ABSTRACT BOOK

Day 2, Monday, July 2nd

ICIS
INTERNATIONAL CONGRESS OF INFANT STUDIES

Celebrating
40 years
of ICIS!

XXI
ICIS Biennial Congress
June 30 – July 3
2018 Philadelphia

2018 ICIS PHILADELPHIA

BUILDING BRIDGES

www.infantstudies.org

@infantstudies

#ICIS18 | #infantstudies | #buildingbridges

ICIS 2018 Abstract Book – Monday 2nd July

Please note: the contents section is interactive – click on a session to view specific abstracts

Contents

Symposium abstracts: Monday, 2nd July

S5.2 Symposium: audiovisual speech processing and language development in typical and atypical populations

S5.2i Infant Selective Attention to Audiovisual Speech Cues and their Processing

David Lewkowicz[1]

[1]Northeastern University

Background: Infants are often exposed to speech and language in the context of social interactions. It is known that social interactions facilitate speech and language acquisition but it is not known what specific mechanism, besides the obvious increase in arousal and attention that social interactions elicit, might mediate these effects. In this talk, I will present evidence that social interaction enables infants to gain access to a talker's face. I will then argue that this gives infants access to spatiotemporally correlated and crossmodally equivalent (i.e., redundant) auditory and visual speech cues and suggest that the greater perceptual salience of such cues enables infants to profit from the multisensory redundancy of these cues and that this boosts their comprehension and acquisition of speech and language. Objective: To investigate whether, how, and when infants can find sources of multisensory redundancy and perceive the multisensory coherence of redundantly specified events, including audiovisual speech. Methods & Results: Our lab investigates attention to audiovisual events in typically developing infants with eye tracking methods and relies on intersensory matching and habituation/test procedures to examine perception of multisensory coherence. First, I will review the results from our recent work showing that infants exposed to talking faces exhibit marked changes in their selective attention to the talker's eyes and mouth across the first 18 months of life. Specifically, I will show that monolingual 4-month-old infants attend more to a talker's eyes, that 8-10 month-old infants attend more to the mouth regardless of language spoken, and that 12-month-old infants only attend more to the talker's mouth when she speaks in a non-native language. I will then show that audio-visual synchrony drives attention to the mouth and that bilingual infants not only shift their attention to the mouth by 8 months but that they continue to attend to it at 12 months and that they attend to it longer than monolinguals in response to both native and non-native speech. Finally, I will present unpublished data showing that 14- and 18-month-old monolingual infants' attention returns back to the mouth. Overall, I will argue that these selective attention shifts are a manifestation of an endogenously driven selective attention mechanism and that this mechanism enables infants to profit from redundant audiovisual speech cues during a

period in development when they are acquiring speech and language. Finally, I will review our earlier findings indicating that the ability to perceive multisensory coherence emerges and improves gradually during infancy and will argue that this enables infants to profit from the newly emerging ability to find sources of audiovisual speech redundancy. Conclusion: I will conclude that emerging selective attention skills that seek out sources of audiovisual redundancy and improving multisensory processing skills contribute to the social facilitation effects usually observed in infant speech and language acquisition.

S5.2ii Infant Sensitivity to Audiovisual Timing Driven by Articulator-Speech Sound Relationship

Heather Bortfeld[1], Martijn Baart[2]

[1]University of California, Merced, [2]Tilburg University

Introduction: During interactions, people experience both auditory and visual speech unfolding together in time. Adults perceive audiovisual speech as coherent rather than as distinct streams; it is less clear whether infants do, as the developmental emergence of sensitivity to audiovisual timing is not fully delineated. This is due at least in part to differences in the complexity of stimuli used in research with children of different ages. Establishing the trajectory of the emergence of this sensitivity is important as a variety of disorders are being traced to early difficulties with audiovisual timing. Thus, the current study was designed to test whether infants demonstrate sensitivity to audiovisual timing when provided sufficient information to do so. Methods: Infants between 5 and 9 months of age were tested using a single-screen looking-time task. They were shown sequential videos of a woman producing one of two trisyllabic pseudowords. One pseudoword contained highly visible articulations (mufapi), while the other contained less visible articulations (kalisu). Videos were edited to produce synchronous and asynchronous versions. For the asynchronous version, the audio stream preceded the visual stream by 300ms, while the timing was untouched in the synchronous version. Videos were blocked by pseudoword and by timing, with block order counterbalanced across infants. A median-split of infants by age resulted in a 2 (age: younger, older) x 2 (pseudoword articulation: visible, less visible) x 2 (timing: synchronous, asynchronous) mixed design. Results: We observed main effects for pseudoword and age. Overall, infants preferred to look at more visible than less visible articulations, and younger infants looked longer than older infants. Beyond these general effects, older infants looked longer to asynchronous than synchronous videos

but only when articulation was highly visible. Discussion: We argue that infants' emerging sensitivity to timing is driven by the causal relationship between articulators and speech sounds.

S5.2iii Looking and Language: Eye Gaze Patterns Correlate with Vocal Complexity and Language Development in Infants at High- and Low-Risk for Autism Spectrum Disorder

Tiffany Woynaroski[1], Pooja Santapuram[2], Jacob Feldman[1], Sarah Bowman[1], Ashley Augustine[2], Alexandra Golden[1], Evan Suzman[2], Neill Broderick[1], Bahar Keceli-Kaysili[1], Carissa Cascio[1], Mark Wallace[2], David Lewkowicz[3]

[1]Vanderbilt University Medical Center, [2]Vanderbilt University, [3]Northeastern University

Introduction: Theory and recent research suggest that attention to audiovisual speech cues may be useful for predicting vocal complexity and broader spoken language development. Specifically, typically developing infants shift their gaze from the eyes to the mouth of a speaker in the second half of the first year of life and again in the second year of life, presumably to facilitate integration of the auditory and visual elements of speech. These shifts appear to correspond with the timing of qualitative changes in prelinguistic and linguistic development, such as the onset of canonical babbling and the vocabulary burst. Gaze patterns to audiovisual speech differ in children who are diagnosed with or at heightened risk for autism spectrum disorder (ASD) relative to their typically developing (TD) or lower risk peers. The present project is evaluating whether individual differences in gaze to audiovisual speech are related to differences in vocal complexity and vocabulary in infants at high risk (i.e., siblings of children diagnosed with ASD) and relatively low risk (i.e., siblings of TD children) for ASD. Methods: Participants were recruited from a larger, longitudinal study of infants at high- and low-risk for ASD from primarily English-speaking households (Sensory Project in Infant Siblings; PI: Woynaroski). Gaze patterns to eye versus mouth regions of the face were measured as infants viewed videos of a woman speaking in infant-directed speech in their native language (English). Concurrent vocal complexity was measured with two full-day audio recordings collected on consecutive days using LENA digital language processors and in the context of the Communication and Symbolic Behavior Scales (CSBS). Concurrent and future word use and understanding was measured with the MacArthur-Bates Communication Development Inventories (MB-CDI). Results: Results from our pilot sample of 13 low risk infants, aged 5-25 months (Mage = 14.4 months, 6 males) indicate that eye gaze patterns to audiovisual speech are associated with several indices of vocal

complexity and vocabulary, with large effects. For example, time looking to mouth correlated with canonical syllabic communication (i.e., the proportion of intentional communication acts that include a canonical syllable; r (12) = 0.60, p = 0.040), consonant inventory (r (12) = 0.62, p = 0.031), receptive vocabulary (r (13) = 0.73, p = 0.005), and expressive vocabulary (r (13) = 0.62, p = 0.023). Data collection on high risk infants is ongoing, but preliminary analyses will be complete prior to the ICIS conference. Discussion: Preliminary findings suggest that eye gaze patterns to audiovisual speech hold some promise for predicting prelinguistic and linguistic development. We hypothesize that a greater amount of time looking to the mouth region will additionally be associated with greater vocal complexity and a larger vocabulary in infants at high risk for ASD. If our hypotheses are born out, we will have identified a novel measure that may facilitate earlier identification of language impairments in infants at heightened risk for ASD.

S5.2iv Sensitivity to Audio-Visual Synchrony and Its Relation to Language Abilities in Children with Autism Spectrum Disorder

Elena Tenenbaum[1], Giulia Righi[2], Carolyn McCormick[3], Stephen Sheinkopf[2]

[1]Women and Infants Hospital, [2]Warren Alpert Medical School at Brown University, [3]Purdue University

Autism Spectrum Disorder (ASD) is often associated with language delays. Though speech is largely processed through hearing, a great deal of information about language is also conveyed visually. The ability to recognize synchrony between auditory and visual information may be important for language development and children with ASD may differ from typically developing (TD) peers in their processing of audio-visual synchrony.
 Objectives: (1) To evaluate whether language impairments in ASD are related to differences in bimodal processing of speech. (2) To explore psychophysiological responses to audiovisual synchrony in social and nonsocial stimuli among children with ASD.
 Methods: We will review recent work in which we used eye tracking to monitor the fixations of children with ASD while they watched two videos presented side-by-side of a woman speaking in animated infant-directed speech in which one video was synchronous with the audio track and the other was asynchronous at a delay of .3, .6, or 1.0s. In the current study, we are monitoring heart-rate variability in response to audiovisual synchrony in social (i.e. a woman speaking) and nonsocial (i.e. toys that make noise) stimuli.
 Results: Our previous work showed that children with ASD do not show a reliable preference for synchronous videos whereas language matched TD

children preferred the synchronous videos in the .6 and 1.0s conditions. Further, preference for the synchronous video (and specifically for the eyes and mouth of the speaker) was related to language ability across groups. Data collection on the psychophysiological response to asynchrony is currently underway.
 Discussion: Our previous work shows that children with ASD differ from language matched TD controls in their attention to audiovisual synchrony and that these patterns of attention to audiovisual synchrony are related to language abilities. This work lends support to the notion that atypical processing of audio-visual synchrony may be one mechanism underlying language impairments in autism. We anticipate that physiological responses to audio-visual synchrony will differ between groups and may provide information about why some children with ASD look less at bimodal social stimuli than TD children.

S5.3 Symposium: Lessons learned from implementing early intervention home visiting programs in communities

S5.3i Implementation of the SafeCare parenting model: Challenges, lessons learned, and recommendations

Daniel Whitaker[1], Jenelle Shanley[2], Shannon Self-Brown[1]

[1]Georgia State University, [2]Penn State University

The SafeCare model is a behaviorally-based parenting program originally designed to address child maltreatment. Though is shares roots with many other behavioral parenting programs, SafeCare addressed proximal risk factors associated with child neglect, the most common form of maltreatment. SafeCare address positive parenting, home safety and cleanliness, and child healthcare skills. The evidence based for SafeCare includes single-case studies validating all modules, quasi experimental, large scale experimental trials. In 2008, the National SafeCare Training and Research Center (NSTRC) was formed to disseminate the SafeCare model. Since that time, sites in 27 states and 6 non-US countries have been trained to implement SafeCare. NSTRC uses a rigorous training model, with ongoing coaching to ensure model fidelity, and a trainer training program for sites to allow for affordable sustainability. This presentation will describe several aspects of NSTRCs efforts to disseminate the SafeCare model. First, we will briefly describe the SafeCare model, and the implementation model, including how NSTRC ensures fidelity by periodic review of audio recordings, and how external trainers are trained to ensure a high level of quality from non-NSTRC trainers. We will spend most of the presentation focusing on describing the individual, organizational, and systemic challenges that have been encountered. From an individual perspective, attitudinal issues, workload issues, and issues of perceived client fit are primary barriers. Providers with less positive attitudes, who do more diverse job tasks, and who perceive SafeCare to be a poor fit with their client needs pose challenges to implementation. Organizational variables can also pose challenges. An organization culture of innovation and adaptiveness are important as is strong leadership to help providers works through the many challenges of implementing a new program. Organizations with strong leaders are needed to help individual staff work through the individual challenges of negative attitudes and poor perceived fit with client needs. Systems perhaps pose the biggest challenge to immediate and sustained implementation. Systems dictate the priorities of child welfare systems, dictate the length and course of services, and structure payment for those services. Systems that prioritize and incentivize the delivery of evidence-based practices have much better uptake of SafeCare than systems that do not. Systems that de-implement non-evidence based practices have better uptake than systems that do

not. We will conclude with a set of recommendation on implementation that have been critical for the success of SafeCare implementations. They are: (1) start small, (2) obtain support at all levels of the system ecology, (3) find a local champion and localize expertise, (4) have patience and persist, (5) allocate appropriate resources for the new model.

S5.3ii Nurse-Family Partnership: Lessons Learned in Dissemination and Implementation

Mariarosa Gasbarro[1], David Olds[1]

[1]University of Colorado Denver

Implementation of evidence-based interventions in community settings is complex. Programs must be conducted with fidelity to the original model to help ensure that community-based programs achieve outcomes comparable to those observed in research, while implemented with sufficient flexibility to meet challenges of community-based practice. The Nurse-Family Partnership (NFP) is a nationally and internationally disseminated program of prenatal and infant/toddler home vising by nurses tested in a series of randomized-clinical trials (RCTs) over the past 40 years. By establishing a systematic process for cultivating new Implementing Agencies, providing education and consultation to nurses, and using data collection to support on-going quality improvement, NFP has sought to navigate the tensions of implementing evidence-based programs with fidelity while simultaneously adapting the model to address the needs of program implementation in real-world community contexts. A framework was developed to identify challenges in NFP community replication, develop innovative approaches to addressing those challenges with input from the field, and test and refine innovations in community practice before integrating innovations into on-going NFP nursing education and practice. This session will be devoted to discussing specific challenges that apply to the NFP and that may have application to other evidence-based early interventions.

S5.3iii Attachment and Biobehavioral Catch-up

Caroline Roben[1], Stevie Schein[1], Amanda Costello[1], Fabianne Blake[1], Mary Dozier[1]

[1]University of Delaware

The Attachment and Biobehavioral Catch-up (ABC) is an attachment-based intervention that targets several key issues with parents of high-risk infants. Infants who have experienced early adversity are at risk for disorganized attachment and biological and behavioral dysregulation. ABC addresses these risks by helping parents behave in ways that are more nurturing when children are distressed and follow their children's lead with delight during play. Sessions are implemented by parent coaches in families' homes, with caregivers and children together for weekly one-hour sessions over a period of 10 weeks. Although session content is guided by a manual, the parent coach's primary role is to provide ''in the moment'' feedback about the parents' interactions with their children. We have evidence supporting the efficacy of ABC from several randomized controlled trials. For example, children enrolled in ABC demonstrate lower rates of disorganized attachment (Bernard et al., 2012) and more normative cortisol levels (Bernard et al., 2014; 2015). Caregivers of children enrolled in ABC have also been shown to have higher levels of sensitivity (Bick & Dozier, 2013; Yarger et al, 2016), and changes in sensitivity mediate intervention effects on child impulse control (Lind et al., 2017) and child receptive language (Freedman et al., 2017). Multiple outcomes were found several years after the completion of the 10-week intervention. As described in the implementation literature (e.g., Hulleman & Cordray, 2009), efficacious interventions often struggle to translate into effectiveness in communities. We have sought to address these challenges through 1) defining, quantifying, and tracking fidelity, 2) identifying characteristics of successful parent coaches, and 3) improving communication and preparedness with local supervisors and organization leaders. We have developed a novel coding system of "in the moment" comments that provides concrete goals for supervision, as frequency of comments is associated with parental sensitivity in subsequent sessions and post-intervention assessments (Meade & Dozier, 2012). We will describe its use in tracking clinicians over time, certification, and recertification. We also created a screening measure that is correlated with frequency of comments in initial sessions (Caron et al., 2017). We will describe this measure, as well as additional parent coach characteristics currently being studied (e.g., executive functioning). Organizational lessons learned from successful and less successful implementation sites will be discussed, including factors relating to site support for parent coaches, client caseload, and referral sources. To date, we have implemented ABC in 15 US states and four countries internationally. Using a semi-structured play assessment (NICHD Early Child Care Research Network, 1996), we analyzed the changes in parenting behaviors from pre- to post-intervention in 221 of the most recent cases across 9 sites, finding significant improvements in sensitivity (Cohen's d = .72). Associations between this measure, fidelity, and parent coach characteristics will be presented. Next steps for the

program include consideration of how to expand the number of families reached while also continuing to train parent coaches with high-intensity supervision and adherence and fidelity to the model.

S5.3iv Enhancing the Effects of Early Head Start through a Focus on Parent-Child Relationships

Brenda Jones-Harden[1], Lisa Berlin[1]

[1]University of Maryland

Early Head Start (EHS) is the nation's largest public program for infants, toddlers, pregnant women, and their families, from low-income backgrounds. The program is designed to be comprehensive, targeting both children and parents, and focusing on the "whole child". One of the EHS program options is home-based services, which have been documented to improve both child and parent outcomes (Chazen-Cohen et al., 2013). Researchers have delineated factors that can improve the benefits of EHS home-based programs, including attention to parent-child relationships (Raikes et al., 2014). This paper will include summaries of secondary analyses of the EHS data set and the results of a recent randomized trial to supplement EHS with Attachment and Biobehavioral Catch-up (ABC). Implications of these findings for the implementation of EHS programs will be explored. EHS Study- In a secondary analysis of the EHS Research and Evaluation project's data set (n=1,385), we examined follow-up outcomes of EHS home-based programs (Jones Harden et al., 2012). We hypothesized that families participating in EHS home-based programs that were implemented in accordance with the Head Start Program Performance Standards (i.e., focus on child and parent outcomes, parent-child relationships) would experience more robust benefits of the program. Families were randomly assigned to a control vs. EHS condition, and participated in pre- and post-test interviews, direct child assessments, as well as live and video-recorded observations of parent-child interactions. Implementation was measured via site visits to the 7 home-based programs, which included observations, interviews, and document review. Findings revealed immediate and long-term positive impacts for families in home-based EHS, mainly regarding children's social-emotional functioning, parenting, and family self-sufficiency. Programs that fully implemented the HSPPS had more impacts on child outcomes, including child cognitive and academic outcomes, as well as broader impacts for parents. EHS + ABC Study- In this randomized-controlled study, we evaluated the implementation and impact of a supplemental parenting intervention -ABC - delivered to mothers and infants receiving home-based Early Head

Start. Our hypothesis was that the enhanced EHS plus ABC model would yield stronger benefits for intervention families, particularly in the parenting domain. Trained parent coaches provided 10 ABC home visits, conducted around families' schedules, to 208 low-income, primarily first-generation Latina mothers with infants and toddlers enrolled in home-based EHS. Impact data, including a psychosocial interview and a videorecorded, semi-structured parent-child interaction (HSPPS; i.e., Three Bag assessment), were collected in families' homes at pre- and post-intervention by two bilingual, bicultural researchers. Results indicate that EHS + ABC increased parental responsiveness/ sensitivity and reduced parental intrusiveness. Implementation data were collected via semi-structured qualitative interviews with Latina mothers (n=10), EHS home visitors (n=10), and ABC parent coaches (n=3), about their experiences of ABC as a supplement to EHS. Interview themes for parents included positive experiences of both EHS and ABC, a high value placed on receiving both programs, and cultural relevance of the ABC program for Latino families (Aparicio et al., 2016). Challenges regarding the sustained integration of ABC into EHS will be explored.

S5.4 Symposium: Recent advances in modeling infants' learning and development

S5.4i A Bayesian statistical approach to understanding the role of social cues in infants' coordinated social attention

Samuel Harding[1], Bennett Bertenthal[1]

[1]Indiana University

Background: During their first year, infants become increasingly proficient at dividing their attention between social partners and a vast array of novel objects found within their environments. Past research has shown that social cues, including the direction of another's eye gaze and their object-directed actions (e.g. reaches), can produce automatic shifts in attention towards distal locations, but it remains unclear at what age infants begin to coordinate their looking with these signals. We adopted a novel, hierarchical Bayesian approach in order to account for age-related differences in sensitivity to these social cues. Methods: Stimuli were prerecorded videos of an actress playing with toys, which were filmed from the first-person perspective of a 12-month-old infant seated across the table, encouraging natural infant-directed behaviors. Remote eye tracking data were collected from 8- and 12-month old infants and adults; resulting fixations were identified as directed towards the face or the hands and objects in the scene, and further labeled according to the most prevalent gaze direction (towards the camera or down towards the objects) and manual action (gestures or object-directed actions) exhibited by the actress during each fixation. Bayesian Modeling: We modeled the proportions of fixations directed towards the face within each gaze/action context using robust hierarchical logistic regression. The effects of each cue were estimated at each age group and separately for each individual. Parameter estimates that simultaneously captured individual variability and the consistent age-related difference in performance were inferred via standard MCMC methods. The full model structure is show in Figure 1. Results: For both infants and adults, we found a reliable increase in the proportion of fixations directed towards the actress's face when she exhibited direct, as opposed to averted, gaze; however the effect of her manual actions varied widely across age groups (see Figure 2). Examination of the posterior distributions capturing sensitivity to action type revealed that only adults produced the expected tendency to look more towards objects during moments of object-directed actions, while 12-month-olds showed no reliable difference, and 8-month olds instead looked more to the face. Discussion: These results suggest that coordinated social attention continues to develop throughout the first year, and that decisions on where and when to attend within a dynamic context are scaffolded by the

actions of one's social partner. Our Bayesian approach provided a means of leveraging individual variability to inform age-related differences in sensitivity to these two classes of social cue. In contrast to the dichotomous decisions produced via null-hypothesis significance test (i.e. p-values), this method expressed hypothesized differences in terms of continuous probabilities, allowing comparisons between relevant parameters and measured outcomes directly from the posterior distributions (Kruschke, 2011). These statistical tools have proven useful for past research, including investigation into infants' motor simulation (Boyer, Harding, & Bertenthal, 2017), and may help encourage the framing of developmental questions in non-dichotomous terms (e.g stating that infants at a certain age can or cannot produce some critical action).

S5.4ii Applying machine learning to infant interaction

Daniel Messinger[1], Paul Ruvolo[2], Javier Movellan[3]

[1]University of Miami, [2]Olin College of Engineering, [3]UCSD/Emotient

Introduction. Infant-mother smiling interactions are frequently described, but formal modeling is rare. Specifically, little is known about the behavioral preferences (the apparent goals) of each partner. A multidisciplinary team of computer scientists and developmental psychologists used inverse optimal control equations to infer infant and mother preferences from interactive smiling behavior. Methods. Thirteen infant-mother dyads were observed in weekly face-to-face between 4 and 17 weeks, and the presence and absence of infant and mother smiles were reliably coded. Modeling. Smiling interactions were formulated as an optimal control problem from the perspective of the infant (and, in parallel, the mother). In each video frame, the infant, for example, is smiling or not smiling and may change or maintain that behavior (stop smiling or continue smiling), given time since the infant last changed smiling state, and time since the mother last changed smiling state (e.g., by smiling). Transition probabilities from observed infant and mother behaviors were assumed to follow a Markov process. To implement inverse optimal control modeling, we 1) searched over a large number of systematically varied reward values assigned to the possible joint configurations of infant and mother behaviors (e.g., both are smiling); 2) calculated the probability of each partner action (e.g., continuing to smile) given the long-term expected reward relative to the other possible action (e.g. stop smiling). Finally, for each reward set, we summed the probabilities for all joint configurations to compute the posterior probability of each hypothesized set of preferences. Results (see Figure 1 and Table 1). Mother's actions were most consistent with a preference for states in which both infant and mother are

smiling, F(1.13,13.55)=13.79, p=.002, ç2=.54--mothers tended to create and prolong simultaneous smiling states. Infant actions were most consistent with a preference for states in which mother was smiling but infant was not, F(1.08,12.99)=66.96, p<.001, ç2=.85--infants tended to create and maintain states in which they were smiled at but were not smiling. In a follow-up study, an infant robot programmed to smile in a pattern consistent with the observed infant preferences elicited more participant-only smiling among 32 undergraduates than alternate patterns (e.g., mirroring), an index of construct validity. Discussion. We applied a formal mathematical model, using observed behaviors to infer preferences. The modeling indicated that infants and mothers have somewhat divergent--if developmentally appropriate--preferences during interaction. Mothers prefer mutual smiling states while infants act as if to maximize the net smiling they receive. In a proof of concept project, the infant preferences were validated in a robotics application, suggesting the potential of rigorous modeling to deepen our understanding of infant preferences during early interaction.

S5.4iii Memory Models of Statistical Learning

Erik Thiessen[1]

[1]Carnegie Mellon University

Recent research has suggested a provocative link between statistical learning and more general memory processes. That is, models of human memory may provide a useful framework for understanding the processes that give rise to statistical learning in humans (and other species). In this talk, I will introduce an exemplar memory model (iMinerva) adapted to simulate infant phonological learning, such as the discovery that lexical stress, in English, is predictive of word onsets. The model produces a set of novel predictions, and serves to identify a set of tractable questions about the nature of the mechanisms underlying statistical learning. One such question is about kind of representations over which statistical learning operates. I will discuss results from a series of phonological learning experiments that indicate that these representations are perceptual (and episodic) in nature, rather than encoded in an abstract, symbolic manner. This informs a related question: how do learners detect and encode statistical relations among elements of the input? Again, a memory-based approach provides a useful prediction: representational strength, rather than transitional probabilities, may provide the best process-level explanation of how learners differentiate between "high probability" and "low probability" events. Representational strength, in turn, can be explained in terms of processes integral to memory such as activation, interference, and

decay. To test this prediction, we presented both human learners and iMinerva with artificial languages in which representational strength was varied independently from transitional probabilities between elements. Human learning varied as a function of representational strength, even when transitional probabilities were preserved. This is consistent with the predictions of the memory-based framework motivating the iMinerva model. A final route of inquiry suggested by a memory-based framework for statistical learning is how this learning might be instantiated in a neurological system. To address this question, we have begun to use neuroimaging techniques (such as Near Infrared Spectroscopy) to investigate the representations that emerge over the course of statistical learning. Our preliminary results suggest that knowledge of statistical structure emerges very quickly, consistent with what we might expect from a learning system that shares a set of underlying processes with the episodic memory system. Further, to the extent that we understand the development of the human memory system, we can use this understanding to identify predictions about changes in statistical learning across developmental time. To begin to explore this question, we have used iMinerva to identify and test predictions about the time course of phonological learning, and the extent to which this learning is driven by experience with linguistic input. Taken together, these behavioral, neurological, and simulation data are consistent with the argument that statistical learning results, at least in part, from more general memory processes like activation, interference, and decay.

