced than Korean mothers. Korean mothers reported engaging in less social interaction than U.S. mothers, but they also reported that they would ideally like to engage more socially than U.S. mothers. Korean mothers reported engaging in fewer didactic exchanges than U.S. mothers, but they did not differ from U.S. mothers in their ideal amount of didactic exchange. U.S. mothers reported higher external attributions of success and lower internal attributions of failure than Korean mothers, and U.S. mothers scored higher in parenting knowledge than Korean mothers.

**Discussion and Conclusions:** Kim and Choi (1994) contended that motherhood is the single most important role for Korean women and that Korean mothers' personhood is fused with that of their children. The relational orientation of Korean mothers is also in evidence in their persistent and enduring support for their children throughout their lives. Choi (1990) reported that Korean mothers place great weight on their role as caregivers, whereas North American Canadian mothers assign equal emphasis to their role as caregivers and their personal development. In Asian cultures, people tend to attribute their successes to external factors, and their failures to internal factors (Choi, Kim, Kim, & Kim, 2000). In our sample and in terms of parenting, however, Asian mothers took more personal responsibility for their successes and their failures. These individual and dyadic allocentric versus idiocentric stresses accord with preferred parenting cognitions in the two societies.

**Sa4-11**

### Constraints on Infants' Object Representations: 8-Month-Olds Individuate Objects But Not Portions of Non-Cohesive Substance

**Rebecca Rosenberg**, Susan Carey

*Harvard University, Cambridge, USA*

**Background:** The mechanisms that subserve mid-level attentional processes in adults have been implicated in infant object representation. One issue in both literatures concerns what entities can be attended, indexed, and traced through space and time. Theories of object-based attention state that objects are privileged, and previous studies show entity tracking is disrupted by non-cohesion. Our past studies suggest infants are unable to index portions of poured sand even when tracking of individuals through occlusion isn't required. The present study removes the observed state change from a pouring to static display to see whether this factor alone disrupts infants' ability to track the substance. We also investigate whether infants simply view multiple portions of non-cohesive substance as "some stuff".

**Methods:** 52 8-month-olds were tested in a visual habituation paradigm. In the sand condition, 16 infants received tactile exposure to sand and were then habituated to one or two portions of sand already at rest on a stage. They then saw six test trials, alternating the new or old number. The object condition was identical except infants were tactilely familiarized to a solid, perceptually similar pile they then saw sitting on a stage. Another 20 infants received tactile exposure to sand and were habituated to small or large portions of sand poured onto a stage, followed by six test trials alternating portion size.

**Results:** Infants discriminated one from two solid piles, but not one from two portions of sand. For the sand condition, infants looked equally long at the novel number (M = 3.95 sec) vs. the familiar number (M = 3.60 sec; $F(1,15) = .331$, ns). Infants in the object condition, however, looked at the novel number (M = 5.88 sec) significantly longer than at the familiar number (M = 3.84 sec; $F(1,15) = 8.09$, $p<.05$). Infants in the size condition looked equally long at the familiar (M = 5.2 sec) and novel size sand piles (M = 5.0 sec; $F(1,19) = .120$, ns).

**Conclusions:** This experiment required infants to discriminate scenes varying in number or size without occlusion. Although infants had no difficulty differentiating one from two solid objects, they failed to distinguish one from two portions of non-cohesive substance or different size portions. These results provide strong evidence for object-based attentional processes in infancy. Objects (bounded, coherent wholes) attracted indexes, whereas non-objects did not. Indeed, infants may not quantify portions of sand as individuals but rather as "some sand".

**Sa4-12**

### Putting the Motion in Motionese: Infants Preferrentially Attend to Infant-directed Action Even with Actors' Faces Obscurred

**Wendy Shallcross**[1] Rebecca Brand[2]

*1. Temple University, Philadelphia, USA; 2. Villanova University, Villanvoa, USA*

Adults spontaneously enact a constellation of action characteristics in the presence of infants, referred to as motionese or infant-directed (ID) action (Brand, Baldwin & Ashburn, 2002). These characteristics include higher interactiveness (e.g., increased eye gaze), greater enthusiasm, larger motions, greater repetitiveness, and greater simplification relative to adult-directed (AD) actions. As with other ID modifications, motionese may encourage attention and facilitate processing of relevant stimuli (e.g., Csibra & Gergely, 2006; Fernald, 1985).

Shallcross & Brand (2007) demonstrated that 6- to 8-month-old infants preferred ID to AD action demonstrations in a preferential looking paradigm. Infants did not have a preference for corresponding still-frame pictures of the demonstrator pairs, indicating that their preference was not driven by the general appearance of the demonstrators.

In light of infants' documented sensitivity to eye gaze and positive emotional expressiveness (Haines & Muir, 1996; Termine & Izard, 1988), it was important to investigate whether these features alone were driving the preference for ID action. Thus, using identical methods with fifty-two 6- to 8 and 11- to 13-month-old participants, we attempted to (1) replicate the preference for motionese, (2), extend the findings to an older age group, and (3) determine whether infants at

both ages would continue to prefer ID action displays with the faces of the demonstrators digitally blurred to hide expression and eye gaze information.

We found that six- to 8-month-old infants in the standard condition looked to the ID clips more than 50% (M = .54, SD = .11), although not significantly, t(13) = 1.37, p = .192. Eleven- to 13-month olds preferred standard ID clips to AD clips (M = .59, SD = .08), t(11) = 4.00, p = .002. Both 6- to 8-month-olds and 11- to 13-month-olds in the blurred condition showed a significant ID preference (M6-8 = .60, SD = .08), t(13) = 4.50, p = .001; (M11-13 = .59, SD = .08), t(11) = 3.77, p = .003. Infants still did not show a preference for ID versus AD demonstrators in the corresponding still frame clips (MID = .47-.50), ts = -.048 to - 1.01, ns.

Results from this study demonstrate that what caregivers do with their faces is not necessary to enhance infant attention; demonstrators' hand, arm, and body movements are in fact sufficient. This hints at the possibility of specialized roles for each of the features of ID interaction and encourages additional research.

**Sa4-13**

### Infants' Sound Production as an Ontogenetic Origin of Singing

**Yohko Shimada**, Shoji Itakura

*Department of Psychology, Graduate School of Letters, Kyoto University, Kyoto, Japan*

**Background and Aims:** Infants' sound production in communicative context have studied well, however, their sound production in solitude had not investigated. the behavior was mentioned only episodically. The present study investigated the difference in sound patterns produced by infants when they are in interaction and in solitude. We hypothesized that infants produce sound in solitude, and the purpose of the behavior is sound feedback.

**Method:** In the experiment, after the experimenter and the mother agreed that the infant was in comfort states, the mother started the first condition: 1) the respond condition, where the mother responded naturally to the infant. The other two conditions were started when the infant started to produce sound spontaneously and continuously in comfort states: 2) the no response condition, where the infant was alone in a comfortable state and produced sound spontaneously, and 3) the no response amplified condition, where the infant was alone and got amplified feedback of their own sound from two speakers. The frequency of sound production and total duration of sounds in the three conditions were compared.

**Results:** The result showed that the frequency of production of longer sound (more than one second) were significantly higher in the no-response condition than the respond condition, and in the no-response amplified condition than the no-response condition. The sound-to silence ratio was also increased in no-response condition and in no-response amplified condition. The result suggested that the infants' behavior in solitude was promoted by the sound feedback itself as we predicted. The possible interpretations of infants' solitude sound production related to ontogenetic origin of singing and communication. (This study was supported by HAYAO NAKAYAMA Foundation for Science, Technology & Culture)

**Sa4-14**

### Learning Words from Social Partners and People on Video

Gabrielle Strouse, Megan Saylor, Georgene Troseth, Kate O'Doherty

*Vanderbilt University, Nashville, USA*

Toddlers make use of speakers' social cues for word learning purposes, including eye-gaze, gesture, and emotional outbursts (see Baldwin & Tomasello, 1998). The present study focuses on whether very young children use social cues presented on video (another potential learning context) to guide their word learning.

A researcher taught 30-month-old children a new word ("modi") for a novel object: She gazed at and repeatedly labeled an object inside an opaque bucket, while either sitting directly across the table (live condition) or appearing on a video monitor in the same location (video condition). The researcher also commented on but did not label a distracter object visible in a transparent container. Children then were asked by another researcher which of the two objects was the "modi."

Two other groups began the study by playing interactive games (including "Simon Says" and singing a song) while seated across from the experimenter (live interactive) or TV (video interactive). In the latter condition, the experimenter in an adjacent room interacted with the child via closed-circuit video. Following the interactive games, the researcher labeled the object and the children's learning was tested as described above.

A univariate ANOVA with condition (live, video) and interactivity as fixed factors and test score (% correct object choices) as the dependent variable revealed significant main effect of condition, $F(1, 72) = 8.34$, $p = .005$, and interactivity, $F(1,72) = 4.88$, $p = .030$, and no interaction. As predicted, children in the live conditions learned the word more often than children in the video conditions; social cues presented face-to-face had more impact. However, our prediction that adding an interaction would highlight the social cues and contingency present in the video (and boost word learning) was not supported. Children in the interactive conditions identified the labeled object significantly less often than children in the original conditions.

In an earlier study, contingent interaction via video helped toddlers use information from that source in an object retrieval task (Troseth, Saylor, & Archer, 2005). The key difference may be the type of interactive activities; in the prior study, parents conversed with the person on video about the child's pets and birthday, and that person focused on and talked about an item in the child's environment. These "personal" aspects may have been important for children to accept the person on video as a social partner. In contrast, our current interaction was similar to those appearing on commercial television, with no personal identifying information used.

**Sa4-15**

### The Developmental Relation Between Cognitive Ability and Shyness

**Christy Wolfe**[1] Martha Bell[2]

*1. University of Louisville, Louisville, USA; 2. Virginia Tech, Blacksburg, USA*

The research literature consistently reports associations between cognition and emotion (Blair, 2002; Wolfe & Bell, 2004; Davis, Bruce, & Gunnar, 2002), and developmentally, the association between the two has been described as reciprocal and dynamic (Bell & Wolfe, 2004). The purpose of the current investigation was to explore the relation between a cognitive construct, namely working memory and inhibitory control (WMIC), and an emotive one, temperamental shyness.

Moderate, yet consistent, associations between cognitive performance and shyness have been reported throughout the child (e.g., Crozier & Hostettler, 2003; Ludwig & Lazarus, 1983; Wolfe & Bell, 2004) and adult (e.g., Eysenck & Calvo, 1992; Lieberman, 2000) literatures. Although the studies are correlational in nature, the majority suggests that the direction of influence goes from personal behavioral style to impact cognitive performance in some way. This assumed direction of influence is readily understandable and is supported by much theory and research on the construct of temperament as biologically-based, individual differences in reactivity (Rothbart & Bates, 1998) and others upholding the biological underpinnings of personality (Eysenck, 1994; Allik & McCrae, 2002). However, recognizing the limitations of correlational research and also that multiple pathways of development exist, might the opposite direction of influence be possible? That is, might cognitive ability during early infancy be influential in the concurrent or subsequent demonstration of inhibited behavioral style?

To investigate this relation between cognitive ability and shyness, a cross-lagged correlational design was used. Twenty children were measured at 8-months of age and again at 4 -years on WMIC ability and temperamental indicators of shyness (i.e., 8-months, "fear", Infant Behavior Questionnaire, Rothbart, 1981; 4-years, "shyness", Children's Behavioral Questionnaire, Rothbart, Ahadi, Hershey, & Fisher, 2001). The results of the cross-lagged panel exploration suggest that cognitive ability at 8-months influences shyness at 4-years, but not vice-versa, as WMIC at 8-months was associated with shyness at 4 -years (r = -.50), but shyness indicators at 8-months were not related to WMIC at 4 -years (r = -09).

These findings will be explained in terms of early individual differences in the efficiency and flexibility of the central executive processor and the articulatory loop (Baddeley and Hitch, 1974; Engle, Kane, and Tuholski, 1999), in the allocation of attentional resources (Kahneman, 1973), and in processing efficiency (Eysenck & Calvo, 1992). A reciprocal and dynamic account will be presented of how individual differences in cognitive processing may provide one pathway to shy and inhibited behavior.

**Sa4-16**

### Can a Self-Propelled Object Change the Position of Its Parts?

**Di Wu**, Renee Baillargeon

*Dept. of Psychology, University of Illinois at Urbana-Champaign, Champaign, USA*

Previous research suggests that by 5 months of age infants realize that self-propelled objects can initiate their motions and resist efforts to move them, but cannot pass through obstacles. In a series of experiments, we have been examining whether 5-month-olds hold expectations about not only the displacements but also the transformations of self-propelled objects. Do infants hold expectations about whether self-propelled objects can alter the appearance, orientation, or position of their parts?

During familiarization, infants saw a self-propelled box with a prominent part (e.g., a brightly-colored "tail") move back and forth across an apparatus. During test, the box stood stationary and a screen was lifted to hide the box and then lowered again. When revealed, the box was either the same as before (no-change event), or its prominent part had changed (change event). In one experiment, the part had changed appearance (e.g., the tail had a new shape); in another experiment, the part had changed orientation (e.g., the tail was now vertical). Infants who saw the change event looked reliably longer than those who saw the no-change event in the appearance but not the orientation experiment. These and control results suggested that, by 5 months, infants realize that a self-propelled object can alter the orientation but not the appearance of its parts.

Additional experiments using a similar procedure examined whether 5-month-olds believe that a self-propelled object can alter the position of its parts. During familiarization, a self-propelled box with a flap on its left and right sides moved across the apparatus; each flap stood parallel to the floor. During test, the box, when revealed, was either the same as before or had changed: one flap had moved to the opposite side of the box, below the other flap. Infants who saw the change event looked reliably longer than those who saw the no-change event. Similar results were obtained when infants saw the box with the two flaps on the same side during familiarization; infants looked reliably longer when the box was revealed with a flap on each side during test.

Thus, 5-month-olds believe that a self-propelled object may change the orientation but not the appearance or the position of its parts—at least, not when this position change involves a symmetry-violating change. Ongoing experiments are examining whether infants would accept a symmetry-preserving position change, in which flaps move higher or lower but remain on the same side of the object.

**Sa4-17**

### 2.5-Month-Olds Hold Different Expectations About the Support of Inert and Self-Propelled Objects

**Sylvia Yuan**, Renee Baillargeon

*University of Illinois, Champaign, USA*

Prior work suggests that by 6.5 months of age, infants possess different expectations about the support of novel inert and self-propelled objects: specifically, they expect inert but not self-propelled objects to fall when released in midair. Researchers have speculated that infants endow self-propelled objects with an internal force which allows them to "resist" falling. Here we asked whether these expectations are already in place by 2.5 months of age.

Infants were assigned to an inert or a self-propelled condition. Infants in the inert condition saw two test events. In the supported event, a gloved hand lowered a cylinder onto a platform and released it; after a pause, the hand grasped the cylinder and lifted it back to its starting position, to begin a new event cycle. Cycles were repeated until the trial ended. In the unsupported event, the hand performed the same actions but the platform now stood to the side so that the cylinder was released in midair; as in the supported event, the cylinder remained stable when released. Infants in the self-propelled condition saw similar test events except that the hand was absent and the cylinder moved by itself.

Infants in the inert condition looked reliably longer at the unsupported than at the supported event, whereas infants in the self-propelled condition looked about equally at the events. These results suggested that, by 2.5 months, infants already hold different expectations about the support of novel inert and self-propelled objects.

However, an alternative interpretation was that the infants in the self-propelled condition were merely confused by the self-propelled cylinder and thus held no expectation about its behavior. Results from a control experiment suggest this was not the case. An experimenter first tilted a small table towards the infants to reveal that its top surface was either closed (closed condition) or open (open condition). Next, the table was placed upright (its top surface was then no longer visible), and infants watched a test event in which the self-propelled

cylinder moved up and down, passing through the top surface of the table. Infants in the closed condition looked reliably longer at the test event than infants in the open condition, suggesting that they realized the cylinder could not pass through the closed surface of the table.

Together, the present results suggest that by 2.5 months of age infants already expect an inert but not a self-propelled object to fall when in midair.

**Sa4-18**

### Array Heterogeneity Affects Infants' Working Memory Capacity

**Jennifer Zosh**, Lisa Feigenson

*Johns Hopkins University, Baltimore, USA*

Adults and infants demonstrate a capacity-limited working memory system that is constrained to representing up to 3 items at once (e.g., Luck & Vogel, 1997; Feigenson & Carey 2003, 2005). However, infants and adults show strikingly different patterns of performance when working memory capacity is exceeded. Infants, unlike adults, exhibit a catastrophic failure of memory when they attempt to represent more than 3 identical items (Feigenson & Carey 2003, 2005). For example, 10- to 14-month-old infants fail to search for any remaining hidden objects when 4 identical objects are hidden and only 1 or 2 of them are removed, suggesting failure to represent the array as "exactly 4," "approximately 4," or even "more than 2." However, recent evidence suggests that properties of the array can dramatically affect performance. When the object array contains heterogeneous, but not homogeneous, objects, infants successfully continue searching when only 2 of the 4 objects have been retrieved (Zosh & Feigenson, 2006). Thus, array heterogeneity appears increase infants' working memory.

How does heterogeneity affect infants' memory? There are two possibilities, 1) heterogeneity expands memory capacity (i.e., allows infants to remember exactly 4 objects) or 2) heterogeneity protects against catastrophic failure and allows infants to remember 4 as "3" (i.e., allows infants to "fill" working memory but does not increase the capacity of working memory beyond the 3-item limit). We tested these possibilities by comparing 13-month old infants' searching after seeing 4 perceptually heterogeneous novel objects hidden and retrieving a subset of them (either 2 or 3). If heterogeneity increases the *number* of objects infants can remember from 3 to 4, they should continue to search for remaining objects after *either* 2 *or* 3 of them have already been retrieved. Alternatively, if infants are remembering 4 heterogeneous objects as "3", they should only continue to search after 2, but not 3, objects have been removed. This is precisely what we found. Infants did *not* reach for the remaining object after 3 objects were retrieved, but did after just 2 were retrieved.

Thus, array heterogeneity appears to prevent catastrophic forgetting, rather than expanding the capacity limit of working memory itself.

## *Communication and Language*

**Sa4-19**

### Longitudinal Change of Speaking Rate in Infant-Directed Speech

**Shigeaki Amano**, Tadahisa Kondo

*NTT Communication Science Laboratories, NTT Corporation, Soraku-gun, Japan*

**Background and Aims:** Infant-directed speech (IDS), which is spoken to an infant by a caretaker such as a parent, plays an important role in infant's language development. Previous researches have revealed that IDS differs from adult-directed speech (ADS) in many respects, particularly in terms of the characteristics that attract infant's attention. For example, it has a higher fundamental frequency (F0), a wider F0 range, a shorter utterance duration, longer pauses, and an exaggerated formant frequency. In addition, IDS has a slower speaking rate than ADS (e.g., Fernald & Simon, 1984). However, the longitudinal change in the IDS speaking rate has not been studied. This study clarified the longitudinal change in the IDS speaking rate as a function of infant's age.

**Methods:** The IDS of two Japanese mothers was longitudinally recorded in natural situations in their home for about one hour per month when their infants were 0 to 60 months old. More than ten thousand examples of IDS were collected, and the speaking rate was calculated by dividing the number of phonemes in an utterance by the utterance duration in seconds.

**Results:** A longitudinal change was found in the IDS speaking rate. An analysis of variance revealed that the infant's age was a significant factor for both mothers [$F(6,2505) = 17.7$, $p < .0001$; $F(6,6254) = 18.9$, $p < .0001$]. An HSD test revealed that the IDS speaking rate differed significantly between 0-5 months and 21-25 months ($p < .05$), but that it remained constant after 26 months. A regression analysis revealed that the speaking rates for both mothers increased significantly between 0 and 25 months ($p < .0001$).

**Conclusion:** These results indicate that the IDS speaking rate is slow when an infant is very young and gradually becomes faster until the infant is about 25 months old. The results also indicate that the IDS speaking rate is almost constant after about 25 months of age, which means that the slow IDS speaking rate ends at about 25 months. A longitudinal change was also found in the high F0 of these mothers' IDS in a previous study (Amano, Nakatani, & Kondo, 2006). However, the high F0 ended at about 17 months, which does not coincide with the end of the slow speaking rate found in this study. This inconsistency suggests that some IDS characteristics disappear at different infant's ages rather than simultaneously.

**Sa4-21**

### Phonetic Specificity of Early Words? Australian Toddlers' Perception of Australian versus Jamaican English Pronunciations

**Catherine Best**[1,2] Michael Tyler[1] Christine Kitamura[1] Anna Notley[1,3] Rikke Bundgaard-Nielsen[1]

*1. MARCS Auditory Laboratories, University of Western Sydney, Penrith South, Australia; 2. Haskins Laboratories, New Haven, USA; 3. Macquarie University, Penrith South, Australia*

**Background and Aims:** To recognize a spoken word, listeners must distinguish phonetic variations that transform its phonological structure from those that preserve its identity. Phonologically transformed words (e.g., BEAR —> PEAR or *GAIR) are often "mis-recognized" by 14- but not 19-month-olds, but such tests cannot alone resolve whether this developmental change reflects a qualitative transition to recognizing words' phonological structure, or continuous growth of underlying cognitive capacities. Perception of phonological constancy across non-transformative variations is equally fundamental to word recognition. Tyler & Best (ICIS 2006) took advantage of cross-dialect pronunciation differences, which can substantially alter a word's phonetic signature without transforming its identity, to probe this ability. American English (AmE) 14-month olds preferred listening to familiar (early vocabulary) over unfamiliar (adult low-frequency) word sets spoken in AmE but not Jamaican English (JamE), whereas 19-month-olds preferred familiar words across dialects. We extended that

approach to a new native dialect, speakers, speech style, and multiple tokens of a larger array of words.

**Methods:** Australian English-learning (AusE) 14- (n = 28) and 19-month-olds (n = 24) completed two preference tests (AusE; JamE) between familiar versus unfamiliar word sets (dialect order counterbalanced). The same infant-controlled preference procedure was used (four trials of each word set alternated across trials within a dialect). Multiple tokens of 24 words per set were selected from new child-directed speech recordings by two native-speaking males for each dialect.

**Results:** Dialect x Word Set x Dialect Order ANOVAs for each age revealed a familiar word set preference across dialects in 19-month-olds ($F(1, 24) = 7.69$, $p < .011$), while 14-month-olds showed this preference only for the AusE-JamE test order, not for JamE-AusE ($F(1, 26) = 3.22$, $p < .085$). Separate Age x Word Set x Dialect Order ANOVAs for each dialect revealed a familiar-words preference for AusE overall ($F(1, 50) = 8.04$, $p < .007$), but for JamE only when AusE was heard first ($F(1, 50) = 9.13$, $p < .015$).

**Conclusion:** Recognition of familiar words in JamE appears to be primed by prior exposure to AusE, across ages. However, word recognition is less stable in younger toddlers, for whom prior exposure to JamE disrupts recognition of AusE words. Young toddlers thus seem to recognize words by their overall native-dialect "phonetic envelope." Older toddlers more easily "hear through" the dialectal phonetic variations to recognize words' underlying phonological constancy, reflecting a nascent understanding of functional relationships between phonetic details and phonological structure.

**Sa4-22**

### A Cross-cultural Comparison of Maternal Gestures to Japanese and Italian-Canadian Infants

**Joanna Blake**, Chantalle Fredette, Eric Karaoylas
*York University, Toronto, Canada*

**Background and Aims:** There is much information available on infant gestures during the transition to language; in contrast, research on maternal gestures to infants is relatively rare. The aim of the present study was to investigate maternal gestures in two quite different cultures: Japanese and Italian-Canadian.

**Methods:** Twelve Japanese mother-infant dyads, 6 male and 6 female infants, were observed at home in naturalistic interaction every 2 weeks for 7 sessions for approximately 30 minutes, beginning at 8.5-10.5 months. Thirty Italian-Canadian mother-infant dyads, 15 male and 15 female infants, were observed at home for 30 minutes for 3 sessions, two between 9 and 10 months and one between 15 and 16 months. Maternal gestures were coded from videorecordings into 5 general categories: Comment (including point, head shake/nod, show, extend arms with palms up), Object exchange, Request (including reach, beckon), Emotive (including clap hands, bounce), and Symbolic (including representation of attributes or actions of specific referents). Inter-rater agreement on the detailed gesture inventory was 95.4% on 14% of the Japanese sessions and 93.6% on 16% of the Italian-Canadian sessions.

**Results:** For each mother, gesture frequencies in each general category across the sessions were summed and divided by the total number of gestures to her infant. These relative frequencies were subjected to a Group X Category X Sex of infant ANOVA, which yielded a significant three-way interaction, $F(4,35) = 3.84$, $p = .011$. T-tests for each group separately showed that Japanese mothers directed more Exchange gestures to female than to male infants, $t(10) = 2.32$, $p = .043$. No significant differences were found for the Italian-Canadian group, although mothers did tend to direct Request gestures more to male infants, $t(28) = 1.92$, $p = .065$. To examine change across sessions, separate Session X Sex analyses were done for each general gesture category for each group. For the Italian-Canadian group, Comment gestures increased linearly across the three sessions, $F(1, 28) = 7.10$, $p = .013$, whereas Request gestures decreased linearly, $F(1, 28) = 9.36$, $p = .005$. For the Japanese group, changes across sessions were more complex and typically restricted to male infants.

**Conclusion:** The two cultural groups did not differ in overall relative frequencies of any gesture category, indicating that the maternal gestural repertoire is universal across these two cultures. Japanese mothers did differ from Italian-Canadian mothers in modulating their gestures more according to the sex of their infant.

**Sa4-23**

### Mothers' Conversations with Their Deaf and Hearing Children

**Mary Fagan**, Kourtney Wonders, **Tonya Bergeson**
*Indiana University, School of Medicine, Indianapolis, USA*

**Background:** In conversations with hearing children, hearing mothers use prompts, questions, and turn allocation devices to encourage reciprocity (e.g., Snow, 1972; Olsen-Fulero & Conforti, 1983). For example, mothers often use questions to signify the end of their turn and set up the infant's turn. Moreover, Snow (1977) found that mothers accept even yawns, sneezes, and coughs of 3-month-old infants as conversational turns. Less is known about mothers' conversations with young children who are deaf. This study examined mother-child interactions with deaf children, before and after children received a cochlear implant (CI), in comparison with the interactions of hearing dyads.

**Method:** Mothers and children belonged to one of two dyads: dyads of hearing mothers and their children who were deaf (HD dyads), and dyads of hearing mothers and their hearing children (HH dyads). Both groups consisted of 9 mother-child dyads observed at two time points determined by time of CI surgery for HD children. At time 1, before CI, HD children were 4.4 to 25.4 months old ($M = 13.4$ months, $SD = 7.69$); at time 2, 6 months after CI, they were15.9 to 33.1 months old ($M = 24.4$ months, $SD = 5.91$). HH children were chronologically age-matched to HD children at both time points.

Mothers in each dyad played with their children with a standardized set of toys for approximately 5 minutes. Data analyses focused on number of maternal utterances, number of child utterances, ratio of mother-child vocalizations, number of maternal questions, and number of overlapping utterances (i.e., vocalizing at the same time).

**Results:** For HD dyads, results indicated an increase from time 1 to time 2 in number of child vocalizations per minute, number of maternal vocalizations per minute, and number of maternal questions per minute, and a decrease in the number of overlapping utterances. Preliminary comparisons of HD with HH dyads indicated that overall HD mothers talked more frequently and asked more questions than did HH mothers, but that HH children vocalized more frequently during both sessions than did HD children.

**Conclusion:** Results reveal effects of hearing status on mother-child interactions. After CI, HD mothers asked more questions than they did at time 1, and both members of HD dyads spoke more frequently and timed their vocalizations to overlap less often. HD mothers may have engaged in these behaviors more frequently than did HH mothers because their children vocalized less frequently than did HH children.

**Sa4-24**

### Modification of Preferential Looking to Derive Individual Differences

**George Hollich**, Kelly George
*Purdue University, West Lafayette, USA*

The National Survey of Children's Health reports that over 40% of the nation's children are at risk for developmental delays, most of whom will not be diagnosed before school age. The long-term goal of this work is to create an early objective measure of language delay that does not rely on parental report or on overt responses such as pointing or speaking. The specific objective of the research presented in this poster was to validate a new version of the preferential looking procedure and explore its ability to reliably detect individual differences in lexical comprehension under the age of two. Intermodal preferential looking is a method that tests comprehension by presenting children with two stimuli and by recording where they look when one of the stimuli is requested. For example, infants might see a shoe and a car on a large video screen while a voice asks, "Where is the shoe?" In our version, 16 objects were shown and requested at three-second intervals. Importantly, each requested object appeared on one side through each block of 8 trials, a manipulation that made it easier for subjects to indicate their understanding and significantly enhanced their looking responses. We tested twenty-eight 15- to 18-months-olds. Results indicated that not only did these infants look longer, on average to the targeted object, $t(29) = 4.52$, $p < .001$, as predicted, but also a linear regression found that individual looking performance in our task accounted for more than 50% of the variance in productive language as measured by parental survey (Macarthur-Bates Communicative Development Inventories), and we believe this task will prove to be a more accurate indicator of individual differences in lexical comprehension.

**Sa4-25**

### Japanese Two-Year-Olds' Use Morphosyntax to Learn Verb Meanings

Ayumi Matsuo[1] **Sotaro Kita**[2] Letitia Naigles[3]
*1. University of Sheffield, Sheffield, UK; 2. University of Birmingham, Birmingham, UK; 3. University of Connecticut, Storrs, USA*

As early as 2 years of age, English-speaking children can infer the meaning of a novel verb, using information from the syntactic frame (the intransitive/transitive distinction) of the sentence (Gleitman, 1990). How might this work in argument drop languages like Japanese, in which surface syntactic cues for verb meaning are not reliably present? Japanese children are not provided with clear mappings between the number of arguments (intransitive vs. transitive) and causal vs. noncausal verb meaning. Thus, we investigate whether Japanese 2-year-olds can utilize the number of arguments when learning the meaning of novel verbs, as English children.

**Methods:** 54 Japanese 2-year-olds (24-31 months; M=27.6) participated in an Intermodal Preferential Looking experiment. The video stimuli were from Naigles (1990) with the audio translated into Japanese with arguments in the canonical order (SOV or SV) with the nominative or accusative case marker. Children first saw a character causing another character to move in a certain way (the causative action) while both characters also performing a different action with one arm (the noncausative action). A novel verb was introduced in a transitive sentence ("The bunny is gorping the duck") for a half of the children and in an intransitive sentence with a coordinated subject ("The duck and bunny are gorping") for the other half. Three such teaching trials were followed by one control and two test trials. During the control trial, the causative and noncausative actions were presented separately on side-by-side videos with the audio "Look, they're different now". The test trials presented the same separated scenes, paired with the directing audio "Where's gorping now?" This procedure was repeated for four novel verbs.

**Results:** The children's direction and duration of visual fixation were coded. The children who heard transitive sentences spent a significantly larger proportion of time looking at the causative action during the test trials (M=.53) than the control trials (M=.45) [$F(1,33)=4.48$, $p=.04$]. The children who heard intransitive sentences showed no difference between the test trials (M=.52) and the control trials (M=.51). A 2(transitive vs. intransitive)x2(test vs. control) ANOVA yielded a significant interaction [$F(1,52) = 4.23$, $p = .04$], revealing that the difference between test and control trials were larger for the children in the transitive condition than for those in the intransitive condition.

**Conclusion:** Two-year-olds learning an argument-drop language can use the number of arguments signaled by case marking to infer a causative meaning for a novel verb.

**Sa4-26**

### Simultaneous Learning of Two Linguistic Rules in Monolingual and Bilingual Infants: Evidence From Eye Tracking

**Agnes Kovacs**, Jacques Mehler
*SISSA, Trieste, Italy*

**Background and Aims:** A fundamental task of young children is to extract patterns and regularities from their environment. In the process of language acquisition, for example, both the lexicon and the underlying grammatical rules have to be learned. Previous studies suggest that already young infants can discriminate linguistic rule-based regularities (Marcus et al., 1999). For an efficient learning, however, one has to go beyond discrimination and integrate the extracted patterns into further constructs. In a series of eye-tracking studies we investigate how preverbal infants integrate rules of varying complexity extracted from linguistic stimuli into different response schemas. Additionally, we ask whether experience with multiple languages could enhance performance when two rules have to be simultaneously followed and matched with conflicting responses. This may be possible, since bilingual children achieve the linguistic milestones in both of their languages at the same time as monolinguals do in one (Petitto et al., 2001).

**Methods:** In both experiments infants were familiarized with non-words of different structures that were paired with objects on the left or right side of the screen, possibly learning that the structure predicts the side where the object appears. During the test we measured infants' anticipatory looks after new non-words with the same structures. In Experiment 1, 7- and 12-month-old infants were exposed to simple linguistic patterns that had a well-defined structure (non-words with repeated syllables, e.g., "kiki") or had no structure (non-words with different syllables, e.g., "kila"). Experiment 2 asked whether 12-month-old monolingual and bilingual infants are able to learn two rules simultaneously when confronted with more complex "grammars" that both had an inherent structure (non-words with adjacent repetitions, e.g., "zozomo", or distant repetitions, e.g., "zomozo").

**Results:** The results of Experiment 1 show that both age groups could generalize the pattern with a well-defined structure but failed with patterns that had no structure. In Experiment 2 monolinguals learned the rule for non-words with adjacent repetitions but not for distant

repetitions. However, bilingual infants succeeded in learning simultaneously both rules.

**Conclusion:** The results suggest that preverbal infants are able to actively use linguistic rule-like regularities for cross-modal integration as soon as they can discriminate them. These powerful abilities seem to be present very early on and may allow infants to tackle on regularities of the linguistic input before the vocabulary is acquired. Furthermore, the findings reveal a surprisingly early effect of bilingualism resulting in more flexible learning.

**Sa4-27**

## Taiwanese Mothers' Speech to 2-Month-Old Infants:Effects of Prematurity and Social Context

**Pei-fen Li**[1] **Hui-chin Hsu**[1] Suh-fang Jeng[2]

*1. Department of Child and Family Development,University of Georgia, Athens, USA; 2. School and Graduate Institute of Physical Therapy,National Taiwan University, Taipei, Taiwan*

**Backgrounds and Aims:** Changes in maternal speech are associated with infants' increased abilities to participate in social interaction. As infants mature, the quantity and complexity of maternal speech increase, which may further facilitate infant behavioral response (Henning, Striano, & Liven, 2005). Cross-cultural studies have demonstrated that although mothers in different cultures differ in the content of their speech to infants (Fernald & Morikawa, 1993), the functional topics of their infant-directed speech appear to be universal, with an affect- or information-salient focus (Bornstein et al., 1992). However, little is known about whether and how infant and contextual characteristics may alter functional topics of maternal infant-directed speech. Thus, this study was designed to investigate the effect of infant birth status (i.e., prematurity) and changes in social context (i.e., interruption to mother-infant interaction) on maternal speech.

**Methods:** 30 Taiwanese mothers and their 2-month-olds (15 full-terms and 15 preterms at corrected age) participated in the maternal still face experiment, during which mothers terminated their interactive behaviors and posed a still face after 2 minutes of routine play. After posing a still face, mothers resumed routine play with their infants for 1.5 minutes. This still face-resumption of play sequence was repeated twice. Maternal speech utterances during the episodes of routine play and resumption of play were transcribed. The functional topic of each speech utterance was classified as affect-salient (e.g., recitation, endearment, and onomatopoeia), information-salient (e.g., statements, interpretations, and questions), or other.

**Results:** Results from mixed-design ANOVAs showed that both infant birth status and social context were associated with the functional topics of Taiwanese mothers' speech to their 2-month-olds. With respect to the effect of infant birth status, although mothers of preterm and full-term infants did not differ in their affect-salient speech, mothers of preterm infants uttered significantly less information-salient speech than did mothers of full-term infants. With respect to the effect of social context, mothers of preterm and full-term infants moderately reduced their affect-salient speech from normal play to the first episode of play resumption, but did not further reduce affect-salient speech from the first to the second resumption episode. Furthermore, although mothers of preterm and full-term infant did not significantly reduce their information-salient speech from normal play to the first episode of resumption, they significantly reduced information-salient speech from the first to the second episode of resumption.

**Conclusions:** This study suggests that the topics of maternal speech vary as a function of infant and contextual characteristics. Preterm infants are less active and more easily distressed. Mothers of preterm infants may perceive their infants as emotionally and cognitively less mature and not ready for learning. As a result, restriction in information-salient speech may be an adaptive strategy. This same restriction strategy appears to be used by both groups of mothers when their infants become more distressed after repeated exposure to the challenge of maternal still face.

**Sa4-28**

## Language Use and Comprehension in Toddlers of Depressed and Well Mothers

**Lillian May**, **Nanmathi Manian**, Marc Bornstein

*National Institutes of Health (NICHD), Bethesda, USA*

Maternal depression can affect the way in which a mother interacts with her child-and potentially alter the child's later language development. Past studies have investigated the effect of maternal depression on children's language acquisition and have found conflicting results (Pan et al., 2005; Cornish et al., 2005). The current study examined the effects of maternal depression diagnosed at 5 months postpartum on the language abilities of children at 15 months postpartum.

Groups of 57 Depressed and 102 Well mothers were selected based on a depression inventory and psychiatric interview at 5 months postpartum. A measure of social desirability (Marlowe Crowne; Crown & Marlowe, 1960) was administered at 5 months. At 15 months, mothers filled out MacArthur CDI and infants were administered the Reynell Developmental Language Scales which were videotaped and scored later on standardized scales of language comprehension and expression. The results indicated that children of mothers who were Depressed at 5 months scored lower on maternal reports of comprehension at 15 months as compared to children of Well mothers. However, there were no significant differences between the groups on the experimenter-given standardized assessment of comprehension and expressive scores.

Additionally, it was found that there was a significant interaction between the type of test (Reynell vs. MacArthur) and mom's past depression status for both comprehension scores and total language scores. That is, there was greater discrepancy between the two test scores for children of previously Depressed mothers as compared to Well mothers. Results of repeated-measures GLM suggested that this discrepancy was significant only for Well mothers. Well mothers appear to have overestimated their children's language abilities while depressed mothers report language abilities more accurately. Furthermore, this result was explained by social desirability, in that well mothers scored higher on social desirability. This finding may be interpreted with respect to the depressive realism hypothesis (Alloy & Abramson, 1979).

It was also found that girls performed better than boys on the Reynell expressive and comprehension measures and the MacArthur expression measure. In addition, a significant interaction was found between maternal depression and first born status, such that later-born children of Well mothers scored lower on the Reynell comprehension measure than first-born children, while there was no difference in children of depressed mothers.