S5.4iv Beyond Bayes: The need for mechanisms in understanding infant category learning

Denis Mareschal[1]

[1]Birkbeck, University of London

Recent years have seen a sharp rise in the number of Bayesian models of infant learning published. While Bayesian accounts capture the need for infants to engage with statistical structures that exists in the environment, such theories operate at what David Marr called the "Computational Level" of description. That is, they describe what structures exist in the environment and what needs to be accomplished to learn a task, but they remain completely agnostic about HOW the necessary learning or information processing takes place. Theories at the "Algorithmic" or mechanistic level, that address the HOW question, are required if we wish to resolve basic questions in psychology such as why learning unfolds according to a particular profile, what the effects of capacity limitations are, or why some individuals fail to learn or perform in predicted ways. This

point will be illustrated by discussing a recent dual-memory connectionist model of infant concept and category learning. Connectionist autoencoder models have been very successful at explaining online learning that occurs during the test session when 3-to4- month-olds are presented with a series of real world images (e.g., Mareschal, French, Quinn, 2000). Such models assume no prior knowledge. However prior knowledge is known to influence online category learning extensively. We present a new model that couple together a long term memory story that gradually acquires extensive background knowledge, with a short-term memory store that rapidly learns clustered sets of individual exemplars (Westerman & Mareschal, 2013). This system mirrors the dual-memory/cortical-hippocampal account of adult learning (McClelland, McNoughton, & O'Reily, 1992). This dual system connectionist model shows (1) the impact of combining the hippocampal (STM) system with a cortical (LTM) system on the structure of the categories formed in long-term memory, (2) illustrates how differing levels of prior knowledge in LTM effect the speed of habituation in a familiarization task, and (3) how the introduction of top-down category labels re-organizations the categories in long-term memory. In all cases, the connectionist model allows us to explore questions about how the learning takes place, how information is represented, and how new knowledge impacts on existing representations. Addressing these questions is possible because connections models offer explicitly learning mechanisms and explicit statements about what constitutes a representation... something that is inherently missing form Bayesian accounts of cognition (Jones & Love, 2011). Jones, M. & Love, B. (2011) Pinning down the theoretical commitments of Bayesian cognitive models. Behavioral Brain Sciences, 34, 215-231. Mareschal, D., French, R. M., Quinn, P. (2000). A connectionist account of asymmetric category learning in infancy. Developmental Psychology 36, 635-645. Westermann, G. & Mareschal, D. (2013) From perceptual to language-mediated categorization. Philosophical Transactions of the Royal Society B, 369: 201220391

S5.5 Symposium: The language-learning environments of Latino infants from Spanish-speaking homes from birth to 36 months

S5.5i Latino Infants' Home Language Inputs: Variations by Caregiver and Routine

Kelly Escobar[1], Catherine Tamis-LeMonda[1]

[1]New York University

Researchers have become increasingly interested in the language development of Latino dual-language learners (DLLs), and there is growing appreciation for the variability that characterizes their linguistic environments during infancy (Escobar & Tamis-LeMonda, 2017). Latino DLLs differ in the age of first exposure to either language, amount of exposure to each language individually, and the relative distribution of both languages (e.g., De Houwer, 2009; Grüter & Paradis, 2014; Hoff et al., 2014). DLLs also vary with regard to their household composition and cultural histories, yet there is much less understanding of how these broader contextual factors shape the linguistic environment. Specifically, information is sparse regarding culturally-guided daily activities that shape infants' home linguistic environments, and who are their daily conversational partners. This is an important omission, as the number of DLLs has grown dramatically, resulting in a national concern in addressing the early development DLLs and how early language environments influence their future academic success. Across two studies, we fill the gap in research by gathering information on how Latino infants' daily activities are structured from birth to 2, and provide a linguistic analysis of how various activities and interactions with multiple household members elicit different language use and vocabulary. In study 1, 138 Latina immigrant mothers (Dominican and Mexican) filled out time diaries of a typical day for their infant at 4 time points: 1 month, 6 months, 14 months, and 24 months. Data were collected regarding the type of activity, amount of time in that activity, and primary family member involved in that activity. In study 2, 20 Mexican families were observed for 2 hours in their home when their children were 2 years-old, and videos were coded and transcribed for language, semantics, and lexical diversity across caregiver and activity. Analyses are ongoing. Preliminary results show that Latino infants' daily activities vary greatly with regard to who engages with them. As expected, study 1 revealed that at 1 month infants spent most of their time with mothers, but increasingly spent more time with other family members over developmental time. Across child-centered tasks, such as play and bookreading, older siblings and fathers were more involved than mothers, while mothers were more frequently involved in caregiving activities, such as bathtime and feeding. These different routines have implications for varying language inputs. Study 2 revealed significant differences in diversity ($F(4,79) = 4.12$, $p = .005$) and amount of

language (F(4,79) = 6.88, p < .001) across routines. Post-hoc comparisons indicate that this child heard more words during unstructured (M = 57.40, SD = 28.06), and grooming (M = 77.40, SD = 23,78) than in play (M = 27.28, SD = 28.42) or literacy (M = 22.20, SD = 22.76), ps < .05. Figure 1 shows 1 infants' diversity of language input across family members across every minute of the visit. As can be seen, fathers and siblings make significant contributions to this child's language environment. Results are discussed in relation to cultural variations in the structure of daily routines, the nature of dual-language input, and family involvement.

S5.5ii Long-term Impacts of Early Shared Bookreading with Infant and Toddler Dual Language Learners on Language and Literacy Outcomes

Carolyn Cates[1], Adriana Weisleder[2], Anne Seery[1], Caitlin Canfield[1], Angelica Alonso[1], Maya Matalon[1], Benard Dreyer[1], Alan Mendelsohn[1]

[1]New York University School of Medicine, [2]Northwestern University

There is general consensus that shared bookreading is an important context for rich language interactions and that bookreading experience is associated with gains in child decontextualized oral language skills (Dickinson & Snow, 1983), vocabulary (Sénéchal et al., 1996), emergent literacy and early reading skills (Lonigan et al. 2000). However, evidence is limited regarding long-term impacts of quantity and quality of shared reading during the infant and toddler period on language and literacy development (Fletcher & Reese, 2005). Furthermore, little is known about nature and impact of early bookreading interactions experienced by Latino children in the US who are simultaneously developing competence in two languages. Therefore, this study explores longitudinal relations between shared bookreading quantity and quality among 226 mother-infant and mother-toddler dyads from Spanish-speaking and Spanish-English bilingual homes in the US and child language, emergent literacy, and early reading outcomes prior to school entry. Mother-child dyads were enrolled post-partum from an urban public hospital as part of a larger study. Assessments of Bookreading Quantity and Bookreading Quality were made at child age 6, 14, and 24 months using the StimQ, a parent-report instrument validated for use with English and Spanish speaking populations. Outcomes observed at 54 months included: 1) Child expressive/receptive vocabulary (54m: Expressive One Word Picture Vocabulary Test-EOWPVT, Receptive One Word Picture Vocabulary Test-ROWPVT), 2) Emergent Literacy (54m: Name Writing, Beginning Sound Awareness, and Print/Word Awareness using PALS Pre-K), and 3) Early Reading (Woodcock Johnson Letter Word Recognition, 54m). Multiple regressions were

performed, adjusted for SES (Hollingshead 4 factor index), firstborn status, experience with preschool/center-based care, any participation in parenting interventions, and child gender and language of assessment. Results indicated that bookreading quantity and quality at child age 6 months predicted expressive vocabulary at 54 months. Bookreading quality at 6 months also predicted receptive vocabulary and early reading at 54 months, as well as a trend for enhanced name writing skills. At 14 months, bookreading quality and quantity robustly predicted receptive vocabulary, and bookreading quality further predicted name writing, beginning sound awareness and early reading. At 24 months, bookreading quality and quantity robustly predicted later expressive and receptive language. At this timepoint bookreading quality predicted beginning sound awareness and a trend in early reading, while bookreading quantity predicted all aspects of emergent literacy skills and early reading. Findings suggest that the quantity and quality of shared bookreading interactions among parent-infant and parent-toddler dyads from homes of Latino dual language learners are critical contributors to key language and literacy skills up to four years later, prior to school entry. Implications of these findings will be discussed alongside those from additional analyses of these data, in progress, which aim to describe the specific types of bookreading behaviors that parents report using with their children across the three timepoints from early infancy through 24 months of age.

S5.5iii How Social Context Shapes Language Interactions in Latino Infants From Spanish-Speaking Homes

Adriana Weisleder[1], Alan Mendelsohn[2], Anele Villanueva[3], Anne Seery[2], Carolyn Cates[2], Caitlin Canfield[2], Jennifer Ledesma[2], Nina Robertson[2], Sabrina Vasques[2]

[1]Northwestern University, [2]New York University School of Medicine, [3]San Diego State University

Many studies with English-learning children have shown that the amount and quality of adult speech are positively correlated with early vocabulary growth (Hart & Risley, 1995; Hoff, 2006). In addition, studies suggest that the quantity and quality of language input varies as a function of the social interaction context - including the number of conversational partners and type of activity. For example, mothers' talk during book reading tends to be denser and more lexically diverse than talk in other settings (Hoff-Ginsberg, 1991), and infant-directed speech during one-on-one interactions has been found to be more strongly related to language development than speech in multi-party interactions (Ramirez-Esparza, 2014). To date, few studies have investigated these

factors in Latino infants from Spanish-speaking homes, especially during early infancy. Given possible cultural and linguistic differences in the environments of English monolingual children and Latino bilingual children, it is important to understand how aspects of the social context might shape language interactions in Latino families. In the current study, we investigated the language learning environments of Latino infants from Spanish-speaking homes over the first year of life. We examine how two characteristics of the immediate social context - the number of conversational partners and type of activity- are related to everyday language interactions in these families. We collected daylong audio recordings in the home, allowing us to capture infants' natural language environment over a variety of social interaction contexts. Participants (n=22) were recorded at 2, 6, 9, and 12 months using LENA, a digital recorder and software system that records infants' audio environment and provides quantitative estimates of the amount of speech. On the recording day, caregivers completed a logbook indicating the participants that were present during each 1-hour interval (e.g., mother, father, siblings) and the activities in which the infant was engaged (e.g., eating, bookreading). Combining quantitative measures of this rich natural language sample with parents' reports of the social interaction context, we explored differences in the number of adult words, conversational turns, and child vocalizations between social configurations and activity contexts. Multi-level models revealed differences in amount of language interaction that were related to the type of activity and social interaction context: 1) Intervals with bookreading exhibited more adult words ($b=25.03$, $p<.001$), conversational turns ($b=0.71$, $p<.001$), and child vocalizations ($b=1.99$, $p<.001$) than non-bookreading intervals, starting at 2 months and persisting through 12 months; 2) There were also more adult words, conversational turns, and child vocalizations when infants engaged in multi-party interactions with their parents and/or siblings than in one-on-one interactions with a single caregiver (all p's<.001); 3) Moreover, activity and social context were related: bookreading was more frequent in multi-party than one-on-one interactions. These results are an important step toward characterizing factors that shape language interactions in infants from Spanish-speaking homes, revealing both similarities and differences with findings from monolingual English-learning children. We will discuss implications of these findings for understanding and promoting language development in diverse groups of children.

S5.5iv Characteristics of English- and Spanish-Speaking Mother-Child Engagement During Free Play

Margaret Friend[1], Allyson Masters[1], Anele Villanueva[1], Pascal Zesiger[2], Diane Poulin-Dubois[3]

[1]San Diego State University, [2]University of Geneva, [3]Concordia University

Dual language exposed Spanish-speaking children in the U.S. show slower vocabulary growth than their English-speaking peers (Hoff, 2017), a finding unexplained by maternal education in the first two years of life (DeAnda et al., 2015, Friend et al., 2017). Two lines of evidence inform this proposal. First, quantity of language input to Spanish-speaking children is positively associated with child vocabulary (Hurtado et al, 2008; Weisleder & Fernald, 2013). Second, maternal responsiveness varies with culture (Tamis-LeMonda et al., 2014): the quality of maternal input may contribute to explaining differential vocabulary growth in Spanish- and English-speaking children. Participants were 50 Spanish- and 50 English-speaking mother-child dyads. Exposure to the dominant language was => 80%. We present preliminary data on 10 Spanish- (5 girls, Mage=31;6, range= 28;27 to 35;10) and 10 English-speaking children (5 girls, Mage=30;15, range=29;0 to 32;27). Dyads participated in 20 minutes of free play and mothers completed the MCDI:WS. Conversations were transcribed to inter-rater agreement =.90. Following Hirsh-Pasek, et al. (2015), we assessed parent-child joint engagement: Symbol Infused, Fluency and Connectedness, and Nonspecific engagement patterns occurred most frequently and are the focus of our analyses (see Figure 1). Symbol Infused Engagement and Fluency and Connectedness were expected to positively correlate, whereas engagement involving Nonspecific language was expected to negatively correlate, with child vocabulary. The English-speaking sample evinced higher maternal education and child expressive vocabulary than the Spanish-speaking sample ($t(17)=2.26$, $p=.031$ and $t(17)=3.97$, $p=.001$, respectively) but samples did not differ in the number of conversational turns (Ms =359 and 330, respectively, $p=.549$) that were the basis for the analyses. We conducted hierarchical linear regression with MCDI expressive vocabulary as the dependent measure, maternal education and language entered in the first step, and three categories of joint engagement entered in the second. Joint engagement significantly improved model fit ($R2=.35$, $p=.001$). There were significant effects of Language and of Fluency and Connectedness. Across samples, Fluency and Connectedness was positively associated with child expressive vocabulary, ($r(9)=.681$, $p=.022$ and $r(9)=.903$, $p=.000$, respectively, see Figure 2). It was also positively associated with maternal education in English ($r(9)=.664$, $p=.018$) but exhibited a negative trend in Spanish ($r(9)=-.467$, $p=.103$). In contrast, Nonspecific engagement correlated negatively with maternal education in Spanish ($r(9)=.-613$, $p=.04$) with a corresponding negative trend in English ($r(9)=-413$, $p=.118$). These preliminary results

are a first step toward characterizing the quality of parent-child joint engagement in young Spanish- and English-speakers. Two results are particularly striking. First, the depression of engagement in the Spanish-speaking sample suggests fewer or lower quality patterns of engagement. Alternatively, there may be compensatory language input that we have yet to capture. Second, in both samples, Fluency and Connectedness emerged as a significant correlate of expressive vocabulary but differed in the direction and extent of association with maternal education. We will have analyzed 50 participants/sample at the time of the symposium, permitting us to calculate stable estimates of these effects.

S5.6 Symposium: The early development of touch perception: body sensing, haptics, and interoception

S5.6i Neurobehavioral evidence of interoceptive sensitivity in early infancy

Lara Maister[1], Teresa Tang[2], Manos Tsakiris[2]

[1]Birkbeck University of London, [2]Royal Holloway University of London

Interoception, the sensitivity to visceral sensations, is fundamental to self-awareness. Despite the known role that interoception plays in cognition and mental health across the lifespan, the developmental origins of interoceptive sensitivity remain unexplored. We developed novel measures of interoception in infancy, and present the first ever demonstration of interoceptive sensitivity at 5 months of age, coupled with electrophysiological markers, to show that (a) infants display an implicit sensitivity to interoceptive signals, and (b), that this sensitivity is responsive to socio-emotional processing demands, as in adults. The novel Infant Heartbeat Task (iBEAT), employs preferential looking to assess whether infants are able to differentiate audiovisual rhythms that are synchronous with their heartbeat from other, non-synchronous cardiac rhythms. Infants viewed an animated character, moving either in synchrony or asynchrony with the infant's own heartbeat, during continuous eye- tracking. A clear visual preference for the asynchronous stimulus (M=5194ms, SD=2697) over the synchronous stimulus (M=4170ms, SD=2167) emerged at the group level, t(28)= -3.267, p=.0029, indicating that infants displayed an implicit sensitivity to interoceptive signals, and an ability to integrate these interoceptive signals with external visual-auditory stimuli. We then measured the Heartbeat Evoked Potential (HEP), an electrophysiological marker of cortical interoceptive processing. The HEP amplitude was recorded in the same infants whilst they viewed short video clips of emotional and non-emotional facial expressions. HEP amplitude was higher (p=.019, SST=577.0) for infants who showed a greater discrimination between synchronous and asynchronous cardiac rhythms during the Infant-HDT in a midline parietal cluster (P2, POz, Pz). Lastly, we also investigated and report significant emotion-specific modulations in HEP amplitude, which correlates with stable traits in infant temperament. Taken together these findings demonstrate that infants' state interoceptive processing is dynamic, flexible and responsive to task demands, and that their experiences of emotions appear to be closely influenced by their visceral reactions.

S5.6ii Which limb is it? The effect of touch on the emergence of body knowledge in early infancy.

Eszter Somogyi[1], Mollie Hamilton[2], Lisa Jacquey[2], Tobias Heed[3], Matej Hoffmann[4], Francesco Mannella[5], Vieri Giuliano Santucci[5], Gianluca Baldassarre[5], Jeffrey Lockman[6], Jacqueline Fagard[2], J. Kevin O'Regan[2]

[1]University of Portsmouth, [2]Université Paris Descartes, [3]Bielefeld University, [4]Czech Technical University, [5]Institute of Cognitive Sciences and Technologies, [6]New York University

Our series of studies examines how the ability to localise cutaneous touch develops across the first year. In an earlier study, we found that topographical awareness of the body emerges around 5 months, with response to touch becoming specific around this age. Younger infants responded to vibrotactile stimulation on the body in an undifferentiated way, by increasing movements of the whole body. Similar observations with older infants show that it is by 7-8 months that infants become able to perform precise movements in order to act upon the impinging stimulus. These results indicate that the body schema emerges gradually in infants during the first months of life. Currently we are investigating the factors that contribute to or facilitate this development. One possible mechanism could be that spontaneous self-touch behaviour, by provoking 'interesting' new effects (felt touch), leads to represent these effects and then later re-activate them as goals based on intrinsic motivations so that infants strive and learn to reproduce them. In order to explore the role of self-touch in building the body schema, we made biweekly recordings of 8 infants' spontaneous activities between 2 and 6 months of age. Our hypothesis is that the body parts infants spontaneously reach emerge in a pattern that is similar to the pattern of the development of their ability to localize touch. A second possible factor that emerges in literature as contributing to the development of body knowledge is externally provoked tactile stimulation (which corresponds to the activation of one goal after learning the skill to accomplish it). We propose that infants build representations of touch events when they receive tactile stimulation from the external world. In turn, the infant will make attempts to reproduce or reactivate these representations through goal-directed mechanisms. In the learning phase leading to acquire these abilities, we expect that the more tactile stimulation infants receive, the earlier they will be able to localize touch on their body. In order to explore this hypothesis experimentally, we are currently following the development of a group of 20 infants over a period from 4 to 8 months of age, who receive weekly (non-social) tactile stimulation on their body. We expect that these infants will produce specific, localized responses to touch earlier than infants who do not receive regular tactile stimulation. We will be presenting results of the above series of studies and linking these to a computational model of the development of body

knowledge. Beyond exploring the effect of touch on the early development of body know-how, the aim of our ongoing series of studies with infants is to provide behavioural data to inform a computational model describing how an artificial agent or robot might learn to interact with its own body, in particular how it might learn the structure of its body in terms of being able to localize and reach for different parts of it.

S5.6iii The development of haptic-visual interactions underlying material perception in infancy

Jiale Yang[1], Natasa Ganea[2], Andrew Bremner[3], So Kanazawa[4], Masami Yamaguchi[5]

[1]University of Tokyo, [2]Goldsmiths, University of London,, [3]Goldsmiths, University of London, [4]Japan Women?s University, [5]Chuo University

Just by looking at an object, adults cannot only recognize the material category to which it belongs (e.g., metal ceramic), but can also identify its non-visual properties, such as its hardness and slipperiness. Conversely, we can also imagine the visual appearance of the material an object is made of by haptic touch. Thus, it seems likely that material perception develops via the interactions of inputs from multiple sense modalities. And yet, until now no studies have yet investigated the development of multisensory material perception. In this talk we will describe our research into: i) the development of visual perception of object materials, and ii) the development of the ability to recognise material properties of object across haptic and visual presentations. We will argue that the development of bridges between haptic and visual abilities drives the emergence of visual material perception in the first year of life. In our studies of visual material perception, we have shown that the ability to differentiate surfaces according to their glossiness (e.g., yellow vs. gold surfaces) develops postnatally between 5 and 8 months of age. During this same developmental period, we have also shown that infants lose the ability to differentiate proximal aspects of surface appearances (e.g. reflection patterns), coming to focus instead on the constant material properties (e.g. matte vs. glossiness). In a more recent investigation we have probed the developmental origins an ability to perceive object properties across visual and haptic modalities in the first year of life. We habituated infants to objects with different surface properties (fur vs. metallic) in both visual (habituation of looking), and haptic (habituation of holding time) presentations, and then measured subsequent dishabituation when the material of the stimuli was changed, using both unisensory (visual-visual and haptic-haptic), and crossmodal transfer (visual-haptic, and haptic-visual) comparisons. It may be that coordinated visual-haptic experience of objects gained following the onset of visually targeted

reaching around 5 months provides the experiences necessary to drive the development of visual material perception. This view is supported by Goda et al. (2016) who showed that the long-term visuo-haptic experience greatly boosted the representation of material in the higher ventral visual cortex in macaque monkeys. If this is the case, we would expect to find a development stage in which the infants can discriminate different materials by touch, but not by vision, and at which haptic-visual transfer is possible but not vice versa. Our preliminary findings show that infants aged 8 months have the ability to discriminate different materials both by vision and by touch. We are currently extending our investigation to pre-reaching 4-month-old infants.

S6.2 Symposium: Extracting neural representations from EEG and fNIRS signals for studies of development and learning

S6.2i Labeling Abstract Representations in the Infant Brain

Claire Kabdebon[1], Ghislaine Dehaene-Lambertz[2]

[1]Yale University, [2]NeuroSpin

As humans, our daily inner life consists in constantly forming and manipulating abstract mental representations. Those everyday computations are highly supported by the use of various symbolic systems such as language, mathematics or music in which an arbitrary signal can stand for a given concept. However, it remains poorly understood whether very young infants, well before language proficiency, readily demonstrate similar abilities for re-describing their environment into mental representations, encoded as variables that are available for further mental operations. In a series of three experiments, we explored 5-month-olds' abilities for building and concurrently monitoring several abstract representations. We used a pairing task in order to test the encoding of abstract auditory patterns (AAB, ABA or ABB) as stable mental representations. Infants were first presented with tri-syllabic words instantiating two of the three repetition-based patterns, and each pattern was systematically followed by a specific arbitrary sensory label 1 second later. Infants were thereafter introduced to some incongruent pairings while they were recorded with high-density electroencephalography (EEG). Classical event-related potentials (ERP) comparing brain responses to the congruent and incongruent visual labels revealed a late surprise response elicited by incongruent pairings. A frequency tagging approach additionally revealed that early visual activations to the label were also modulated by pattern-label congruency, with stronger activity in response to congruent pairings. Finally, inspection of the silent period between the tri-syllabic word and the following label revealed the build-up of anticipatory activity before the occurrence of the label. Altogether, these three neural responses demonstrate that abstract patterns can be captured by the infant brain and encoded as unitary mental representations, which could be paired with the following label. These results also evidenced a sophisticated series of neural computations, showing that, although still immature, the infant brain relies on a vast network of connections to process and transfer complex representations between remote brain modules.

S6.2ii Decoding Perceptual Similarity from EEG Patterns in 5-month-old Infants

Sid Kouider[1], Andreas Poulsen[2], Cecile Gal[1], Thomas Carlson[3], Sofie Gelskov[1]

[1]Ecole Normale Supérieure, [2]Technical University of Denmark, [3]The University of Sydney

Previous work in adults demonstrates that visual objects that appear similar also share similar patterns of neural activity. This line of research, first established with fMRI data and extended recently to EEG patterns, reveals that perceptual similarity can be inferred directly from neural data when subjective reports are unavailable, as it is the case for infants. Here, we tested whether such neural signature of perceptual similarity could be used to probe the nature of perceptual contents in infants. We used abstract visual patterns (see Figure 1) constructed from identical perceptual sub-units (oriented Gabor patches) but combined such that each pattern had a unique global shape or perceptual 'Gestalt'. This allowed us to rely on visual patterns that were all equivalent in terms of low-level visual similarity but could either be similar or dissimilar at more abstract perceptual levels, in terms of global shape (see examples of stimuli in the figure below). On each trial, 5-month-old infants (N = 32) watched each stimulus individually while EEG data were recorded with a 128 channels system and submitted to a response similarity analysis (RSA) of neural patterns across trials. Our results reveal that neural representational similarity increased for visual stimuli that fell within the same Gestalt group (i.e., similar global shapes) compared to stimuli from different categories. However, further analysis revealed that infants were more limited in their perceptual abilities compared to adults, as the decoding of neural representational patterns was primarily driven by a restricted number of gestalt principles (e.g., opposite bias). These findings demonstrate that perceptual information can be decoded from neural representational patterns in preverbal infants and directly compared to the nature of perceptual contents in adult populations.

S6.2iii Probing the Time-course of Face Representations with Time-resolved Multivariate Pattern Analyses of EEG Signals

Laurie Bayet[1], Benjamin Zinszer[2], Julia Cataldo[3], Emily Reilly[4], Radoslaw Cichy[5], Benjamin Balas[6], Charles Nelson[4], Richard Aslin[7]

[1]Harvard Medical School and Boston Children's Hospital, [2]UT Austin, [3]Harvard Medical School - Boston Children's Hospital, [4]Boston Children's Hospital, Harvard Medical School, [5]Free University Berlin, [6]North-Dakota State University, [7]Haskins Laboratories

Time-resolved multivariate pattern analysis ("decoding") of magneto-encephalography (MEG) data can be used to quantify the information about a given stimulus that is

embedded in event-related neural signals. MEG decoding has been used to uncover time-resolved neural representations in adults. Electro-encephalography (EEG), a low-cost alternative to MEG, is generally better suited for infant research. However, developmental EEG signals tend to yield lower signal-to- noise than adults' MEG signals. Thus, a question is whether decoding EEG signals from developmental participants, such as infants, could be achieved to uncover the timing of neural representations in these populations. In two experiments, we used EEG decoding to uncover the timing and properties of neural representations associated with high-level visual perception in young children and infants. In a first study, 5-7 year-olds (N=18), 8-10 year-olds (N=18), and adults (N=18) watched pictures of real or doll faces presented in an upright or inverted orientation for a total of 160 trials, while EEG data were recorded at 250Hz from 64-channels (EGI). Face orientation, but not animacy, could be decoded in children from 244-336 ms ($p < 0.05$, Figure 2). Similar analyses in adults yielded a significant cluster for face orientation at 104-204 ms, but none for animacy. Thus, despite significant effects for grand average event-related potentials (ERPs) in the P100/N170 components in children and adults (Balas et al., 2017; Bayet, Saville & Balas, under review), in children face orientation could only be reliably decoded at relatively late latencies around 300 ms. In adults, however, face orientation could be decoded at an earlier latency consistent with the P100/N170 components. Face animacy could not be decoded in any age group. These results are consistent with the notion that aspects of high-level visual perception, including face perception, become faster, more automatic, more reliable, and more engrained during development. In a second study, 6-9 month-old infants (N=14) and adults watched pictures of animals or parts of the body (cat, dog, bunny, teddy bear, hand, foot, mouth, or nose), while EEG data were recorded at 1000Hz from 128-channels (EGI). Time-resolved decoding of stimulus type (e.g. cat vs. dog) showed a peak around 130-250ms, with no difference between within-category (e.g., cat vs. dog) and between-category (e.g. cat vs. hand) classification (Figure 3). By contrast, in adults, between-category classification accuracy exceeded that of within-category classification after about 200ms post-onset, demonstrating a categorical organization of perceptual representations at these time-points. These results concur with the idea that high-level visual perception is more robustly organized according to categorical boundaries in adults than in preverbal infants. Taken together, these findings demonstrate the potential of EEG decoding for developmental cognitive neuroscience research on high-level visual perception.