These findings suggest that literature which evidences children of depressed mothers to have lower language ability may have to be reevaluated in light of the present study.

**Sa4-29**

### Function Words Facilitate Word Recognition in One-Year-Olds

Jessica Peterson[1] **Jessica Maye**[1] Jeff Lidz[2]

*1. Northwestern University, Evanston, USA; 2. University of Maryland, College Park, USA*

**Introduction:** Function words (functors) provide cues to a word's grammatical category that may aid in infants' discovery of syntactic structure. As early as 12-14 months infants use functors to infer the grammatical category of novel words (Mintz, 2006; Höhle et al., 2004). Functors have also been found to facilitate word recognition in adults. The present study asked whether functors have the same facilitatory effect on word recognition in one-year-old infants.

**Methods:** 22 infants between 13-17 months of age were tested using the head-turn preference procedure (Kemler-Nelson et al., 1995). In each of 4 blocks of trials infants were presented with two familiarization trials followed by 3 test trials (see Table 1). Familiarization trials consisted of several sentences in which a nonce word was preceded by functor. In one familiarization trial the functor was a determiner (e.g., her keb), in the other it was an auxiliary verb (e.g., will dak). Each test trial was a repetition of a nonce word preceded by a functor, with the same functor used in all three test trials. On one test trial the functor-nonce word pairing was novel but grammatical (e.g. my keb); on another the pairing was ungrammatical (e.g., my dak); and on a third the nonce word was unfamiliar (e.g., my sull). We predicted that infants would prefer Grammatical test trials over the other two. Also, if infants show no difference in preference between Ungrammatical trials and Unfamiliar trials it would suggest they do not recognize the familiarized nonce word when presented in an ungrammatical context.

**Results:** Average looking times (LTs) were 11.98 sec for Grammatical, 8.04 sec for Ungrammatical, and 8.45 sec for Unfamiliar test trials. LTs for Grammatical trials were significantly higher than for either Ungrammatical ($t[21] = 3.53$, $p < 0.002$) or Unfamiliar trials ($t[21] = 3.49$, $p < 0.002$), indicating that infants preferred familiarized items presented in grammatical contexts. However, LTs did not differ between Ungrammatical and Unfamiliar trials ($t < 1$, NS), suggesting that infants did not recognize the familiarized items when presented in ungrammatical contexts.

**Conclusion:** These results replicate previous findings that infants use functors to infer the syntactic category of a novel word and expect words to occur in the same syntactic context in the future. In addition, the presence of a grammatical functor can facilitate infants' recognition of a familiarized word, indicating a continuity in word recognition between infancy and adulthood.

**Sa4-30**

### Naturalistic Acoustic Packaging: Mothers Coordinate Speech and Action in Input to Infants

**Meredith Meyer**[1] Bridgette Hard[1] Rebecca Brand[2] Dare Baldwin[1]

*1. University of Oregon, Eugene, USA; 2. Reed College, Portland, USA*

**Background/Aims:** Human action is largely continuous and evanescent, posing a challenge to infants who need to parse this complex signal into meaningful units. Researchers have suggested that infants may make use of acoustic units present in the speech stream to segment the action stream (Hirsh-Pasek & Golinkoff, 1996). More recently, Brand and Tapscott (2007) demonstrated infant sensitivity to such "acoustic packaging." Infants were familiarized with a sequence of actions in which certain pairs were always accompanied by a narration overlay. On test, infants older than 9.5 months preferred to watch "unpackaged" pairs. Infants' responsiveness to the joint presence of speech and action invites the question: What is the nature of the coordination of speech and action when parents are interacting with their infants? The current study examines the timing profile of speech and action to determine whether naturalistic interaction is characterized by the tight coordination assumed by previous discussions of acoustic packaging.

**Methods:** Mothers (n=11) demonstrated assembly of two toys (stacking rings and nesting cups) to their six- to twelve-month-old infants. Points of action and speech onset and offset were identified during mothers' first complete assembly of the toys. Action onset was defined as the point at which a toy component (e.g., ring) was first moved toward the main assembly (e.g., ring post), and action offset was defined as the point at which a toy component had been placed on the assembly. Speech units were considered separate if they had pauses of greater than 260 ms between them.

**Results:** To examine the assumption present in the literature that acoustic units are temporally coordinated with action units in input to infants, we examined alignment of speech and action onsets as well as speech and action offsets. Alignment scores were compared against scores expected if speech and action onsets/offsets were independently distributed. (See Zacks, Tversky, & Iyer, 2001 for description of alignment scores; means express average temporal distance between speech and action onsets/offsets.) Speech and action onsets were more aligned than expected by chance, $M_{observed}$=.5 s (SD=.4) vs. $M_{chance}$=.74 s (SD=.34), $t(10)=3.18$, $p=.01$. Speech and action offsets were also more aligned than expected by chance, $M_{observed}$=.53 s (SD=.4) vs. $M_{chance}$=.82 s (SD=.38), $t(10)=2.39$, $p=.04$.

**Conclusions:** Naturalistic interaction between mothers and infants features systematic coordination of action and speech. In input to infants, mothers align action and speech, supporting the hypothesis that acoustic packaging could help infants discover relevant units within action.

**Sa4-31**

### Finding Word Boundaries: Does French Liaison Pose a Challenge to Children's Acquisition?

**Elena Nicoladis**, Johanne Paradis

*University of Alberta, Edmonton, Canada*

**Background and Aims:** Across languages, word boundaries most often correspond to syllable boundaries. One constraint guiding infants' early parsing of the speech stream is an assumption that word and syllable boundaries coincide. If so, then children may have a difficult time recognizing words when the phonology of surrounding words affects the syllable-word correspondence, e.g., French liaison. In French, vowel-initial nouns are almost always pronounced as if they start with the last consonant of the preceding written word. For example, ami 'friend' could be pronounced [nami] if preceded by un 'a' or [zami] if preceded by des 'some' or les 'the'. Research has shown that young children sometimes chunk the liaised consonant (e.g., [n] or [z]) as word-initial. Bybee (2001) argued that it is more appropriate to think of liaised forms as being stored with the determiner, as a collocation unit, rather than multiple words. Few studies have examined French-speaking children's use of liaised forms with which they have some familiarity.

**Methods:** In this study, we asked 31 French-speaking children between the ages of 3;7 and 5;3 to produce high-frequency vowel-initial nouns in four contexts: after un(e) 'a', deux 'two', beaucoup de 'a lot of', and un(e) petit(e) 'a small'. Children were also given a standardized vocabulary test. We expected the children with smaller vocabularies to produce the vowel-initial words in a single, consonant-initial form (e.g., un petit nami, deux namis). Children should become increasingly correct as their vocabularies grew.

**Results:** The results showed that the children with the largest vocabularies were the most correct. However, the children with the smallest vocabularies rarely produced an incorrect liaison. Instead, they most often produced a vowel-initial form of the word (e.g., un petit ami, deux amis).

**Conclusion:** These results suggest that the children had inferred that vowel-initial words are indeed vowel-initial, and thus had correctly determined the word boundary early on. If French adult speakers store liaised forms as collocations rather than as individual words (Bybee, 2001), this representation may be the result of learning to use liaison correctly.

It is possible that the children's initial representation of liaised words includes an initial consonant. However, with exposure to the same word in many different types of liaison contexts, the children come to infer that the words are vowel-initial since the consonants would be different, but the vowel-initial form-meaning mapping remains constant (see Bybee, 1995).

**Sa4-32**

## The Language Use Inventory: a Standardized Parent-Report Measure to Assess Pragmatic Language Development in 18- to 47-Month-Olds

**Daniela O'Neill**

*University of Waterloo, Waterloo, Canada*

This poster introduces the Language Use Inventory for Young Children (LUI), a newly developed and standardized parent-report measure designed to assess pragmatic language development in 18- to 47-month-olds. Currently, no standardized test (observational or stand-alone parent-report) is available specifically designed to assess toddlers' and preschool children's pragmatic language competence (i.e., their focus is largely on vocabulary and grammatical skills).

An urgent need for reliable, valid, and standardized measures specifically targeting pragmatic language development has been identified in order to identify and diagnose language and developmental disorders as early as possible (McCardle, Cooper & Freund, 2005) and given the increasing recognition that communicative impairment can occur primarily at the level of pragmatics rather than vocabulary or grammatical acquisition (Adams & Bishop, 1989).

In developing the LUI, the focus was on identifying developments in children's language use influenced by their developing understanding of their own and other people's behaviors, mental states, and differing perspectives (i.e., theory of mind). This is consistent with pragmatic language approaches that stress the importance of an understanding of intentional human action and of an interlocuter's state of mind in communication (Ninio & Snow, 1996). The firm grounding of the content items in established research findings meets current calls for assessment tools with greater "empirical validity" (Hirsh-Pasek et al., 2005).

The LUI has been demonstrated to possess excellent internal reliability discriminative validity, with sensitivity and specificity levels in discriminating typically-developing from language-delayed children of over 95% (O'Neill, 2007, Journal of Speech, Language and Hearing Research). Children's social competence as rated by parents and teachers has also been found to be significantly correlated with children's scores on the LUI (O'Neill et al., in prep.).

This poster will present, for the first time, data from a standardization (normative) study of the LUI involving over 3500 Canadian children. Growth trends will be described for children scoring at various percentile levels (e.g., 10th, 25th, 50th, 75th, 95th) and in relation to several demographic factors including: sex (boy/girl), parent status (lone vs. two), income (low-income as defined by Statistics Canada vs. not low income) and maternal education level (university vs. lower than university).

For clinicians and researchers, the LUI provides a measure to investigate and distinguish more systematically differences in areas of impairment (i.e., lexical or grammatical vs. pragmatic); examine profiles of pragmatic competence; and equate children for overall pragmatic language development when investigating environmental or cognitive correlates of language use.

**Sa4-33**

## Korean Mothers' Referential Speech in Joint Attention Context: Association with Language and Play Development in 1-Year-Olds

**Jiihyun Sung**, Hui-chin Hsu

*Dept. of Child and Family Development, University of Georgia, Athens, USA*

During interaction with their infants and toddlers, mothers often make verbal comments about objects or activities in the environment. This type of speech is termed referential speech (e.g., Baldwin, 1991). Mothers synchronize their referential speech with their children's current activities. Compared to mothers' verbal comments about nonpresent events or objects, their referential speech better facilitates word learning in toddlers. However, little is known about whether and how maternal referential speech uttered in different contexts makes similar contribution to language and play development. Furthermore, cultural differences have been found in maternal referential speech. For example, Korean speaking mothers use more verbs than English speaking mothers (e.g., Gopnik et al., 1996). Thus, this study examined different types of referential speech by Korean mothers in two different contexts (i.e., joint attention vs. non-joint attention) and their associations with language and play development in one-year-olds.

Twenty Korean mothers and their one-year-olds participated in this study. They were observed during floor play for 20 minutes in their homes. Verbal utterances by mothers were transcribed. Maternal referential speech and its context (i.e., occurring in a joint attention or not) were further identified. According to syntactic structure and pragmatic intent, mothers' referential speech was classified as simple (i.e., labeling or short description of the referent), elaborative (i.e., verbal comment or explanation about the referent), or prompting (i.e., utterance used to elicit child response). Toddlers' language was measured by the Korean Version of McArthur Communicative Development Inventory. Based on Belsky and Most's (1981) coding system, toddlers' play was classified as exploratory, functional, or symbolic.

Results showed that Korean mother uttered more referential speech in joint attention context than in non-joint attention context. In both contexts, Korean mothers uttered more simple than prompting or elaborative referential speech. Furthermore, different types of referential speech uttered by Korean mothers in different contexts were differentially related to their 1-year-olds' language and play. Within the context of joint attention, elaborative speech was related to greater

receptive vocabulary and frequent symbolic play, whereas prompting was associated with frequent symbolic play. Within the context of non-joint attention, simple referential speech was related to less advanced expressive and receptive language and less frequent functional play, whereas prompting was related to less frequent functional play, but more frequent exploratory play.

In conclusion, it appears that not all types of maternal referential speech contribute to toddlers' language and play development. Whereas referential speech by mothers during joint attention is linked to more advanced language and play in 1-year-olds, referential speech during non-joint attention context is linked to less advanced development. It is plausible that shared attentional focus with mothers helps toddlers clarify maternal intentions about the referent object or activity, which may further allow co-constructing symbolic interactions with their mothers. By contrast, mismatched attentional focus may not only disturb toddlers' play activities, but also lead to errors in mapping between the words and the referent.

**Sa4-34**

## Child Effects on Caregiver Responsiveness: Infants' Use of Gestures to Respond TO Caregivers Elicits Responsiveness FROM Caregivers

**Claire Vallotton**

*Harvard Graduate School of Education, Cambridge, USA*

Do infants' communicative behaviors affect the quality of care they receive from non-parental caregivers? Non-parental caregivers are important to study in order to enhance caregiver training and quality of care. Caregivers in group-care settings interact with multiple children who each bring their own characteristics and behaviors. Research shows mothers' responses are affected by children's temperament, gender, and appearance; yet results are inconclusive as to whether infants' communicative cues - including crying or positive interactive behaviors - affect mothers' responsiveness. It is difficult to determine whether these possible child effects are indicative of infants' effects on mothers, or whether variation in infant behavior is influenced by the systematic care they receive. Non-parental caregivers in group-care present the opportunity to examine infants' systematic effects on caregiver responsiveness across multiple caregivers. Thus, I ask:

1. Do infants elicit systematically different responsiveness across caregivers?
2. Do infants' communicative gestures affect caregiver responsiveness?

I collected videotapes of caregiver-child interactions in a classroom with 10 infants (ages 5 to 18 months) cared for by 18 student caregivers over the course of eight months. I videotaped each caregiver an average of 10 times. Separate teams of observers coded videotapes for infants' and caregivers' communicative gestures and caregiver responsiveness. I used multi-level modeling with observations nested within caregiver, with dummy variables indicating each infant, to determine individual infant effects and the effects of infants' communicative behaviors on caregiver responsiveness.

Two infants received significantly less and one significantly more responsive care compared to average responsiveness. Further, controlling these child effects, child age, caregiver experience, and caregiver gesturing, infants' use of communicative gestures specifically to respond to their caregivers elicited more responsiveness from caregivers. Thus, infants' communicative behaviors do affect the quality of care they receive, and gestures are a tool for infants' to elicit responsive care.

**Sa4-35**

## The Ontogeny of Joint Attention: The Role of Child Effects in Infant-Mother Interactions

**Ann Mastergeorge**[1] Leslie Olswang[2] Katherine Masyn[1]

*1. University of California, Davis, USA; 2. University of Washington, Seattle, USA*

Infants begin to co-regulate their transactions with mothers early in development and are actively engaged in the co-construction of the joint attention experience. While the bi-directional influence of joint attention has been described by others as the coordination and synchrony of interactions, there have been few studies that examine the infant's role in these participatory interactions. Overall, little is know about the effects of early ontogenesis of infants' gestures and joint attention. Consistent with a dyadic systems view of interaction, the aims of this study were to examine the role of infant communication in the development of joint attention, and the effects of joint attention behaviors on children's language development.

Thirty-nine mother-infant dyads were observed when infants were 7 and 11 months old. Each interaction consisted of a free play segment and an elicited requesting segment, each approximately five minutes. In the elicited requesting segment, mothers were provided with two toys that required adult assistance to operate. Caregivers were instructed to use the toys in order to elicit moments of requesting from their infants. These data were coded to examine the emergence of child joint attention behaviors - including initiation, and pre-intentional communication attempts in interaction with maternal linguistic and nonlinguistic behaviors, and the role of these child behaviors in the co-construction of joint attention. At 11 months, infant language was measured using both the Vineland Adaptive Behavior Scale and the MacArthur Communicative Development Inventory. Both qualitative and quantitative results will be discussed regarding joint attention behavior in infancy and relative contributions to understanding the role and effect of child-initiated behaviors in three components of mother-child interaction: (1) contingency and reciprocity in mother-child joint attention; (2) bids for initiation and responsiveness in mother-child dyad activities; and (3) strategies that both mother and child utilize to initiate, maintain, and sustain joint attention.

**Sa4-36**

## The Influence of the Frequency of Maternal Speech Acts vs. Children's Responsiveness to Those Speech Acts in Typically Developing Children and Children with Autism

**Lauren Swensen**[1] Letitia Naigles[2] Deborah Fein[2]

*1. NYS Institute for Basic Research in Developmental Disabilities, Staten Island, USA; 2. University of Connecticut, Storrs, USA*

**Background:** Mothers use various speech acts during children's second and third year of life that facilitate language development (Ninio & Snow, 1996). For example, mothers who ask more Y/N- Questions have children who later use more auxiliary verbs (Newport, Gleitman, & Gleitman, 1977). We know that joint attention facilitates language growth in typically developing children and children with autism (Rosenthal-Rollins and Snow, 1998). Little research has explored whether different types of maternal speech acts facilitate language in children with autism.

**Objectives:** We investigated how specific maternal speech acts, and children's responsiveness to these, influence their language development.

**Method:** 10 boys with Autism Spectrum Disorder (ASD) and 14 typically developing children (TYP) were studied longitudinally. Every four months (ASD: 33-45 months old; TYP: 17-29 months old), mother-child dyads participated in 15 minute free play sessions, which were transcribed and analyzed. The groups were roughly equivalent in language production at visits 2 and 3.

**Results:** Few relationships emerged between the frequency of maternal speech acts and children's subsequent language. Many relationships were found between children's responsiveness to specific speech acts and their subsequent language. Additionally, at visit 2, responsiveness to all types of maternal speech acts influenced children's language for the TYP group. These widespread responsiveness effects were not seen for the ASD group until visit 3.

**Discussion:** Findings suggest that it is not mothers' usage of specific speech acts that facilitates language, but instead how children responded to these speech acts. By responding to certain speech acts, the children may have been forced to use certain elements of speech. Certain speech acts may only influence children's language when the children are "engaged" during that utterance. Therefore, although there are differences in the influence of discourse elements in maternal input for ASD and TYP children, these elements are informative for both groups.

## *High Risk and Pediatric Issues*

**Sa4-37**

### Healthy Preterm and Term Infant Perceptual, Cognitive, and Verbal Development in the First Year of Postnatal Life

Charlene Hendricks[1] **Marc Bornstein**[1] Chun-shin Hahn[1] Nancy Auestad[2] Deborah O'Connor[3]

*1. NIH/NICHD, Bethesda, USA; 2. Kellogg, Battle Creek, USA; 3. University of Toronto, Toronto, Canada*

**Background and Aims:** Premature birth is a major cause of developmental delay. One strategy for making predictions of long-term effects is to compare term and preterm infants differential development in the context of equivalent postnatal experience. In this prospective longitudinal multivariate study, we investigated stability and change in visual acuity, novelty preference, general behavioral development, and language in healthy first and laterborn girls and boys who were born preterm or term.

**Sample:** Preterm infants were recruited from neonatal intensive care units, and term infants were enrolled from hospitals and pediatric practices in the U.S. Preterm infants with birth weights of 50 to 1805 g and whose gestational age was less than 33 weeks and term infants of normal birth weights (> 2500 g) were eligible for enrolment. The final sample consisted of 465 infants, 175 preterm and 290 term (Ross Infant Studies; O'Connor 2001; Auestad 2001).

Measures: Visual acuity at 2, 4, and 6 months was determined using the Teller Acuity Card Procedure; the infant's ability to process information was assessed at 6 and 9 months with the Fagan Test of Infant Intelligence; language ability at 9 and 14 months was assessed using the MacArthur Communicative Development Inventory; and, cognitive and motor skills were assessed at 12 months with the Bayley Scales of Infant Development.

**Results:** Virtually all of the measures we assessed in infants perceptual, cognitive, and verbal development showed stability of individual variation in preterm and term babies across the first year of life. Preterm and term babies were alike at 2 of the 3 ages in visual acuity and in maternal reports of both their language comprehension and language production. Moreover, both preterm and term infants showed novelty preferences at 6 and 9 months. However, on assessments of mental and psychomotor development, firstborn and secondborn term boys outperformed preterm boys. Term babies also required less looking time in the Fagan task then preterm babies.

**Conclusions:** Term and preterm infants perform similarly in several domains of perceptual and cognitive visual development and in language. When there is a difference between term and preterm infants, it emerges in general behavioral development and favors term babies.

**Sa4-38**

### A Cycled Light Intervention with Premature Infants: Effects on Maternal Adjustment

**Debra Brandon, Sharron L Docherty**

*Duke University School of Nursing, Durham, USA*

Objectives: It has been well documented that the hospitalization of a preterm infant is a stressful time for mothers. The purpose of this study was to explore whether the timing of a cycled lighting intervention (early vs. late) with preterm infants impacted maternal adjustment to hospitalization and post discharge caregiving.

Study Design: A longitudinal randomized experimental design tested the effects of a low intensity cycled light infant intervention on maternal adjustment to the birth, hospitalization and post discharge caregiving. The infant study examined the effects of early(28 weeks) and late(36 weeks) cycled-light stimulation on short- and long-term health and developmental outcomes of preterm infants born at < 29 weeks. Mothers of infants participating in the cycled-light intervention were recruited during hospitalization before their infant's 30th week postmenstral age. Forty-three mothers were enrolled when their infants were between 28 and 30 weeks postconceptional age. Maternal adjustment was evaluated using four standardized self-report instruments and one semi-structured qualitative interview. The self-report instruments measured maternal depression (Center for Epidemiologic Studies Depression Scale: CESD), anxiety (State-Trait Anxiety Inventory: STAI), stress (Parental Stressor Scale:Neonatal Intensive Care Unit: PSS:NICU), and worry (Child Health Worry Scale: CHWS), at infant postmenstral age 30, 35, 40 and 45 weeks and at discharge home, and every 5 months after discharge home. The qualitative interview was completed following discharge home.

**Results:** The timing of a cycled light intervention (early vs. late) with preterm infants had no impact on maternal worry and depressive symptoms.The greatest influence on maternal worry and depression was marital status with single mothers experiencing more worry and depression. Having other children in the home was associated with lower levels of worry and stress. Regardless of the intervention group mothers reported having less concern about their infant while they were away from the hospital because of their participation in the study. Mothers felt that study personnel would be "keeping watch" on their infant.

**Conclusions:** Marital status influenced the degree of maternal adjustment. Mothers who had the perceived support of a spouse and who did not have to experience the hospitalization of an infant alone recorded much lower levels of worry and stress than a mothers who felt as if they are all alone (Miles et al., 2002). In addition, mothers who had previously given birth and had gone through the experience of raising a child at least one other time were more likely to report lower levels of worry and stress because of this experience (Allen et al., 2007).

Mothers' adjustment to the hospitalization and post discharge care of their infant was not related to the timing of the cycled light intervention. However, mothers in both infant intervention groups verbalized less concern about their infant during hospitalization because of their participation in the infant intervention.

**Sa4-39**

## Effects of Smoking in the Household on the Developmental, Growth, and Health Outcomes of Premature Infants of African American Mothers

**Jada Brooks**[1] Diane Holditch-Davis[1] Mark Weaver[2]

*1. Duke University School of Nursing, Durham, USA; 2. University of North Carolina at Chapel Hill School of Nursing, Chapel Hill, USA*

**Purpose:** Previous research has suggested a relationship between exposure to environmental tobacco smoke (ETS) and occurrences of respiratory illnesses and related complications in young children. Because mothers of lower socioeconomic status are more likely to smoke during infant's first year of life, their children are at increased risk for negative health and developmental outcomes. Although some studies have addressed postnatal exposure to ETS, few have examined longitudinal effects of smoking on premature infant growth and development. Therefore, the purpose of this study was to examine the effects of smoking in the household on the developmental and health outcomes of premature infants of African American mothers residing in rural counties within North Carolina. Specifically, we determined the degree to which smoking in the household affected growth (weight, height, and head circumference), infant development (MDI, PDI, and PLS-4), and development of health problems (asthma and otitis media).

**Method:** One-hundred ninety-two premature infants (81 males and 111 females) of African American mothers with a mean gestational age at birth of 28.4 weeks and mean birth weight of 1115 grams were included in a secondary analysis. They averaged 15.1 days of mechanical ventilation. Approximately 70% of the mothers were single and over half received public assistance. Mothers had a mean age of 26 years and received an average of 12.6 years of education.

**Findings:** Mothers reported that 13-33% of children were exposed to smoke at 2, 6, 12, 18, and 24 months corrected age. Mothers with less education were more likely to smoke. Mixed general linear models were calculated to determine the extent to which smoking affected infant development and growth outcomes. Infants exposed to smoking initially were longer and had larger head circumferences. Their rates of growth were slower than non-exposed infants, and by 12 months exposed infants were the same size as non-exposed infants. Generalized linear models were calculated to determine the extent to which smoking predicted health and developmental outcomes. Premature infants exposed to ETS were more likely to develop otitis media. Smoking did not affect weight, asthma, or cognitive, language, and motor skills.

**Discussion:** Thus, factors in the immediate social environment, particularly ETS, may negatively impact developmental and health outcomes of premature children who are at high-risk for growth and health outcomes because of their decreased birthweight and compromised immunity. Interventions targeted at reducing ETS could potentially minimize its influence on the growth and health outcomes of premature infants.

**Sa4-40**

## Maternal Smoking in Pregnancy and Early Language Development

**Claire Coles**[1] Juile Kable[2] Mary Lynch[1] Julie Carroll[1]

*1. Psychiatry, Emory University School of Medicine, Atlanta, USA; 2. Pediatrics, Emory University School of Medicine, Atlanta, USA*

**Background and Aims:** This study is one of a series examining the relationship between prenatal tobacco exposure, auditory processing and language development during the first 24 months. Smoking in pregnancy is a major public health problem but effects on development remain controversial. We hypothesize that tobacco exposure affects auditory processing and that infants of smokers will demonstrate delayed early language.

**Methods:** Smokers, categorized into "Low" (M=8.67 cig/day, n=142) and "High" Dose (M=20.95; n=60), and demographically-similar, non-smokers (n=99) were recruited post partum. Infants were followed at 6- and 15-months. At 6- and 15-months, early language was measured by standardized observation using the Bayley Scales of Infant Development (2nd Ed) (BSID-II; Bayley, 1993) and at 15 months by caregiver report using the McArthur Communicative Development Inventory/Words and Gestures (CDI; Fenson, et al., 1993); 160 infants completed the BSID at both 6 and 15 months, and 179 caregivers, the CDI.

**Results:** The BSID-II language-age, facet scores were computed for 6 and 15 months. Language gain over the interval was obtained by subtracting the raw facet scores. Analysis of covariance found a significant group effect ($F(2,159)=3.02$, $p < .05$) with exposure groups making lower gains than the controls (Control=10.9 (2.7); Low Dose=10.0 (3.2); and High Dose=10.2 (3.8). In addition, performance at 15-months was categorized as being language impaired or not using raw scores at or below 14 (equivalent to 9 months development). In the High Dose group 17.9% were classified as language impaired compared to 9.8% of the Low Dose and 6.6% of the controls. A significant linear trend between dosage group and being at risk was found (Spearman's rho= .128, $p < .048$).

At 15-months, 179 caregivers reported on infant's language totals (gestures; words understood; words produced) using the CDI which provides age and gender-normed language scores and is highly correlated with other language and communications measures. Parents reported no group differences in gestures used or words understood; however, there was a significant linear trend indicating a dose/response pattern in total words-produced with more tobacco exposure associated with fewer words (Control group-M=61.39 (31.56); Low Dose; M=55.37 (27.78) High Dose, 50.16 (27.03), $F(2,161) =3.94$, $p<.02$, linear contrast =.006).

**Conclusions:** These results suggest that smoking during pregnancy is associated with delays in language development, particularly in language production, that can be identified both by examiners blind to infant's experimental condition and by caregivers.

Sa4-41

## Development at Risk in Vulnerable Brazilian Samples Assisted in the Family Health Program

**Maria Crepaldi**[1] Margaret Santa Maria-Mengel[2] Maria Beatriz Linhares[2]

*1. Universidade Federal of Santa Catarina, Florianópolis, Brazil; 2. University of São Paulo, Ribeirão Preto, Brazil*

The politics for Health in the developing countries must take into account preventive programs for vulnerable population. The communities living in poverty environment include families usually expose at several adverse events. They are at multiple risks route. The Family Health Program was implemented in Brazil in order to promote primary preventive interventions care for the population. In this program it could be found families with different socio-economic status, risks and resources. The families were mainly attended in their health problems. Otherwise, in this program little investment was done to better understand the child at risk for developmental problems. The aim of the present study was to track risk indicators to child development problems in the six first years of life and to identify protective resources in the familiar environment in vulnerable population. The sample was composed by 275 children of both sex and their mothers that were registered in Family Health Programs in two cities (Florianópolis and Ribeirão Preto) of the South and Southest regions of Brazil. The study was conducted in the Family Health Program of the School of Medicine of two universities (Federal University of Santa Catarina and University of São Paulo). The data collection was done in children's home. The children were assessed by the Developmental Screening Test - Denver- II - and the Language Development Survey. The familiar environment was assessed by the HOME Inventory (responsiveness, punitive and restrictive behavior, physical environmental organization, materials offering, mother attachment). In addition, the socio-economic status was classified using an instrument adapted for Brazilian population. In the data analyses were calculated the correlations between the environmental variables and the developmental outcomes. The results showed that around 30% of the study sample was composed by children at risk for developmental problems. The lower was the socio-economic status, the higher was the developmental risk. It was observed for both global development score and specific language and motor skills. In addition, it was found that the lower mother attachment and the lower physical environmental organization were associated with the higher risk for developmental problems. The findings highlight the relation between psychosocial risk and child development; it has to be taken into account for planning preventive interventions in Family Health Programs for accomplish optimal outcomes in the child developmental pathway.

**Acknowledgments:**

The Coordination of higher education personal improvement (CAPES)

The National Council for Scientific and Technological Development (CNPq)

The Santa Catarina Research Foundation (FAPESC)

Sa4-42

## Findings of Ethnic Differences in Cognition at 18-22 Months in a Cohort of Infants Born <1000 grams (ELBW)

**Susanne Duvall**[1] **Peggy MacLean**[1] Jean Lowe[2] Michele Shaffer[3] Kristi Watterberg[2]

*1. University of New Mexico, Albuquerque, USA; 2. University of New Mexico Hospital, Department of Neonatalogy, Albuquerque, USA; 3. Penn State College of Medicine, Department of Public Health Sciences, Hershey, USA*

**Introduction:** Infants born preterm and extremely low birthweight (ELBW; <1000 grams) are at significant risk of neurological abnormalities, developmental delays, functional delays, attention, learning, and self-regulation difficulties (Hack, Friedman, & Fanaroff, 1996; Vohr et al., 2000; Anderson et al., 2003). The role of ethnicity, self-regulation, attention, neonatal medical severity and family socio-economic status on children's development was examined in 244 children born ELBW with the following ethnic grouping: 118 Anglo, 90 African American, 25 Hispanic and 11 Asian. The children were 18 to 22 months with age adjusted for prematurity.

**Methods:** Development was assessed using the Bayley Scales of Infant Development II with a Mental Developmental Index (MDI) calculated as a measure of cognition. Self-regulation and attention behavior was assessed using the Emotion Regulation and Orientation/Engagement Scale of the BSID-II Behavior Rating Scale. Demographic (child ethnicity, maternal education, family income) and neonatal medical variables (birthweight, gestational age, medical severity-CRIB score) were also obtained.

**Results:** Neurodevelopmental outcomes were analyzed using analysis of covariance. MDI score was found to significantly differ between Anglo (mean=85.90) and African American children (mean=72.48; p<.0001) as well as between Anglo and Hispanic children (Mean=77.38; p=.04); even after scores were adjusted for birth weight, neonatal medical severity (CRIB score), maternal education and income. Overall significance was maintained with MDI score and birth weight (p=.04), gestational age (p=.03) and CRIB score (p=.001); relationships were non-significant for maternal education and income. Additionally, a significant difference was found on Orientation/Engagement, a measure of self-regulation between the children of African American ethnicity (Mean=38.29) versus the Anglo group (Mean=47.38; p=.02).

**Conclusion:** The finding that Hispanic and African American children had significantly lower MDI scores indicates the need to target these groups for both Early Intervention and Medical Intervention. These differences could not be accounted for by socio-economic variables; while medical variables were directly linked to MDI scores. Thus far the literature has primarily focused on sequelae of extreme prematurity in African Americans but now we are also finding that Hispanic populations have a similar risk. It is unclear if cognitive test score differences between ethnic groups within this cohort are due to true differences in performance, biases within tests themselves or another factor. Further inquiry is needed to determine these relationships.

**Sa4-43**

## Posttraumatic Stress Symptoms Among Mothers of VLBW Infants

**Nancy Feeley**[1,2] Phyllis Zelkowitz[1,2] Lyne Charbonneau[2] Carole Cormier[3] Annie Lacroix[4]

*1. McGill University, Montreal, Canada; 2. SMBD Jewish General Hospital, Montreal, Canada; 3. Royal Victoria Hospital, Montreal, Canada; 4. St Justine Hospital, Montreal, Canada*

**Background:** Little is known about posttraumatic stress disorder (PTSD) symptoms among mothers of very-low-birthweight (VLBW) infants and what factors might be associated with PTSD symptoms. It appears that postnatal infant illness severity may be related to the development of maternal PTSD symptoms. However, previous studies have often asked mothers to recall symptoms many months or years after the birth. Moreover, some studies have used maternal report of infant postnatal illness severity rather than objective indicators of the infant's medical condition. The purpose of this study was to examine mothers' PTSD symptoms after discharge from the NICU, as well as how PTSD symptoms were related to mother and infant characteristics, mothers' interaction with their infant and infant cognitive development.

**Methods:** In the context of a pilot study to determine the feasibility of an intervention program for mothers, data were collected on mothers' PTSD symptoms post-intervention when the infants were 6 months corrected age. The participants were 21 women whose infants were hospitalized in the NICU and weighed <1500 grams at birth. Maternal post-traumatic stress was assessed with the Perinatal PTSD Questionnaire (DeMier, Hynan, Harris, & Manniello, 1996) (PPQ) that examines symptoms of PTSD specifically related to childbirth. A score of greater than 6 on the PPQ would qualify for a diagnosis of PTSD if such questions were posed in a diagnostic interview. Mother-infant interaction was assessed with the Emotional Availability Scales which measure parental and child emotional availability. The Bayley Scales of Infant Development was used to assess infant development and the Revised Nursery Neurobiological Risk Score was used to measure postnatal illness severity of the infant.

**Results:** Mothers' mean PPQ score was 3.95 (SD = 3.27) and 25% of mothers scored in the clinical range. Mothers with higher PPQ scores had infants who weighed less at birth (r = -.67), were born more prematurely (r = -.68), experienced more medical complications (r = .55), were hospitalized longer (r = .73) and spent more days on oxygen therapy (r = .62). Moreover, mothers who had greater PTSD symptoms at 6 months were less sensitive (r = -.50) and less effective at structuring interactions (r = -0.49) with their infant. Maternal PTSD symptoms were not related to infant development.

**Conclusion:** When the medical condition of a VLBW infant is poor after birth and the infant is born smaller and earlier, mothers may be at greater risk for developing PTSD.

**Sa4-44**

## Differential Impact of Forms and Properties of Infant Crying at Five Weeks of Age on Maternal Frustration

**Takeo Fujiwara**[1] Ronald Barr[1] Rollin Brant[1] Frederick Rivara[2,3] Marilyn Barr[4]

*1. Centre for Community Child Health Research, Child and Family Research Institute, Vancouver, Canada; 2. Departments of Pediatrics and Epidemiology, University of Washington, Seattle, USA; 3. Harborview Injury Prevention and Research Center, Seattle, USA; 4. British Columbia Shaken Baby Syndrome Prevention Program, Vancouver, Canada*

**Objective:** Caregiver frustration due to infant crying in the first months of life is legendary. Although assumed to be due to properties such as duration and inconsolability, there is almost no empirical evidence about what forms or properties of crying are most strongly associated with caregiver frustration. The purpose of this study is to investigate the differential association of combinations of 3 forms (fussing, crying, unsoothable crying) and 3 properties (duration/day, frequency/day, maximum bout length (MBL)) of infant distress with maternal frustration.

**Methods:** This is a secondary analysis of two randomized controlled trials designed to evaluate different educational materials to prevent shaken baby syndrome in Seattle and Vancouver. Since the materials were not differentially associated with maternal frustration, intervention and control groups results were combined. The sample consisted of 1065 mothers in Vancouver, BC, Canada and 1857 mothers in Seattle, WA, USA. Infant distress and maternal frustration levels (by linear analogue scale) were measured daily for 4 consecutive days during the fifth week by the Baby's Day Diary (Barr et al, 1988). First, we used generalized estimating equation models (GEE model) to predict maternal frustration by 9 infant distress parameters (full model). Second, selecting significant distress parameters from the full model, maternal frustration was further predicted using a GEE model (selected model) and coefficient (β) of each distress parameter. These were compared by linear combinations of estimators.

**Results:** With the selected model, the order of *significantly different* distress parameters in Vancouver was: (1) MBL of unsoothable crying (β=0.28) and frequency/day of unsoothable crying (β=0.22; P>0.2 from each other); (2) duration/day of crying (β=0.11); and (3) duration/day of fussing (β=0.06). Others (duration/day of unsoothable crying, frequency/day of fussing and crying, MBL of fussing and crying) were not associated with maternal frustration in full model. In Seattle, the order was: (1) MBL of unsoothable crying (β=0.31) and frequency/day of unsoothable crying (β=0.25; P>0.05 from each other); (2) MBL of crying (β=0.07), duration/day of crying (β=0.07), duration/day of fussing (β=0.07; P>0.7 from each other); and (3) frequency/day of crying (β=0.02). Others (duration/day of unsoothable crying, MBL of fussing, and frequency/day of fussing) were not associated.

**Conclusions:** The relationship of crying with maternal frustration is differentially associated with its forms and properties. Although unsoothable crying makes up <10% of overall distress, MBL and frequency/day of unsoothable crying was most strongly predictive of maternal frustration in both sites. Perhaps surprisingly, these properties were more strongly associated than the overall duration/day of unsoothable crying. Fussing, although much more common, had no significant association with maternal frustration.