S6.2iv Connectivity Development from Infancy to Adulthood: A Reliable Functional Connectivity Comparison

Sagi Jaffe-Dax[1], Lauren Emberson[1]

[1]Princeton University

Cortical connectivity supports the development of broad cognitive aptitudes and skills, from perception through language to social behavior. Moreover, atypical development (e.g., of preterm infants) is often associated with impaired connectivity. It is thus important to be able to measure connectivity in a reliable and non-confounded method. When measured by functional connectivity (FC), long-range connectivity is difficult to compare across populations where neural noise levels may vary. Specifically, greater neural noise leads to lower reliability in the neural response which will appear as diminished connectivity but actually represents a confound. Combining representational decoding (to quantify neural reliability) with functional connectivity will allow more refined comparisons across populations. This approach has been used previously with fMRI data comparing dyslexics to good readers, and revealed that dyslexics' impairment is specific to connectivity while their neural representation is intact. Here, we extend this approach to fNIRS, which allows us to conduct recordings with actively perceiving infants, and present the first comparison of representational similarity and functional connectivity between infants and adults. We quantify neural reliability or noise through Representation Similarity Analysis (RSA). Participants watch a set of video clips of animate and inanimate scenes. Using a large multi-channel fNIRS array, we decode neural responses between categories (animate vs. inanimate) and compare the pattern similarity within-category to the pattern dissimilarity between-category. The decoding accuracy for the perceived stimulus and correspondence between the stimulus space (animate vs. inanimate) and fNIRS patterns quantify the reliability of neural representation. This approach reveals that while the RSA (i.e., the ability to decode responses across stimulus categories) across infants and adults is comparable, FC values differ. fNIRS decoding allows us to verify, for the first time, that differences in functional connectivity across development do not arise from differences in neural noise. These findings suggest that cognitive development relies on augmentation of connectivity rather than on refinement of neural representation. In addition, it offers that connectivity might serve as a useful site for targeted intervention to overcome developmental difficulties. Such an intervention might be based on cognitive tasks or, at a younger age, on neuro-feedback methods.

S6.3 Symposium: Innovative interventions in nursing, pediatric healthcare, and early education to improve children's language-learning

S6.3i Bridging the Word Gap through Pediatric Healthcare

Carolyn Cates[1], Adriana Weisleder[2], Samantha Berkule Johnson[1], Anne Seery[1], Caitlin Canfield[1], Harris Huberman[3], Benard Dreyer[1], Alan Mendelsohn[1]

[1]New York University School of Medicine, [2]Northwestern University, [3]SUNY Downstate

The early emergence and long-term persistence of poverty-related disparities in school readiness underscore the need for effective interventions prior to school entry. The quantity and quality of the early language experiences are key predictors of school readiness and later academic success, and represent a promising target for preventive interventions (Brooks-Gunn & Markman, 2005; Hart & Risley,1995; Hoff, 2003). Pediatric healthcare represents an underutilized opportunity to address disparities through promotion of language- and literacy-rich activities such as reading aloud and play during the critical period from birth to 5 years, with potential for low cost, universal, frequent access to low income families beginning in infancy and continuing through school entry. This Video Interaction Project (VIP) builds on this opportunity through an interventionist who meets with families during each healthcare visit and video-records the parent and child during play and shared reading utilizing a provided toy and/or book. The video is reviewed to identify and reinforce targeted behaviors (e.g., talking to child, responding to vocalizations, expanding on child language) and given to the parent to promote generalization of these behaviors in the home. In the context of a randomized controlled trial, we analyzed trajectories of parenting related to participation in VIP 0-3 from child age 6 to 54 months. We expected that early impacts of VIP on responsive parenting would be sustained throughout the course of the intervention (36m) and 1.5 years post-intervention completion (54m). 450 mother-infant dyads (42% high school graduates, 91% Latino, 85% immigrant) were recruited from in the postpartum unit of a large urban public hospital serving low-income, immigrant families and were randomized to VIP or to Control. 386 families (194 VIP; 192 Control) were assessed at one or more timepoints at child age 6, 14, 24, 36 and 54 months using the reading [READ], parent verbal responsivity [PVR], and parent involvement in developmental advance [PIDA], and availability of learning materials [ALM] subscales of the StimQ, a parent-report measure validated for use in low-income English and Spanish speaking populations. A StimQ Total score was obtained from the sum of these StimQ subscales. Parent verbal input was also measured in the context of observed

bookreading interactions using the wordless picture book, Frog, Where are you? at 54m. Videotaped bookreading interactions were transcribed using CHAT and analyzed using CLAN for word types, tokens, and number of utterances. Multilevel models of trajectories, adjusted for child age, gender, maternal literacy, and any participation in intervention beyond age 3 showed: 1) sustained impacts of VIP 0-3 on READ, PVR, PIDA, ALM, and StimQ Total (linear effect). Multiple regressions showed increased number of mother utterances, word types, and word tokens in bookreading interactions at 54m. Findings indicate persistence of VIP impact on parenting through 1.5 years post-intervention, and highlight the potential role of pediatric healthcare interventions in preventing disparities in school readiness at the population level.

S6.3ii Talk With Me Baby: Maximizing the Power of Nursing and Public Health Workforces to Educate and Coach Parents on the Primacy of Language Nutrition

Jennifer Stapel-Wax[1], Ashley Darcy Mahoney[2], Arianne Weldon[3], Kimberly Ross[4]

[1]Emory University, [2]George Washington University, [3]Get Georgia Reading: Campaign for Grade Level Reading, [4]Georgia Department of Public Health

Talk With Me Baby (TWMB) is a statewide initiative aimed at bridging the word gap. It is a cross-sector initiative designed to ensure that every child, from birth, receives essential "language nutrition." TWMB is designed to help transform parents and caregivers into conversational partners with their babies. Language nutrition coaching is implemented by large-scale work forces that interact with new and expectant parents, beginning with nurses. Language exposure is critical to early brain development and significantly impacts a child's future educational achievement and long-term health outcomes. Ensuring that all children benefit from abundant language exposure during the first three years of life is, therefore, imperative to improve outcomes for children. Currently, a significant majority (77 percent) of Georgia's fourth graders living in low-income households are reading below grade level, placing them at greater risk of dropping out of high school and facing poor health outcomes and a shorter life expectancy. Effectively addressing this epidemic at the population level can have a considerable positive impact on these children and the state as a whole. A growing body of research shows the mediating effects of early language exposure on young children's brain development and long-term health outcomes and also reveals that the single strongest predictor of a child's academic success is the quality and quantity of words spoken to the baby in the first three years of life - outweighing socioeconomic status, ethnicity, and level of parent education. The Talk With Me Baby (TWMB) workforce approach and

public-action campaign aims to ameliorate this epidemic by systematically educating the public on Language Nutrition -- defined as the use of language that is sufficiently rich in engagement, quality, quantity, and context that nourishes the child neurologically, socially and linguistically. TWMB is a cross-sector coalition aimed at transforming parents into conversational partners by: 1. training large-scale workforces to act as Language Nutrition coaches in their interactions with new and expectant parents, and 2. increasing the public's awareness of the importance of Language Nutrition through publicly accessible media. With 99% of mothers and infants seeing a nurse up to 7 times between 25 weeks gestation and 12 months of age for the infant, the focus on training nurses is clear. Additionally, over 60% of children are served by the Women, Infants and Children (WIC) program where regular visits with a nurse or dietician provide a ready community caregiver to educate and coach parents on both physical and language nutrition. Within these two available and ready work forces, the potential for repeated messaging and coaching is immense and largely untapped. The preliminary data supports the feasibility and initial impact of training work forces on Language Nutrition and mobilizing them to act.

S6.3iii Using Quality Early Care and Education Programs as a Platform for Addressing the Word Gap

Dale Walker[1], Gabriela Guerrero[2], Shannon Guss[3], Bridging the Word Gap Acceleration Partner Educare Schools Kansas City KS, West DuPage IL, Tulsa OK[4]

[1]University of Kansas, [2]University of Kansas, Juniper Gardens Children's Project, [3]University of Oklahoma, [4]Educare

The use of an evidence-based naturalistic communication intervention (PC TALK) to increase child language-learning across a randomized study in two high quality early education programs along with a parent-implemented component are described. Lessons learned about community-based research-practice partnerships to promote intervention implementation by teachers and parents will be shared. Research has demonstrated that deficits in early language development may arise from disparities in children's earliest language-learning environments. There is increasing understanding about the word gap and its consequences when infants and young children are not presented with rich language-learning opportunities. Without intervention, this gap in experience often leads to future deficits in language and early literacy. The PC TALK intervention was designed to be maximally flexible to ensure individualization for the unique skills and needs of infants and young children and their caregivers. The

manualized intervention was designed to be adapted for children and families including those from culturally and linguistically diverse learning backgrounds, and different contexts in which intervention is delivered. Data sharing techniques were used to support adult engagement and implementation of the intervention across classrooms and during monthly parent meetings. Multi-level growth curve modeling techniques and descriptive analyses were employed. In bi-monthly observations of teachers' level of intervention use and concurrent child communication during classroom activities, teachers' rate of strategy use was significantly higher for teachers in Intervention classrooms compared to Control classrooms (d = 1.41). Controlling for primary language, disability, and age, teachers' intervention use was positively related to observed child communication growth (d = 0.60). Teachers' use of the intervention was also found to be positively related to growth on a progress monitoring measure of communication (d = 1.33), and teachers' level of strategy use had a positive effect on the Preschool Language Scale (PLS) expressive communication. The PC TALK intervention led to more strategy use by teachers, which, in turn, led to a significant difference in the PLS expressive communication score (d=0.57). Level of intervention use by parents attending monthly meetings was also found to be associated with the rate of observed parent-child communication and child communication outcomes on a progress monitoring measure. Children whose parents used more of the PC TALK strategies had higher communication scores and fewer behavior concerns as rated by teachers. When early educators use the intervention strategies in their classrooms and parents use the strategies learned through community meetings, infants and toddlers communicate more frequently over time and have greater communication growth as documented in direct adult-child observations and through standardized assessments. Implications for translational community-based intervention and policy will be discussed.

S6.4 Symposium: Characterizing the temporal structure of infants' early auditory experiences and relations to infant learning

S6.4i Quantifying Inter-Word Temporal Spacing In Infants' Home Language Environment

Emmaline Drew[1], Elika Bergelson[1]

[1]Duke University

Work from cognitive psychology has shown that temporal structure can affect learning, e.g., spaced learning yields better long-term retention than massed learning (the spacing effect, Cepeda et al., 2006). In contrast, little work has characterized the temporal structure of language in naturalistic settings and how this structure may in turn influence infant learning and development. Our goals were to 1) relate learning theory from cognitive psychology to infant language learning in a naturalistic setting and 2) quantify the temporal structure of the words an infant hears in their environment, as well as their own language production. To this end, we analyzed concrete nouns in infants' input and output in 1-hour long, monthly video recordings of 44 infants (from ages 6 to 17 months) from the SEEDLingS corpus. Nouns were selected for this analysis due to their primacy in the early receptive and productive vocabulary (Benedict, 1979; Fenson et al., 2000). In order to quantify the distribution and temporal structure of child-directed and child-produced speech, we calculated the top 10 nouns heard and the top 5 nouns said by each child across all recordings, and for each child in each month, we calculated the type-token-ratio and the burstiness coefficient over all nouns. Burstiness is a metric of event regularity (Slone et al., 2017; Goh and Barabási, 2008), which was used here to quantify the time between occurrences of nouns in the recordings. For instance, a bursty distribution of words would exhibit short, intense bursts of words followed by longer periods with few to no word occurrences. Our results revealed several key findings. First, while the nouns in this corpus overall were random (rather than bursty or periodic), infants' top 10 input nouns and top 5 output nouns (as determined by frequency of occurrence), were relatively more bursty (Δinput = 0.13, $p < .05$; Δoutput = 0.15, $p < .05$; see Table 1). Second, the more nouns (token count) a child said, the more bursty their speech output was ($r_s = 0.58$, $p < .001$). Third, the more lexical diversity (i.e., the higher the type-token-ratio) in the child's speech, the less bursty (i.e., the more randomly distributed in time) their speech output was ($r_s = -0.53$, $p < .001$; see Figure 1). This work represents first steps in characterizing the distribution and temporal structure of words in an infant's home environment, using the frequency, variety, and timing regularity (burstiness) of concrete nouns. Such analyses over naturalistic home data are critical as a

window into infants' day-to-day experiences, and their own early word production within them. Taken together, our results suggest that the timing properties of the most frequent nouns in the environment differ from those of lower-frequency nouns, and that while infants' higher volubility corresponded to more bursty word productions, higher word diversity was instead linked with inter-word timing with a more random distribution, mirroring the overall input. This work suggests that the natural temporal spacing of words is a promising correlate of early language learning and production.</p>

S6.4ii Bursty dynamics in early music input

Caitlin Fausey[1], Jennifer Mendoza[1]

[1]University of Oregon

Babies acculturate to their soundscape over the first year of life (e.g., Hannon & Trainor, 2007; Hannon & Trehub, 2005; Werker & Tees, 1984). Importantly, the everyday business of tuning one's auditory skills requires integrating experiences that are distributed in time. The details of these temporal distributions therefore constrain what learning problem infants solve as they build knowledge. Here, we report on the real-life temporal dynamics of a ubiquitous early ecology in which foundational auditory skills get built: music (Custodero et al., 2003). How do infants encounter music -- with its notes, melodies, rhythms, and words -- over the course of their daily life at home? Does music occur (1) periodically, such as "every hour on the hour", (2) randomly throughout the day, or (3) in bursty fashion, such that clusters of music happen close together in time and are separated by longer periods without music? These dynamics each present distinct opportunities for predictability and memory integration as young learners encounter the input over time. Infants (N=35; ages 6-12 months) wore a lightweight audio recorder at home (LENA; Ford et al., 2008) for up to 16 hours (Median=13.13 hours). Trained coders identified music bouts within this everyday soundscape: uninterrupted live and/or recorded singing, instrument playing, and vocally produced pitched, rhythmic patterns (e.g., humming) (Fig. 1). Two coders independently coded music bouts for each infant's day. The number of seconds per each minute throughout the day that each coder judged as music was very highly correlated (Median r=.94, SD=.08). Therefore, the music bouts from one coder per infant day were randomly selected for analysis. Fully annotated recordings reveal that infants encountered almost one hour of music per day (Median=55.20 minutes, SD=66.00 minutes). Individual music bouts were short (Median=13.00 seconds, SD=57.94 seconds) and they showed

characteristically bursty dynamics (Median B=.27, SD=.11) (Goh & Barabási, 2008) (Fig. 2). These bursty dynamics are consistent with other human communicative activities (Goh & Barabási, 2008). Notably, this real learning schedule is remarkably different from the random or periodically distributed auditory content of many in-lab studies of early sound learning. Every infant heard music during their day. Ongoing analyses of the musical content that infants encountered reveal that infants heard the same voice (Median= 27 repetitions; range: 2-178) and tune (Median=12 repetitions, range: 4-115) multiple times per day. We will present and discuss a model in which the overall daily dynamics as well as the specific profiles of musical content work together with other indices of high-quality experiences (e.g., live, vocal, and infant-directed; Weisleder & Fernald, 2013) to add up to a recipe for auditory learning success in the first year of infancy.

S6.4iii Temporal synchrony of parents' naming and infants' exploration

Lynn Perry[1], Adriana Valtierra[1], Stephanie Custode[1]

[1]University of Miami

Imagine an infant who is just beginning to learn words. She first hears her mother say cup in the context of a cluttered mealtime setting. In order to figure out what cup means, she has to 1) identify the referent of this word in the moment; 2) understand what properties are relevant for cup category-membership (shape rather than color or material); 3) and apply the word to new cups she encounters. Evidence from recent studies of parent-infant interactions with novel objects suggests the timing of auditory inputs is key to infants' word learning. If parents name an object as the infant holds it occupying their visual field, then the infant is much more likely to learn and remember that name. However, infants are not only learning about cups: they need to learn many other words for which other properties matter (e.g., for nonsolid substances like juice, they learn that material is more important than shape). Although we know infants' learning about nonsolid substances lags behind their learning about solid objects, little is known about how they learn about them. Here, we compare the temporal synchrony of parent's naming and infants' exploration of solid objects and nonsolid substances during free play, asking how infants leverage temporal regularities to learn words for different kinds of things. Here we use head-cameras to gain a first person perspective of infants' experiences with objects and substances that could lead to these differences in naming (see Figure 4). Fourteen mothers and their infants (8 female; mean age=20 months) participated in two (order-counterbalanced) short free-

play sessions with three novel objects (e.g., wooden pac-man shape) and three novel substances (e.g., purple mayonnaise) while wearing head-cameras. Parents were told the names of things beforehand, but were not explicitly instructed to teach these names. After free-play, we tested infants' comprehension accuracy and generalization (based on shape or material). Videos of free-play were transcribed and coded for the timing of parents' naming and infants' manual and visual behaviors. We found systematic differences in the frequency and timing with which parents talk about solids and nonsolids corresponding to differences in the way infants explored and subsequently remembered them. Parents were significantly less likely to name the nonsolids than the solids, and even after controlling for this difference in naming frequency, were less likely to name nonsolids synchronously with infants' touching and looking. However, infants' generalization of both solid and nonsolids was tied to the timing of parent naming. As can be seen in Figure 5, the infants were more likely to select the material match for nonsolids and the shape match for solid objects when they had previously heard them named synchronously to their own exploration. Together, these results reveal that despite differences in parents' tendency to coordinate their naming with infants' behavior for different kinds of things, infants nevertheless benefit from temporal synchrony as they learn new words.

S6.4iv The Temporal Structure Of Parent Speech Predicts Infant Word Learning

Lauren Slone[1], Drew Abney[1], Linda Smith[1], Chen Yu[1]

[1]Indiana University

Much research indicates that the structure of language is not random. Words are not randomly sampled, but rather clustered in time such that the probability of hearing a word (e.g., "spoon") is higher if you just heard it compared to its probability in the distribution of words as a whole. This is likely a property of parents' speech to their children, and our question is whether this matters for children's word learning. We recorded audio from 52 parent-infant dyads (children aged 13-26 months) during play with six novel objects in a laboratory. Parents were told the novel objects' names and instructed to play naturally. After free-play, infants' comprehension of the novel objects' names was tested. We (1) characterized the temporal structure of parent talk about individual objects during free-play, and (2) examined whether the type of temporal structure related to the infant's comprehension of the object's name. Parent speech was transcribed and chunked into utterances that were coded for the object referenced. We used the burstiness metric (B) from Kim and Jo (2016) to describe

the temporal structure of utterances about each object (Figure 6). B can take values from -1 to 1, with particular points along this range corresponding to different types of temporal structure. B=-1 indicates the timing of utterance onsets is perfectly periodic, like a metronome. B=0 indicates a Poisson distribution where utterance onsets are independent of each other. B=1 indicates bursty timing where utterances cluster together in time, separated by lulls of no utterances. B was computed for parent talk about each object, for each dyad. We used a bootstrapping procedure to estimate 99% confidence intervals for the range of B values corresponding to a Poisson distribution. Utterance distributions with B values within this range were categorized as "Random". Utterance distributions with B values falling outside and below, or outside and above, the confidence intervals for a Poisson distribution were categorized as "Periodic" or "Bursty", respectively. Parents' utterances to their children were predominantly structured (76% of distributions were Bursty, 21% were Periodic), rather than randomly distributed (3% were Random) in time. For each infant, we computed the proportion of objects talked about in a Bursty way that were comprehended, and the proportion talked about in a Periodic way that were comprehended. A linear mixed model - with proportion names comprehended as the dependent variable, number of utterances and speech structure (Bursty, Periodic) as independent variables, and dyad as a random factor - revealed that speech structure accounted for significant variance in infants' object name comprehension scores. Infants were more likely to learn the names of objects talked about with Bursty temporal structure compared to those talked about with Periodic structure, regardless of the amount of talk about the objects (Figure 7). These findings suggest that parent speech to children during naturalistic toy play is structured, and that the type of temporal speech structure children are exposed to relates to word learning. We will discuss how bursty speech structure may support object name learning through attentional and memory mechanisms.

S6.5 Symposium: Bridging research on emotional development and social cognition

S6.5i Can young infants predict another person's emotional response to a situation?

Ashley Ruba[1], Andrew Meltzoff[1], Betty Repacholi[1]

[1]University of Washington

The ability to accurately predict another person's emotional response to a particular situation is important for children's social-emotional development. However, the developmental origins of this ability are not well documented. Two recent studies have reported that 10-month-old infants expect positive events to elicit positive emotions, but do not to expect negative events to elicit negative emotions (Hepach & Westermann, 2013; Skerry & Spelke, 2014). The current studies extend this work on young infants' emotion predictions by using ecologically valid eliciting events involving human agents and a looking-time procedure. In Study 1, 10-month-olds (N=48) were randomly assigned to the Happy or Anger condition. Each infant watched two videotaped events in which an Emoter interacted with another person and a toy (see Figure 1 for descriptions of events). One event was Anger-congruent (Toy Taken) and the other was Happy-congruent (Toy Given). After two familiarization trials of one of the events, the Emoter facially and vocally expressed either happiness or anger. The video was then paused to provide a still-frame of the Emoter's facial expression. Infants' looking time to this still-frame expression was recorded until the infant either looked away for 2 continuous seconds or the 60s trial ended. The same procedure was followed for the other event. Event order was counterbalanced. If infants are sensitive to the link between emotions and situations, they should look longer at the incongruent emotional displays. Infants looked significantly longer at the Anger expression when it followed the Give event compared to the Take event. Infants also looked significantly longer at the Happy expression when it followed the Take event compared to the Give event. Thus, infants expected a positive emotion to be elicited by a positive event and a negative emotion to be elicited by a negative event. In Study 2, we then examined whether young infants can link specific negative emotions to specific negative events. Ten-month-olds (N=72) were randomly assigned to the Anger, Fear, or Disgust condition. The procedure was similar to Study 1 except new events were employed (see Figure 1). One event was Disgust-congruent (New Food) and the other was Fear-congruent (Strange Toy). Results indicated that infants seemed to view all three negative emotions as being appropriate reactions to each event. This research is the first to demonstrate that, in the first year of life, infants can link a negative emotion to a negative eliciting event (Study 1). However,

these young infants do not seem to make finer-grained distinctions. They do not expect specific negative emotions to be elicited by different negative events (Study 2). Taken together, these data provide support for theories proposing that preverbal infants only have valenced-based representations of emotions.

S6.5ii Infants' ability to detect emotional incongruency: Deep or shallow?

Cristina Crivello[1], Melissa Lazo[1], Diane Poulin-Dubois[1]

[1]Concordia University

Previous research has demonstrated that infants can identify when an individual's emotional reaction is incongruent with an event and prefer to trust an informant who is emotionally reliable (Chiarella & Poulin-Dubois, 2013, 2017; Chow, Poulin-Dubois, & Lewis, 2008; Reschke, Walle, Flom, & Guenther, 2017; Walle & Campos, 2014). Although it is well established that infants prefer to trust reliable individuals, the mechanisms underlying this ability are largely debated (Heyes, 2017; Poulin-Dubois, 2017). According to the "rich" view, infants' theory of mind (ToM) abilities guide their selective trust. In contrast, the "lean" interpretation suggests that infants use low-level cognitive abilities (i.e., associative learning). A recent study demonstrated a relation between 18-month-olds' selective trust and their ToM abilities, but not with their statistical learning abilities (Crivello, Phillips, & Poulin-Dubois, 2017).</p> The objective of the present study was to further contribute to this debate by examining whether 14-month- olds' selective trust is linked to domain-specific (i.e., ToM) or domain-general (i.e., associative learning) abilities. The sample included a total of 102 14-month-olds (congruent condition: n = 51; incongruent condition: n = 51). Infants observed an experimenter express happiness while looking inside a box that was empty (incongruent) or that held a toy (congruent; Repacholi, 1998). Then, infants were given the opportunity to follow the experimenter's gaze behind barriers (Moll & Tomasello, 2004). A ToM task assessing knowledge inference (Moll & Tomasello, 2007) and an associative learning task (Bhat, Galloway, & Landa, 2010) were also administered. We hypothesized that infants in the incongruent condition would show an increased latency to examine the contents of the box across trials compared to infants in the congruent condition, indicating that they detected the incongruency of the cues provided by the emoter. We also hypothesized that infants in the incongruent condition would be less likely to follow the experimenter's gaze behind barriers. Moreover, it was hypothesized that infants who demonstrated superior associative learning abilities would be more selective in their behaviour toward the incongruent emoter, but no relation would be expected with ToM due to their young

age.</p> The results revealed that infants in the incongruent condition took significantly longer to examine the content of the box across trials, $F(1,100) = 11.62$, $p = .001$ (see Figure 1). Infants also tended to follow the congruent emoter's gaze ($M = .39$, $SD = .34$) behind barriers more often compared to the incongruent emoter ($M = .26$, $SD = .34$), $F(1,91) = 3.19$, $p = .077$. Additionally, a relation between infants' ToM abilities and their selective trust was observed, $F(1,78) = 6.38$, $p = .01$, but no such link was observed with infants' associative learning abilities, $F(1,60) = .50$, $p = .48$ (see Figure 2). Specifically, infants who passed the knowledge inference task were better able to detect the emotional incongruency of the informant's vocal and facial expressions compared to infants who failed, as they took longer to examine the contents of the box on the last trial. These results provide further support for a "rich" interpretation of infants' selective trust.</p>

S6.5iii Did you mean to do that? Infants use emotional communication to infer and re-enact others' intentions

Peter Reschke[1], Eric Walle[1], Daniel Dukes[2]

[1]University of California, Merced, [2]University of Amsterdam

Infants readily imitate others' intended actions during the second year of life (Meltzoff, 1995). However, the role of emotion in appreciating others' intentions and how this understanding may develop in infancy remains understudied. Previous research has demonstrated that infants are less likely to imitate actions perceived as accidental (Akhtar, Carpenter, & Tomasello, 1998), and are more likely to imitate actions that were performed jokingly (Hoicka & Gattis, 2008). The current study extends this research by directly examining the effect of emotional communication on infants' inferences and responses to others' unintended actions.</p> Eighteen-month-old infants ($n = 20$) participated in a modified version of the behavioral re-enactment procedure in which they observed an experimenter attempt, but fail, to perform several goal-directed actions using novel objects (Meltzoff, 1995; see Figure 1). Importantly, infants only observed the experimenter's failed attempt at performing the target actions. Each novel object and associated attempted action are described as follows: Prong = fail to hang a bracelet on a prong protruding from a stand; Box = fail to activate an obscured buzzer with a baton; Base = fail to place a translucent cover over a knob protruding from a base; Container = fail to drop string of beads into a container; Dumbbell = fail to separate ends of dumbbell. The order of objects was counterbalanced.</p> Novel to this study, infants were randomly assigned to view the experimenter express either

frustration or neutral affect after each attempt. Infants were given 20 seconds to interact with each object after observing the failed action. Infants' re-enactment of the target action for each object was coded (see Figure 1 for criteria). It was predicted that infants would imitate the intended action significantly more in the frustration condition than the neutral condition.</p> Infants' imitative responses were analyzed using a repeated-measures mixed effects model specified with a binomial distribution, a logit link, and a diagonal covariance matrix with emotion as a between-subjects factor. The model used Restricted maximum likelihood (REML). Preliminary analyses revealed no significant effect of object ($p = .46$) nor a significant object × emotion interaction ($p = .64$), and thus subsequent analyses were collapsed across object. The primary analyses of interest revealed a significant effect of emotion, $F(1, 90) = 5.73$, $p = .02$, $\eta p2 = .06$, indicating that infants in the frustration condition ($M = 3.0$) imitated significantly more target actions than infants in the neutral condition ($M = 1.7$; see Figure 2).</p> This study is the first to directly examine whether the manipulation of observed emotional communication impacts infants' imitation of unobserved intended actions. These findings suggest that 18-month-old infants use others' emotions to disambiguate intentions, lending support to recent calls for closer examination of how infants utilize emotions to infer others' mental states (Reschke, Walle, & Dukes, 2017; see also Lewis & Todd, 2005; Freeman, 2000). Implications for the role of emotion understanding in psychological reasoning will be discussed.</p>

S6.6i Relations between early motor development and communication skills in typically, at risk and atypically developing infants

Alessandra Sansavini[1], Jana Iverson[2]

[1]University of Bologna, [2]University of Pittsburgh

Changes in gross and fine motor skills in the first two years of life provide infants with a wide range of new opportunities for actively interacting with the physical and social worlds, improving not only motor skills but also cognitive and language skills. Relations between early motor achievements and development of communication skills have been recently explored in typically developing (TD) infants, but they have received relatively little attention in atypically developing (AD) infants and in infants at high risk (HR) for developmental delays (Iverson, 2010; Oudgenoeg-Paz et al., 2017; Sansavini et al., 2014). The present symposium addresses this issue with four papers investigating these relations in TD, HR, and AD infants, using behavioural coding schemes, standardized tools, and longitudinal designs. Paper 1, examining relations between walking, pointing

and language skills in TD infants, provides evidence of a stronger link between gross motor and communication skills in early development. Papers 2 and 3, investigating relations between object exploration and language skills in HR infants, highlight the role of object exploration in representing information and affecting communication development. Specifically oral and manual exploration at 6 months and functional actions at 10 months show cascading effects on word comprehension, gesture and word production respectively in extremely preterm infants (Paper 2) and infant siblings of children with ASD (Paper 3). Finally, Paper 4 highlights the role of parental manual behaviours in maintaining focused play and modulating vocabulary development of infants with Down Syndrome who show reduced manual object exploration.

S6.6 Symposium: Relations between early motor development and communication skills in typically, at risk and atypically developing infants

S6.6ii Walking, pointing, talking - The interrelation of motor, communicative, and language development

Carina Lüke[1], Ute Ritterfeld[1], Juliane Mühlhaus[2]

[1]TU Dortmund University, [2]Trier University of Applied Sciences

The relationship between gross motor skills, early communication, and language acquisition has been intensely discussed (see overview: Iverson, 2010) and had been addressed in numerous empirical studies (e.g. Clearfield, 2011; He, Walle, & Campos, 2015; Libertus & Violi, 2016). Especially the onset of independent walking is recognized as a significant milestone in children's overall development. With the beginning of independent walking infant's point of view changes and the occasions for experiencing and interacting with their physical and personal environment enhances (Campos et al., 2000). Infants who walk independently produce more gestures accompanied by a gaze to an interaction partner, spent more time in interactions, and use more vocalizations compared to same-aged infants who were not yet able to walk independently (Clearfield, 2011). In addition, numerous studies demonstrate a strong connection between early pointing gestures and the language acquisition of children (meta-analysis: Colonnesi, Stams, Koster, & Noom, 2010). Especially pointing gestures produced with the extended index finger are an important milestone in social-cognitive, communicative, and language development (Liszkowski & Tomasello, 2011; Lüke, Grimminger, Rohlfing, Liszkowski, & Ritterfeld, 2017). Infants who produce index-finger points at the age of 12 months have better language skills and a lower risk for language delay at 24 months than children who do not point with the index finger at 12 months (Lüke et al., 2017). With this study we aimed at integrating these two research threads for a better understanding of the interrelation between early walking, pointing, and speaking. We hypothesized that the onset of independent walking, early index-finger pointing and early language skills are correlated, but that index-finger pointing is also correlated with and predictive for language skills at 3;0 and 4;0 years of age. Forty-five children (24 boys) and their primary caregivers participated in a longitudinally study between 12 months and 4;0 years of age. The gestural behavior of the children, their ability to walk independently, and their vocabulary skills were observed between the age of 12 and 21 months in five laboratory sessions. At 2;0, 3;0, and 4;0 years the language skills of the children were measured using standardized language tests. On average, the first observation of index-finger pointing was at 12.58 months (SD = 1.20) and therefore, approximately one month earlier than the onset of independent walking, M = 13.44, SD

= 2.11, t(44) = -3.04, p < .01. We found significant correlations between the onset of independent walking and first index-finger pointing as well as between these two aspects and language skills (Tab. 1). Beyond that, regression analyses revealed a predictive value of both abilities for language skills at 2;0 years of age. But, at 3;0 and 4;0 years of age only index-finger pointing predict language skills. It need to be discussed why these interrelations are found and how they could be explained. One possibility is that the onset of independent walking supplied an initial change in children's development, but that this early benefit does not lead to long-term gains.

S6.6iii Does early object exploration support gesture and vocabulary acquisition in extremely preterm and full-term infants?

Mariagrazia Zuccarini[1], Annalisa Guarini[1], Erika Benassi[1], Silvia Savini[1], Jana Iverson[2], Alessandra Sansavini[1]

[1]University of Bologna, [2]University of Pittsburgh

Introduction Studies of typically (TD) and atypically developing infants suggest that motor skills play a key role in communicative and language development (Iverson, 2010). Object exploration provides opportunities to extract information and build semantic representations and is related to language development in TD infants (Ruddy & Bornstein, 1982; Siegel, 1981). This association has not been thoroughly investigated in preterm infants, a population at risk for motor and language delays (Sansavini et al., 2014). Two studies have reported that active exploratory behaviors in the first year are associated with cognitive (Ruff et al., 1984; Zuccarini et al., 2017) and linguistic skills (Zuccarini et al., 2017) at 24 months. However, studies investigating the links between active exploratory behaviors and specific communicative-linguistic skills in the first year of life are lacking both for TD and preterm infants. Aims and Hypothesis The present study examined relations between active exploratory behaviors at 6 months and communicative-linguistic behaviors at 12 months in extremely low gestational age (ELGA, GA<28 weeks) infants compared to full-term (FT) infants. We hypothesized that 6-month Oral and Manual Exploration would be related to 12-month word comprehension, gesture and vocal production, and that these relationships would be maintained after controlling for neonatal status and cognitive performance. Methods Twenty ELGA infants with no brain injury and 20 FT infants were videotaped during mother-infant play interaction with age-appropriate toys at 6 and 12 months (corrected age for ELGA infants). At 6 months, Oral and Manual Exploration were coded (Zuccarini et al., 2017) and proportional durations were calculated for the analyses; cognitive

performance was assessed with the Performance subscale of the Griffiths Mental Developmental Scales (Griffiths, 1996). At 12 months, spontaneous communicative behaviors, i.e., gestures and vocal productions, were coded and mean rates per 10 minutes were calculated (Benassi et al., 2016); word comprehension was assessed with the parental questionnaire Primo Vocabolario del Bambino (Italian version of the MB-CDI, Caselli et al., 2015). Results Linear regression analyses accounting for neonatal status and cognitive performance revealed that: 6-month Oral Exploration predicted 12-month word comprehension (β = .35, p =.048) with a R2 of .22 [F(1, 38) = 3.65, p = .014]; 6-month Manual Exploration predicted 12-month gesture production (β = .44, p =.006) with a R2 of .22 [F(1, 38) = 3.68, p = .013] and 12-month vocal production (β = .61, p <.001) with a R2 of .31 [F(1, 38) = 5.40, p =.002]. Conclusions Active exploratory behaviors at 6 months are positively associated with communicative-linguistic achievements at 12 months, independently of neonatal status and cognitive performance. Oral Exploration and Manual Exploration were respectively related to word comprehension and gesture and vocal production, highlighting their potential role in representing information about objects. We speculate that Manual Exploration which involves advanced motor skills (e.g., bimanual coordination) may impact expressive communicative behaviors that require coordinated manual and articulatory skills. Early evaluation and customized interventions focused on enhancing object exploration skills to support language development are discussed.

S6.6iv From functional actions to language: exploring the relation between tool use and language in infants at heightened risk for autism spectrum disorder

Jessie Northrup[1], Laura Sparaci[2], Olga Capirci[2], Jana Iverson[1]

[1]University of Pittsburgh, [2]National Research Council of Italy

The ability to grasp, explore and use objects functionally supports many skills contributing to vocabulary acquisition (e.g., categorization, motor skills, object perception; Bates et al. 1979; Iverson 2010; Yu & Smith 2012). Recent studies underscore delays in object exploration and grasping in infants at heightened risk (HR) for ASD (i.e., younger siblings of children with ASD; Kaur et al. 2015; Koterba et al. 2014; Libertus et al. 2014), and these delays have been linked with later difficulties in functional play and language development (Bhat et al. 2012; Christensen et al. 2010; Iverson & Wozniak 2007; LeBarton & Iverson 2013). While numerous studies offer detailed descriptions of grasping and functional object use in typical development (Connolly & Dagleish 1989; Lockman 2000), comparable data in HR infants are lacking. Hypotheses: The present

study provides longitudinal data on grasping and functional actions and evaluates the relation between functional action production and later vocabulary in HR infants. Methods: This study reports data on 41 HR infants: 15 without ASD (HR-ND), 15 with language delay (HR-LD), and 11 diagnosed with ASD at 36 months (HR-ASD). As part of a larger longitudinal home visit, infants were videotaped in a semi-structured interaction with an experimenter during which they were given the opportunity to interact with a spoon and bowl. Spontaneous behavior was coded using a novel classification taxonomy analyzing: (1) whether infants produced at least one spoon grasp; (2) whether the first grasp produced "facilitated" or "hindered" spoon use (determined based on hands used, object affordance, grip type and object projection; Connolly & Dagleish 1989; McCarty et al. 1999); and (3) whether a functional action was produced (i.e. spoon dipped in the bowl or placed in the bowl and brought to the mouth). Analyses focused on outcome group differences in these variables, and relations between functional action production and later word comprehension and production as measured using the MacArthur-Bates Communicative Development Inventories (CDIs; Fenson et al. 2007). Results: Analyses indicated: (1) no differences in percent of infants grasping the spoon at any age point (all ps >.05), by 10 months 75.6% of infants produced at least one grasp; (2) a significant difference at 24 months in percent of infants producing 'facilitating' grasps between HR-ASD and HR-ND (p=.047), but not between HR-LD and HR-ASD (p=.141) or HR-ND (p=1.0); (3) a significant difference at 10 months in percent of infants producing a functional action between HR-ASD and HR-ND (p=.007), but not between HR-ASD and HR-LD infants (p=.211); (4) production of functional actions at 10 months significantly predicted words comprehended at 12 months (p=.021) and words produced at 24 months (p=.001) and 36 months (p=.050). Conclusion: Data indicated later consolidation of purposeful grasping and later onset of functional actions in HR-ASD infants, as well as an overall relation between early functional action production and later language development. Reduced consolidation of purposeful grasping and late onset of functional actions may hinder infant functional play and caregiver interactions, leading to cascading effects on later communication skills in ASD.

S6.6v Manual Behaviours During Interaction Between Infants/Toddlers with Down Syndrome and Their Parents

Hana D'Souza[1], Dan Brady[1], Michael Thomas[1], Denis Mareschal[2], Annette Karmiloff-Smith[1]

[1]Centre for Brain & Cognitive Development, Birkbeck, University of London, [2]Birkbeck, University of London

Across a range of neurodevelopmental disorders, infants and toddlers demonstrate significant delays in object manipulation. This is likely to constrain how they learn about their environment, and impact the development of domains such as 3D perception and language. However, little is known about the manual behaviour of infants/toddlers with neurodevelopmental disorders and their parents during parent-child interaction. Hypotheses. Here we focus on dyads with infants/toddlers with Down syndrome (DS), the most common known cause of intellectual disability. We hypothesized that object manipulation differs between dyads with children with DS and dyads with typically developing (TD) children. We also predicted that variability in manual behaviours is associated with developmental outcomes, such as vocabulary size, in infants/toddlers with DS. Methods. Nineteen parent-child dyads participated in this study. Ten infants/toddlers with DS between 18 and 30 months were matched on mental age to nine TD infants/toddlers (using the Mullen Scales of Early Learning). We examined object manipulation in infants/toddlers and their parents during 5-minute free play. Results. The children with DS spent significantly less time interacting with objects overall than the TD controls (Fig.1a). They also spent significantly less time per object (Fig.1b). Therefore, we observed reduced manual behaviour in infants/toddlers with DS even when accounting for their mental age. Interestingly, we did not observe any differences between the parents from the two groups on how long they spent interacting with objects (Fig.1a) or how much time they spent per object during the parent-child interaction (Fig.1b). We further compared number of manual bouts. The infants/toddlers in the two groups produced the same number of manipulation bouts (Fig.1c). They also handled the same number of unique objects (Fig.1d). No differences in these two measures were found between the parents of both groups (Fig.1c-d). When we compared the infants/toddlers with their parents within the dyad, there was no significant difference between how long the infants/toddlers with DS handled the objects compared to their parents (Fig.1a-b). A different pattern emerged in the TD group. The TD infants/toddlers manipulated objects for significantly longer than their parents (Fig.1a-b). Finally, a smaller number of unique objects handled by the parent, indicative of more focused play, was associated with a larger expressive vocabulary in the infants/toddlers with DS, measured using the MacArthur-Bates Communicative Development Inventories ($r=-.72$, $p=.019$). Conclusion. Although there was a significant difference in how long the TD children and children with DS spent on manipulating objects, the number of objects they manipulated was not different. This is consistent with an interpretation that while curiosity seeking behaviour is similar across groups,

infants/toddlers with DS struggle with perseverance and sustained attention. Interestingly, the behaviour of the parents did not differ between the dyads in the TD and DS groups. Yet, variability in parental manual behaviour was associated with developmental outcomes in the children. Atypicalities in object manipulation in infants and toddlers with DS during interaction with their parents may contribute to the emerging phenotype in this neurodevelopmental disorder. Parental manual behaviours are likely to modulate developmental outcome.

S6.7 Symposium: What explains the origins of human prosociality? A debate featuring three divergent perspectives

S6.7i Everyday Social Interactions are Essential to the Ontogeny of Prosocial Behavior

Audun Dahl[1], Celia Brownell[2]

[1]University of California, Santa Cruz, [2]University of Pittsburgh

By early in the second year, infants cooperate with, share with, and help others in everyday life and in the laboratory (Brownell & Carriger, 1990; Brownell, et al., 2013; Dahl, 2015; Hammond, et al., 2017; Svetlova, et al., 2010; Warneken & Tomasello, 2007). What roles, if any, do adults play in the ontogeny of prosociality? This presentation will argue that family members contribute to the emergence and early development of prosocial behavior in a variety of ways. This view contrasts with the view that infants become prosocial independently of support from caregivers. Our proposal entails a broadened view of socialization: Family members contribute to the development of infant helping, sharing, and cooperating not only via explicit instruction and reinforcement but also by subtler ways of facilitating infant involvement in everyday routines and household activities that serve as the foundation for the emergence of autonomous prosocial behavior. (Brownell & The Early Social Development Research Lab, 2016; Dahl, 2018). From very early in life, infants are attuned to social interactions as part of a fundamental affiliative motive (Baumeister & Leary, 1995) that drives them to engage others socially, emotionally, and cognitively (Bowlby, 1969; Hobson, 2008). During the first year, infants derive pleasure from social interactions and through them develop capabilities for joint attention and engagement involving objects and people (Brownell, 2011; Sroufe, 1995). We propose that infants' early prosociality emerges from their broader interest and engagement in everyday social interactions. At first, for example, there may be little distinction between reciprocal play and sharing, cooperating, or helping from the infant's perspective. In this view, infants transition from prosocial behavior with others to prosocial behavior for others, and from behavior without prosocial intent to voluntary, intentional prosociality. We further propose that caregivers build on infants' interest in social interactions to model, scaffold, encourage, and support prosocial behavior. For example, helping-related situations in the everyday lives of infants typically involve explicit caregiver support (Dahl, 2015); and both laboratory and naturalistic studies have found positive associations between caregiver scaffolding and infant helping (Dahl, 2015; Pettygrove & Hammond, 2013). Importantly, caregivers adapt their scaffolding as infants become older and more proficient helpers (Waugh, Brownell, & Pollock, 2013). A given form of support, such as praise for handing

objects to an adult, may promote prosocial behavior at an early age, but not later in development (Dahl, et al., 2017). Finally, testing hypotheses effectively about how socialization fosters the ontogeny of prosocial behavior requires a combination of naturalistic and experimental methods (Dahl, 2016). Naturalistic observations must begin during infancy, before autonomous prosocial behavior emerges. Correlations between caregiver encouragement and infant prosocial behavior should then be tested experimentally to determine causality (Dahl et al., 2017). Moreover, longitudinal designs are critical for discovering the sequential links between caregiver-child interactions and individual trajectories in the emergence and development of prosocial behavior. The presentation will conclude by pointing to key questions and methodological considerations for research on the development of infant prosociality.

S6.7ii Young children's helping is based upon an evolved capacity for genuine prosociality

Felix Warneken[1], Robert Hepach[2]

[1]University of Michigan, [2]University of Leipzig

One major question about human nature concerns the origins of human prosocial behavior. Here we argue that the extant evidence on human children's and non-human primates' helping behaviors suggests a biological predisposition for genuinely prosocial motivations (Warneken, 2018). In contrast to the once dominant view of socialization as the major or only source of prosocial behavior, we argue that already young children care about the welfare of others and are intrinsically motivated to see others receive the necessary help (Hepach, Vaish, & Tomasello, 2012). Young children are thus motivated by a genuine concern for others and not but strategic motives to obtain a return benefit for themselves or improve their own standing. Evidence from this view comes both from studies with young children, as well as from comparative studies with nonhuman apes (Melis, 2018). We synthesize this vast body of work on helping behaviors collected over the last decade that combines developmental and comparative studies to elucidate the origins of human prosociality. Our discussion includes recent advances in methodological paradigms to study the internal underlying mechanisms of children's prosociality. First, we argue that this evidence necessitates a theoretical perspective that emphasizes the biological foundation of human prosocial behavior. Comparative studies with nonhumans have shown that while facilitative, human-unique socialization practices are not necessary for basic prosocial behaviors to emerge. Therefore, the dominant focus on socialization as an explanatory model for the ontogeny of social

behavior is insufficient. In contrast, we suggest how developmental models of prosociality can conceptualize socialization as shaping biological predispositions over ontogeny. Second, we argue that one major developmental challenge is for children to develop into competent social beings who balance their prosocial motivations with their own personal needs. Specifically, evolutionary models of cooperation provide the necessary framework to identify the proximate, psychological mechanisms that need to develop over ontogeny for behaviors to emerge as evolutionary stable and socially adaptive strategies. Children have to make decisions about when to help and whom to help, considering who reciprocates and who will know about their choices to be prosocial or not (Leimgruber, 2018, Engelmann & Rapp, 2018). In sum, we advance the hypothesis that children develop from being initially less differentiating in their helping to becoming increasingly more selective in their prosocial behavior based upon evolutionary relevant cues such as reciprocity, reputation, and group-membership. As children accumulate more experience and expand their cognitive abilities over ontogeny, they become better able to decide how to allocate their prosocial behavior. Several of these evolutionary relevant processes emerge only later in childhood, years after children have already begun to show first instances of helping. We conclude with offering new directions to study the contribution of socialization to better understand the processes by which prosociality is shaped in the first years of life.

S6.7iii Is early prosocial behavior selective?

J. Kiley Hamlin[1]

[1]University of British Columbia

A host of recent research in developmental psychology suggests that prosocial behaviors such as helping, informing, sharing, and comforting emerge extremely early in human development, within the first two years of life (for review see Eisenberg, Spinrad, & Morris, 2013; Svetlova, Nichols, & Brownell, 2010; Vaish & Tomasello, 2013; Warneken, 2016). The basis of this emergence is a matter of some debate, with researchers stressing both internal motivations (e.g., that prosociality is built-in and the result of children's own prosocial motives; Hepach, Haberl, Lambert, & Tomasello, 2016; Hepach, Vaish, & Tomasello, 2012; Vaish, Carpenter, & Tomasello, 2009; Warneken, 2013; Warneken & Tomasello, 2008, 2013a) and external ones (e.g., that prosociality emerges via various social influences external to the child; Barragan & Dweck, 2014; Brownell, Svetlova, Anderson, Nichols, & Drummond, 2013; Dahl, 2015; Hammond & Carpendale, 2015; Newton et al., 2016). In addition to questions about what explains the

emergence of prosociality in early development, researchers have recently been interested in whether or not early prosociality is selective: Do infants and toddlers indiscriminately help everyone, or are they differentially prosocial toward distinct individuals? Prosocial behaviors are clearly selective later in life; for example, preschoolers preferentially share with those in need, with close relations, with individuals who have shared with them, and with individuals who have shared with others (e.g., Malti et al., 2016; Olson & Spelke, 2008). In contrast, the evidence with infants and toddlers is more mixed. Indeed, some empirical work has demonstrated a clear developmental shift in selectivity, with infants and toddlers helping and sharing indiscriminately but older children being selective (e.g., Dahl, Schuck & Campos, 2013; Warneken & Tomasello, 2013b; see also Kenward & Dahl, 2011). Other work has not shown such a shift, with even toddlers performing prosocial acts on the basis of the past behavior of their recipients (Hamlin et al., 2011; Surian et al., 2017; Van de Vondervoort et al., 2017). This talk will outline the arguments and evidence for and against the selectivity hypothesis in early prosocial development, ultimately concluding that prosocial behavior is selective from the start, at least in some circumstances. In particular, the talk will focus on 2 distinct ways in which prosocial behaviors can be selective, referred to as "partner choice" and "partner fidelity" models in theorizing about the evolution of cooperation, and will provide evidence that toddlers' prosocial behaviors are consistent with both forms of selectivity. The implications of this varied selectivity will be discussed. Finally, the talk will consider why the evidence for early selectivity is mixed, highlight unanswered questions, and propose studies for answering them.

S7.2 Symposium: from pre-registration to ethical data peeking: practical solutions for improving infant research

S7.2i How many babies should I test? What we can learn from 14 meta-analyses

Christina Bergmann[1]

[1]Max Planck Institute for Psycholinguistics

Statistical power, the probability to observe an effect when it is truly present in the population, depends on two factors for a given study design: sample size and effect size. In other words, when testing more subtle effects, more participants are needed to observe a significant group difference than when testing a stronger effect. However, effect sizes are often not reported. Consequently, little is known about the range of effect sizes to be expected in infant studies in general. The resulting lack of information makes it difficult to estimate just how many participants should be tested. In addition, given this state of affairs, laboratories tend to base their sample size decisions on seminal papers or "typical" samples. Both strategies have substantial shortcomings when the resulting sample size is small, as it is overall more likely to run an underpowered study that will show a null result in the presence of a "true" effect (in other words, a false negative). Typical sample sizes do not take into account the specific strength of the effect under investigation, and seminal papers often over-estimate effect size. All presented results are based on MetaLab (http://metalab.stanford.edu), a standardized database of meta-analyses on early language acquisition, subset to data on infants aged between 0 and 36 months and studies predicted to yield a significant result (thus e.g. excluding non-native vowel discrimination above 6 months). The results show that effect sizes in infant studies typically are small to moderate (median Cohen's d = 0.47). At the same time, the median number of infants included in a study is 19 in within-participant designs and 38 in between-participant designs. The resulting power is low, with a typical probability to observe a significant effect given it is truly present of 48% (range:6-97%). This means that fewer than one in two experiments designed as a "typical infant study" will detect a true effect (i.e. show a significant p-value). How can we improve? When possible, a priori power analyses are highly recommended, and MetaLab offers ready-to-use tools to do so. When conducting entirely novel research or in the absence of available meta-analyses, considering the range of effect sizes typical for infant research can serve to improve sample size planning: The sample size necessary for a sufficiently powered study (i.e. an 80% chance to observe a significant outcome) of an effect of Cohen's d = 0.47 is 38 participants in a within-subject design (and 72 in a between-participant design). In other words, doubling the typical sample size dramatically reduces the risk of a false negative. There are several hurdles to moving beyond simply

testing as many participants as a previous study, most prominently a lack of familiarity with and availability of effect sizes. Recent initiatives aim to ameliorate the situation with calls for improved reporting, data sharing, and cumulative research. The benefits for the individual researcher include more reliable study designs, a smaller file drawer, and a way to discuss null results in terms of effect sizes and power.

S7.2ii But really, should I test more babies? A guide to ethical data peeking for infant researchers

Esther Schott[1], Mijke Rhemtulla[2], Krista Byers-Heinlein[1]

[1]Concordia University, [2]UC Davis

In recent years, worries about underpowered studies and failures to replicate have led to calls for larger sample sizes (e.g., Oakes, 2017). But for researchers studying infants, recruitment and testing is a slow and sometimes cumbersome process (Frank et al., 2017). When participants are a precious resource, the pressure to use the available participants in an efficient way is greater. One strategy that researchers may be using to optimize efficiency is data peeking (or "optional stopping"), that is, doing a preliminary analysis of collected data to decide whether to continue data collection. In a survey of infant researchers, one third reported stopping a study when the results did not look promising, or testing additional infants when a result nearly missed significance (Eason et al., 2017). The problem is that data peeking inflates the possibility of finding a spurious result (Simmons, Nelson, & Simonsohn, 2011) and can inflate effect size estimates (Pocock & White, 1999). However, in other fields (e.g., medicine) controlled ways of data peeking are used, in conjunction with practices that offset its negative consequences. This talk will attempt to bridge the gap between solutions used in medicine/statistics and practices in infancy research. We show that adopting some of these solutions allows infant researchers to use their limited resources more efficiently. Solution 1: Pre-registered data peeking plan This plan is useful when a researcher plans to test a large sample size, but wants the flexibility to stop data collection if preliminary results are statistically significant. In this case, the researcher can specify at what points during the data collection the results will be analyzed and a decision will be made on data collection. Using sequential analysis, the corresponding p-values are then adjusted (Lakens, 2014) so that the final alpha level is still at the desired significance level (e.g., p =.05). Solution 2: Post-hoc data peeking plan What if a researcher did not make an a-priori peeking plan, and discovers after collecting the planned sample size that the result nearly missed statistical significance? In this case, the researcher can use an

adjustment that takes into account the initial p-value, the unplanned sample size increase and the final p-value (Sagarin, Ambler, & Lee, 2014). Some researchers might be concerned that these solutions for ethical data peeking increase researcher degrees of freedom (Simmons et al., 2011), or make it more difficult to estimate effect sizes. We think that researchers are often torn between the desire improve their research practices and the realities of sparse resources in infancy, and planned data peeking can be a solution. In addition, introducing planned data peeking in infancy research may also encourage all researchers to report their methods for determining sample size with more transparency. This is beneficial in two ways: It encourages an honest debate on best practices in research, and it enables the reader to critically evaluate the research practices that resulted in the report they are reading.

S7.3iii Preregistration: A practical guide for developmental psychologists

Anne Scheel[1]

[1]Eindhoven University of Technology

In the past years, psychologists have proposed several new research and publication practices to minimise bias, increase the transparency of the research process, and eventually make research results more reliable. One of these is the practice of preregistration, in which research hypotheses, sampling plan, and analysis plan are specified and "frozen" before any data are collected. This prevents an inflated rate of false-positive findings caused by researchers' conscious or unconscious tendencies to adjust hypotheses post hoc ("HARKing"), cherry-pick significant results, or make analytical decisions that favour specific outcomes ("p-hacking"). A special case of preregistration are Registered Reports, a publication format in which the Introduction and Method section of a paper are reviewed -- and a decision about the (provisional) acceptance of the paper is made -- before data are collected, thus guarding against publication bias. Preregistrations and Registered Reports have become increasingly popular among psychologists in general as well as developmental psychologists in particular -- one example being the launch of Registered Reports as a new submission format at the ICIS journal Infancy in 2017. Preregistration introduces changes to the conventional workflow of a research project. Developmental researchers, especially infant researchers, may encounter specific challenges -- for example sample size planning when participants are hard to recruit and dropout rates are difficult to predict, or the necessity of data-dependent analytical decisions in studies using eye-tracking or EEG. At the same time, preregistration also offers unique advantages for developmental

researchers, for example as it can increase the informational value of null results, making them more "publishable" (or, in the case or Registered Reports, making the acceptance of a paper independent from its results), thus salvaging the hard-to-collect samples typical for the field. This talk will attempt to build bridges between the nascent "open science" movement and developmental psychology, offering a practical overview of the "why and how" of preregistration using concrete examples from infant research, and addressing the potential challenges -- as well as the specific benefits -- that developmental researchers might experience.