**Sa4-45**

## Brainstem Dysfunctions Effects on Sleep Patterns of Premature Infants

**Ronny Geva**, Ruth Feldman

*The Gonda Brain Research Center, Bar Ilan University, Ramat Gan, Israel*

**Background and Aims:** One of the primary behaviors of the newborn infant is sleep. The main brain structure that mediates sleep and wakefulness is the brainstem. Auditory brainstem evoked responses (ABR) in preterm infants first appear at 26 weeks gestational age, around the age of extra-uterine viability. The ABR function then undergoes detectable maturational changes up until 34 weeks gestational age,

and thus this process overlaps the period of neonatal intensive care unit (NICU) care for most preterm neonates. Brainstem trauma, as assessed by abnormal ABRs usually appears to resolve in the neonatal period (Wilkinson et al., 2007), yet its physiological and behavioral consequences may be identifiable in the neonatal period. The goal of this study was to explore whether neonatal brainstem dysfunction is related to differences in sleep patterns in the neonatal period.

**Methods:** Using supra-threshold intensities of 70 dB hearing level, at 10.1 Hz. With a micro earphone, ABR recordings were evoked in newborn preterm infants (gestation age>30 weeks, N=66). Two groups were formed on the basis of ABR classifications (normal or abnormal), as determined by a trained audiologist. Sleep diaries (with 15 minute époques), as well as actigraph recordings (Model Actiwatch - AW4) were kept for 72 consecutive hours before discharge from the NICU to evaluate sleep characteristics and arousal cyclicity.

**Results:** As expected, sleep of neonates with abnormal ABR (ABR-Abn, N=35) was less optimal than those with normal ABR recordings (ABR-n, N=31). Infants in the ABR-Abn group slept for longer époques as compared to controls (mean percent sleep=95.84±1.67 and 94.59±2.62, respectively, $p<0.05$); they tended to exhibit less motion during sleep episodes (mean 329.86 ± 179.25 and 505.76 ± 426.58, respectively, $p<0.05$); and they woke less often than the Abr-n group (mean 1.85 ± 0.84 and mean 2.50 ± 1.14, respectively, $p<0.01$). Regression analysis revealed that ABR normality accounted for unique variance in all three major sleep measures (% sleep, motion and length of episodes), while controlling for gestational age and birth weight

**Conclusions:** Sleep characteristics of infants with brainstem abnormality are indicative of a deeper sleep state that is maintained for longer periods of time. This pattern may be related to the remedial process attributed to sleep in infants with early brain insult. Data indicate that an ABR evaluation may be a particularly valuable diagnostic tool of premature infants during the neonatal phase for the detection of very early-sleep related symptoms.

**Sa4-46**

### The Number of Daily Breastfeedings Predicts Maternal Sensitivity

**Jarno Jansen**, Carolina de Weerth, Marianne Riksen-Walraven

*Developmental Psychology Group, Behavioural Science Institute, Radboud University Nijmegen, Nijmegen, The Netherlands*

**Introduction.** The beneficiary role of breastfeeding in the development of infant attachment has often been assumed, but so far, scientific evidence has failed to support this notion. Maternal sensitivity reflects the ability of the mother to adequately read and respond to signals provided by the infant and has been shown to be a strong predictor of later attachment security. In the present study we investigated whether breast- and bottle-feeding mothers differed in maternal sensitivity, as an early predictor of infant attachment.<p>

**Method.** We video-recorded 53 mother-infant dyads at approximately 5 weeks post-partum during a bathing routine, and subsequently assessed sensitivity based on the Emotional Availability Scales by Ainsworth et al. (1978). Additionally, mothers reported on the average number of daily breast- and bottle feeds on a weekly basis. These data were averaged over the first 4 weeks of life, and used to divide the group in breastfeeding mothers (N=43; >70% of feedings directly from maternal breast) and bottle-feeding mothers (N=10; <30% of feedings from breast).<p>

**Results.** Breastfeeding mothers were younger than bottle-feeding mothers (31.8 ± 3.9 vs 34.4 ± 2.9, MW: Z=-1.97, $p<0.05$), while no differences in education level were found (MW: Z=-0.48, p=.96). Maternal sensitivity was not different between the groups (breastfeeding: 5.2 ± 1.5; bottle-feeding: 5.6 ± 2.3, MW: Z=-1.04, p=.30). Regression analysis within the breastfeeding group provided a model that explained 37% of the total variation in maternal sensitivity ($p<0.01$). Maternal age (ß=1.25), the number of breastfeedings (ß=3.18), and interaction between the number of breastfeedings and maternal age (ß=-3.48) all predicted maternal sensitivity, with the interaction indicating that the effect of number of daily feedings on maternal sensitivity was more pronounced in younger mothers. Maternal education level (ß=0.23) and the total number of feedings (breastfeedings and bottle-feedings, ß=-0.47) did not predict maternal sensitivity.<p>

**Conclusions.** These results indicate that while the choice between breast- or bottle-feeding need not affect maternal sensitivity, more frequent breastfeeding may be beneficial for maternal sensitivity, especially in younger mothers. Whether breastfeeding promotes later infant attachment security and whether this may be mediated by changes in maternal sensitivity is currently being investigated.

**Sa4-47**

### Parental Attitudes, Sleeping Arrangements and Infant Sleep

**Irena Keller**, Carl Frankel, Joseph Campos

*Department of Psychology, University of California, Berkeley, Berkeley, USA*

This study investigated the relationships between parental attitudes towards childrearing, infant sleeping arrangements and infant sleep patterns (sleep duration, awakenings, ease of falling asleep). Many professionals in United States endorse solitary sleeping arrangements with a minimum parental involvement as strategies fostering self-regulation in infants. Ethnographic studies report that some parents apply these strategies even if they contradict their general attitudes to childrearing. We hypothesized that the effects of sleeping arrangements on infant sleep could differ depending on the goodness of fit between the strategies and the general parental attitudes.

**Methods:** The study was based on responses from parents of 152 7-9 months old infants. In a Parenting Questionnaire parents were asked to rank the importance of 9 items expressing parental attitudes and dependence on professional/other advice. Three factors with high inter-item correlations were derived through the Factor Analysis: orientation on baby feelings, orientation on structure, and valuing advice. A Sleep Questionnaire asked 20 questions about sleeping arrangements (current/retrospective locations, occasional co-sleeping and nighttime interactions) and infant sleep patterns.

**Results:** Neither sleep locations nor nighttime interactions were related to parental attitudes. In accord with ethnographic studies a moderating effect of valuing advice was found using ANOVA: only for parents who did not value others' advice was there a significant relation between parental orientation on baby feelings and sleep locations (F=9.2, p<.005). Parental involvement and closer sleep locations were related to awakenings, but also to a better mood of the infant in the mornings (r=.30, p<.001). Parental reluctance to respond at night however was NOT related to a better sleep but was related to a worse mood of the infant. Parental attitudes were not associated with sleep patterns. ANOVA revealed a significant interaction (F=2.5, p<.05) of attitudes with occasional co-sleeping: co-sleeping was only related to less sleep in infants if parents held a contradicting rather than compatible with co-sleeping attitude.

**Conclusions:** The findings suggest that attitudes are important and should be considered together with parental behaviors. Although parental involvement correlates with awakenings the causal direction

is unclear: involvement might represent a result rather than a cause of awakenings. Moreover, reluctance to respond (a strategy parents intentionally choose, in contrast to involvement) does not correlate with a better sleep. Also needing further study is the extent to which parenting strategies that result in grumpy mornings for infants may be undermining exactly the self-regulatory capacities in infants that they claim to be fostering.

**Sa4-48**

### A Randomized Controlled Trial of a Post Discharge Neurobehavioural Intervention Program in VLBW Infants: Six Months Outcome

**Dominique Meijssen**[1] Karen Koldewijn[2] Marie-jeanne Wolf[2] Bregje Houtzager[2] Aleid van Wassenaer[2] Joke Kok[2] Anneloes van Baar[1]

*1. Tilburg University, Tilburg, The Netherlands; 2. AMC, Amsterdam, The Netherlands*

**Background and Aim:** Prematurity and perinatal insults lead to an increased developmental vulnerability. This may be mediated by socio-environmental and parenting factors. The Infant Behavioral Assessment and Intervention Program (IBAIP), based on the same theory as NIDCAP, was used to offer a neurobehavioral home based intervention in the first six months post-term. This is the first RCT to study its effects on infant development and behavior and mother-infant interaction.

**Methods:** VLBW infants were enrolled in the RCT at 34 weeks corrected age. Based upon the infant's behavior, environmental facilitation strategies and/or co-regulatory support were offered to the infant, with a focus on positive parent-child interactions. The intervention group (I) received one intervention just before discharge and 6-8 home interventions until the corrected age of 6 months. The control infants (C) received standard care. After completion of the intervention program, the Bayley Scales of Infant Development (BSID-II) were assessed and mother infant interaction was observed with the Still Face procedure by an investigator masked for trial assignment. For the interaction observation the Infant and Caregiver Engagement Phases (ICEP; Weinberg & Tronick, 1999) were coded.

**Results:** Mean birth weight in group I was 1242 g, in group C 1306 g, mean gestational age was 29.6 versus 30 weeks. The groups were well balanced except for more infants on oxygen at 28 days and more septic episodes in group I. After adjusting for baseline differences, group I (n=86) performed significantly better on the mental, motor and behavioral scales of the BSID-II at 6 months compared to group C (n=83)(7 points difference). 112 mother-infant dyads participated in the Still Face procedure. Mothers from group I (n = 57) showed more positive interaction behaviour (positive vocalizations, motherese and smiles) compared to the group C mothers (n= 55)(t=-2,25; p=.026). No differences were found in infant interaction behaviour.

**Conclusion:** The IBAIP improves the mental, motor and behavioural outcome of VLBW infants and positive maternal interaction behaviour at six months. We are now evaluating whether these effects sustain at 18 and 24 months.

**Sa4-49**

### Rural African American Mothers Parenting Preterm Infants: Parenting Stress and Daily Hassles

**Margaret Miles**[1] Diane Holditch-Davis[2] Suzanne Thoyre[1] Linda Beeber[1]

*1. University of North Carolina, Chapel Hill, USA; 2. Duke University School of Nursing, Durham, USA*

Mothers parenting prematurely-born children during the infancy period experience normal parenting stress, as well as stressors unique to rearing a prematurely-born-child. These parenting stresses must be considered in the context of other life stressors which can be especially salient for low-income African American mothers living in rural areas of the South. The ecology of the South can be characterized by low wage jobs, high poverty rates, limited resources, and high rates of single motherhood. It is important to understand and reduce maternal stress because it can impact on the mother-child relationship. However, little is known about these maternal stresses and how they change over time especially in rural African American mothers. This paper describes the level of parenting stress and daily hassles reported by rural African American mothers with prematurely-born-infants, and examines the specific sources of this stress over the first two years of the infants' life. Participants were 177 rural, African American mothers of preterm infants who weighed less than 1500 gm or required mechanical ventilation. They were participants in a larger study testing a nursing support intervention. Since the intervention had no significant impact on parenting stress or daily hassles, the entire sample was used in this analysis. Data collection instruments focused on parenting stress measured by the Parental Stressor Scale: Prematurely-Born Child and daily hassles measured using the subscale of the Hassles and Uplift Scale. In addition data were collected on depression, state anxiety, and post traumatic stress symptoms. Both parenting stress and daily hassles were highest in the first six months of infancy and went down over time. However, the scores remained moderately high and there was a group of mothers with very high scores over time. Both sources of stress were significantly related to maternal depression, anxiety, and post traumatic stress symptoms. Specific sources of parenting stress and daily hassles provide insight into the issues faced by rural African American mothers during the first two years of the infant's life.

**Sa4-50**

### Risk Factors of Perinatal CNS Pathology

**Tatsiana Mordovina**

*National Scientist Research Center "Mother and Child", Minsk, Belarus*

**Introduction:** Up to 80% children CNS pathology cases is the result of perinatal CNS damage.

Aim & Materials: The aim of the study was to analyse the risk factors in children with perinatal CNS pathology of various severity in patients (2 monthses-2 years old) of neurological department of National Scientist Research Center "Mother and Child" (Minsk, Belarus) during 2002-2006 years.

**Results:** Retrospective analysis of 1984 perinatal CNS pathology cases were done (males 1067, females 917). It was analyzed: infant health status, birth weight, gestational age, the course of pregnancy, delivery, mother age, genital and extragenital pathology, obstetric-gynecology anamnesis.

41.83% of children were born prematurely, 10.69% in severe condition and required intensive care. Among the patients with severe neurological pathology, 57.07% required intensive care.

25.45% of children were born with low birth weight (≤ 2499g), 30.14% high birth weight (≥3500g). But children with severe neurological pathology had low birth weight in 38.48% and high birth weight in 29.81% of cases.

Perinatal CNS pathology baby mothers had obstetric pathology in 24.55% of cases (medical abortions; spontaneous abortions; non-developing pregnancy). But mothers of children with severe CNS pathology had obstetric pathology in 31.73% of cases. Genital pathology was revealed in 7.05% of cases (colpitis; adnexitis).

Extragenital pathology was revealed in 23.44% of cases (respiratory infections; pyelonephritis; somatic pathology).

**Conclusions:** Presenting risk factors were revealed more often in the patients with severe neurological pathology. Children with presenting factors (in anamnesis) are required special follow-up for minimization perinatal CNS pathology complications.

**Sa4-51**

### Adaptation Following Enucleation in Infancy

**Sarah Norgate**[1] Karen Littleton[2] Christine Weston[2] Hester Duffy[3]

*1. University of Salford, Salford, UK; 2. The Open University, Milton Keynes, UK; 3. University of East London, London, UK*

**Background and Aims:** The loss of an eye results in a reduction to the horizontal visual field by around 20%. Of infants diagnosed with eye cancer, around 75% have an eye surgically removed within the first two years (Goddard et al. 1999, British Journal of Ophthalmology, 83: 1320 - 1323.). The frequency with which these infants are later referred for early visuomotor intervention (Ross et al., 2001, Archives of Pediatric Adolescent Medicine, 155:80-83) raises the possibility that they do not develop head-turning strategies to compensate for the visual field loss, and one study in a laboratory setting (Gonzalez et al., 1992, Clinical Visual Science, 7:257-261) has provided evidence of this. However, a clearer indication of individuals' ability to compensate may be obtained in a more natural caregiver-child interaction setting. The present study investigated compensatory head turning in a low demand everyday task by comparing the pattern of head movements during performance on their affected and non-affected side.

**Method:** Fourteen individuals who had undergone enucleation in infancy participated in the study when they were between 30.5 and 68.8 months. In eight 2 minute trials involving either a table-top activity or a conversation, participants alternated between interacting with their caregiver on the side of their affected eye versus on the side of their non-affected eye. The duration of head movement in each of the following orientation categories was recorded from video: towards parent: 1 to 29 degrees; 30 to 59 degrees; 60 to 89 degrees; face straight ahead and 91-180 degrees away from parent. To control for differential caregiver adaptation as a confounding factor, on a half the trials, caregivers were requested to keep their own head position 'forward and still' while maintaining 'verbal responsiveness'

**Results:** Children were more likely to adapt their head movement so that their face was turned more toward their parent when s/he sat on the side of their non-functioning eye($p < .05$). This did not vary as a function of test age, enucleation age, or time since enucleation.

**Conclusion:** The fact that children made greater adaptations on the side of their non-functioning eye showed that, they compensated for horizontal field loss. What remains to be seen, is the extent to which affected children are capable of adapting in environments involving competing attentional demands, which may give rise to difficulties discussed by Ross et al. (2001). Pursuing this issue would help to inform provision for rehabilitation following enucleation.

**Sa4-52**

### Emerging Self-regulation in Toddlers Born Preterm: Parenting, Temperament, or Differential Susceptibility?

**Julie Poehlmann**[1] Aj Schwichtenberg[1] Rebecca Shlafer[2] Emily Hahn[1] Jon-paul Bianchi[1] Rachael Warner[1] Brianne Friberg[1]

*1. University of Wisconsin, Madison, USA; 2. University of Minnesota, Minneapolis, USA*

**Background and Aims:** Preterm low birthweight infants are at risk for developmental problems, including compromised self-regulation and behavior problems. The current study investigated three competing theoretical models leading from child and family risks (i.e., infant health risks and socioeconomic risks) to measures of toddler self-regulation. On the basis of attachment theory (Bowlby, 1982), we proposed a model testing maternal sensitivity during early interactions as a mediator of the association between risks and toddler self-regulation. Our second model hypothesized that infant temperament would mediate the relation between risks and toddler self-regulation. Finally, Belsky's (2005) model of differential susceptibility was used to create a third model. In this model, children with difficult temperamental qualities were expected to be more susceptible to parenting influences.

**Methods:** Ninety-eight infants born preterm or low birthweight and their mothers participated in this longitudinal study. Infants were born between 25 and 37 weeks gestation and weighed between 490 and 3328 grams. Infant gestational age, birthweight, and family sociodemographic characteristics were collected at NICU discharge. At 4 months, parenting was assessed through parent-child free play coded with the Parent-Child Early Relational Assessment. At 9 months, infant temperament was assessed using the Revised Infant Temperament Questionnaire. At 24 months, toddlers completed the routing subtests of the Stanford-Binet and participated in an effortful control paradigm that assessed delay, slowing motor activity, suppressing activity to signal, and effortful attention. Mothers completed the Child Behavior Checklist.

**Results:** The attachment model was partially supported. Mothers experiencing fewer sociodemographic risks exhibited more sensitivity, and children experiencing more sensitivity, $F(2,95)=12.94$, $p<.01$, $R^2=.21$, and positive maternal mood/affect, $F(5,91)=8.27$, $p<.01$, $R^2=.31$, performed better on the effortful attention task. For our temperament model, only direct associations emerged. For example, infants with easier temperaments performed better on the slowing motor activity, $F(6,88)=.91$, $p<.05$, $R^2=.17$. Results partially supported the differential susceptibility model. For the effortful attention task, infant temperament interacted with maternal anger/hostility, $F(7,89)=7.09$, $p<.01$, $R^2=.36$, and maternal anxiety, $F(7,89)=8.17$, $p<.01$, $R^2=.39$. Children with difficult or slow to warm up temperaments who experienced higher levels of maternal anger or anxiety exhibited less optimal attention regulation.

**Conclusion:** Our findings were consistent with the attachment and differential susceptibility models, but only for toddler effortful attention. In addition, behavioral self-regulation did not appear to be a unitary construct in this sample of preterm, low-birthweight infants. Our findings have implications for research concerning diverse pathways to self-regulation, as well as interventions for preterms.

**Sa4-53**

## An Investigation Into the Effect of Maternal Psychological State on the Feeding Behavior of Preterm Infants: Comparing Feeding By Mother and Neontal Nurse Practitioner

**Nadja Reissland**[1] Victoria Maskell[1] Mithilesh Lal[2] Sunil Sinha[2]

*1. University of Durham, Durham, UK; 2. James Cook University Hospital, Middlesbrough, UK*

**Background and Aims:** Although it is known that problematic feeding interactions between mothers and their preterm babies in the neonatal unit persist long-term (Talmi & Harmon, 2004) there is no research to date comparing health professional and maternal feeding practices. We expected that neonatal nurse practitioners, having been trained, would feed preterm infants in an optimal way but mothers without such training would be less proficient in their feeding techniques (Schroeder & Pridham, 2006; Pridham et al, 2007). Not only feeding technique but also maternal psychological state affects how infants experience feeding times (Pridham et al, 2005). Most mothers of preterm infants express symptoms of anxiety, depression (Singer et al., 1996) and stress(Adams et al., 1999), while tube feeding their preterm infants, which has long-term effects on feeding (Coulthard & Harris, 2003). Maternal depression is not only negatively associated with positive mother infant interaction, (e.g. Paulson et al, 2006) but also with infants ability to expression of emotion appropriately (e.g. Reissland & Shepherd, 2006). In sum, maternal psychological state can affect the health and later development of their infants. Hence we tested the hypothesis that mothers will show more negative behaviours when feeding their preterm infants compared with neonatal nurse practitioners.