S7.3iv Are your figures worth a thousand words? Optimizing the information value of your visualizations

Sho Tsuji[1]

[1]Ecole Normale Superieure

Data visualization is an essential tool to communicate scientific findings. However, the way data are visually summarized is often not ideally suited to evaluate critical characteristics of the underlying dataset. Instead of choosing their visualization based on features like sample size and distribution, researchers often rely on standard practice. For instance, bar graphs, frequently used for visualization, are often not suited for data from infant studies. They are ill-suited for datasets with small sample sizes, and can mask meaningful differences between conditions (e.g., Saxon, 2015; Weissgerber, Milic, Winham, & Garovic, 2015). Figure 1 demonstrates this by comparing visualizations of the same simulated dataset based on barplots, boxplots, violin plots, and individual data points. Barplots do not reveal differences in sample size (n = 20 for Group 1 and Group 2, n = 2 for Group 3). They also fail to illustrate differences in the distributional characteristics between groups (unimodal for Group 1, bimodal for Group 2). In addition, barplots are suboptimal for representing paired data. During this presentation, I will first demonstrate the relevance and usefulness of adequate data visualization based on examples from infant studies. I will then introduce visualization techniques that can help to better represent different kinds of datasets. Often these are easy to adopt by the research community, and a small change can go a long way. For instance, a bar graph can be replaced with a violin plot to give an idea of sample size and distribution. Datasets with differently distributed groups are better represented by a violin plot or individual data points than by a boxplot. In order to represent paired data, lines can be added between the individual data points of the same infant in two conditions. Finally, both descriptive statistics (such as means and distribution) and raw

data can be combined into one graph to maximize the amount of information provided. We recommend that the visualization of choice chooses a level of detail that both provides a simplified overview of the data while preserving sufficient information to evaluate its characteristics accurately. Techniques such as manipulating size, shading and opacity of different elements of the graph can be used to reduce complexity (e.g., Phillips, 2016). Considering how to adequately visualize one's data is one important step in evaluating and communicating scientific results. This is especially true for infant studies, where data are often based on small, possibly uneven datasets with high variance. References Phillips, N. D. (2016). https://www.r-bloggers.com/the-pirate-plot-2-0-the-rdi-plotting-choice-of-r-pirates/ Saxon, E. (2015). Beyond bar charts. BMC Biology, 13(1), 1-2. doi:10.1186/s12915-015-0169-6 Weissgerber, T. L., Milic, N. M., Winham, S. J., & Garovic, V. D. (2015). Beyond Bar and Line Graphs: Time for a New Data Presentation Paradigm. PLoS Biology, 13(4), 1-10. doi:10.1371/journal.pbio.1002128

S7.3 Symposium: Prenatal and perinatal biopsychosocial risk factors and their associations with early child cognitive outcomes in low-SES Families

S7.3i Prenatal Maternal Anxiety and Child Neurodevelopment: Stress Physiology and Inflammation

Ana Vallejo Sefair[1], Thomas O'Connor[1]

[1]University of Rochester

Background: Research findings extending over a decade and spanning many countries suggest reliable associations between maternal prenatal anxiety or distress and poorer performance by the child on numerous indicators of neurodevelopment. The findings are robust, but are limited by a general focus on normal-low risk samples. Also, the limited research on mediating mechanisms has focused on HPA axis-related explanations, and has not yet considered equally plausible explanations, such as inflammatory mechanisms. The proposed study addresses important gaps in this literature. Method: This longitudinal study followed a sample of 210 ethnically diverse, low-income women who presented for OB care in a medium-size city; women who self-reported elevated anxiety were oversampled. Psychosocial, psychiatric, and biological assessments of the mother were conducted in the 2nd and 3rd trimesters, and when the child was 2, 6, and 16 months of age. At each postnatal assessment we included measures of child stress reactivity using cortisol response to a challenge; inflammation from a venipuncture was also assessed. At 6 and 16 months we conducted cognitive assessments using the Bayley scales and temperament measures using observational and maternal report instruments. Covariates included maternal pre-pregnancy BMI, socio-demographic stress, maternal education and IQ, perinatal health, and caregiving quality. Analyses were limited to children from normal, healthy pregnancies. Results: Analyses indicated that, at 6 months of age, maternal prenatal anxiety and stress physiology was reliably associated with infant cognition and behavior. For example, maternal diurnal cortisol at 32 weeks gestation (using the area under the curve method) was negatively associated with child language ($r = -.24$, $p<.05$); in addition, maternal anxiety, according to both self-report and clinician-assessed anxiety, was associated with increased fearfulness and negative affect according to observed and maternal-reported temperament (r's range from .14 to .33, $p<.05$). The effects held after accounting for covariates. The effects diminished somewhat at the 16m month assessment, but remained significant in a repeated measures analysis of variance. In addition to direct (diurnal cortisol) and indirect (maternal anxiety) measures of stress physiology, we also found that maternal inflammation, indexed y pre-pregnancy obesity, was also associated with child neurodevelopment; the effect on child cognitive development was

independent of anxiety and cortisol. Discussion: The findings provide new evidence for a possible causal role of maternal stress physiology and inflammation on child neurodevelopment in an at-risk ethnically diverse sample. Further analyses will examine the mediating role of child inflammatory markers on measures of child neurodevelopment, and its possible mediating role of the prenatal maternal effects.

S7.3ii Perinatal Risk Factors, Infant General Cognition, and Preschooler Executive Function: A Cascade Model

Marie Camerota[1], Michael Willoughby[2]

[1]University of North Carolina at Chapel Hill, [2]RTI International

The Developmental Origins of Health and Disease (Barker, 1998) and Prenatal Programming (Lucas, 1991) hypotheses suggest that prenatal conditions have lifelong implications for health and development. Tests of these hypotheses have found that adverse prenatal exposures (e.g., substance use, stress) predict poorer executive function (EF) in children (e.g., Buss, Davis, Hobel, & Sandman, 2011). A separate line of literature has found evidence for a cascade process, whereby perinatal conditions such as prematurity predict deficits in higher-order cognitive functioning indirectly through infants' foundational cognitive abilities (e.g., Rose, Feldman, Jankowski, & Rossem, 2008). The current study tested a cascade model where the relationship between perinatal risk and preschool EF is mediated through general cognitive ability in infancy. This study involved 1,292 children from the Family Life Project (FLP), a prospective, longitudinal study of children growing up in poor, rural areas of the US. When infants were 2 months of age, mothers retrospectively reported on pregnancy and delivery complications, serious emotional problems during pregnancy, and pre-pregnancy obesity. Mothers also reported infant birth weight and gestational age, which we used to determine whether infants were low birthweight or premature. These variables were entered into a principal components analyses to create a single indicator of perinatal risk. When infants were 15 months of age, they completed the Mental Developmental Index of the Bayley Scales of Infant Development (MDI; Bayley, 1993). At 35 months, children completed a battery of EF tasks assessing working memory, inhibitory control, and cognitive flexibility. All models controlled for maternal education, race, infant gender, income-to-needs ratio, and observer report of home and childcare quality (HOME; Caldwell & Bradley, 1984). Structural equation models were used to test study hypotheses. Descriptive statistics are displayed in Table 1, while the final model tested appears in Figure 1. The final model fit the data well, $\chi 2(9) = 20.0$, CFI = .98, RMSEA =

.03. Consistent with our hypotheses, perinatal risk negatively predicted infant MDI at 15 months (β = -.14, p < .001). Infant MDI in turn was significantly associated with EF at 35 months (β = .13, p = .001). The indirect path from perinatal risk to EF through MDI was significant (β = -.02, p = .008), whereas the direct path from perinatal risk to EF was not (β = -.03, p = .35). These findings suggest that perinatal risk factors such as maternal emotional problems and prematurity make a significant contribution to preschooler's executive function above and beyond postnatal factors, but that these contributions are largely indirect. Our findings are consistent with a cascade model by which perinatal risk impacts higher-order cognitive functioning through foundational cognitive abilities.

S7.3iii Maternal prenatal life event stress is associated with child executive function at 5 years in a high-risk sample

Elizabeth Loi[1], Jeffrey Measelle[1], Jennifer Ablow[1]

[1]University of Oregon

Research demonstrates that poverty is associated with poor executive function (EF) outcomes in children. EFs are fundamental to academic success. As such, knowledge of risk factors that predispose children to EF difficulties would inform interventions that bolster EF development. Maternal distress during the prenatal period, in particular, pregnancy-specific anxiety, is tied to later child inhibitory control, with the effect evident in girls but not boys. The influence of other forms of potentially relevant prenatal stress, namely anticipated parenting-specific stress, has not yet been investigated. Furthermore, no research to date has examined relations between maternal distress during pregnancy and child EF outcomes in high-poverty samples. The current study investigated the associations between four forms of maternal distress during pregnancy (depression, anxiety, life event stress, and parenting-specific stress) and child EF skills at 5 years across three domains (working memory, visual attention, and inhibitory control), controlling for the same constructs of maternal distress at 5 years. This study was conducted in a sample characterized by poverty (N = 75; M income = $10,000 - $20,000). Our main hypothesis stated that higher maternal parenting-specific stress during pregnancy would be related to worse outcomes across all domains of EF at 5 years, with child sex moderating the association between maternal parenting-specific stress during pregnancy and child inhibitory control. During the third trimester of pregnancy and at 5 years, mothers completed the Center for Epidemiologic Studies Depression Scale, the Beck Anxiety Inventory, the Horowitz Life Events Inventory, and the Prenatal Maternal Expectations Scale or the Parenting Stress Index. At 5 years,

children completed the Day/Night and Snow/Grass tasks, the visual attention subscale from the NEPSY, and the working memory subscale from the Stanford-Binet. The results of multiple regression analyses indicated that maternal depression, state anxiety, and parenting-specific stress during pregnancy were not associated with child executive function outcomes. However, maternal life event stress during pregnancy was related to child visual attention, inhibitory control, and a composite EF measure of working memory, visual attention, and inhibitory control (all $p < .05$). Moreover, the effect of maternal prenatal life event stress was significant for boys and not girls on visual attention, with boys performing better in the context of higher maternal prenatal life event stress ($\beta = .27$, $p < .01$). In addition, the effect of maternal prenatal life event stress was significant for girls and not boys on inhibitory control, with girls, whose mothers reported higher prenatal life event stress, performing worse ($\beta = -.02$, $p < .05$). Taken together, these results indicate that maternal life event stress during the prenatal period may affect boys and girls differentially. For boys, greater maternal life event stress may serve to bolster EF development in the domain of visual attention, whereas for girls, greater maternal life event stress may lead to EF decrements in the domain of inhibitory control. These associations spanning the first five years of life underscore the enduring impact of prenatal life event stress on children's executive function development.

S7.4 Symposium: Evolution of music perception: a comparative approach in infants, children and other species

S7.4i Can developmental studies inform the question of whether music was an evolutionary adaptation?

Laurel Trainor[1]

[1]McMaster University

Much debate has centered on the question of whether music was an evolutionary adaptation or a cultural creation. In some ways, music behaves like a cultural creation. It is highly flexible, generative, and can change rapidly over time. Evidence consistent with an evolutionary hypothesis, on the other hand, is that music appears to be unique to humans and universal across human societies. Also consistent with an evolutionary hypothesis is that very young infants process aspects of musical structure and show attentional and emotional responses to music. Here I argue that complex behaviors like music probably have complex origins, such that some aspects of music may have involved evolutionary exaptations - they evolved for other reasons, but enabled music - while other aspects may have been true adaptations in that the musical capacity directly increased fitness. Further, music probably evolved through a complex series of stages. Initially, traits that evolved for other reasons might have enabled some aspects of musical behavior. However, once in place, music might have been evolutionarily adaptive, and evolved further from its beneficial effects. I propose here that many aspects of music are not specific to music. Specifically, I argue that much of musical pitch and timing structure was made possible by adaptations for auditory scene analysis, and therefore, these aspects of music are exaptations. Developmental evidence also shows that young infants are able to perform quite sophisticated auditory scene analysis, and this capacity is found across many nonhuman animals. However, some important aspects of music do not appear to be related to other behaviors such as language or auditory scene analysis. For example, the ability to entrain movements to a beat and the social cohesion that music can engender appear to be specific to music, and are thus candidates for true musical adaptations. Recent developmental research is consistent with this restrictive adaptive hypothesis in showing that affiliative consequences of music and synchronous movement can be found in infancy. Thus developmental research is contributing to the idea that the origins of music are complex and probably involved, exaptation, cultural creation and evolutionary adaptation.

S7.4ii Music perception in human infants: Social and emotional benefits

Laura Cirelli[1], Sandra Trehub[1]

[1]University of Toronto Mississauga

Infants are born into a musical world. Their caregivers sing regularly to them, and they may also hear music from toys and in the background inside and outside of their homes. The immature auditory system is well prepared to process such musical input. Infant brains extract temporal information from auditory streams, which is necessary for perceiving the beat and meter of music. Infants are also proficient at perceiving and remembering pitch patterns. Musical exposure in infancy and beyond enhances and shapes music perception and lays the groundwork for subsequent music perception and production. The human propensity for musical engagement has intrigued evolutionary theorists. One evolutionary model emphasizes the social benefits of musical engagement. For example, music is thought to enhance social bonds and promote social cohesion, with direct benefits for those involved. I will consider this hypothesis from a developmental perspective. After reviewing the developmental trajectory of music perception in human infants, I plan to present recent findings that highlight the social and emotional effects of musical engagement in infancy. First, I will outline our findings on the arousal-regulatory consequences of maternal singing. We used skin conductance as a measure of sympathetic arousal to investigate maternal and infant arousal changes while mothers sang "Twinkle Twinkle Little Star" to infants in a playful or soothing manner. As the soothing rendition unfolded, maternal and infant arousal decreased, in contrast to the playful rendition, which heightened maternal arousal and infant attention. I also plan to discuss ways in which musical interactions with 14-month-olds shape their social behavior. In a series of studies, 14-month-olds offered more help to an unfamiliar adult who "danced" in synchrony with them compared to one who danced out of synchrony. Like adults, infants seem to have a social preference for synchronously moving social partners. More recently, we investigated the influence of infant-directed singing on infant prosociality. Although infants were more helpful to the adult in the singing condition than in a baseline condition, their degree of familiarity with the song predicted the extent of their helpfulness The aforementioned studies indicate that musical engagement--singing as well as synchronous movement to music--has important prosocial consequences in infancy. These early social and emotional consequences of musical perception are consistent with social evolutionary models of music perception that emphasize social cohesion.

S7.4iii Music Preference in Degus (Octodon degus): Analysis with Chilean Folk Music

Shigeru Watanabe[1]

[1]Keio University

Hearing music often causes a pleasurable experience in humans, but most non-human animals do not show selective preference for types of music. We have, however, demonstrated that Java sparrows show a selective preference for particular music (Watanabe and Nemoto, 1998). Although the reinforcing property of music has not been thoroughly examined, humans and songbirds (Java sparrows) appear to be exceptional species for showing preferences for particular types of music. Researchers have typically employed only Western classical music in such studies. Thus, there has been bias in music choice. Mingle et al (2014) observed that chimpanzees moved closer to the sound source when African music was broadcast. These results suggest the possibility of preference for native folk music in the animal's habitat over Western (non-habitat) music. Degus (Octodon degus), originally from the mountain areas of Chile, have highly developed vocal communication. Here, we examined music preference of degus using not only Western classical music (music composed by Bach and Stravinsky), but also South American folk music (Chilean and Peruvian). The degus preferred the South American music to the Western classical music but did not show selective preference between the two Western classical music choices. Furthermore, the degus preferred the Chilean to the Peruvian music to some extent. In the second experiment, we examined preference for music vs. silence. Degus overall showed a preference for Chilean music over silence, but preferred silence over Western music. The present results indicate that the previous negative data for musical preference in non-human animals may be due to biased music selection. Our results may suggest the possibility that the soundscape of an environment influences folk music created by native peoples living there and also the auditory preference of other resident animals there.

S7.4iv A comparative study on evolution of music and prosociality in humans and cockatiels (Nymphicus hollandicus)

Carla Aimé[1], Uyen Tran[1], Mathilde Le Covec[1], Dalila Bovet[1], Rana Esseily[1]

[1]Paris Nanterre University

Music exists in all human cultures, and evolutionary biologists have suggested that musical capabilities may have spread in humans because music promotes group cohesion (Roederer, 1984; Dunbar, 2017). Consistently, developmental psychologists have found joint music production to increase children's empathy (Rabinowitch et al.

2012), helping behaviors and cooperation (Kirschner & Tomasello, 2010). However, to date, the effects of hearing music on prosociality are still unknown, and the specific properties of music involved in this relation are unidentified. Moreover, it is unclear whether a shared musical experience promotes prosocial behaviors between only the individuals of the same group who share this experience, or whether it also includes other people. In non-human primates, most studies have failed to show spontaneous music production or musical preferences. Conversely, some birds seem to be sensitive to music, as they show musical preferences (Watanabe & Nemoto, 1998) and rhythm entrainment (Bottoni et al., 2003). Musical capabilities may have evolved in a convergent way in humans and some birds, especially those capable of vocal learning (Patel, 2006). However, no study to date has investigated the effect of music on prosociality in birds. Here, we explored the relationship between music and prosociality in a comparative approach to better understand the origins and biological functions of musical capabilities. First, we led a comparative experiment with children and cockatiels (a species of social birds capable of vocal learning) to investigate the effects of hearing music on prosociality. We played back to dyads of 3- to 5- year-old children either consonant or dissonant music, or recordings of their ecological environment (class background). Sharing, cooperative and helping behaviors were then measured and compared between the conditions. For cockatiels, we played back either consonant or dissonant music (or nothing in control condition) in the aviary. Sharing behaviors were recorded and compared between the conditions. We found no significant differences for the main outcomes neither in children or birds. However, we observed significantly more social interactions between children who heard consonant music compared to dissonant and neutral, and a significant decrease of the cockatiels' agonistic behaviors in presence of music (consonant or dissonant). Secondly, to investigate whether a shared musical experience in children promotes prosocial behaviors between the individuals of the same group who shared this experience or whether it also promotes prosocial behavior with out-group individuals, we conducted a similar experiment except that half of the children were tested with children with whom they heard music and half were tested with children with whom they did not have any musical experience. A control group where children spent time together without hearing music was designed to ensure that the effect observed is due to shared musical experience and not shared time. Our hypothesis was that children who shared a musical experience will cooperate more than those who did not share the musical experience or who only shared time together hearing other stimuli. Preliminary results show such an effect, however analysis are still ongoing. A similar experiment with cockatiels is planned for the near future.

S7.5 Symposium: Infant-directed behavior: examining the roles of parental speech, action, and both, on infants' action and word learning

S7.5i How Gestures facilitate Word Learning in Shared Storybook Reading

Yayun Zhang[1], Chen Yu[1]

[1]Indiana University

One well-known problem in word learning is referential uncertainty (Quine,1960). In a shared storybook reading context, to learn the correct word-object mappings, learners need to be able to link what they see with what they hear. However, when parents name objects for their children, there are usually multiple potential referents within a naming moment. It is not clear how infants direct their attention to target objects on a given book page. Using high-density multimodal data of gaze, speech and gesture, we aim at providing a mechanistic account of how correct word-object mappings may be established in the context of book reading. More specifically, we want to investigate how and in what ways parent's and child's gestures can help infants follow or direct their attention to identify the correct word-object mappings? We hypothesize that infants and parents may not be able to jointly attend to the same object when parents name objects on a page, but their abilities to follow and use gestures to direct the other social partner's attention can reduce referential uncertainty significantly. Method. Fourteen parent-child dyads participated (Mage=18.5 m.o.). Parents were asked to read 1-5 commercially available wordless storybooks to their children. Both participants wore head-mounted eye trackers and their moment-by-moment eye gaze was recorded and analyzed (Figure 1). In total, we collected 45 book reading sessions, providing 2.5 hours of video footage for coding and analyses. Results. 1) Basic statistics on gestures: both parents and children use gestures during reading. Parent gestures (M=9.52, SD=5.51) more often than child (M=3.49, SD=3.36). Gesture duration does not differ between parent and child. Each pointing gesture lasts for about a second (Child: M=1.02, SD= 0.85; Parent: M=1.02, SD=0.53). 2) Coupling of naming and gesture: we calculated how likely parent/child gestures given a naming event happens. Our result shows that a majority of naming instances are coupled with gestures (74%); Parent gestures more (56%) with naming compare to child (18%). Parent also points at the named target more (43%) than child (13%). 3) Effect of gesture on attention (child look) during naming: we measured how often infants look at the named object 3 seconds after the onset of a naming event. As shown in Figure 2A, we found that about 10% of learning instances are highly informative, meaning that when a naming event happens, infants are looking at the named object 100% of the time. There is also a large proportion (above 50%) of learning instances that infants do not look at the named object at all. However, infants

are significantly more likely to look at the target object when either a parent gesture (β=.27, p<.001, Figure 2B) or a child gesture (β=.36, p<.001, Figure 2C) is coupled with naming. Our findings suggest that infant-directed gestures effectively direct infants' attention to a target object named by the parents. Moreover, infants' own gestures on an object can also elicit parent naming on that object. Taking together, gestures in accompany with parent naming create naming moments with low referential uncertainty that are ideal for naming.

S7.5ii Two-year-olds learn faster from their mothers in novel word learning situations

Rianne van Rooijen[1], Eline Bekkers[2], Chantal Kemner[1], Caroline Junge[1]

[1]Utrecht University, [2]University of Amsterdam

For language acquisition, the maternal voice is special. It is the only voice that neonates have most experience with and prefer over any other voice. Children further process her voice faster and increase activation in brain areas related to language and attention. But does this advantage also extend to novel word learning? We use eye-tracking to test two-year-olds' (n=127) word-learning abilities (design closely followed Ma et al., 2011). Since the beneficial effects for maternal speech is typically examined either via live speech (with the experimenter functioning as control; e.g. Parise & Csibra, 2012), or via pre-recorded stimuli (with the maternal stimuli presented once to the mother's child, and once to an unfamiliar child as control; e.g. Barker & Newman, 2004), we tested the advantage of mother's voice in both situations. Results show that voice familiarity indeed matters for novel word learning (significant interaction: F(1,123)=4.78, p=.03): children who learn from maternal speech look significantly longer at target than distracter (F(1,65)=11.5, p=.001), whereas children who learn from unfamiliar speakers do not (F(1,59)<1). While the advantage for maternal speech is more pronounced in the live setting than in the prerecorded version, this difference did not reach significance (See Figure 1). We are further examining whether speaker familiarity might also heighten children's level of engagement by tabulating how often children produced the novel words or pointed at the screen. Preliminary results (i.e. from live version) suggest that children are more likely to repeat words from a familiar speaker. Moreover, at the individual level we observed correspondences between both word production or pointing and their learning performances. Thus our results confirm that children learn words more rapidly from their mother than from an unfamiliar person. It appears that

maternal speech not only facilitates word learning, but also affects the child's engagement.

S7.5iii Parent Action and Speech in Natural Teaching: Relationships with Action Learning

Natalie Brezack[1], Amanda Woodward[1]

[1]University of Chicago

While the effects of motherese have been studied extensively in relation to language learning, little is known about impacts of infant-directed speech and action on children's action learning. Learning to perform skilled actions from social partners is a central part of cultural learning and an important learning challenge in children's everyday activities. There is relatively little known about how parents tailor their speech and actions, separately and in combination, towards children when naturally teaching novel actions. The present exploratory study examined how parents naturally teach their toddlers, as they would in everyday situations at home. Thirty-two primary caregivers taught their 2-year-olds (22-26 months; mean age = 23.5 months, 17 males) to perform novel action sequences on two toys. An experimenter, who was unaware of which toys had been taught to the child, then tested toddlers' action knowledge on the two "taught toys" and two untaught, baseline "control toys" (Figure 1). Fine-grained coding of teaching examined how parents taught the actions to be learned and how parents employed verbal assistance while teaching. These teaching factors were then compared to test scores, which reflect children's accuracy in reproducing the taught actions. Additionally, children's vocabularies were assessed using the MCDI to investigate whether teaching strategies varied by individual differences in language skills. To learn the actions being taught, it follows that more exposure to actions might benefit learning. Plausibly, longer time teaching, more parent demonstrations, and increased child actions might boost learning. In fact, none of these variables affected learning; children demonstrated learning after seeing sequences only once or up to four times. However, the distribution of actions between parents and children did affect learning; children who performed proportionally more steps during teaching scored higher at test ($r = .382$, $p = .041$; Figure 2). Additionally, preliminary analyses suggest that children who collaborated more with parents, taking turns on each step, learned more ($r = .355$, $p = .075$). Thus active experience and structuring teaching in a social context might be more beneficial than mere action exposure. Despite the task's focus on action rather than language, children's vocabularies predicted learning on the toys they were taught ($r = .450$, $p =$

.014), but not on baseline control toys. Additionally, children with higher vocabularies performed proportionally more actions during teaching (r = .342, p = .055; Figure 2), suggesting there may be differences in parent teaching, children's active engagement, or both based on children's linguistic competence. In terms of parent verbal input, more speech might logically increase test scores; however, preliminary results suggested that more time talking did not boost learning. While coding is ongoing to explore the content of parent speech, verbal input, like actions, might vary by children's linguistic competence. Analyses are also underway exploring relationships between parent speech and action that impact learning. Generally, these findings could provide insight into how natural teaching occurs early in life and how different features of teaching (active experience, collaboration, verbal assistance) might help toddlers at different skill levels learn novel actions.

S7.5iv Action learning in infancy: Motherese and motionese combine forces

Melanie Schreiner[1], Marlene Meyer[2], Johanna van Schaik[3], Jelena Sucevic[4], Sabine Hunnius[5]

[1]University of Göttingen, [2]University of Chicago, [3]Leiden University, [4]University of Oxford, [5]Radboud University

When interacting with their infants, mothers have been shown to modify their speech compared to speech directed at adults (Fernald et al., 1989; Soderstrom, 2007). Similarly, actions directed at infants differ from those directed at adults (Brand, Baldwin, & Ashburn, 2002). Independently, these modifications have been shown to facilitate word and action learning, respectively (Ma et al., 2011; Williamson & Brand, 2013). Yet, whether these modifications are interrelated or independent and whether the learning benefits of motherese also operate multi-modally to facilitate action learning is unknown. Against this background, the current study examines speech and action recordings of mothers interacting with their infants to assess the relation of motherese and motionese and their impact on action learning. In the present study, 36 mothers demonstrated four novel objects each with a unique opaque function to their 14-month-old. Mothers were free to talk to, demonstrate and exchange the objects with their infant. Speech was recorded with an unobtrusive microphone and their action kinematics were tracked using wireless motion tracking (see Figure 1). Infants' action learning was assessed by scoring their ability to repeat the object function previously demonstrated by their own mother. Analyses of mothers' prosodic speech characteristics (e.g., pitch range) revealed that these matched characteristics reported in

the motherese literature. Similarly, we found that mothers significantly modified their movements (e.g., motion path length) when addressing their infant versus adult partners. Interestingly, mothers who adjusted their movements more also used wider pitch ranges when talking to their infants, $r(36)=.34$, $p=.044$ (see Figure 2). Moreover, wider pitch ranges and longer motion paths together significantly predicted infants' successful action learning, $F(2,33)=3.70$, $p=.036$. In addition, the extracted factor from a principal components analysis of the mothers' movement characteristics correlated significantly with mothers' estimation of their infants' motor abilities assessed through parental questionnaires, $r(36)=-.38$, $p=.020$. This means that parents used less-modified motionese if they rated their infants' motor abilities as high. Moreover, those parents who had higher scores in an empathy questionnaire also seemed to exaggerate their speech during action demonstration, $r(36)=.36$, $p=.033$, however, mothers' empathy seemed to be unrelated to their infant-directed movements, $r(36)=.08$, $p=.659$. To better understand the relation between motherese and motionese, we currently analyze the temporal contingency of motionese and motherese. In summary, the results of the current study show that individual differences in mothers' action demonstration, both in speech and motion, depend on infants' perceived motor abilities and in turn seem to impact infants' learning success. In addition, the findings suggest that infant-directed speech is not only beneficial for early language acquisition but infants' action learning may also benefit from more exaggerated speech input (cf., Floccia et al., 2016, Schreiner & Mani, 2017). Importantly, the current study suggests a close relation between motherese and motionese and offers novel implications for multi-modal learning in infancy.

S7.6 Symposium: The development of updating working memory representations

S7.6i Infants Update Working Memory to Reflect New Categorical Cues: Evidence from Change Detection by 10- and 12-Month-Olds

Su-hua Wang[1], Elizabeth Goldman[1]

[1]University of California, Santa Cruz

The present research examines infants' ability to update working memory (WM) when constructing representations of ongoing physical events. Existing research converges to show that infants attend to information that is relevant for categorizing an event (e.g., Casasola, 2005; Hespos & Baillargeon, 2006; Rigney & Wang, 2015; Wilcox, 1999). The present research investigates whether 10- and 12-month-olds update WM to reflect new categorical cues. By 4.5 months, infants detect impossible changes to object height for events involving occlusion but not covering, and by 12 months, infants do so for events involving hiding an object under a cover but not a tube (Wang & Baillargeon, 2006; Wang & Onishi, 2017). Here we varied the content and timing of new categorical cues to examine whether infants altered their categorization of an event, as indicated by their detection of a height change. All test events presented a small object next to a hiding device. The device was lowered over the object, fully hiding it, and then lifted to reveal the object. The object, when revealed, became much taller (change event) or remained the same (no-change event). If infants noticed the impossible change to object height, they should look reliably longer at the change event than the no-change event.
 Experiment 1 confirmed that categorical cues, provided before test, guided infants' working memory of object height. Twelve-month-olds were shown a cover or a tube before the test event began. Although infants saw identical test events, only those in the show-cover condition noticed the change, $F(1, 24) = 5.49$, $p < .05$. Thus, whether infants detected the change in test depended on which device was shown. Experiment 2 manipulated the timing of new categorical cues to examine updating of WM. Twelve-month-olds were led, by the pre-test showing, to believe that a cover was being used. During the test event, the device was rotated to reveal that it was indeed a tube. This new information was presented before or after the device was lowered over the object (pre- or post-hiding). Only infants in the post-hiding condition noticed the change, $F(1, 28) = 8.78$, $p < .01$. Thus, 12-month-olds updated their representation according to the new information, but only when it was provided before the crucial segment of the event (the hiding of the object) occurred. Experiment 3 demonstrated 10-month-olds' fragile ability to update WM. Infants were shown occlusion before the hiding of the object occurred. However, they still maintained the initial categorization (occlusion), which led

them to detect changes in test events (covering) that they would have typically missed, F (1, 24) = 4.86, p < .05.
 Together, these experiments showcase infants' ability to update WM and construct representations on the fly. Identical events can be perceived differently depending on the most updated categorical information in WM. By 12 months, infants readily incorporate new information in their representations of complex events as long as it is provided early in time.

S7.6ii Toddlers with ASD can use linguistic information to update their mental representations

Allison Fitch[1], Annalisa Valadez[2], Alice Carter[2], Zsuzsa Kaldy[2]

[1]Boston University, [2]University of Massachusetts Boston

The capacity to update mental representations in the face of new information is necessary to navigate the world efficiently. This information may come in the form of visual, directly observable change, but often we learn new information about objects and events that are not visible through verbal reports from other people. For typically developing (TD) children, the ability to use language to update mental representations in low-demand tasks emerges by 16 months (Ganea et al., 2016). This type of updating, however, may pose a difficulty for young children with autism spectrum disorder (ASD), due to their general weaknesses in language and communication (e.g. Luyster et al., 2008). In contrast, adults with ASD can form implicit visual memories for object-location bindings without any difficulty (Ring et al., 2015), suggesting that the ability to use visual information to update mental representations may be intact in the condition. Here, we examine differences between TD toddlers and toddlers with ASD matched on nonverbal mental age in their ability to update object locations using visual and verbal information.
 Twenty-two toddlers with ASD (18-36 months, M = 25.5 months) and 26 TD toddlers (15-20 months, M = 18.6 months) were tested. Using an eyetracker, we presented toddlers with a scene of a cat, dog, and bed. The scene was occluded, and toddlers received information about one of the animals changing location through visual (e.g. the cat jumping to a now occluded bed) or verbal means (auditory testimony: "Now the cat is on the bed!"). We then presented an outcome scene that was either congruent to that information (the cat on the bed), or incongruent (the dog on the bed) for eight seconds. Toddlers participated in both visual and verbal conditions, which each contained a congruent and an incongruent trial; order was counterbalanced. Looking time to the outcome was compared across trial congruency, modality, and diagnostic group. Toddlers' mental age was assessed on the Mullen Scales of Early Learning

(MSEL).
 As expected, toddlers with ASD had significantly poorer verbal skills on the receptive language scale of the MSEL as compared to TD toddlers, p <.001. Eyetracking findings revealed a significant main effect of congruency, F (1, 46) = 6.302, p = .016, where looking time was longer when outcomes were incongruent than congruent--a violation-of-expectation (VoE) effect. There was also a main effect of diagnosis, F (1, 46) = 12.228, p < .001, where the ASD group's average looking time was shorter than the TD group's. There were no significant effects of modality, nor interactions.
 Results indicate that despite significantly weaker receptive language skills, toddlers with ASD showed no impairments in using verbal information to update their expectations about an object's location in our task. Rather, toddlers with ASD showed the same VoE effect to the incongruent outcomes as their TD peers, regardless of modality. Group differences in overall looking may be attributed to differences in chronological age. Together, these findings suggest that, when task demands are low, toddlers with ASD can use language to update their mental representations.

S7.6iii Individual Differences in Verbal Updating Among 2-Year-Old Children

Begum Ozdemir Demirci[1], Patricia Ganea[1]

[1]University of Toronto

Much of children's knowledge about the world is based on information received verbally from other people. Recent research on children's ability to update mental representations through language has shown differential performance across updating tasks and within the same age group (Ganea et al., 2007; Ganea & Harris, 2010; 2013). At 22 months children are more likely to update an absent object's representation when told about a property change than when learning about a location change. Children tend to perseverate to the object's original location, and their ability to update is more fragile as shown by their more variable performance. Although 22-month-olds perform at chance as a group, there was still a non-negligible number of children (around 40%) who successfully updated in the location task (Ganea & Harris, 2013).
 The current study aimed to replicate prior findings using two updating tasks with the same group of children and to explore cognitive processes underlying children's variable performance. A total of 70 2-year-old children (mean age = 26.6 months, range = 21.4 - 34.5) were administered two versions of verbal updating tasks: property and location change. Working memory, inhibitory control and expressive vocabulary were also measured. Consistent with previous findings, children showed more variable performance when updating an object's location than its property. At 26 months, 75% of the children

passed the property change task while only 57% of the children passed the location change task. More importantly, when comparing individual children's performance across the two tasks, we found that children were more likely to pass the property change but failed the location change task than showing the reverse pattern (i.e., failing the property but passing the location change task) ($p = .052$, McNemar test). Performance in both verbal updating tasks correlated with age ($ps < .02$). Surprisingly, performance in the property task also correlated with performance in one of the working memory tasks (Hide the pots, $p = .035$). However, separate logistic regressions for location and property change performance indicated that working memory, inhibition, and language did not uniquely predict children's performance in either task. Age was found to be the only significant predictor of performance.
 We propose that updating in contexts where there is inherent conflict between new and old information, requires more specialized working memory processes, such as the updating function of working memory (Ecker, Lewandowsky, Oberauer, & Chee, 2010). There are currently no tasks assessing this working memory process type in young children. Future research could explore whether sub-processes of working memory predict performance differentially across different tasks. We also argue that the increased prevalence of displaced speech during the third year of life (Adamson & Bakeman, 2006), may explain age-related improvement in children's performance across both verbal updating tasks. Future research examining processes and factors that contribute to children's ability to revise their representations of the world on the basis of what they are told will shed light on a fundamental aspect of human cognition and learning.

Flash talk abstracts: Monday 2nd July

S5.8 Flash talk session 5: Babies in their natural habitat – the role of ecological validity in studies of learning

S5.8i Cerebral activations to socially positive, negative, and non-social contingency during live interactions in infancy

Yoko Hakuno[1], Masahiro Hata[1], Taku Hachisu[2], Kenji Suzuki[2], Yasuyo Minagawa[1]

[1]Keio University, [2]University of Tsukuba

Objective: Social and linguistic input from other people during infancy and childhood plays an essential role for typical development. Yet, neural activity in infants while they are socially interacting with others remains poorly understood (see Lloyd-Fox et al., 2015). Our previous study revealed that 6- to 8-month-old infants showed increased activation in the right TPJ region in response to contingent smiles of a social partner (Hakuno et al., in prep). In this study, we examined 4- to 5-month-old and 6- to 7-month-old infants' brain activity in response to socially positive, socially negative, and non-social contingent stimuli during natural social interactions across the right temporal (temporoparietal junction: TPJ and superior temporal sulcus: STS) and frontal (medial prefrontal cortex: mPFC) regions using functional near infrared spectroscopy (fNIRS). Methods: Twenty-three 4- to 5-month-old and twenty-seven 6- to 7-month-old infants participated in the study. During the fNIRS recording, a female experimenter spoke to the infant using a picture book and puppets. There were three experimental conditions: the social-positive, social-negative, and non-social condition. Within the social-positive condition, the experimenter responded to the infant contingently by smiling immediately after the infants referred her face while the experimenter responded to the infant contingently by stopping smiling during the social-negative condition. Within the non-social condition, not the experimenter but a light-emitting device, which was on the experimenter's head, emitted visible light contingently. During the baseline, the experimenter behaved in the same manner except that the responses were delayed by 3 s. The three experimental conditions were tested separately and each condition was presented in between baseline trials. To investigate infants' cortical activation, we used a multichannel NIRS system covering the infant's right temporal and frontal lobes. Results and Conclusions: The fNIRS recordings indicated increased activation from baseline in the right TPJ region during all three conditions only for 6- to 7-month-old infants. 6- to 7-month-olds also showed increased activation from baseline in the mPFC region in the social-negative condition and decreased activation in the mPFC region in the social-positive and non-social condition while 4- to 5-month-olds showed increased activation from baseline in the

mPFC region only in the social-positive condition. Moreover, we found increased functional connectivity between the right TPJ and the mPFC for 6- to 7-month-olds during the social-positive and social-negative conditions. These results indicated an early involvement of the TPJ and mPFC in processing a highly communicative behavior of others (i.e., contingent responsiveness) during natural social interactions. Since the TPJ and mPFC are known to form the social brain network in human adults, increased sensitivity to contingent stimuli during infancy presumably plays an important role in the development of social cognition.

S5.8ii Symbolic Play and Language Acquisition: New Insights from a Naturalistic Longitudinal Study

Noelie Creaghe[1], Daniel Angus[2], Evan Kidd[3]

[1]The ANU, [2]University of Queensland, [3]Max Plank Institute for Psycholinguistics

Infant symbolic play and language acquisition have long been linked. Although both activities are inherently social, and their acquisition is typically scaffolded by a competent other (e.g., Haight & Miller, 1993), most studies investigating the symbolic play-language link have considered the relationship in contexts of solitary play. These studies have also typically lacked a baseline non-symbolic context as a point of comparison. In the current study we present research that investigated language use in caregiver-infant interactions within an ecologically-valid joint symbolic play setting, which we compared to a non-symbolic "functional" play setting. Fifty-two (N = 52) 24-month-old infants and their primary caregiver engaged in a 20-minute play session that manipulated play type. In the symbolic play condition, the dyads were given toys that typically elicit symbolic play (e.g., toy tea set), and in the functional play condition the dyads were given toys that were clearly goal-oriented and therefore less likely to elicit pretence (e.g., jigsaw puzzle). The play condition was a within-participants manipulation. The presentation of the conditions was counterbalanced with seamless transitions between the two (dyads were offered a new set of toys at the 10-minute mark of each session). Our data analysis focused on the dynamics of the communicative interactions across the two play sessions. Each session was coded for linguistic content (e.g., lexical content, speech acts) and conversational structure. The results showed that communicative interaction is very different across conditions. Specifically, we found that in the symbolic play session caregivers used significantly more interrogatives (wh- and yes/no questions) than in the functional play session, where they used significantly more imperatives (i.e., commands like put this here) (see Figure 1). Interrogatives have been shown to positively predict language

development (Rowe, Leech, and Cabrera, 2016), suggesting that symbolic play may provide a fertile context for language acquisition. This suggestion is further supported by our analyses of the dynamics of the conversational structure. The interactions from both sessions were analysed using Discursis (Angus, Smith, and Wiles, 2012), a computational information visualization tool that shows conversational concepts recurring within and between speakers. Discursis revealed that children initiated more turns and showed overall more complex interactional conversation patterns and conceptual overlap in the symbolic play condition when compared to the functional play condition (see Figure 2). These results suggest that symbolic play provides infants with more opportunities to participate and engage in interactions than comparable non-symbolic activities. Therefore, symbolic play may support language acquisition because it provides a social and explorative environment in which the primary caregiver invites child-driven language production. These valuable dynamic patterns of language acquisition are only visible in natural communicative settings, and our results support the need for further ecologically valid research to explore the symbolic-play language relationship.

S5.8iii Infant race preferences within a social interaction

Jonathan Prunty[1], Jolie Keemink[1], David Kelly[1]

[1]University of Kent

From early in the first year of life, infants use social information to learn about the identities and intentions of others. The infant's social environment, however, is not easily captured through the use of traditional static stimuli. Faces in real life are rarely frozen at peak expressive amplitude; expressions are constantly changing and communicated, in part, through motion (Võ, Smith, Mital, & Henderson, 2012). Social cues also do not appear according to a strict experimental clock, but are often contingent on the active participation of the infant (Striano, Henning, & Stahl, 2005). To investigate classic social learning questions with greater ecological validity, we have developed a novel eye-tracking (Eyelink 1000+) paradigm that simulates social interactions. By combining dynamic stimuli and gaze contingency, infants are able to trigger video responses from the on-screen actor by engaging them in eye contact (see figure 1). With this method, we hope to investigate complex behavioural phenomena such as face processing with greater sophistication and realism by bridging the gap between lab-based experiments and more naturalistic observations. Using static images, three-month-old infants have been shown to prefer own-race over other-race faces (Kelly et al., 2005). In a recent experiment, we sought to replicate this finding using our paradigm, with six-, nine- and twelve-month

infants triggering either "socially-engaging" (SE; mutual gaze, smiles) or "non-engaging" (NE; head-turns away) responses depending on their condition (SE N = 39, NE N = 22). The two characters (Caucasian [own-race] and African [other-race]) were then presented side by side during two test-phase trials. We found that own-race preference disappears within a social interaction (Caucasian M = 49.46%, t(59) = .325, p = .747, BH(0, 8) = .214). A more specified "eye-contact" preference emerged (see figure 2), as fixations within the eye-region area of interest (AOI) were significantly higher for the own-race face (Caucasian test-phase M = 55.65%, t(53) = 2.509, p = .015, d = .69). Interestingly, although there were no significant differences between conditions (NE vs SE), it was infants that showed themselves to be "socially attentive" (N = 41); who engaged with the simulated interaction on at least two trials by either fixating the smile (N = 26, SE condition) or following the direction of the averted gaze (N = 15, NE condition), that demonstrated this own-race eye-region preference against chance (Caucasian M = 55.76%, t(40) = 2.297, p = .027, d = .73). Infants that did not reliably demonstrate these social scan patterns (N = 19) had reduced own-race eye-region fixation durations in comparison (Caucasian M = 46.25%, t(58) = 2.027, p = .047, d = .53), with proportional fixation number showing a strong other-race preference against chance (African M = 57.02%, t(18) = 3.450, p = .003, d = 1.63). As own-race preferences only emerged within infants that reliably demonstrated social scan patterns, this suggests that social learning and the attention to social information in the environment could be the driving force behind the development of own-race preferences. These findings demonstrate that by seeking to increase ecological validity, without compromising on scientific rigour, not only can we uncover different results, but we can also add a level of nuance and complexity to our findings and potentially deepen our understanding of social learning in infancy.

S5.8iv The Ecology of Prelinguistic Vocal Learning: Statistical Structure of Parental Speech in Response to Babbling

Steven Elmlinger[1], Jennifer Schwade[1], Michael Goldstein[1]

[1]Cornell University

Introduction What is the function of infants' prelinguistic vocalizations or "babbling" in real-world early learning environments? Results from vocal learning studies on humans (Goldstein & Schwade, 2008), songbirds (King, West, & Goldstein, 2005), and primates (Takahashi et al., 2015) indicate that adults who coordinate their vocalizations with their offspring's immature vocalizations create contingent social feedback that facilitates learning of more advanced vocal patterns. While past work has focused on the timing of

feedback, the present research examines the statistical structure of parental speech that is contingent on babbling to examine whether babbling elicits different structural patterns in parents' infant-directed speech. Methods Thirty parent-infant dyads participated (M infant age = 9.68 mo). Dyads made two visits to the lab. In visit 1, dyads engaged in 30-minute unstructured free-play sessions with toys; in visit 2, dyads did the same for 10 minutes. Parents were instructed to play like they normally would at home. Recordings of infants' vocalizations and parents' speech during free-play were obtained. Parents' speech during play was transcribed in full. Utterances from parents were categorized as contingent if they occurred within 2 seconds after infants' vocalizations; all other parent utterances were categorized as non-contingent. The lexical diversity of parental speech was measured by counting the number of unique words parents spoke in visit 1. To further assess lexical diversity, we measured the type-token ratio of parent's speech, calculated by dividing the number of unique words parents uttered by the total number of words they uttered in visit 1. We categorized the infraphonology of all infant vocalizations during the second visit (Oller, 2000). To assess the maturity of infants' vocalizations, we calculated the proportion of infant vocalizations which contained consonant sounds to all vocalizations. Results We found that parents simplify the speech they use in response to infants' babbling compared to non-contingent speech (Figure 1). During unstructured play sessions, contingent parental speech is less lexically diverse and shorter in utterance length than non-contingent speech. Contingent speech is also less repetitive (has a higher type-token ratio) and contains a higher proportion of single word utterances than non-contingent speech. We analyzed the relation between parents' speech complexity and the development of mature vocal forms (vocalizations with consonant-vowel alternation). The lexical diversity of contingent parental speech predicted vocal development ($r(28) = .41$, $p = .02$, Figure 2). The lexical diversity of non-contingent speech did not predict vocal development ($p = .80$). Additional analyses showed that prosodic features (e.g. pitch contour) of parental speech did not differ significantly across contingent and non-contingent utterances; mean fundamental frequency (f0) of parents' speech (282 Hz) was consistent with previous reports of f0 for infant-directed speech (Thiessen, Hill & Saffran, 2005). Such stability of prosodic features may highlight changes in underlying statistical structure in parents' contingent infant-directed speech, as these modifications may be relevant for vocal learning and language. Our findings suggest that infants' babbling may function to elicit changes in the structure of parents' infant-directed speech which may facilitate infant communicative development.

S5.8v Navigating through Variable Input: A Role for Phonological Anchors in Learning Vowel Categories from Infant-Directed Speech

Frans Adriaans[1]

[1]Utrecht University

During the first year of life infants begin to discover the vowel categories of their native language (Polka & Werker, 1994). It is widely assumed that categories are learned using a distributional learning mechanism that groups together tokens that are similar along acoustic dimensions (Maye et al., 2002). However, studies assessing the ecological validity of the distributional learning hypothesis have found that vowels in infant-directed speech (IDS) are highly variable, and it is unlikely that the problem of category learning can be solved by relying exclusively on distributional learning (Swingley, 2009). Computational modeling studies have explored different sources of contextual information which might support distributional learning in a highly variable environment. For example, Dillon et al. (2013) showed that vowel learning in Inuktitut could be supported by phonological context. Since vowels in Inuktitut are systematically lowered before uvular consonants, they found that a model that takes this context into account outperformed a model without context. However, the role of context in infants' category learning is still unclear. How could an infant discover relevant phonological contexts? To what extent does phonological context help the infant to navigate through the variability found in IDS? The current study presents a computational model which selects multiple consonantal contexts based on frequency in the input, and uses these contexts to learn contextual categories. To assess the effects of phonological context on vowel learnability, the model's performance is evaluated using an ecologically valid data set of unscripted American-English IDS. To explore whether consonantal context affects the distribution of vowels in infant-directed speech, a total of 1800 tokens of 'iy' and 'ih' were extracted from natural mother-infant interactions (Adriaans & Swingley, 2017). The five most frequent consonants preceding these vowels were selected as phonological contexts. Figure 1 illustrates that vowel distributions in IDS are affected by the consonant preceding the vowel. The question is whether a learner that has access to this small selection of highly frequent consonantal contexts would be able to learn vowel categories more effectively than a learner without context. To this end a new model was created which anchors each vowel token in its phonological context (i.e., the consonant preceding the vowel). This leads to a set of anchored distributions, from which contextual category parameters are estimated. The learner then estimates the vowel categories by generalizing across different contexts. Table 1 shows that our Anchored Distributional Learning model outperforms a Distributional Learning model without context. The model's performance

approaches that of a supervised learner, which gives a ceiling performance on the data set. The results show that phonological anchors could be used as a possible source of information to facilitate distributional vowel learning from infant-directed speech. From a language development perspective, it is important to note that the learner does not need the full consonant inventory, but only relies on a small set of highly frequent consonant environments, which infants can discriminate, and possibly learn, at a young age. These findings support a view in which the infant's distributional learning mechanism is anchored in context, in order to cope with variability in the linguistic environment.

S5.8vi Using a home-video method to assess infant gross motor development : A feasibility study

Marike Boonzaaijer[1], Floryt van Wesel[2], Jacqueline Nuysink[1], Chiel Volman[2], Marian Jongmans[1]

[1]HU University of Applied Sciences Utrecht, [2]Utrecht University

Background The current widespread use of smartphone-camera's allows for home-video assessment to monitor infants at risk. We developed a home-video method for parents enabling Pediatric Physical Therapists (PPT) to assess infant's gross motor development with the Alberta Infant Motor Scale (AIMS) (Boonzaaijer et al, 2017). In a longitudinal pilot study, parents were instructed to make five home-videos over a 9-month-period and upload them to a secure server (web portal). After each assessment, parents received feedback on their infant's motor development. The possibilities for parents to record their infant's motor behavior in a familiar environment and at a suitable time are tempting aspects of this method. The main objectives of the present study were: 1) to explore the experiences of parents with this new home-video method, and 2) to identify facilitators and barriers of this home-video method. Methods Forty-six Dutch parents of typically developing infants (0-19 months) participated in this longitudinal study on gross motor trajectories. A sequential mixed methods design was chosen, including questionnaires (n= 46) and semi-structured interviews (n= 8). Whereas the questionnaires consisted of items on the practical feasibility of the home-video method, the interviews offered parents the opportunity to report on their personal experiences. Descriptive statistics and a Wilcoxon Signed Rank-Test were used to analyze the quantitative results. The interviews were analyzed using a qualitative thematic analysis approach. Results Overall, the results demonstrated that the home video method was feasible for these parents. The main barrier parents reported was time planning. It was sometimes difficult to find a moment that both parents were at home and their baby was in a proper state to show optimal

motor behavior. Technical problems with the web portal, which made uploading of the videos time consuming, were also experienced as a barrier. According to parents, facilitators of this home video method were (1) the idea that the home-videos were valuable for family-use, (2) receiving feedback from a professional about the infant's motor development and (3) the fun to interact with their baby in a different way and to have a moment of 1-on-1-attention. Moreover, the instructions and home video recording resulted in an increased parental awareness of, and insight in the gross motor development of their infant. Conclusions/ discussion Although, this study contained a relatively small sample of parents with healthy infants, we gained insight in the main facilitators and barriers of the home-video method. Most barriers have a practical nature that can be addressed in future applications. Next step is to investigate this method for parents of infants at risk. The home-video method has the potential to become a valuable tool for both research and PPT-practice monitoring infants at risk. Furthermore, the method might become a tool to empower parents who have an infant at risk for developmental delay. The active parental involvement can lead to a better understanding of the infant's development and improve shared decision-making between parents and professionals. Keywords home-video, infant motor development, parental facilitators and barriers

S5.8vii Accent adaptation in the real world: Infants learn from live exposure

Melissa Paquette-Smith[1], Angela Cooper[2], Chen Peng[2], Keren Smith[2], Elizabeth Johnson[2]

[1]University of Toronto, [2]University of Toronto Mississauga

In a diverse multicultural society, children are regularly exposed to different accents or variants of their native language. Previous work has suggested that before 19 months of age infants have difficulty recognizing familiar words when they are spoken in an unfamiliar accent (e.g., Best et al., 2009). However, these studies may not reflect infants' real-world adaptation abilities. Presenting infants with audio recordings of isolated words in the lab is a far cry from the rich face-to-face interactions that infants have with accented speakers in the real world. In this study, we examine whether traditional laboratory tasks may have underestimated infants' abilities by testing infants' accent adaptation after live exposure to accented speakers. In Experiment 1, two groups of infants (ages 16-18 months and 21-24 months, N = 32) engaged in a 10-minute interactive reading of their favorite books with a Mandarin-accented English speaker. After interacting with the Mandarin-accented speaker, infants completed a preferential looking task, where they viewed two familiar objects and heard one of them being named. In half of the trials, the

target word and sentence frame (i.e., Look at the [target]!) was produced by the Mandarin speaker they had interacted with, and in the other half of the trials the sentences were produced by an unfamiliar Australian-accented speaker. As expected, we found that the older 21- to 24-month-olds were better able to recognize words in accented speech than the younger 16- to 18-month-olds, $F(1, 30) = 4.87$, $p = 0.04$. However, unlike previous work, both age groups were able to recognize familiar words produced by the Mandarin-accented speaker. This is surprising, given that children do not recognize words in foreign accents until around 19-months in traditional laboratory studies. Although, live interaction seemed to facilitate 16-month-olds' recognition of words in the Mandarin-accent, they did not recognize words in the unfamiliar Australian accent, $t(15) = .806$, $p = .433$. This may indicate that infants learned something specific about the Mandarin speaker instead of becoming more willing to accept non-standard pronunciations overall. However, it is also possible, that the Mandarin accent was simply easier for 16-month-olds to understand. In order to tease apart these two explanations, in Experiment 2, 16- to 18-month-olds interacted with a Canadian-accented speaker prior to completing the word recognition task. After the Canadian interaction, infants were not able to recognize words in the unfamiliar Mandarin-accent, $t(15) = 1.01$, $p = .33$, which provides additional evidence that they were adapting to a specific speaker in Experiment 1. In a follow-up study, we are currently examining whether live interaction is necessary to elicit adaptation. To test this, we have replaced the live exposure phase with a video of the Mandarin-accented speaker. If video exposure can elicit adaptation, then 16-month-olds should be better at recognizing words in the Mandarin-accent after exposure. Taken together, this line of research suggests that if children are given more ecologically valid word recognition tasks, they are able to adapt to unfamiliar accents earlier than previous work has suggested. This work highlights the importance of considering how live interaction may ameliorate many of the processing difficulties reported in typical laboratory studies.