**Methods:** Mothers and nurses were video- and audio-taped with a premature infant while tube feeding the same infant and type of touch (stroking, holding) and verbal behaviour (comment on infant physical sensation, on own ability to feed) and length of feeding the prescribed amount, were analysed.

**Results:** The preliminary results indicated that nurses are significantly faster at tube feeding the premature baby (mean 24 minutes) compared to mothers (mean 38 minutes). Furthermore, mothers were 4 times more likely compared with nurses to express doubt in their own abilities. In contrast nurses were significantly more likely to interpret infant behavioural reactions in terms of the infant's physical sensations (e.g. stomach filling up). Although mothers compared with nurses stroked their infants significantly more frequently the overall length of touch was longer for nurses than mothers. Nurses held the infants rather than stroking them.

**Conclusion:** The potential impact of this study is discussed in terms of improved education of mothers. Such enhanced education of mothers could reduce maternal stress and depression levels and therefore lead to improved infant health.

**Sa4-54**

## Disentangling Effects of Moderate and Extreme Preterm Birth For Cognitive Development

**Anneloes van Baar**[1] Edwin Knots[2] Jos Bruinenberg[3] Boudewijn van den Boezem[4] Johannes Bauer[5] Corrie Jacobs[6] Joost Bonenkamp[7] Eric Brouwer[8] Martin de Kleine[9] Titia Katgert[9] Anouk de Bruijn[1]

*1. Tilburg University, Tilburg, The Netherlands; 2. Catharina Hospital, Eindhoven, The Netherlands; 3. Elisabeth Hospital, Tilburg, The Netherlands; 4. St Anna Hospital, Geldrop, The Netherlands; 5. Oosterschelde Hospital, Goes, The Netherlands; 6. Bosch Medical Center, 's-Hertogenbosch, The Netherlands; 7. Twee Steden Hospital, Tilburg, The Netherlands; 8. Elkerliek Hospital, Helmond, The Netherlands; 9. Maxima Medical Center, Veldhoven, The Netherlands*

**Background and Aim:** Information on developmental outcome of moderate preterm infants, born between 32 and 36+6 weeks gestation is important, as it concerns a large group of children at risk: in The Netherlands around 11.000 children (6.2%) per year. Moderate preterm birth constitutes an insult for the still immature brain of the infant. At 34 weeks gestational age the overall brain weight is 65% of term weight and dendritic arborization is still poor (Kinney, 2006). Follow up information on these children is scarce. Extreme preterm children, born before 32 weeks gestation, are at a greater risk for developmental problems. Further theorizing concerning brain development in the last weeks of gestation, may evolve from comparing cognitive functioning of moderately preterm born children to term, as well as to extreme preterm children.

**Method:** 380 moderately preterm children (M=34.7, SD=1.2 weeks, range 32-36+6 weeks), without need for neonatal intensive care, no dysmaturity (SGA) and no congenital malformations (CM), 86 extreme preterm children (M=28.1, SD=1.2 weeks, range 25-31+6 weeks) excluding those with intraventricular hemorrhages, SGA or CM, and 183 term children (M=39.5, SD=1.4 weeks, range 37-43 weeks) were examined with an intelligence test, around 8 years of age. The RAKIT-IQ short form was used, that consists of the subtests Exclusion, Discs and Hidden Figures, Idea production, Word Meaning and Learning Names. The first three subtests measure perceptual skills, abstract reasoning, visual analysis and spatial - motor skills and form a Perceptual Reasoning factor. Also a Verbal factor can be distinguished which consists of the subtests Word Meaning and Learning Names, that measure (passive) word knowledge and learning and remembering verbal concepts. A multivariate analysis of variance on group differences was done, corrected for parental education.

**Results:** A difference between all groups was found in total IQ (moderate preterm M=105, SE=.80, versus term group M=108, SE=1.15 and extreme preterm group M=97, SE=1.69), $F(2, 580)=15{,}87$; $p<.0001$. Analyses of the subtests revealed that the groups specifically differed in the Perceptual Reasoning Factor (moderate preterm M=16.79, SE=.22, versus term group M=17.57, SE=.32 and extreme preterm group M=14.17, SE=.47), $F(2, 583)=18{,}11$; $p<.0001$. The groups did not differ in the Verbal factor (moderate preterm M=14.94, SE=.22, versus term group M=15.38, SE=.32 and extreme preterm group M=14.17, SE=.47), $F(2, 583)=1{,}52$; $p=.22$.

**Conclusion:** Preterm birth disturbs brain development in that building blocks for later perceptual reasoning are affected in moderate preterm infants, and more clearly in extreme preterm children.

**Sa4-55**

## Does Maternal Feeding Style Contribute to Infant Weight Gain?

**John Worobey**, Monica Medina

*Rutgers University, New Brunswick, USA*

**Background and Aims:** This investigation was conducted to identify precursors of excess weight gain in the first year of life. Given national findings on risk factors for child overweight, we deliberately enrolled low-income minority mothers who were to be formula-feeding their infants.

**Methods:** Maternal demographic data, infant growth measures, and maternal attitudes toward feeding were obtained for 96 mother-infant

dyads that were visited when the infants were approximately 3-, 6- and 12-months-old. At 3- and 6-months, each mother was observed feeding her infant using the NCAST Feeding Scale and instructed to keep a 24-hour diary of all things fed to her baby, and her was infant weighed and measured. At 12-months the families were again visited to obtain infant growth measures.

**Results:** Regression analyses were run to examine predictors from the initial set of variables to weight gain from birth to 3-months, 3-month measures to weight gain from 3?6 months, and 6-month measures to weight gain from 6?12 months. None of the demographic, weight, or attitudinal variables were associated with weight gain to 3-months. The number of feeds per day at 3-months was the only predictor to weight gain from 3?6 months (Beta = .107), with number of feeds (Beta = .152) and maternal insensitivity to infant feeding cues (Beta = -.121) additionally predictive from 6?12 months.

**Conclusion:** These maternal behaviors are not inconsequential, as 40% of tees infants were at or above the 85th percentile of weight for length at 1-year. As maternal insensitivity and more frequent feeds were the most salient predictors of greater weight gain, caseworkers who serve low-income populations should pay special attention to guiding formula-feeding mothers who may be at risk for over feeding their infants.

Work on this project was supported by grants R03 HD39697 and R01 HD47338 to the first author

## *Social Development*

**Sa4-56**

### Relations Between Maternal Behaviors and Temperament in Infancy, Toddlerhood, and Early Childhood

**Yoko Anji**[1] Yoichi Sakakihara[2] Kiyotaka Tomiwa[3] Yukuo Konishi[4]

*1. Research Institute of Science and Technology for Society, Japan Science and Technology Agency, Tokyo, Japan; 2. Ochanomizu University, Tokyo, Japan; 3. Kyoto University, Kyoto, Japan; 4. Tokyo Women's Medical University, Tokyo, Japan*

**Background and Aims:** In Japan Children's Study (JCS), we have investigated how children's social abilities develop from infancy to early childhood in the preliminary longitudinal study. We assumed that social ability of children was based on neurological, cognitive, and social-cognitive bases. In line with this premise, we made a neuro-behavioral assessment scale which consisted of three domains of observations corresponding to these bases. The items of the scale were selected from the neurological examinations and the developmental tests and scales. The purposes of this study were to examine the relations between neurological, cognitive, and social-cognitive functioning of infants at their 4 months and 9 months of age, and the longitudinal correlations between two occasions.

**Methods:** The subjects were infants who participated in Japan Children's Study at one of the research sites. When the subjects were at 4 and 9 months of age, the neuro-behavioral assessments of them were carried out by either pediatricians or clinical psychologists.

In order to validate the assessments, we videotaped all the examinations and interviews with the parent.

Informed consent was obtained from the parents or guardians before the assessments.

**Result and Discussion:** The items of observation were divided into several sub-domains; hypotonia, gross motor, fine motor, coordination, object perception, object manipulation, thinking, social cognition, language, and communication. The sub-domains of object perception and social cognition were assessed only at 4 months, and thinking, language, and communication were assessed only at 9 months. The correlation analyses were conducted using the composite variables calculated by each sub-domain in summation of item scores. At 4 months, hypotonia was negatively correlated with gross motor($r=-.78$, $p<.01$), coordination($r=-.29$, $p<.01$), object perception($r=-.23$, $p<.01$), and social cognition($r=-.20$, $p<.05$). The similar pattern of correlations was obtained at 9 months. These results showed that hypotonia was negatively correlated not only with neurological development but also cognitive and/or social-cognitive development at both 4 and 9 months.

The examination of longitudinal correlations among composite scores between two occasions revealed that the neurological development at 4 months may predict the development of the same domain at 9 months. On the other hand, the cognitive development at 4 months was correlated with neurological development at 9 months, and the social-cognitive development at 4 month was correlated with cognitive development at 9 months.

The correlations between different domains may give insight into the neurological backgrounds for early cognitive and social development of infancy.

**Sa4-57**

### Functions of Infant Touch and Gaze Behaviors during Mother-Infant Face-to-Face Interactions

**Sabrina Chiarella**, Robin Moszkowski, Dale Stack

*Concordia University, Centre for Research in Human Development, Montreal, Canada*

Infant touch and gaze are two of the first communicative modalities that infants develop in the first months of life. Although the types of infant touch and the direction of infant gaze have been shown to vary with changes in maternal availability, research has not directly examined how infants use touch to serve different functions (i.e. self-regulatory, engagement). Moreover, there is a paucity of research examining where infants are looking when they gaze *away* (proximal, distal) from their mothers particularly during periods where maternal availability varies. Linking functions of touch with direction of gaze would reveal how they co-vary and underscore the importance of infants' proximal and distal behaviors for self-regulation and communication.

The present study was designed to examine the functions of touch and the direction of gaze in 44, 5 -month-old infants during a Still-Face procedure: two normal periods of interaction (N1, N2) preceded and followed the Still-Face period (SF), whereby mothers were instructed to be emotionally unavailable to their infants (unresponsive while maintaining a neutral facial expression without talking or touching). Interactions were videotaped and coded for 1) the functions of infant touch (using the Functions of Infant Touch Scale), and 2) the direction of gaze.

Results indicated that infants used touch to serve more playful (Intense/Light/Passive) functions in N1 and more regulatory (Soothing/Reactive) and exploratory functions in SF, suggesting that infants experience more distress during the SF compared to the Normal periods. Moreover, infants showed more dysregulation in N2 than in either N1 or SF. Findings suggest that infants' distress carried over from the SF period to N2 and infants changed how they used touch in order to reduce the possible distress following the SF. Furthermore, infants changed their direction of gaze across periods: they looked

significantly longer at their mothers during N1 and N2 compared to the SF. In contrast, during the SF infants looked away more than at their mothers and did so distally (into the distance) more than proximally (at self), suggesting a more intense response to their mothers' unresponsiveness.

Taken together, results demonstrate that touch and gaze serve important means of communication for infants: infants use these modalities to engage and disengage from their mothers and use touch to self-regulate and explore when their mothers are unavailable. Findings underscore the increasing sophistication of infants' developing communicative abilities and emphasize the importance of examining infants' non-verbal behaviors during the pre-verbal stages of development.

**Sa4-58**

### The Ecology of Mother-Infant Attachment

Jacinthe Emery[1,2] **Louise Cossette**[1]

*1. Université du Québec à Montréal, Montréal, Canada; 2. Université de Montréal, Montréal, Canada*

Developmental psychologists have highlighted the impact of the quality of early mother-infant attachment on child development. Insecure patterns of attachment - avoidant, resistant, and disorganized - are related to various problems in childhood, adolescence, and adulthood. It thus seems crucial to better understand the factors that can contribute to the development of an insecure mother-infant attachment. A large number of studies have tried to identify these factors but most of them were concerned with mothers' characteristics and behaviours. Based on an ecological perspective, the aim of the present study was to investigate the impact of the family context on the patterns of mother-infant attachment.

Forty infants (18 male, 22 female) and their mothers participated in the study. They came from various socio-demographic backgrounds. Mothers were met at 5, 10, and 14 months following birth to complete a questionnaire on their socio-demographic characteristics, an adapted version of the Arizona Social Support Interview Schedule (Barrera, 1981) to assess social support, and an adapted version of the Life Change scale (Holmes and Rahe, 1967) to assess negative life events. Moreover, the infant temperament was measured at 5 and 10 months using the Infant Characteristics Questionnaire (Bates et al., 1979), and the mother's perceived stress was measured at 14 months with the Parenting Stress Index (Abidin, 1995). Maternal sensitivity was also assessed during each meeting using the Maternal Behaviour Q-Sort (Pederson et al., 1999) and the Ainsworth's Sensitivity scale. Attachment was assessed at 14 months using the Strange Situation procedure (Ainsworth and Wittig, 1969).

Preliminary results revealed that mothers of secure infants experienced better life conditions than those of insecure infants. They were older, more educated, and had higher incomes. They were also more likely to benefit from the presence of a spouse, were more satisfied with social support, and reported less stressful life events. According to mothers' reports, fathers of secure infants were also more likely to be involved with their infants than fathers of insecure infants. Finally, mothers of secure infants showed higher level of sensitivity than mothers of insecure infants. Infant temperament and parenting stress did not differ according to patterns of attachment.

Negative life conditions have a clear impact on insecure patterns of attachment in early infancy. These findings will be discussed in relation to the particular ecology of the mother-infant dyad and to the need to provide adequate intervention and support to those living in more difficult conditions.

**Sa4-59**

### Temperament Trajectories From 4 to 24 Months: Mitigating Factors Across Multiple Levels of Analysis

**Kathryn Degnan**[1] Amie Hane[2] Heather Henderson[3] Jennifer Martin McDermott[1] Nathan Fox[1]

*1. University of MD, College Park, USA; 2. Williams College, Williamstown, USA; 3. University of Miami, Miami, USA*

Infant temperament reflects individual differences in reactivity to novelty, with some infants responding with high levels of negative affect and some with high levels of positive affect. Negatively reactive infants display behavioral inhibition in early childhood. Positively reactive infants display exuberant behavior during these same age periods. Behaviorally inhibited children are at risk for internalizing disorders (Perez-Edgar & Fox, 2005) and exuberant children may exhibit more externalizing problems (Putnam & Stifter, 2005). However, there is also discontinuity within these trajectories (Degnan & Fox, 2007) and the mitigating factors are important to identify. Furthermore, these factors may be different for positively vs. negatively reactive infants. The current study examined three factors thought to influence temperament trajectories: infant frontal electroencephalogram asymmetry (FEA), early social communication skills (ESCS) and maternal caregiving behaviors (MCB). We expected FEA to moderate the continuity of negative reactivity, ESCS to moderate the continuity of positive reactivity, and MCB to moderate negative and positive reactivity.

At 4 months, 291 infants were evaluated for positive and negative reactivity to novelty. At 9 months, ESCS (Mundy et al., 1996), including initiating joint attention with positive affect (IJA-pos) and responding to joint attention (RJA), and FEA were assessed. Additionally, maternal sensitivity during caregiving activities was assessed for quality of MCB (Hane & Fox, 2007). At 24 months, toddlers participated in one paradigm to assess inhibition and one to assess exuberance. Proximity to mother, latency to vocalize, and latency to approach were aggregated for inhibition. Positive vocalizations, proximity/talking to experimenter, and smiling were aggregated for exuberance.

Four-month negative and positive reactivity were not directly related to 24-month inhibition and exuberance. However, 9-month RJA and FEA moderated the relation between 4-month negative reactivity and 24-month inhibition. In addition, 9-month IJA-pos and MCB moderated the relation between 4-month positive reactivity and 24-month exuberance. Infant negative reactivity was significantly related to toddler inhibition when RJA behavior was low, or infants exhibited right frontal asymmetry. Infant positive reactivity was significantly related to toddler exuberance when IJA-pos behavior was high or MCB was high.

The current results suggest that multiple factors contribute to early temperamental trajectories and that specific combinations of infant temperament and mitigating factors inform best the pattern of continuity or discontinuity. Infant negative reactivity continued into toddlerhood when infants responded with less joint attention or evidenced right FEA. Similarly, infant positive reactivity continued into toddlerhood when infants initiated more social communication or experienced greater MCB.

**Sa4-60**

## Parental Responsiveness Relating to Toddlers' Eagerness to Learn and Attention Seeking Behaviours

Liane Kandler[1] **Marie-pierre Gosselin**[1] David Forman[2]

*1. Concordia University, Montreal, Canada; 2. University of Connecticut, Montreal, Canada*

Eagerness to learn from the parent has been shown to have important implications for social and conscience development in children. In the poster we test whether eagerness to learn is promoted by parent responsiveness via the child's expectation that interactions will be positive.

Both attachment theory and the reciprocity approach to socialization hold that expectations of parent responsiveness lead children to be more receptive to socializing attempts from the parent. To examine children's expectations of parental responsiveness, we observed attention-seeking patterns when the parent was unavailable to the child. It was expected that the link between parental responsiveness and eagerness to learn would be mediated by the attention seeking.

One-hundred-and-six children with their primary caregivers were observed (*mean age* = 26.4 months, 59 boys). Dyads attended two lab visits approximately two weeks apart (*mean* = 10.7 days). Parental responsiveness was coded microscopically, based on a system developed by Kochanska, which assesses the quality of parental response to each child initiated interaction (*kappa* = .76). Responsiveness was coded during four dyadic activities (play time, snack, block building, and gift), totalling 21 minutes. Attention seeking was coded during a questionnaire task, in which the parent was physically present but unavailable to the child. Attention seeking was coded in 30 second intervals, assessing both the quality (affect, persistence, intensity, and confidence in the caregiver's positive response), and quantity of bids (*ICC from* .81 to .98). We expected the quality rather than the quantity of bids to reflect the child's expectations of responsiveness. Eagerness to learn was evaluated during an imitation activity, coded in 30 second intervals based on attention, affect, cooperation, and sharing (*ICC* = .79).

As expected, the quality of attention seeking significantly mediated the link between parental responsiveness and eagerness to learn (based on the Sobel test following regression analyses). This model was not supported for the quantity of attention seeking. These findings suggest that parental responsiveness leads children to form positive expectations about interactions, and these expectations, as reflected by positive and confident attention-seeking patterns, influence children's eagerness to learn from parents. However caution is needed due to the correlational nature of the data. Future directions include examining child responsiveness in different contexts, and the mechanisms through which child responsiveness generalizes outside of the parent-child relationship.

**Sa4-61**

## Recovery from Jealousy Evocation: Contributions of Maternal Sensitivity and Infant Characteristics

**Sybil Hart**, Louanne Jenkins

*Texas Tech University, Lubbock, USA*

**Background and Aims:** Previous research has shown that infants are disturbed when maternal attention is directed toward another infant, or jealousy-evocation (JE). The present study explored infants' recovery from JE by examining events during an interaction episode following JE in which exclusivity is restored to the mother-infant interactive context. Evidence that maternal sensitivity is a strong predictor of infants' affectivity and regulatory capacities, as well as recovery from other types of instances of maternal unresponsiveness led us to predict that this maternal characteristic would play a similar role in the context of recovery from JE. We also explored whether recovery would differ with infant characteristics, including gender, birth order, Bayley MDI scores, positive and negative temperamental affectivity.