S6.8 Flash talk session 6: Let's make this less WEIRD – Moving away from Western, educated, industrialised, rich, democratic participants in infancy research

S6.8i Adaptation of the Mullen Scales of Early Learning for use among infants aged 6-24 months in rural Gambia

Bosiljka Milosavljevic[1], Perijne Vellekoop[2], Helen Maris[1], Saikou Drammeh[3], Lamin Sanyang[3], Momodou Darboe[3], Sophie Moore[4], Clare Elwell[5], Sarah Lloyd- Fox[1]

[1]Birkbeck, University of London, [2]Netherlands Society for Tropical Medicine and International Health, [3]Medical Research Council Unit Gambia, [4]King's College London, [5]University College London

There is growing evidence of the detrimental impact that early-life risk factors associated with living in low resource settings (e.g. undernutrition and poverty) have on child health outcomes, educational attainment and quality of life (e.g. Victora et al., 2008). However, research into the impact, timing and reversibility of early life insults on cognitive development in resource poor settings remains sparse. Furthermore, measurement of cognitive abilities in these settings is limited by the fact that standardised measures are language and culture dependent and validation has been conducted in Western, English-speaking societies. The aims of the present study were to (1) adapt the Mullen Scales of Early Learning (MSEL; Mullen, 1995) for use in infants in rural Gambia; and (2) collect normative MSEL data on cognitive functioning among Gambian infants. The MSEL was adapted in several steps; items were translated into the Mandinka language, stimuli that were inappropriate for the context were substituted for culturally appropriate ones; and local field staff were trained in administration to ensure standardisation across assessments. In Phase 1 (February to November 2013), we tested this adapted Mullen on 2 cohorts of infants. One group of infants (n=41) was tested longitudinally at two time points, three months apart, between the ages of 9-16 months. A second group was tested at 18-24 months (n=17). In this initial phase, we noted that the field staff often resorted to the use of parent report rather than infant observed responses. One contributing factor was the unfamiliar setting and therefore hesitancy of the rural Gambian infants to respond in this structured play environment. Subsequently, a second wave of training and optimisation was undertaken. In Phase 2 (February to April 2014), 117 infants, aged 6-24 months (27 infants aged 6 months, 31 aged 12 months, 27 aged 18 months and 32 aged 24 months), participated. Performance on each subscale and the over-all Early Learning

Composite (ELC) score were compared to standardised norms for each Phase of data collection (see Figures 1 & 2). Through additional training the level of parent report in Phase 2 fell to levels consistent with those seen in other settings. Results showed that infants in both datasets attained significantly lower ELC, language and visual reception scores than expected norms for their age group. This effect was most highly pronounced at the 24-month age point (see Figure 2). A developmental trend was also observed, whereby the gap between obtained scores and expected norms increased with age (see Figure 1). We successfully adapted the MSEL to be administered in infants in rural Gambia. Findings using the adapted scales suggest that infants in this low-resource setting have reduced developmental level for their age group and this becomes more apparent with increasing age. Adaptations such as this, which have been culturally tailored and validated, offer the potential to better identify infants at risk for cognitive delay in low-resource settings.

S6.8ii Parenting in chaotic environments: Differing effects on behavior problems by child race/ethnicity during toddlerhood

Kathryn Cherry[1], Emily Gerstein[1]

[1]University of Missouri, St. Louis

Overwhelming chaos in the home, such as crowding or lack of routine, can result in self-regulatory difficulties, attention problems, and aggression in young children (Martin et al., 2012). Such environments may interfere with the development and maintenance of parent-child relationships, modeling inconsistency and unpredictability (Wachs & Evans, 2010). However, emotionally responsive parenting could protect against the detrimental effects of chaos on children's behavior problems (Bronfenbrenner & Evans, 2000). Additionally, both the perception of chaos and impact of parenting styles on children's behavior may vary by participant racial or ethnic background (Ferretti & Bub, 2014; Holochwost et al., 2016). This longitudinal multi-method study examined the relations among chaos, maternal emotional responsivity, and children's behavior problems in 283 participants in the Early Head Start Family and Child Experiences Study (Baby FACES; Vogel & Boller, 2015). It was hypothesized that more chaos would be associated with more behavior problems, but that parenting would moderate this relation. Mean levels of all three variables were expected to differ relative to the child's ethnicity, but we did not expect differences in overall relations. At age 2, mothers completed demographic questionnaires, a measure of home chaos, and were observed for emotionally responsive parenting (i.e. expression of warmth, verbal responsiveness) using the HOME. Behavior

problems were measured at age 3 with the BITSEA. Longitudinal weighting was used for more accurate representation. Participants were 38.6% Hispanic/Latino, 32% White, and 20.6% African American. Approximately: 75% of the mothers were on welfare, 45% had their first child before age 20, 38% were single mothers, and 31% had less than a high school education. Findings indicated that more behavior problems were generally associated with less maternal emotional responsivity and more chaotic homes. The interaction between chaos and parenting on behavior problems was not significant in the overall model. However, when the interactions were examined separately by race/ethnicity, African American children showed a pattern opposite that of Hispanic and White children. The interaction for African American children was significant (ß=1.14, p<.001) with few behavior problems in highly responsive mothers in low chaos environments, but many behavior problems in high chaos environments (Figure 1). However, Hispanic and White children's patterns indicated that behavior problems generally increased at higher levels of chaos, but behavior problems increased the most for children with low levels of emotionally responsive parenting (White: ß=-.15, p=.050, Hispanic: ß=-.26, p=.001, Figure 2). Additionally, behavior problems were higher when in lower socioeconomic environments, and when there was more exposure to violence. It is clear that chaos and emotionally responsive parenting both influence children's behavior problems early in life, and these are important influences to consider for future research and prevention efforts. Further, these distinct findings by racial/ethnic background are important to consider, as they may represent the differing effects of parenting across cultures, as well as potential variations in attachment styles or perceptions of chaos. Yet, these analyses are based on parent reports of the child's race/ethnicity, which may not fully represent the child's experience of ethnicity and culture.

S6.8iii A non-WEIRD Cross-linguistic Approach to Computational Models of Infant Word Segmentation

Georgia Rengina Loukatou[1], Sabine Stoll[2], Damian Blasi[2], Alejandrina Cristia[3]

[1]LSCP, Département d'études cognitives, ENS, EHESS, CNRS, PSL Research University, [2]University of Zürich, [3]ENS, EHESS, Centre National de la Recherche Scientifique

One of the key tasks infants must resolve is to figure out where words start and end in the continuous stream of speech (Brent, 1999). The past 20 years have seen numerous experimental and computational studies which highlight potential mechanisms infants may employ to solve this task (Saffran, 2003; Bergmann & Cristia, 2016; Black & Bergmann, 2017). However, a great majority of this work focuses on English, a unique language for

segmentation because most words are monomorphemic and monosyllabic. Research suggests that polysynthetic languages with long words composed of several morphemes may present additional difficulties to segment (Fourtassi, Börschinger, Johnson & Dupoux, 2013). This performance difference could also be due to the fact that algorithms might be optimized for English (Gervain & Erra, 2012). Moreover, previous work had focused on orthographic words as the segmentation target, but infants could segment morphemes rather than words (Phillips & Pearl, 2014). Our study is the first to test a set of cross-linguistic corpora selected to vary in their morphological structure, using 3 conceptually diverse word segmentation algorithms evaluated on both orthographic and morphemic representations. We selected Chintang and Japanese, based on their maximal difference in several morphological aspects, from the ACQDIV database (Moran, Schikowski, Pajović, Hysi & Stoll, 2016). Despite having similar levels of syllabic complexity and word length, Chintang is a great deal more morphologically complex than Japanese. These large corpora contain word and morpheme level annotations comparable across languages (see Table). As in previous modeling work, we converted orthographic transcriptions of the adult speech into text-like phonological forms, from which word/morpheme boundaries are removed to mimic running speech. Our models varied in the locality of cues used. The Diphone Based Segmentation algorithm (DiBS) is based on the intuition that infrequent diphones are likely to span a word boundary (Daland & Pierrehumbert, 2011). The Transitional Probabilities algorithm (TPs) is based on the concept that syllable pairs that tend to co-occur belong to the same word (Saksida, Langus & Nespor, 2017). Finally, the lexical-based Adaptor Grammar (AG) tries to find the optimal lexicon which generates the input corpus (Johnson, Griffiths & Goldwater, 2007). We split the corpora into 10 subparts to fit a regression with the factors of language (Chintang/Japanese), algorithm (DiBS/TPs/AG) and evaluation level (word/morpheme), which overall explained a great deal of variance (R2=.96; see Figure). Japanese performed significantly better than Chintang (ß=.056). 2- and 3-way interactions suggest that Japanese outperforms Chintang for AG-morphemes, AG-words and TPs-morphemes. Performance is greatly affected by the algorithm: DiBS and TPs have significantly lower scores than AG. Finally, scores are significantly lower when considering words than morphemes. Surprisingly, our study reveals that language morphology has a minor impact compared to algorithm (ß=.16-.31) and level (ß=.11). These results highlight the importance of model and evaluation methods for language acquisition modeling studies, as well as the need to test on more non-WEIRD languages. Future modeling research could further approach the impact of cross-linguistic differences by considering other factors, such as syllable structure.

S6.8iv Not so WEIRD object play in Tajikistan

Lana Karasik[1], Joshua Schneider[2], Yana Kuchirko[3], Catherine Tamis-LeMonda[3]

[1]College of Staten Island, City University of New York, [2]University of Pittsburgh, [3]New York University

In the first two years, infants show remarkable advances in object interaction, especially during play when they discover and refine new skills. In Western infants, the developmental progression in object exploration is well documented. Infants advance from visual inspection, to simple manual contact, to more complex juxtaposition of actions tailored to object features. Learning about object features and discovering actions unique to object properties depend on opportunities and access to objects. In Western cultures, toys are ubiquitous. Caregivers encourage exploration and play by providing toys and highlighting intended actions on objects (e.g., fitting a shape in a shape sorter). </p> Here, we examined visual-manual exploration in 97 8- to 24-month-olds in Tajikistan, raised in a "gahvora" cradle from birth. The gahvora constrains infants' posture, limbs, and movement and limits visual input. Although younger infants spend more hours in the cradle than older infants, there is enormous variability within age and differences in the distribution of hours in the cradle during a 24-hr day. By 12 months, in 50% of infants, arms are freed while the rest of the body remains constrained. Accumulated and distributed daily gahvora use may affect access to objects and the gahvora's restrictive features may influence discovery of actions on objects. </p> First, we examined the developmental progression of object actions during two minutes of structured play with a novel "busy-cube." We scored global actions on the object (mouthing, banging), tailored actions unique to object properties (using fingers to push bead along spiral path) and extent of exploration (number of sides explored). Infants displayed enormous variability within age in actions on objects and increases over age. Global actions remained consistent; tailored actions increased with age. Infants who discover and persist on a tailored action explore less of the cube than infants who display a variety of actions. </p> Second, we asked about object engagement during spontaneous activities (M=43.5 minutes) when out of the gahvora. In ongoing coding and analyses, we are examining the number and type of objects infants contact. Preliminary findings show infants in manual contact with objects for M=50.8% of their observation--similar to Western infants--and access different types of objects (M=4.1) including natural kinds (twigs, pebbles) and artifacts (utensils, toys). Engagements with diverse objects increase with age thereby expanding infants' object opportunities. </p> Third, we will examine relations between gahvora use and object engagement in the structured task and during spontaneous activity. We hypothesize infants who spend longer in the gahvora or those who spend

longer in the gahvora during the day may contact fewer objects as the gahvora may lessen opportunities to explore. Moreover, we hypothesize that infants whose arms remain unswaddled while cradled will display more actions on objects and more varied actions during structured play. </p> Findings indicate similar developmental progression as in Western infants. We will examine how variations in gahvora use affect infant object behaviors to show whether drastically different childrearing shape object opportunities and in turn manual skills. This cross-cultural research will offer new insights and broaden current accounts of infant development. </p>

S6.8v Hyperarticulation and Infant-Directed Speech in a Small-Scale Society

Elise McClay[1], Senay Cebioglu[1], Tanya Broesch[1], Henny Yeung[1]

[1]Simon Fraser University

Compared to adult-directed speech (ADS), infant-direct speech (IDS) is spoken at a slower rate, with an increased pitch range and mean pitch (Fernald, 1989), while consonants and vowels are also hyperarticulated, and spoken with greater within-category variability (Kuhl et al. 1997). The function of these segmental differences is an active debate (Martin et al. 2015), which may be informed by knowing whether hyperarticulation in IDS is universal. However, the vast majority of IDS research has sampled from industrialized, large-scale societies (urban areas in Asia, North America, and Europe). While the signature prosody of IDS is still used among both mothers and fathers in small-scale societies (Ratner & Pye, 1984; Broesch & Bryant, 2015; Broesch & Bryant, 2017), it is unclear whether IDS is universally hyperarticulated. We conducted research on Tanna, Vanuatu, where some villages identify themselves as Kastom (living exclusively by traditional cultural norms, unlike geographically neighbouring non-Kastom villages). Thus, both our Kastom and non-Kastom participants all live within a small-scale society, but each have distinct attitudes towards child rearing. A local research assistant (RA) worked with the second author to elicit IDS and ADS from local mothers, translating from West Tanna dialects--which share similar sound systems (Lynch, 1978). We invited a mother with her child (6-18 months old), and an adult peer to participate in the study. We played three video clips introducing names of toys for the mother and child (Figure 1). The names were nonce words (/tisisi/ /kususu/ /pasasa/) designed to maximally sample the vowel space for the dialects in question. Once the mother had learned the toys' labels, the first stage ended. The crucial stage of the elicitation involved recording the mother speaking about the named toys first to her child (for the IDS sample), then to her peer (for the ADS sample). Mothers were asked to try get their children to place the toys in a basket and take them

out. Next, mothers described this activity to their adult peers. During each interaction, the RA recorded how many times the mother said each nonce word, ending the interaction after each word was spoken by the mother 8 times. Fifteen mothers from Kastom villages and 22 mothers from non-Kastom villages participated. Vowel formants from nonce words were extracted using Praat (Boersma & Weenink, 2008) and the Montreal Forced Aligner (McAuliffe et al., 2017). After rejecting vowels for excess background noise and other acoustic artifacts, we analysed 653 /a/, 669 /i/ & 379 /u/ tokens in ADS, and 765 /a/, 812 /i/, & 553 /u/ tokens in IDS. We used phonR (McCloy, 2016) to calculate triangles between the mean values of /i/, /a/, and /u/ tokens in both ADS and IDS. In Figure 2, a larger IDS triangle signifies hyperarticulation, and larger ellipses signify greater within-category variability. Results show that in both Kastom and non-Kastom villages, Tanna mothers' target vowels had higher, more variable pitch in IDS than ADS, replicating prior work on mother-infant interactions in Tanna (Broesch & Bryant, 2015). However, mothers from Kastom and non-Kastom villages did not hyperarticulate IDS vowels, nor did IDS vowels have more within-category variability. Results reinforce the idea that IDS prosody is universal, but also suggest that segmental characteristics of IDS are not, varying in accordance with socio/linguistic factors.

S6.8vi The Global Temperament Project: Infant Surgency, Negative Affectivity, and Regulatory Capacity in 31 Countries

Sam Putnam[1], Ava Alexander[1], Aaron Zweig[1], Lynn Jensen[2], Sarah Galdiolo[3], Alexandra Marquis[4], Margaret Moulson[4], Célia Matte-Gagné[5], Chamarrita Farkas Klein[6], Jie He[7], Milon Potmesil[8], Petra Potmesilova[8], Zdenka Bajgarová Bajgarová[9], Iveta Blazkova[9], Christina Salmivalli[0], Niina Junttila[10], Gisa Aschersleben[11], Franziska Vogel[12], Suzanne Mudra[13], Krisztina Lakatos[14], Judit Gervain[15], Ildoko Toth[14], Noemi Scheuring[14], Ildiko Danis[14], Maayan Davidov[16], Yael Paz[16], Dana Shai[17], Ariel Knafo-Noam[16], Lior Abramson[16], David Mankuta[16], Sarah Nazzari[18], Alessandra Frigerio[18], Teresa Farroni[19], Guilia Orioli[19], Fulvia Dotto[19], Ermanno Quadrelli[20], Chiara Turati[20], Alessandra Simonelli[21], Chiara Sacchi[21], Astuko Nakagawa[22], Masune Sukigara[22], Emiko Kusanagi[23], Nobuko Hoshi[24], Ji-Young Lim[25], Yun-Jin Bae[25], Keumjoo Kwak[26], Diane Putnick[27], Diana Zande[28], Jana Ozolina[28], Zalilah Shariff[29], Liyana Razak[29], Ingrid Grech Lanfranco[30], Angela Abela[30], Phil Cowan[31], Carolyn Cowan[31], Blanca Huitron[32], Bolanle Ola[33], Eva Potharst[34], Anneloes Van Baar[35], Catharina Hartman[36], Albertine Oldehinkel[36], Annette Henderson[37], Wojciech Dragan[38], Piotr Zylicz[39], Dorota Gosztyla[39], Paulo Dias[40], Irene Cadime[41], Florin Tibu[42], Patricia Ganea[43], Teodora Gliga[44], Helena Slobodskaya[45], Elena Kozlova[45], Alba Ayneto[46], Nuria Sebastian-Galles[47], Miguel Carrasco Ortiz[48], Ana D'Ocon Gimenez[49], Ana Sancho

Rossignol[50], Keng-Ling Lay[51], Su-Ying Huang[51], Yi-Chieh Chen[51], Selin Salman-Engin[52], Nebi Sümer[52], Ece Sagel[52], James McHale[53], Ozden Yalçnkaya-Alkar[54], Muyesser Fazlioglu[54], Elif Ozmert[55], Dilara Demirpence Seçinti[56], Holly Rayson[57], Laura Bozicevic[57], Ken Ong[58], Daniel Olazabal[59], Maria Gartstein[60], Esther Leerkes[61]

[1]Bowdoin College, [2]Curtin University, [3]Université catholique de Louvain, [4]Ryerson University, [5]Université Laval, [6]Pontificia Universidad Católica de Chile, [7]Zhejiang University, Xixi Campus, [8]Palacky University Olomouc, [9]University of South Bohemia, [10]University of Turku, [11]Saarland University, [12]Otto Friedrich University of Bamberg, [13]University Medical Center Hamburg-Eppendorf, [14]Institute of Cognitive Neuroscience and Pscyhology, [15]CNRS - Université Paris Descartes, [16]The Hebrew University of Jerusalem, [17]The Academic College Tel Aviv Yafo, [18]IRCCS Eugenio Medea, [19]Università degli Studi di Padova, [20]University of Milano-Bicocca, [21]University of Padova, [22]Nagoya City University, [23]Kokugakuin University, [24]Junior College of Sapporo, [25]Kyungpook National University, [26]Seoul National University, [27]Eunice Kennedy Shriver National Institute of Child Health and Human Development, [28]University of Latvia, [29]Universiti Putra Malaysia, [30]University of Malta, [31]University of California, [32]National Autonomous University of Mexico, [33]Lagos State University, [34]University of Amsterdam, [35]Utrecht University, [36]University Medical Center Groningen, [37]The University of Auckland, [38]University of Warsaw, [39]Warsaw School of Social Psychology, [40]Catholic University of Portugal, [41]Universidade do Minho, [42]Institute of Child Development, [43]University of Toronto, [44]Birkbeck, University of London, [45]FSBI Scientific Research Institute of Physiology and Basic Medicine, [46]Universitat Pompeu Fabra, [47]Pompeu Fabra University, [48]UNED, Universidad Nacional de Educación a Distancia, [49]University of Valencia, [50]Service de Psychiatrie de l'enfant et de l'Adolescent, [51]National Chung-Cheng University, [52]Bilkent University, [53]University of South Florida, [54]Ankara Yildirim Beyazit Universitesi, [55]Hacettepe University Faculty of Medicine, [56]Training Hospital, [57]University of Reading, [58]University of Cambridge, [59]Universidad de la República Uruguay, [60]Washington State University, [61]The University of North Carolina at Greensboro

The pervasive nature of culture makes it a unique lens for examining relationships between individuals and their environment. Multiple studies in the past decade have documented cross-cultural differences in temperament, but nearly all have focused on only two to four cultures (c.f., Putnam & Gartstein, 2017), limiting inference regarding the role of societal processes suggested as contributors to cross-cultural differences. The current study addresses this shortcoming through analyses of differences in infant temperament gathered as 60 independent samples in 31 countries. Methods: Researchers from Australia, Belgium, Canada, Chile, China, Czech Republic, Finland, Germany, Hungary,

Israel, Italy, Japan, Korea, Latvia, Malaysia, Malta, Mexico, Netherlands, New Zealand, Nigeria, Poland, Portugal, Romania, Russia, Spain, Switzerland, Taiwan, Turkey, United Kingdom, Uruguay and United States provided parent-report data on a total of 9244 infants (4390 female, 4799 male; 55 unknown; mean age = 8.42 months). Temperament was measured with the Infant Behavior Questionnaire - Revised (Gartstein & Rothbart, 2003), yielding scores for Surgency (SUR), Negative Affectivity (NEG) and Regulatory Capacity (REG). Results: Sex*Nation ANOVAs, with age included as covariate, indicated substantial effects of nation for the three dimensions. F-values, R2 and marginal means for the three dimensions across the 31 countries are shown in Table 1. Regarding SUR, post-hoc (Tukey) tests indicated infants from Mexico, Romania, Turkey, Malta and Malaysia scored significantly higher than > 15 other cultures, whereas U.K., Switzerland, Japan and Latvia scored lower than most others. Results concerning NEG suggested higher scores in Nigeria, Turkey, Portugal, Romania, Malaysia, Switzerland, Chile and Israel than more than half of other nations; with the Netherlands, Finland, Canada and the U.S demonstrating lower levels than most other countries. REG scores were higher than most nations in Malta, Mexico, Belgium, Romania, Turkey, Uruguay, Switzerland, Nigeria, Chile, Italy and Israel; and lower than most others in Japan and Taiwan. Nation-level marginal means for the three dimensions were then correlated with archival scores on Hofstede's six dimensions of cultural orientation and Gross National Income (GNI) per capita (see Table 2). Consistent with meta-analytic results reported by Putnam and Gartstein (2017), high levels of NEG were linked with Collectivism, high Power Distance and low GNI; high SUR with Short-Term Orientation; and REG with Indulgence. In addition, Surgency was associated with Collectivism, high Power Distance and low GNI. This investigation provides the most extensive perspective to date on worldwide patterns of individual differences in infants, and suggests multiple directions for future research. Primary among these is the pervasive issue of the degree to which parent reports represent objective differences or subjective interpretations of child characteristics. Current views (e.g., Rothbart & Bates, 2006) suggest temperament scores reflect both, both possibilities as useful in revealing implications of culture for human development. Another critical direction concerns exploration of proximal mediators of the distal force of societal differences. It is our hope that the Global Temperament Project database becomes a valuable tool for developmental scientists to better understand these connections.

S6.8vii Associations between early child development and maternal depression in a representative sample from Mexico City.

Betania Allen-Leigh[1], R. Argelia Vázquez-Salas[1], Jean Marie Place[2], Aremis Villalobos[1], Filipa De Castro[1]

[1]National Institute of Public Health of Mexico, [2]Ball State University

With this study, where psychologists, public health experts, demographers and social scientists collaborated, we aimed to explore the associations between early child development and maternal depressive symptoms in a representative sample of women and young children in Mexico City. Trained fieldworkers collected information from a probabilistic sample of 339 children 24-36 months and their mothers, recruited at 42 Ministry of Health clinics in Mexico City. Computer-assisted questionnaires were applied to mothers. Complex survey design and analytic weights were taken into account in analyses. Maternal depressive symptomatology, or the frequency of women reporting moderate to severe depressive symptoms in the past 7 days, was measured by CESD-7, validated for use in Mexico, with a cut-off point of 9. Early child development was measured using the Ages & Stages (ASQ3) questionnaire, adapted for application by interviewers to the child's mother. In this preliminary analysis, we used only the communication domain, which we dichotomized as a high or low developmental level (eliminating the middle level) using cutoff points for US populations. Health at birth (preterm birth, low birth weight, infant hospital stay in the neonatal period), family context (single parent, mother's education), child age in months and child gender were control variables. We report univariate and bivariate analysis of association; further analysis including definition of cut-off points for the Mexican population and multivariate analysis, is in progress. Most mothers had a junior high (44%) or high school (29%) education and 80% were married/cohabiting. About a fourth of mothers (26%) reported moderate or severe depressive symptoms. Mean child age was 30.11 months, 52% of the children were boys. Most children (88%) scored high on communication. See table 1 for bivariate data. A higher proportion of mothers whose children had a high communication score had at least a junior high school education. More children who were not hospitalized during the neonatal period also had high communication scores. In the logistic regression model, moderate to severe maternal depressive symptoms, lower maternal education and low birth weight are associated (but not statistically significant) with low child development scores in the communication domain. Only neonatal hospitalization had a statistically significant association with maternal depressive symptoms and maternal education did not have a clear trend. This may be due to the need to define cut off points of the ASQ3 tool specifically for the Mexican population; this analysis is ongoing and will be ready for the conference presentation. Prevention and treatment of maternal depression, as well as being a women's health priority, could also contribute to improving children's early

development. Systematic screening for maternal depression, use of proper diagnostic tools and provision of treatment should be integrated into primary healthcare, emphasizing care provided during the perinatal period and well child check-ups. Community-based interventions that incorporate a maternal mental health component could also contribute to improving the health of mothers and the early development of their children. In addition, in methodological terms our study shows that the Ages & Stages tool can be successfully adapted to measure early child development in large surveys, but cut off points need to be defined for specific study population.

S7.7 Flash talk session 7: Modeling and interpreting individual differences

S7.7i Epigenetic modification of the oxytocin receptor gene impacts infant brain response to emotional facial expressions

Kathleen Krol[1], Meghan Puglia[1], James Morris[1], Jessica Connelly[1], Tobias Grossmann[1]

[1]University of Virginia

The ability to detect and discriminate between emotional facial expressions emerges early in human ontogeny and is considered a vital skill important for effective social functioning. By seven months of age, infants have been shown to distinguish between happy, angry, and fearful facial expressions. However, little is known about specific biological factors that contribute to individual variability in infants' responses to facial expressions. In adults, epigenetic modification (DNA methylation) in the promoter of the oxytocin receptor gene (OXTR) shows variability, is predictive of gene expression, and has been linked to differences in brain responses to social information including facial emotional expressions. Greater levels of DNA methylation of OXTR, which have been linked to reduced expression of this gene, have also been seen in postmortem brain tissue of individuals with autism spectrum disorder. Given the evidence implicating epigenetic modification of OXTR in contributing to variability in social brain function, it is critical to probe its impact during infancy, when social skills relying on facial emotion processing first emerge. In the current study, we adopted a developmental neuroimaging epigenetics approach in order to examine whether OXTR methylation (CpG site -924) impacts infants' brain responses to emotional facial expressions. We presented a large sample of seven-month-old infants (N = 84) with happy, angry, and fearful facial expressions while measuring their brain responses using functional near-infrared spectroscopy (fNIRS). OXTR methylation was measured from saliva sampled at age 5 months through a procedure validated with adults. Our fNIRS analysis revealed that brain responses within the right inferior frontal cortex (rIFC) significantly differed as a function of emotion. Critically, variability in OXTR methylation at 5 months predicted differences in brain responses within rIFC to emotional facial expressions at 7 months. Specifically, our data show that decreased OXTR methylation, linked to greater expression of OXTR, predicts a heightened rIFC response to happy faces while simultaneously predicting an attenuated rIFC response to angry and fearful faces (Figure 1). These findings demonstrate that, early in development, activity in a brain region implicated in face processing and emotion understanding differs depending upon epigenetic modification affecting the endogenous

oxytocin system. Specifically, the pattern of findings suggests that decreased OXTR methylation, linked to greater expression of OXTR and likely more effective utilization of oxytocin, relates to greater responsiveness to facial signals indexing approach (happy faces) but to reduced responsiveness to negative (aversive) facial signals (angry and fearful faces). This is in line with accounts that assign a role to oxytocin in enhancing approach while reducing withdrawal tendencies during social interactions. Taken together, the current study identifies OXTR methylation as a promising biomarker involved in contributing to variability in social brain function during infancy and points to the right IFC as a brain region sensitive to endogenous variability in the oxytocin system.