**Methods:** N=70 mothers and their 10-month-old infants were videotaped in 2 episodes of the Lab-Tab procedure for eliciting positive affect (puppet game, Simon). The dyads were then observed in 3 interaction episodes: Play (on carpeted area with a large assortment of toys), JE (in which the mother directed affectionate attention fully toward a lifelike doll representing an infant), and Reunion (on carpeted area with toys). Mothers then completed Distress-to-Limits (DTL) subscale of the IBQ-R (Rothbart) and demographics questionnaires.

Reliable observers who were blind to the hypotheses coded infant positive affect and approach responses in the Lab-Tab conditions. Maternal and infant behaviors in the Play and Reunion conditions were coded for Maternal Sensitivity and infant Responsivity and Involvement (Birengen). Infant behavior in the Reunion episode was also coded for: Seeks Maternal Attention, Comforted by Mother, and Level of Distress.

**Results:** MANCOVA analyses were used to examine the effects of 2 continuous, composite, within-subjects variables: Maternal Sensitivity and Infant Temperamental Affectivity, and 2 between-subjects variables: Sex and Birth Order (first/later) on the 5 infant behaviors during Reunion. Results revealed a significant main effect for Maternal Sensitivity. ANOVA analyses indicated that greater maternal sensitivity predicted infants' heightened Responsivity, Involvement, and Comforted by Mother. Correlations revealed that Maternal Sensitivity was highly stable across conditions. None of the infant measures were significant.

**Conclusions:** Findings suggest that at the 10-month stage, jealousy is attenuated by maternal sensitivity. Findings will be discussed in terms of implications for insight into the role of maternal sensitivity as a contributor to the infant's regulation of jealousy, and as a potential reinforcer of jealousy.

**Sa4-62**

## Mother-Infant Interaction at 3 and 6 Months: a Comparison of Measures of Responsiveness

**Anne Henning**, Gisa Aschersleben

*Saarland University, Saarbrücken, Germany*

**Background and Aims:** An extensive line of research has investigated the quality of early mother-infant interaction as well as its predictive associations with later developmental outcome (Bornstein & Tamis-LeMonda, 2001, for an overview). Comparison of the findings, however, is hindered by the great variety of different constructs and operational definitions that have been employed to define and measure parental responsive behaviour. Therefore the aim of the present work is threefold:

1. compare different commonly employed quantitative measures of parental responsiveness based on a micro-analytic coding method,
2. compare these quantitative measures with a validated qualitative measure of global interactive style, the Child-Adult Relationship Experimental Index (CARE-Index, Crittenden, 2006),

3. assess the stability of maternal and infant interactive behaviour across different partners in two age groups (3 and 6 months).

**Methods:** We are currently in the phase of data collection and analyses. A total of 60 infants (30 3-month-olds and 30 6-month-olds) and their mothers will be included in the final sample. Dyads are invited to the lab in pairs (two same-aged infants) and each infant interacts first with her own mother and subsequently with the unfamiliar mother for 10 minutes in a free play context including a standard set of 3 toys. The videotaped interactions are coded using a computerized program (InterAct, Mangold) and a micro-analytic method to assess on- and offsets of specific interactive behaviours of each partner from which various quantitative measures will be derived. In addition, the interactive style of each partner in each interaction is coded according to the CARE-Index.

**Results:** Preliminary results for a sub-sample of dyads show that according to the CARE-Index criteria, both maternal and infant interactive style differ across interaction partners (familiar versus unfamiliar partner) in dyads with both 3- and 6-month-old infants.

**Conclusion:** So far, these results suggest that interactive style is dyad-specific rather than a stable intrapersonal characteristic. A high degree of "plasticity" in interactive style lends support to the implementation in health care of early intervention programs and consulting services for parents with young infants.

**Sa4-63**

## Who's Calling? : Shifting Attention to Invisible Persons' Voices in 3- to 7-Month-Olds

**Emiko Kezuka**[1] Sachiko Amano[2] Atsuko Yamamoto[3]

*1. Gunma Prefectural Women's University, Gunma, Japan; 2. Kagawa Nutrition University, Saitama, Japan; 3. Kagawa Nutrition University, Tokyo, Japan*

**Background and Aims:** Converging data have suggested that young children with autism have difficulties developing a selective attention to a caregiver's voice, joint attention and understanding another's mind. In contrast, non-autistic infants are sensitive to voices and they seem to easily and early on be able to understand the other's intention. This study aimed to find what developmental changes took place in the first seven months in infants'ability to shift attention from their communicative partner to the third person. The experimental design was a modified joint attention paradigm, examining whether infants could disengage attention from the partner, and make a new relation (or further triadic relation) with a third person who breaks into their dyadic interaction instead of being introduced by their partner.

**Methods:** 30 infants in 3 age groups (3-4, 5, 6-7 month-olds) participated in this experiment.The infants were seated on their mothers' laps and engaged in a face-to-face interaction with the first experimenter (E1). After that, the second experimenter (E2) initiated calling the infant by name while in front of them. Then E2 proceeded to call the infant's name from outside the infant's view: from the right side, the left side, and behind the infant in random order for each infant. While E2 was calling the infant's name, E1 remained silent and expressionless. This was then repeated in the exact same pattern, with non-social stimulus (castanet sounds) substituted for the experimenter's voice. Whether they turned their faces to the voices (or sounds) was recorded.

**Results:** An ANOVA (three age groups x voice or sound x three directions) revealed that there was a significant main effect of age, $F(2, 29) = 26.11$, $p < .001$, a main effect of direction, $F(2, 29) = 41.85$, $p < .001$ and an age x direction interaction, $F(4, 58) = 3.55$, $p < .05$.

**Conclusions:** These results suggest that infants are trying to co-ordinate auditory stimuli (voices or sounds) with their visual images or representations. When there was a discrepancy between visual figures and auditory stimulus, 3- and 4-month-olds still showed visual preference for E1's face, but 5-month-olds were on the verge of being able to integrate the visual to coincide with the auditory. Some looked alternately between E2 and E1, apparently shifting their visual attention to the direction of the voice with the expectation of finding another person. The 6- and 7-month-olds demonstrated that they had completed this transition.

**Sa4-64**

## Infants' Social Responses to Strangers in the First Year of Life

**Hung-chu Lin**

*University of Louisiana at Lafayette, Lafatette, USA*

**Background and Aims:** Previous research has indicated that 3- and 4-month-old infants' responses to strangers differ from those to their mothers (Jaffe, Beebe, Feldstein, Crown, & Jasnow, 2001; Lamb, Morrison, & Malkin, 1987). However, there is little information on age-related changes in the moment-to-moment organization of social behaviors in interactions with strangers. This study examined 31 infants' responses to novel social partners during face-to-face interaction at 4, 7, and 10 months of age.

**Methods:** Two 3-min adult-infant interactions (mother versus adult female stranger) were videotaped in a laboratory setting. Infants' behaviors were coded sec-by-sec for looking direction (at partner, at object, away), vocalizations (vocalize, fuss, silent), and facial expressions (smile, frown, blank). Repeated measures ANOVAs were used to compare individual behaviors (percentage of time) in the two conditions. The associations of behaviors were analyzed using GSEQ (Bakeman & Quera, 1995) and log-linear analyses of age, condition, and the lagged durations of behavior codes. Adjusted residuals were used to locate specific associations. Infants' sociability was rated to provide concurring evidence for the microanalysis.

**Results:** Across all ages, the Stranger condition elicited significantly more looking at the partner [$t(30) = 10.01$, $p < .001$, Mean [Mother] = 20.87 (% of time), Mean [Stranger] = 43.48] and less attention to objects [$t(30) = 4.96$, $p < .001$, Mean [Mother] = 48.57 (% of time), Mean [Stranger] = 34.72]. Younger infants responded to the stranger with more sociable and coordinated behaviors. Specifically, at 4 months infants made fewer distress vocalizations with strangers than with mothers [$t(30) = 2.42$, $p < .05$, Mean [Mother] = 8.08 (% of time), Mean [Stranger] = 1.45]. At 4 months, infants combined smiling and vocalizations only with strangers, and they also coordinated their looking at the stranger with vocalizations. By 7 and 10 months, however, these associations disappeared. At 4 months, infants combined looking at the partner, smiling, and vocalization, but only with the stranger; at 7 and 10 months, this "tri-modal" coordination had disappeared. At 4 and 7 months, infants were rated as more sociable in the Stranger condition, but the difference disappeared at 10 months.

**Conclusion:** The results showed that 4-month-old infants exhibited more coordinated social responses to strangers than to mothers during face-to-face interactions. By 7 and 10 months, there was little differential response to these two social partners. The marked reduction in social responsiveness will be discussed in reference to attachment theory (Bowlby, 1969, 1973) and stranger wariness (Spitz, 1965).

**Sa4-65**

### Social and Cognitive Factors in the Emergence of Pointing

**Ulf Liszkowski**, Malinda Carpenter, Michael Tomasello

*Max-Planck-Institute for Evolutionary Anthropology, Leipzig, Germany*

Recent research has demonstrated that infant pointing at 12 months, when it has just emerged, is a fully communicative, cooperative act (Tomasello, Carpenter, & Liszkowski, 2007). But extremely little is known about how pointing actually emerges. Whereas some researchers hypothesize a more individualistic emergence, others emphasize its social origins. On a social account, one could imagine that the amount of modelled pointing, infants' comprehension of adults' pointing, and infants' imitation skills would relate to the emergence of pointing.

The current study addressed these hypotheses with a correlational design. Twelve-month-olds (n=39; approximately half of whom already pointed and half of whom did not) were recruited and tested on several tasks. In one task, mothers and infants were brought into a room decorated with posters and toys. Mothers were instructed to 'have a look around together' with their children (5 minutes), with no mention of pointing or the purpose of the study. Spontaneous pointing by mothers and infants was recorded. Next, infants were tested on a standard object permanence task; on several point comprehension tasks (point-following to lateral targets, behind barriers, and occluded referents); and on several imitation tasks (goal-directed imitation, role reversal, and gesture mimicry). In addition, a free play situation between mother and infants with toys (5 minutes) was recorded.

Results showed that mothers of pointers pointed more than mothers of non-pointers ($p=.039$, 1-tailed), and pointers were better than non-pointers on each of the three point comprehension tasks ($p's<.05$). Mothers' and infants' pointing did not correlate. The number of infants who passed two of the point following tasks (to lateral targets and occluded referents) correlated significantly with their status as pointer or non-pointer ($r= .318$; $r= .367$), and the number of correct passes (of 2 trials) on these tasks correlated significantly with the number of infant points in the first 5 minutes ($r's=.370$). Imitation was not related to either pointing or point comprehension, and gesture mimicry was overall very poor. Object permanence skills had no significant impact. Qualitative and quantitative analyses of the free play session are still in progress.

Results suggest that point comprehension and amount of maternal pointing influence point emergence, while simple gesture mimicry and general cognitive capacity (as measured here by object permanence) do not. Methodological and theoretical implications are discussed, as is the possibility of using this design to investigate cultural variation in the emergence of pointing.

**Sa4-66**

### Infant-Mother Attachment and Maternal Mental-State Talk at 24 Months

**Nancy McElwain**[1] Cathryn Booth-LaForce[2]

*1. University of Illinois at Urbana-Champaign, Urbana, USA; 2. University of Washington, Seattle, USA*

**Introduction:** A caregiver's propensity to consider and talk about mental states may be integral to a secure child-caregiver attachment (Fonagy & Target, 1997; Meins, 1997; Oppenheim & Koren-Karie, 2002). Among previous studies examining associations between attachment and mental-state talk, secure-insecure differences have typically been tested and mental-state talk has been assessed concurrently or prior to child-mother attachment. The current research aimed to extend this work by examining the extent to which infant-mother attachment groups (ABCD) at 15 months differed on maternal mental-state talk at 24 months. Further, we considered the type and referent of maternal mental-state talk. Child gender was also examined as a moderator of associations.

**Method:** Data from the NICHD Study of Early Child Care were utilized. At 15 months, infant-mother attachment classifications were assessed during the Strange Situation: insecure-avoidant (A), secure (B), insecure-resistant (C) and disorganized (D). At 24 months, maternal mental-state talk was coded from mother-child interaction during a 15-minute laboratory play session. Maternal mental-state terms were coded for type (cognitive, desire, emotion) and referent (child, other). If the referent was the child, we also coded whether the mental-state reference appeared to be appropriate or inappropriate (i.e., concordant or discordant with the child's cues). Maternal total utterances during the play session were also assessed.

**Results:** One-way ANCOVAs (controlling for data collection site and maternal total utterances) were conducted with the ABCD attachment groups and child gender as the between-subjects factors. Main effects of the attachment classifications emerged for cognitive terms that referred to the child's (appropriate only) or others' mental states (B > A, D), and emotion terms that referred to others' mental states (B > A, C). No main effect emerged for desire terms, but a significant attachment x gender interaction indicated more child-appropriate desire terms for girls versus boys among the A, B, and C groups, whereas this pattern was reversed for the D group. No attachment-related differences emerged for child-inappropriate mental-state talk.

**Discussion:** The current findings suggest that mothers of infants classified as securely attached at 15 months engaged in more talk about their child's and others' cognitive states (compared to avoidant and disorganized groups) and others' emotion states (compared to avoidant and resistant groups) at age two. Additionally, when making appropriate references to their child's desires, mothers of infants classified as disorganized may exhibit a non-normative gender pattern (i.e., more talk about desires with boys versus girls). The results highlight the importance of distinguishing among the insecure attachment groups as well as adopting a more fine-grained approach to assessing maternal mental-state talk.

**Sa4-67**

### Effects of Altered Early Social Experience on Brain Activity to Infant-Directed Speech and Vocabulary Development in Infants of Depressed Mothers

Emily Chinitz[1] Rebecca Bitsko[2] Elizabeth Sheehan[1] **Debra Mills**[1]

*1. Emory University, Atlanta, USA; 2. Center for Disease Control, Atlanta, USA*

Adults use a number of consistent prosodic modifications when they talk to infants. This special speech register is called infant-directed speech (IDS). The use of IDS is thought to play an important role in language development by increasing attention to relevant cues, facilitating speech segmentation and word learning. Zangl & Mills (2007) showed that IDS elicited increased brain activity relative to adult-directed speech (ADS) in 6- and 13-month old infants. At 6-months IDS elicited increased brain activity linked to increased attention; whereas at 13-months the activity also included increased neural activity linked to word meaning. The exact function of IDS in language development is still somewhat of a mystery. One way to study the effect of IDS is to examine individuals with altered early social and language experience. Mothers with depression produce vocalizations that lack the

expanded pitch contours characteristic of IDS. If infants are not hearing IDS from their primary caregiver on a regular basis, they may not benefit from its potential functions. The purpose of the present study was to investigate whether infants of mothers with depression exhibit different patterns of brain activity in response to IDS vs. ADS, and to assess whether this atypical processing of IDS is related to later language delays. The event-related potential (ERP) technique was used to measure neural activity to familiar and unfamiliar words presented in IDS vs. ADS in 6-month-old infants of mothers with depression (N=17) and infants of healthy mothers (N=17). Additionally, the MacArthur-Bates Communicative Development Inventory (CDI) was given at 13- and 20-months to address possible effects of maternal depression on vocabulary development. The results for infants of healthy mothers replicated that from Zangl & Mills. In contrast, for infants of mothers with depression IDS did not elicit increased neural activity relative to ADS. Additionally, the difference in percentile ranking of CDI scores at 13 and 20 months between the two groups was marked. None of the infants of mothers with depression scored above the 53rd percentile on the CDIs, whereas infants of healthy mothers were displayed a normal distribution. The present study provides a significant contribution to the existing literature on both IDS and maternal depression. As a result of the widespread prevalence of depression among new mothers, it is important to raise awareness for the potential effects their depression may have on their children's development in order to encourage mothers to seek treatment.

**Sa4-68**

### Two-Year-Olds' Understanding of Delayed Video Images of Themselves

**Michiko Miyazaki**[1] Kazuo Hiraki[2]

*1. Center for Evolutionary Cognitive Sciences, The University of Tokyo, Yokohama, Japan; 2. Interfaculty Initiative in Information Studies, The University of Tokyo, Meguro-ku, Japan*

**Background and Aims:** A "mark test," which is well known as an index of visual self-recognition, has recently come to be regarded as an index for testing whether or not subjects explicitly understand that their visual images reflect their current states (Povinelli et al., 1996). The success rate in the mark test varies depending on the images used for presentation. For instance, 90% of the 2-year-olds passed the test when their images were presented via a mirror, whereas only 35% in the video presentation group did so (Suddendorf et al., 2007). Furthermore, when the video image was presented with a 2-s temporal delay, less than 20% of the children passed the test (Miyazaki & Hiraki, 2006).

We have recently found a factor affecting the performance of the mark test. With regard to the 2-year-olds, a mirror-like video image was recognized more easily than a reversal image as a reflection of current selves. This finding suggests that the mirror-like spatial relationship contributes to the detection of a contingent relationship between visual and proprioceptive information.

The present study examines whether the mirror-like relationship improves the performance of the mark test, even when the feedback was presented with a 2-s delay.

**Methods:** Forty-three children, aged 2 years (24-35 months), were divided into two groups according to feedback conditions (mirror-like/reversal). A colorful sticker was covertly placed on their frontal hair, while a dummy game was used to attract their attention. After it was placed for over 2 minutes, an experimenter presented them with their mirror-like or reversal image, which was delayed by 2-s. The children's responses to the sticker were categorized into four behaviors: removal of the sticker, searching for the sticker on their heads (reaching), searching for the sticker on the monitor, and no response.

**Results:** The percentages of responses to the sticker were significantly differed between the feedback conditions ($p < .05$, Fisher's exact test). Although the percentages of the "removal" response hardly changed in either condition ("removal": 33% (reversal), 32% (mirror-like)), "reaching" and "monitor" responses were increased in the mirror-like view condition ("reaching": 5% (reversal), 23% (mirror-like); "monitor": 0% (reversal), 18% (mirror-like)).

**Conclusions:** These findings suggest that the mirror-like relationship changes 2-year-olds' understanding of delayed video images of themselves. However, this does not constitute a positive improvement in the performance of the mark test. Further researches should be conducted to clarify the implications of the reaching and monitor responses.

**Sa4-69**

### The Co-Occurrence Between Infant Touch and Affective and Gaze Behaviours during Mother-Infant Interactions

**Robin Moszkowski**, Amelie Jean, Dale Stack

*Centre for Research in Human Development, Concordia University, Montreal, Canada*

Infant touch is a critical modality of communication during pre-verbal development, and different types of touch convey various messages. While some research has examined infant touch in isolation, there is a paucity of research investigating how touch combines with infants' other communicative behaviours. Yet, infants' behaviours are organized into meaningful displays during social interactions. By examining how touch co-occurs with other behaviours, potentially important discoveries about infants' underlying states are revealed.

The current study was designed to investigate the co-occurrence between infant touch and infant gaze and affect during face-to-face interactions. Forty-four dyads participated in the SF procedure, which consists of two Normal periods separated by a period where mothers are instructed to gaze at their infants while maintaining an expressionless face and refraining from vocalizing and touching (i.e. mimicking emotional unavailability). Infant touch was coded using the Infant Touch Scale, a reliable and systematic measure documenting the types and locations of touch.

Results revealed that infant touch varied across periods of the SF procedure. Infants exhibited greater soothing (fingering, stroking, mouthing) and reactive (grabbing, pulling, patting) types of touch when mothers were unavailable. During the Normal periods, infants used more passive touch. When examining how the types and locations of touch co-occurred, results demonstrated that infants touched themselves using passive or soothing types of touch, suggesting a nurturing or regulatory function of touch. When touching their mothers, infants varied from using passive to reactive touch, likely depending on the amount and nature of stimulation their mothers provided.

In addition, infants exhibited variations in their gaze and affect. Infants spent more time in neutral affect and gazing into the distal environment during the SF period, and these combined with passive and soothing types of touch. When infants gazed at the proximal environment (i.e. self, infant seat) during the first Normal and SF periods, they used reactive types of touch, implying an exploratory role for touch. During both Normal periods, infants exhibited increased gaze at their mothers and smiling, which co-occurred with various types of infant

touch, implying that infants were engaged in interaction when mothers were available.

Taken together, findings reveal how infant touch co-occurs with other non-verbal behaviours during social interactions. Through the different combinations of touch with gaze and affect as a function of period, results imply that infants are sensitive to changes in maternal availability and carry implications for the communicative, regulatory, and exploratory roles of touch.

**Sa4-70**

### Postnatal Depression and Respiratory Sinus Arrhythmia as Predictors of Maternal Sensitivity

**Erica Musser**, Jeffery Measelle, Jennifer Ablow

*University of Oregon, Eugene, USA*

**Introduction:** Previous work has established that maternal depression is a risk factor for a variety of negative cognitive, behavioral, and socioemotional outcomes in infants and young children (Cummings & Davies, 1994; Downey & Coyne, 1990). Although maternal sensitivity has been found to mediate this risk (Campbell, Cohn, & Meyers, 1995), the underlying relationship between maternal depression and maternal sensitivity has been largely unexplored. Exploration of women's psychophysiology provides one way to investigate both the dysregulatory effects of depression as well as the role played by autonomic regulation in shaping sensitive parenting. In particular, compromised parasympathetic functioning has been linked to lowered emotion regulation capacity and greater stress vulnerability. Several studies have shown that clinically depressed individuals exhibit compromised parasympathetic functioning as indexed by lower baseline levels of respiratory sinus arrhythmia (RSA) relative to non-depressed controls (e.g. Rechlin, Weis, Spitzer, & Kaschka, 1994). Thus, it is possible that women with depression have difficulty regulating their own physiological responses to stress, due to a low resting level of RSA. Therefore, women with depression may have fewer resources to devote to responding sensitively to their infants' cues due to greater stress vulnerability. The aim of this study is to explore the relationship between maternal depression, maternal sensitivity, and RSA.

**Methods:** Participants in this study were ninety-five women and their five-month-old infants. Maternal depression was assessed at five-months postpartum, using the Center for Epidemiological Studies Depression Scale. Baseline measures of RSA were collected using an electrocardiogram and James Long Software. Participants and their infants then completed the Still Face procedure. The reunion phase of the Still Face procedure was coded for maternal sensitivity using the Global Rating Scales of Mother-Infant Interaction.

**Results:** Initial analyses support our prediction that mothers with depression are both less sensitive with their infants and have lower resting levels of RSA than non-depressed women. Additionally, we predict that low resting levels of RSA will moderate the relationship between maternal depression and maternal sensitivity, such that women with both depressive symptoms and low resting levels of RSA will be the most insensitive with their infants.

**Conclusion:** Results suggest that depression and dysregulated parasympathetic functioning maybe a risk factor for insensitive parenting. Discussion will consider the possibility that depressed and autonomically dysregulated mothers appear to attend to their own physiological needs first, rather than their infants.

**Sa4-71**

### Effects of Maternal Interaction Styles on the Developmental Process of the Intersubjectivity and the Attachment Systems

**Shigeru Nakano**, Kiyomi Ikemura, Megumi Sekine

*Hokkaido Health Sciences University, Sapporo, Japan*

**Background and Aims:** It is little known what aspects of maternal interaction styles relate to the developmental process of the infant intersubjectivity. Recently, Hobson et al. (2004) reported that maternal sensitivity (MS) related to levels of secondary intersubjectivity. This finding suggested the possibility of an interrelationship between the intersubjectivity and the attachment systems. However, Nakano, et al. (2007) evidenced that 4 month infant's sensitivity to social contingency measured by the Double-Video (Murray & Trevarthen, 1985) related to mothers' playfulness, but not to MS. Thus, in this longitudinal study the effects of maternal interaction styles on the development of intersubjectivity and the development of attachment are examined through infancy.

**Methods:** 29 mother-infant dyads were constantly participated through assessments. The measures used in this study and assessment timings were as follows.

Mothers:

At the one month before delivery, Adult Temperament Questionnaire (ATQ); at the one month of infant age, ATQ and Self-Rating Depression Scale; at 3 months, MS; at 4 months, playfulness in the Double Video interaction (PLY); at 6 months, MS.

Infants:

At 3 months, Infant Behavior Questionnaire (IBQ); at 4 months, sensitivity to social contingency in the Double-Video (primary intersubjectivity); at 6 months, object orientation and sensitivity of infant's attention to the object his/her mother offers; at 10 months, secondary intersubjectivity tasks; at 14 months, attachment types by AQS.

**Results:** The mothers' temperament scores before and after delivery were highly stable and related to PLY, but did not to MS. A path-analysis revealed that maternal playfulness consistently explained the development of infant intersubjectivity, but MS did not. However, MS showed a strong relation to the infant attachment security score (AQS) at 14 months. Further, infant's sensitivity to social contingency at 4 months had a relation to attention sensitivity on IBQ at 16 months.

**Conclusion:** The results from the present study indicated that maternal interaction styles; PLY and MS may foster differently the development of infant interpersonal relationships; intersubjectivity and attachment respectively. This finding is considered to suggest intersubjective relationships may reflect a bio-social (temperamental) aspect of human relationships while attachment is acquired through dyad interaction experiences.

**Sa4-72**

### Developmental Change in Emotional Face Processing From 5 to 7 Months of Age: Behavioral and ERP Evidence

**Mikko Peltola**, Jukka Leppänen, Silja Mäki, Jari Hietanen

*Department of Psychology, University of Tampere, Tampere, Finland*

**Background and Aims:** Previous research on the development of emotional face processing has shown that 7-month-old infants display an attentional preference for fearful over happy faces. This is indicated by longer looking times to fearful vs. happy faces in visual paired

comparison (VPC) tasks and by a larger central mid-latency negativity in event-related potential (ERP) studies. To examine more closely the developmental time-course of this attentional bias, we measured ERPs and looking times to fearful and happy facial expressions in 5- and 7-month-old infants.

**Methods:** ERPs were recorded from 5- and 7-month-old infants ($n$ = 14 and 16, respectively) while they viewed 1000-ms presentations of fearful and happy faces and matched visual noise control images. The analyses were targeted on the Nc component, a negative deflection most prominent over central electrodes and peaking around 400 ms after stimulus presentation. After the ERP recording, a VPC task with fearful and happy faces was presented. The VPC presentation consisted of two trials of fearful/happy face pairs, both trials presented for 10 seconds. Differences in looking were analyzed from the mean looking times for fearful and happy faces, averaged over the two trials.

**Results:** In 5-month-olds, neither the ERPs nor looking time measures provided evidence for discrimination of fearful and happy faces. The 7-month-olds, however, exhibited the typical pattern of results by showing longer looking times and a larger Nc amplitude (both $p$s < .05) for fearful than happy faces.

**Conclusion:** The present results suggest that there is a developmental transition in the processing of fearful facial expressions between 5 and 7 months of age. Thus, as assessed by behavioral and electrophysiological measures, 7-month-old infants display an attentional bias toward fearful faces, whereas 5-month-olds do not. This may be taken to indicate that the neural systems underlying the differential processing of fearful and happy emotional expressions come online at this age period. Such attentional preference could also be considered to reflect a rudimentary understanding of the social meaning conveyed by fearful faces in 7-month-olds.

**Sa4-73**

### Gaze Following Depends on the Presence of Communicative Cues

**Atsushi Senju**[1] Sotaro Shimada[2] Gergely Csibra[3]

*1. Centre for Brain and Cogntive Development, Department of Psychology, Birkbeck, University of London, London, UK; 2. Meiji University, Kawasaki, Japan; 3. Birkbeck, University of London, London, UK*

**Background and Aims:** Gaze-following plays a critical role in social learning in infancy, but the function of this behaviour remains unclear. The current study examined whether gaze following in young infants serves a communicative function like referent identification. If gaze following reflects infants' expectation for referential communication, infants would follow gaze only when it occurs in a communicative context created by an ostensive signal such as eye contact.

**Methods:** Six-months-old infants were randomly assigned to one of two experimental conditions: eye contact condition (EC, n = 10) and non-social attention-getter condition (NA, n = 10). Each infant watched a sequence of six movies, in which a female model turned towards one of the two objects. In the EC condition, the model looked directly at the infant before turning towards the object. In the NA condition, the model made no eye contact but a salient animation was overlaid on top of her face to attract infants' attention. The timing of the onset and the duration of the animation were matched to that of eye contact in EC condition. Infants' gaze was measured with a Tobii 1750 eye-tracker. The first saccade towards one of the objects after the model's head turn was considered as the gaze following response.

**Results:** Conventional difference scores (the number of times infants looked first at the attended object minus the number of times they looked first at the unattended object) were calculated for each infant and tested whether they are significantly larger than zero (i.e., whether infants followed the gaze rather than randomly looking at one of the two objects). Infants in the EC condition followed the gaze more frequently than chance [$t(9) = 6.33$, $p < .001$], while infants in the NA condition performed at chance level [$t(9) = .81$, $p > .1$]. In addition, infants in the EC condition followed the model's gaze significantly more frequently than infants in the NA condition [$t(18) = 2.57$, $p < .05$].

**Conclusion:** These results suggest that a preceding ostensive signal, such as eye contact, is required for 6-months-olds to follow adults' gaze, which supports the proposal that communicative-referential expectations are manifested in this behaviour.

**Sa4-74**

### Can Emotional Availability at Home and Child Care Experiences at Age Three Predict Relationships with Teachers and Peers in Pre-Kindergarten Mexican Heritage Children?

**Sandra Soliday Hong**, Carollee Howes

*University of California at Los Angeles, Los Angeles, USA*

**Background and Aims:** Early experiences with relationship formation at home and at child care influence children's ability to form collaborative relationships with teachers and peers once the children enter school (Howes , Hamilton, & Phillipsen, 1998). Recent studies have found that when children have less sensitive mothers, child care experiences can negatively affect their social competence (NICHD ECCRN, 1997). This study examined the moderating effect of maternal and child emotional availability on the predictability of child care experiences for social competence with teachers and peers at pre-kindergarten. Fifty-three immigrant children and their mothers who self-identified as being of Mexican-heritage participated in this research. The mothers mostly spoke Spanish as their primary language.

**Methods:** The data was collected in this study in Spanish by research assistants who were bilingual in Spanish/English and of Mexican or Central American descent. Video-tapes collected in the home were coded with the Emotional Availability Scale (EAS; Easterbrooks & Biringen, 2000). Child care observations were time-sampled. At pre-kindergarten age, all of the children were enrolled in public full- or half-day,center-based Pre-K programs sponsored by the State Department of Education. Children were assessed within their Pre-K classrooms with the Peer Play Scale (Howes & Matheson, 1992) and the Children's Behavior Ratings (CBR; Ladd, 1999).Teachers reported on the quality of child-teacher relationships and children's social competence.

**Conclusion:** Occurrences of both maternal structuring EAS and caregiver scaffolding were relatively infrequent. Maternal EAS and children's experiences in child care were not related. Children's social competence in pre-kindergarten was not predicted by child care use but, mothers who were less sensitive and used child care at age three, had children who engaged in less competent social ineractions at Pre-K. For children enrolled in child care at age three, social competence in pre-kindergarten could be predicted from home EAS and caregiver scaffolding in child care.

**References:**

Easterbrooks, M. A., & Biringen, Z. (2000). Guest editors' introduction to the special issue: Mapping the terrain of emotional availability and attachment. Attachment and Human Development, 2, 123 - 129.

Howes , C., Hamilton, C. E., & Phillipsen, L. (1998). Stability and continuity of child-caregiver and child-peer relationships., 69, 418-426.

Ladd, G. W. (1999). Peer relationships and social competence during early and middle childhood. American Review of Psychology, 50, 333-359.

NICHD ECCRN. (1997). The effects of infant child care on infant-mother attachment security results of the nichd study of early child care. Child Development, 68, 860-879.

**Sa4-75**

## Relations between Maternal Behaviors and Temperament in Infancy, Toddlerhood, and Early Childhood

**Jessica Stoltzfus, Katherine Karraker**

*West Virginia University, Morgantown, USA*

Previous research has found that mothers of preschool children with slow-to-warm-up and difficult temperament demonstrate more controlling behaviors toward their children than mothers of easy and intermediate preschoolers (Simonds & Simonds, 1981). Data from the National Institute of Child Health and Human Development Study of Early Child Care (NICHD SECC) were used in the present study to further examine relations between maternal behaviors and temperament in infancy, toddlerhood, and early childhood. Participants were 1,072 mothers and their children. Temperament was assessed at 6 months using a modified version of the Revised Infant Temperament Questionnaire (RITQ; Carey & McDevitt, 1978). Temperament category scores were derived as outlined by Carey and McDevitt (1978) from the raw data obtained at 6 months. The maternal behaviors evaluated in the present study were maternal sensitivity, derived from a laboratory observation, and maternal stimulation and support, derived from the Home Observation for the Measurement of the Environment (HOME).

A two-way mixed design analysis of variance was conducted to evaluate associations between maternal sensitivity at 6, 15, 24, and 36 months and the 6-month temperament categories. Significant main effects were found for Age ($p < .01$) and Temperament ($p < .01$). The Age x Temperament interaction was nonsignificant. Pairwise comparisons revealed that mothers of difficult infants demonstrated significantly less sensitivity toward their 6-month-old infants when interacting with their children than mothers of easy or intermediate infants, and this pattern continued in toddlerhood and in early childhood.

A second two-way mixed design analysis of variance evaluated associations between the overall HOME score at 6, 15, and 36 months and infant temperament category at 6 months. Significant effects were found for Age ($p < .01$), Temperament ($p < .01$), and for the interaction of Age x Temperament ($p < .01$). Pairwise comparisons revealed a number of effects of temperament. In particular, mothers of children who were difficult in infancy demonstrated significantly less stimulation and support toward their children at 36 months than did mothers of children who were slow-to-warm-up, easy, or intermediate in infancy.

Results from the present study support and expand earlier findings by indicating that children who are difficult in infancy receive less stimulation and support in the home and less sensitivity from their mothers in infancy, toddlerhood, and early childhood than children who are slow-to-warm-up, easy, or intermediate in infancy. Interventions promoting mothers' understanding of their children's temperament characteristics may help to reduce these differences.

**Sa4-76**

## Helping Behavior in the Second Year: Actions versus Emotions

**Margarita Svetlova**, Sara Nichols, Ranita Anderson, Maryam Khatami, Celia Brownell

*University of Pittsburgh, Pittsburgh, USA*

Infants as young as 18 months are able to help adults with household tasks (Rheingold, 1982) and goal-directed actions (Warneken & Tomasello, 2006). While prosocial behavior in adults is based on complex social understanding and motivation to act in others' interest, infants' helping responses could be driven by more basic mechanisms, such as adult scaffolding and general interest in actions. Our study examined early prosocial behavior as a function of the nature of the inference that the child had to make about an adult's need for help, and the explicitness of the adult's communicative cues.

Twenty-two infants (12 18-month-olds, 10 30-month-olds) were administered 9 tasks in which the experimenter pretended to have a difficulty. Three conditions manipulated the nature of the difficulty (3 tasks per condition). In the Action condition, the experimenter's action was interrupted because an object was out of reach. In the Emotion condition, the experimenter demonstrated a negative internal state which the child could alleviate by bringing an object. In the Emotion + Altruism condition, a negative internal state was again demonstrated, but the object needed was the child's own. For each task, the experimenter provided the same sequence of eight progressively more explicit communicative cues about the nature of her need, from facial/bodily expression to specific request. A helping score was assigned according to the cue level (1-8) at which the child helped the adult by bringing the needed object.

Preliminary analyses on the average helping scores yielded main effects for age, condition, and a significant interaction (all p's < .03). Older children out-performed younger children, and the Action condition was easier than the Emotion conditions. Younger children needed less communicative support in the Action condition than in either Emotion condition, which did not differ from each other, requiring the most explicit cues. Older children performed better in the Action condition than in the Emotion condition, which exceeded performance in the Emotion + Altruism condition. Thus, 18-month-olds' helping behavior may be based more on action understanding than inferences about others' internal states. 30-month-olds' responses demonstrated a greater social understanding and differed depending on whether the needed object was their own. Data collection is ongoing and will be completed by the time of the conference. Findings will be discussed in terms of the developing social cognition and prosocial motivation.

| | **18 months** | **30 months** | |
|---|---|---|---|
| Action | 3.1 | 1.0 | 2.1 |
| Emotion | 5.7 | 2.4 | 4.1 |
| Emotion + Altruism | 5.9 | 4.4 | 5.2 |
| | 4.9 | 2.6 | |

Note: Lower scores indicate earlier response with less communicative support.

**Sa4-77**

## Infants' Responses to Indirect Emotional Information: Does the Referent Matter

**Tamara Toub**, Betty Repacholi
*University of Washington, Seattle, USA*

**Background and Aims:** Repacholi and Meltzoff (2007) recently demonstrated that, by 18 months of age, infants engage in emotional eavesdropping. They are able to regulate their own actions in response to emotions that they happen to overhear and see (i.e., indirect emotional information). The current study explored the conditions under which infants respond to indirect emotions. In particular, do infants take into account the referent of the emotional display (i.e., what the emotion is about)?

**Methods:** Seventy-two 18-month-olds were randomly assigned to one of three conditions (Anger-experimenter, Neutral-experimenter, Anger-magazine). Each infant watched an Experimenter demonstrate an action on an object (twice). Another adult (the Emoter) entered the room and watched another demonstration. The Emoter subsequently expressed either Anger (Anger-experimenter) or Neutral (Neutral-experimenter) affect toward the Experimenter in response to her action. In the Anger-magazine condition, however, the Emoter expressed anger as she looked at something in a magazine. In all conditions, infants were then given 20s to play with the object. During this time, the Emoter watched the infant but was silent and neutral. Two additional trials followed, using different actions and objects, but an otherwise identical procedure.

**Results:** There were no differences across conditions in infants' latency to touch the objects or in the total duration of touch. Each infant received an imitation score (0-3) based on the number of trials in which they reproduced the modeled action. Parametric and non-parametric tests revealed that infants in the Anger-experimenter condition had lower imitation scores ($M$=1.63) than did infants in the Neutral-experimenter condition ($M$=2.29), $ps < .05$. There was no significant difference between the Anger-experimenter and Anger-magazine ($M$=1.79) conditions.

**Conclusions:** This study replicated the indirect emotion effect first reported by Repacholi and Meltzoff (2007). After the Emoter expressed anger toward the Experimenter, infants reproduced fewer actions than did those infants previously exposed to the Emoter's neutral display. These infants may have expected the Emoter to get angry again if they themselves performed the modeled actions. Interestingly, when anger was expressed in response to something in a magazine, infants were also loath to perform the actions. On the other hand, these infants were not wary of the object itself (e.g., they quickly touched it). This pattern of results suggests that infants in the Anger-magazine condition mistakenly connected the Emoter's anger to the Experimenter's prior actions. The findings will be discussed in terms of previous research exploring infants' understanding of referential intent.