S7.7ii Person-Centered Profiles of Infant Affect-Biased Attention are Associated with Maternal Anxiety and Infant Negative Affect

Alicia Vallorani[1], Xiaoxue Fu[1], Santiago Morales[2], Vanessa LoBue[3], Kristin Buss[1], Koraly Pérez-Edgar[1]

[1]Pennsylvania State University, [2]University of Maryland, [3]Rutgers University

Affect-biased attention (ABA) reflects selective attention to stimuli of a particular emotional valance (Todd, Cunningham, Anderson, & Thompson, 2012), which may shape individual behavior. Individuals who selectively attend to threatening stimuli and are temperamentally inhibited exhibit greater levels of social withdrawal (Nozadi et al., 2016; Pérez-Edgar et al., 2010, 2011; White et al., 2017) and social anxiety (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007; Van Bockstaele et al., 2014). Individuals who are exuberant and selectively attend to rewarding stimuli exhibit greater levels of externalizing (He, Li, Wu, & Zhai, 2016; Morales, Pérez-Edgar, & Buss, 2016). As ABA for both threatening and rewarding stimuli appear to relate to early emerging patterns of behavior, it is important to consider how both biases may emerge in early life. With age, infant attention to social stimuli changes. 4.5-month infants attend to physically salient stimuli, whereas 6-month infants reliably attend to faces (Kwon, Setoodehnia, Baek, Luck, & Oakes, 2016). Negative affect interacts with age to impact how infants orient to threatening stimuli (Pérez-Edgar et al., 2017). Maternal anxiety predicts infant attention bias to threat, even when negative affect does not (Morales et al., 2017). The current study assesses the relations between age, negative affect, and maternal anxiety and early patterns of ABA. 260 infants participated in the study with 167 infants (98 male, 4 to 24 months, Mage = 12.24, SDage = 5.74) providing complete data. Composite negative affect scores were created using both observed behavior (reactivity - Kagan & Snidman, 1991; Lab-TAB - Buss & Goldsmith, 2000) and parent report (IBQ-R - Gartstein & Rothbart,

2003; TBAQ - Goldsmith, 1996). Mothers self-reported their anxiety via the BAI (Beck, Epstein, Brown, & Steer, 1988). Infants provided data on their attention to threat (angry faces) and reward (happy faces) via eye-tracking across three tasks (dot-probe, overlap, vigilance). Dwell times and latencies to faces and probes were extracted across the three tasks. The R package mclust was used to conduct a latent profile analysis across the extracted values to identify groups of infants. The model with the best fit (lower BIC and ICL) was comprised of two groups (ABA = 105, low ABA = 62). To assess the associated factors, we tested a moderated mediation model in PROCESS. Age was entered as the predictor and posterior probabilities for the whole sample of being in the ABA group were entered as the outcome. Negative affect was entered as a mediator and maternal anxiety was entered as a moderator of all paths. Infants exhibited greater negative affect with age only when maternal anxiety was high ($t = 2.15$, $p = .03$). Additionally, infants exhibited greater likelihood of being in the ABA group when negative affect and maternal anxiety were high ($t = 2.13$, $p = .04$). Results suggest that maternal anxiety plays an important role both in shaping negative affect and in interacting with negative affect to predict ABA. Future work may consider how these processes develop longitudinally.

S7.7iii Deciphering the mechanisms of audiovisual speech processing in infancy: Insights from studying brain and behaviour

Nicole Altvater-Mackensen[1], Tobias Grossmann[2]

[1]University of Mainz, [2]University of Virginia

Infants are mostly involved in face-to-face interactions that typically provide multimodal language input, i.e. both auditory and visual speech information. Although infants seem to be sensitive to the congruency between auditory and visual speech cues from early on (e.g., Kuhl & Meltzoff, 1982), recent research suggests considerable improvements in audiovisual speech perception across the first year of life, paralleling the development in auditory speech perception (for a review, see Maurer & Werker, 2014). Yet, despite the wealth of behavioural data on the development of infant speech perception in the first year of life, the underlying mechanisms and neural processes are still only poorly understood. Recent research suggests that changes in speech perception are linked to changes in infants' recruitment of visual and motoric speech information (Lewkowicz & Hansen-Tift, 2012; Yeung & Werker, 2013), and that areas in left inferior frontal cortex (IFC) might play a pivotal role in associating such multimodal information during phonological learning (e.g., Dehaene-Lambertz et al., 2006; Perani et al., 2011; Kuhl et al., 2014). We will report results from a series of studies in which we assessed behavioural and

neural correlates of infants' audiovisual speech perception to address (a) the role of IFC in infants' multimodal speech perception, and (b) the influence of visual and motoric information on infant speech processing. In total, we collected data from more than 100 six-month-old infants using functional near-infrared spectroscopy (fNIRS), eye tracking and behavioural questionnaires. Infants were presented with audiovisual recordings of a female speaker and we measured (a) activation of various frontal brain regions in response to speech as compared to non-speech stimuli, (b) attention to the speaker's mouth as compared to her eyes, and (c) vocal language behaviour. In particular, infants were presented with videos in which auditory and visual speech cues either matched or mismatched in segmental content (Study 1), with videos that provided either unimodal auditory or visual speech information or multimodal auditory and visual speech information (Study 2), with videos that presented multimodal human speech syllables or monkey vocalisations (Study 3), and with videos in which infant-directedness was manipulated in terms of speech style and gaze direction (Study 4). The results from the first two studies reveal left-lateralized activation of areas in inferior frontal cortex in response to speech that is modulated by the congruency of auditory and visual speech cues (Figure 1A) and by infants' attention to the speaker's mouth (Figure 1B) but not by speech modality (Figure 1C). We take these data to suggest that inferior frontal cortex supports automatic retrieval and mapping of information from different domains during language learning and processing, irrespective of the modality of the input. We are currently analysing results of Study 3 and 4 to assess whether activation of left IFC in infants is specific to language processing or serves multimodal processing more generally, and to examine how attentional processes modulate the recruitment of left IFC during speech processing. We will discuss how results shed light on the neural basis and behavioural correlates of speech processing in infants and critically advance a more mechanistic understanding of the early development of speech perception and learning in infancy.

S7.7iv A Person-Centered Approach to Understanding Maternal Emotion Talk Trajectories in Early Childhood

Laura Marie Armstrong[1], Pamela Cole[2], Kayla McCreadie[2]

[1]University of North Carolina, Charlotte, [2]Pennsylvania State University

Maternal emotion talk predicts child socio-emotional and cognitive outcomes and provides children with a lexicon to label, interpret, and express their emotional experiences with words (Taumoepeau & Ruffman, 2008). However, few studies investigate

how maternal emotion talk changes as children age, as most include only two age points. We need more extended longitudinal designs to identify meaningful individual differences in child outcomes. Also, most findings represent educated, economically advantaged families or urban poor families, potentially confounding or overwhelming language effects. The current study focused on rural and semi-rural economically strained families (above poverty threshold but below middle class) to examine maternal emotion talk trajectories without additional correlates associated with poverty or economic advantage. Study aims were to identify subgroups of mothers with distinct emotion talk patterns over time, determine whether child language and maternal sensitivity predict group membership, and test whether subgroups differentially predict child emotional competence. Maternal emotion talk data were gathered from 120 mothers during a 5-minute wordless picture book task when children were 18-, 24-, 36-, and 48-months. Average household income (M=40,459.70) yielded a mean income-to-needs ratio (INR) of 2.32 (INRmiddle income = 3 and INRpoverty ≤ 1). Group based multi-trajectory modeling (Nagin, 2005) was used to identify subgroups of mothers who followed distinct emotion talk trajectories, reflecting unique patterns of change across three types of emotion talk: labeling, explaining, and questioning. Predictors of group membership (child language and maternal sensitivity) were examined using multinomial logistic regression. Child language skill was assessed at 18m using mother-report on the MacArthur Communicative Development Inventory. Maternal sensitivity was observed during a naturalistic home visit at 18m. ANCOVA was used to test whether certain maternal emotion talk trajectories predict two aspects of children's emotional competence--emotion expression (duration of angry, sad, and calm expressions) and use of emotion terms--at age 5 years. Child emotion expression was coded from video records of an 8-minute delay task, and child use of emotion terms was assessed during a post-task interview. Child gender and maternal education were control variables. Trajectory modeling yielded four subgroups (Figure 1): Low Emotion Talk, Moderate Emotion Talk, Questioning, and High Emotion Talk. The average posterior probability for all groups (range=.907 to .992) exceeded the recommended .7. Maternal sensitivity, but not child language, increased the odds of being in the Moderate (B=.776, SE=.305, $p<.05$), Questioning (B=1.255, SE=.503, $p<.05$), and High Emotion Talk (B=1.30, SE=.737, p=.078) groups relative to the Low Emotion Talk group. The child language skill by maternal sensitivity interaction was not significant. Control variables did not predict group membership. Finally, group membership was related to child emotional competence, $F(3,90)=4.910$, $p<.01$. Compared to mothers in the Low Emotion Talk group, those in the Moderate group had children who displayed significantly longer bouts of calmness during

the delay task at age 5 years. Analyses of children's emotion terms at age 5 years is in progress. The findings may suggest possible ways parenting interventions can be refined.

S7.7v Analyzing complex datasets using mixed-models: Individual differences perspectives on conformity, personality, and parental style

Kahl Hellmer[1], Gunilla Stenberg[1], Christine Fawcett[1]

[1]Uppsala University

In a majority of empirical developmental psychology studies, behavioral differences between conditions or ages are measured to let us know if some phenomenon exists or when it might develop. However, we can also measure whether a phenomenon correlates with other factors to let us know about its why's and who's. Such research designs are core to individual differences perspectives, which can potentially give richer answers to inquiries about behaviors. In this presentation, we describe how we have used regression models to investigate individual differences in conformity. We also address an important issue regarding research designs with multiple trials from each participant - in which common strategies are to conduct analyses on participant averages rather than on trial data. Such strategies can be statistically unsound because within-participant variability is unjustifiably removed by reducing trial data to singular means. Here, we show how mixed-models facilitate incorporation of questionnaire data tapping participant and parental variables, and a more sound analysis of multiple-trial data. The current presentation focuses on data analyses of an Asch-style conformity paradigm with additional data from an anonymous sharing and an obedience task, as well as questionnaire items tapping personality (Big 5, for child and parent) and parental style (authoritarian, authoritative, and permissive). In the conformity experiment, participants ostensibly played a game with four other children, represented by images of their faces on the screen. In the game, children were instructed to select the largest of three different sized animals. On 8 of the 16 trials, the co-participating children chose an incorrect target which opened up the possibility to measure participants' behavior: They could choose what the others chose (conformity); choose the correct target (non-conformity); or choose the smallest target (maverick). Initial correlation analyses of average conformity scores and other variables show that conformity scores correlated with anonymous sharing ($r=.30$, $p=.03$) and authoritarian parental style ($r=.37$, $p<.01$), but not with any other factor. To obtain a more accurate measure of associations, we then conducted multinomial logistic mixed-model regressions with participant as a random factor, explicit choice as dependent variable and other factors as fixed effects. We replicated the initial findings that authoritarian parental

style ($p<.05$) and altruism ($p<.05$) were associated with greater conformity. We were additionally also able to show gender effects over permissive parental style ($p<.05$) and conscientiousness ($p<.01$) - indicating associations between parental permissive style and boys' conformity as well as a link between participants' conscientiousness and conformity. We have here introduced an analysis method that allows us to refrain from violating the assumption that trials are independent and instead incorporate within-participant variability into the model. We also show how other factors, such as data from questionnaires and auxiliary experiments, can be added to provide additional and explanatory aspects to an observed behavior. Our results indicate that conformity is associated with both parental style and personality, as well as anonymous sharing. We hope that this, and similar, strategies of data analyses open up for novel experimental designs in which individual differences are given more consideration.

S7.7vi Infant empathy predicts aggression in infancy and toddlerhood: the moderating role of sex

Malou Noten[1], Kristiaan van der Heijden[1], Stephan Huijbregts[1], Nienke Bouw[1], Stephanie van Goozen[1], Hanna Swaab[1]

[1]Leiden University

Objective: Research has indicated that impaired empathy is an important risk factor of aggression, but results are contradictory in infancy and toddlerhood (Lovett & Sheffield, 2007). One factor that might underlie the contradictory results is that empathy is still developing. In infancy, sharing emotions of others is challenging and overwhelming, and empathy-eliciting situations typically result in self-oriented empathic behaviour (i.e. trying to relieve one's own distress). However, other-oriented empathic behaviour (i.e. trying to relieve the other's distress) can also be observed in infancy and becomes more prominent in toddlerhood (Liew et al., 2011; McDonald & Messinger, 2011). Since empathic behaviour is still developing infancy and toddlerhood, associations between empathy and aggression may differ for self-oriented and other-oriented empathic behaviour. Sex is another factor that might underlie the contradictory results regarding the association between empathy and aggression in infancy. Studies on infants have shown that girls generally express more empathic behaviour than boys (Knafo et al., 2008), whereas boys show more aggressive behaviour than girls (Alink et al., 2006). Therefore, this study investigated whether self-oriented and other-oriented empathic behaviour in infancy predicted physical aggression in infancy and toddlerhood, while taking a potential moderating effect of sex into account. Methods: Data were collected as part of the Mother

Infant Neurodevelopment Study - Leiden (MINDS-Leiden). 162 primiparous women, recruited during pregnancy, were included in the current study. Empathic behaviour was observed during a distress simulation task 20 months post-partum and physical aggression was assessed by maternal reports at 20 and 30 months post-partum. Results: Hierarchical linear regression analyses revealed interactions between sex and self-oriented empathic behaviour (β = -.259, t = -2.261, p = .025), as well as between sex and other-oriented empathic behaviour (β = -.339, t = -3.043, p = .003) in the prediction of concurrent aggression. Furthermore, toddler aggression was predicted by the interaction of sex and self-oriented empathic behaviour in infancy (β = -.430, t = -3.675, p < .001). Post hoc analyses revealed that more empathic behaviour was associated with less aggression in girls, but more aggression in boys. Conclusion: This study indicates that the association between empathy and aggression is already present in infancy and that infant empathy is a predictor of aggression in toddlers. More empathic behaviour during an empathy-evoking situation predicted lower levels of aggression in girls, but higher levels of aggression in boys. Furthermore, self-oriented empathic behaviour seemed to be a better predictor of aggression over time than other-oriented empathic behaviour. The positive associations between empathy and aggression in boys might be explained by general deficits in social inhibition. Such deficits result in impulsive responses (e.g. approaching the other) to both empathy- and aggression eliciting situations. Since the basis for the inhibition of aggression is established in infancy, this would be a particularly interesting period for future studies to investigate the effects of interventions aiming to increase empathy and reduce aggression.

S7.7vii Infant language development and home environment in northeast China

Ruoyu Duan[1], Siman Liu[2], Ming Li[1], Qian Zhang[1], Shan Lu[2], Zhengyan Wang[3], Betsy Lozoff[4], Twila Tardif[4]

[1]Peking University First Hospital, [2]School of Psychology, Capital Normal University, [3]Capital Normal University, [4]University of Michigan

Objective:The aims of this study were to examine whether levels of language development at 9 months were predictive of levels of language development at 18 months, and further explore bidirectional associations between infant language development and home environment in a Chinese sample. Participants and Methods:This sample, including 635 infants in Hebei province of China, was part of a cooperative project between China and America (NIH R01HD052069). Home environment was assessed by mother report using the modified at 9 months (T1) and again 18 months (T2). Language development was

measured by mother report at T1 and T2, using Communication Development Inventory (CDI). Two time point cross lag models were conducted in Mplus Version 7.4, controlling for infant?fs gender and age. Results:Word comprehension at T1 was positively associated with word comprehension at T2. Word production at T1 was also positively associated with word production at T2. Word comprehension at T1 predicted word production at T2 (see Figure 1). As for the link between home environment and infant language development, cross-lag models indicated that total score of HOME at T1 predicted increase in later word comprehension at T2. Also, word comprehension at T1 positively predicted total score of HOME (see Figure 2). In contrast, neither the path from total score of HOME at T1 to word production at T2 nor the path from word production at T1 to total score of HOME at T2 was significant. Conclusion:Early language development at 9 months predicts later language development at 18 months. There are bidirectional associations between home environment and infant word comprehension.

S7.8 Flash talk session 8: Will new technology save us or sink us?

S7.8i Online Testing and Automatic Face Tagging For More Efficient and Reproducible Infant Research

Rhodri Cusack[1], Brea Chouinard[1]

[1]Trinity College Dublin

Objective. Collecting data from infants in the laboratory is time-consuming and hard work for scientists and parents alike. To make the process more efficient, we recently reported it is possible to recruit and test infants online, presenting video and recording the infants' reactions with a webcam. This increased the ease of testing for parents and scientists alike, and achieved rapid recruitment of infants. However, it was still necessary for one or more raters to manually tag the video recordings from the webcam, which is a time-consuming and subjective process. Methods. In this work, we evaluate automatic face recognition of data acquired online, using a cloud-based service running a deep neural network. We evaluate automatic recognition performance as a function of lighting conditions, video quality, and the infant's characteristics such as eye colour. We also investigate the effect of multiple faces in the frame, and the potential of the algorithm to capture multiple outcome measures, such as looking vs. not looking, or looking left vs. right. Results. We find good performance for many infants, particularly when there is sufficient light, and for infants with large open eyes. If multiple faces are present in the frame, each is identified, and its age reliably estimated. The algorithm was more accurate at looking vs. not-looking discrimination, as this could often be determined from head orientation, than left vs. right discrimination, which required analysis of eye position. Conclusions. Automatic face recognition technology is already sufficiently advanced to replace manual coding in some protocols. In addition to being much less time consuming and cheaper than manual coding, it is objective and does not differ between raters or laboratories, making studies more reproducible. When combined with online testing, all aspects of the experiment can be shared in code, which removes the risk of undocumented procedures, improving transparency and facilitating replication and collaboration.

S7.8ii A Novel Gaze Based Measure of Object Label Knowledge in Toddlers at a Heightened Familial Risk for Autism Spectrum Disorder

Kathryn Hauschild[1], Anamiguel Pomales-Ramos[1], Mark Strauss[1]

[1]University of Pittsburgh

Background: Previous research has studied word-comprehension using standardized assessments that rely on parent report or direct interaction with a test administrator. Toddlers with ASD may have language, social, and communicative deficits (i.e. gaze aversion and reduced understanding of or engagement in gesturing) that become confounds when completing standardized assessments. Thus, standardized assessments may not fully capture the abilities and underlying knowledge of infants at risk of and children with ASD. Objective: To explore the feasibility of measuring object label knowledge with a visual array task (VAT) using eye tracking technologies. Such a task may be well suited to the study of infant and ASD populations, as it requires minimal behavioral and no verbal responses from the participants. Methods: The study sample reported here includes data from 90 toddlers with at least one typically developing older sibling (low-risk; LR) or one older sibling diagnosed with ASD (high-risk; HR). Cross-sectional data was obtained from 67 children: 25 (19 HR, 6 LR) 16-month-olds and 42 (12 HR, 30 LR) 24-month-olds. An additional 23 children (10 HR, 13 LR) completed the VAT at both a 16- and 24-month visit. Stimuli were eight item arrays chosen from 24 possible color illustrations of objects paired with an audio recording that instructed the toddlers to look at a target object ["(target label). Look at the (target label). Where is the (target label)? See the (target label)?"]. Toddlers were shown 12 trials, each lasting 8-11 seconds. Eye tracking movements were recorded using a Tobii X120 stand-alone eye tracker. The number of fixations infants made to each object was analyzed by defining areas of interest (AOIs) that evenly delineated each illustration (see Figure 1). These AOIs were then used to compute the proportion of fixations made to the target object when looking to any of the stimulus objects. Results: One-sample t-tests indicated that both groups fixated the target object greater than chance (1/8). One-Way ANOVAs also indicated that both groups demonstrated a significant increase in performance across age (see Table 1). Cross-sectional group comparisons revealed that at 16-months there were no significant differences in the proportion of fixations to the target object made by the HR and LR toddlers, [$F(1,46) = 1.63$, $p = 0.21$]. In contrast, at 24-months of age, LR toddlers made reliably more fixations to the target object than did the HR toddlers, [$F(1,62) = 3.97$, $p = 0.05$)]. Additionally, correlational data from the longitudinal cohort indicated a strong association between task performance at 16 and 24 months of age for the LR group [$r(10) = .654$, $p = .015$]. There was no correlation between scores from the Receptive Language subscale of the Mullen Scales of Early Learning (MSEL; Mullen, 1995) measured at 16 and 24 months of age [$r(13) = -.33$, $p = .27$]. Conclusions: This task demonstrates

the potential application of eye tracking technologies to the measurement of object label knowledge in typical and atypical populations. The VAT captured the expected developmental increase in receptive vocabulary between 16 and 24 months of age as well as risk group difference at 24 months of age. Additionally, correlational data from the longitudinal cohort indicated a greater ability of this task to predict performance from 16 to 24 months of age for the LR group than the Receptive Language subscale of the MSEL.

S7.8iii Utility of Heart Rate Increase for Prediction of Challenging Behavior Episodes in Young Non-Verbal Children with Autism

Heather Nuske[1], Emma Finkel[1], Liza Tomczuk[1], Darren Hedley[2], Valentina Parma[3], Melanie Pellecchia[1], Cheryl Dissanayake[2], David Mandell[1], John Herrington[1]

[1]University of Pennsylvania, [2]La Trobe University, [3]SISSA

Background. Understanding the triggers to challenging behavior is difficult in some children with autism due, in large part, to their limited communication abilities generally, and communicating emotions in particular. Physiological indicators such as increase in heart rate are well-established, fine-grained measures of emotional stress; they may provide important insights on the triggers to challenging behavior. Objectives. The study aim was to determine the predictive utility of increase in heart rate to indicate a challenging behaviour episode in children with autism with frequent challenging behaviors. Methods. Whilst wearing a ECG monitor, 41 children with autism recruited as part of a larger study aged 2-4 years participated in tasks from the Laboratory Temperament Assessment Battery, which mimic everyday life experiences requiring emotional regulation in low-level stress situations (e.g., waiting for a snack). Coders blind to diagnostic group coded challenging behaviors during the 1-1.5 hour-long sessions (i.e., aggression, self-injury, property destruction, loud noises and non-compliance, n=212) and random non-challenging behaviors (n=106). Only 13/41 participants exhibited challenging behaviors. Baseline-corrected heart rate (HR) was computed for each behaviour. The predictive utility of HR in challenging vs. non-challenging behaviors was examined via Receiver Operating Curve (ROC) analysis and a binary logistic regression model was run to examine the contribution of participant characteristics on the association between HR and challenging vs. non-challenging behaviors. Results. On average, children with autism showed a 21±10% HR increase from baseline, 58±22 s before the onset of a challenging behaviour. The ROC analysis indicated that the peak HR change predicts fairly well the onset of a challenging behaviour vs. non-challenging behaviors (area under the curve= .71, $p < .001$, 95% CI= .66 - .77), see Figure 1. However,

across children there was considerable variation in area under the curve coefficients (.28, p= .20; - .95, p= 04). Binary logistic regression results indicated that the behavioral outcome (challenging vs. non-challenging behavior) was explained by peak HR change (Nagelkerke R2= .21, p< .001), and additionally by participants' gender [female] and age [older] (Nagelkerke R2 change= .06, p= .002). Autism severity and developmental ability did not significantly contribute variance to the model (see Table 1). Conclusions. Results indicate that physiological stress predicts challenging behaviour episodes in preschoolers with autism, particularly for girls and older preschoolers. Given the recent technological advances in wearable biosensing, our results indicate that incorporating HR monitoring in intervention for autism may be helpful for some children. By signalling children's stress, such wearables may allow parents and teachers to intervene and create learning opportunities for emotional expression and regulation. However, given the strength of the prediction and likelihood of false positives, individualised human-computer interaction and machine learning algorithms may be needed to increase the utility of including such information in moment-to-moment treatment planning.

S7.8iv Variety wins: Soccer-playing robots and infant walking

Ori Ossmy[1], Justine Hoch[1], Patrick MacAlpine[2], Shohan Hasan[1], Peter Stone[2], Karen Adolph[1]

[1]New York University, [2]University of Texas at Austin

Traditionally, developmental researchers have studied infant walking using standard gait--a simplified walking task that requires infants to take continuous steps along a straight, forward path. However, during natural locomotor activity, infants' paths are immensely varied. They walk along curved, multi-directional paths with frequent starts and stops. Is the variability in spontaneous infant walking a "feature" or a "bug"? Given that it is not feasible to control infants' everyday walking experience, we exploited the computational power of "RoboCup" - the world's premier robot soccer competition, to experimentally test the hypothesis that paths varying in shape, step direction, number of steps, and number of starts and stops are better training for walking than less varied paths. Specifically, we compared the outcomes of different robot training regimens using simulated robot-soccer competitions. By using robots as models of real-world infant walking, we could control the training regimen and obtain robust estimates of performance over thousands of games of RoboCup. We aimed to: (1) experimentally examine the role of varied paths in learning to walk, and (2) test whether differences in the natural variety of infant walking paths affect functional performance. We addressed

these aims in two simulated robot soccer tournaments. In Tournament 1, we trained one team of robots on a training course composed of infants' natural--and highly varied--walking paths. The "opposing" teams were trained using uniform geometric paths: straight-lines, squares, and circles. To evaluate the success of the different training regimens, each pair of teams played off in a series of soccer games. Across 1000 head-to-head simulated soccer matches, the infant-trained team consistently beat all teams trained with less varied walking paths (Figure 1). In Tournament 2, we compared robots trained on infant walking paths that varied in several aspects--shape, step direction, number of steps, and number of starts and stops. Variety in path shape--some straighter and some curvier paths--reflects the ability to control the two sides of the body independently. Variety in step direction--forward, backward, and sideways--reflects the ability to produce steps in every direction. Variety in the number of steps reflects the ability to produce both short and long bouts of locomotion. Finally, the number of starts and stops reflects the ability to initiate and control disequilibrium. We clustered infants into five groups based on these measures of path variety (Figure 2A) and trained soccer teams according to the five sets of paths. The team trained with the most varied combination of all measures outperformed robot teams trained with less varied paths (Figure 2B-E). This evidence indicates that variety is a crucial, functional feature of learning to walk. More generally, we propose that robotics provides a fruitful avenue for formally testing hypotheses about infant development; reciprocally, behavioral observations of infant behavior may inform research on artificial intelligence.

S7.8v What Big Data and Automated Measures Can Tell Us About Language and Social Development in Early Intervention Classrooms

Lynn Perry[1], Emily Prince[1], Adriana Valtierra[1], Camila Rivero-Fernandez[1], Mary Anne Ullery[1], Lynne Katz[1], Brett Laursen[2], Daniel Messinger[1]

[1]University of Miami, [2]Florida Atlantic University

Although parent speech has become a subject of increasing study and intervention, less is known about speech in childcare settings. What is known often comes from observations at the level of classroom rather than at the level of individual infant. For example, teacher language quality is assessed as a static trait of the teacher, missing the fact that classrooms are busy interactive places in which different infants have different types of conversations with each other and with their teachers. It is only with the use of automated measurement and big behavioral data that we can understand how different infants' experiences vary even within a shared classroom and what consequences that

variability can have on their development. We conducted a longitudinal study of language input and use in an early-intervention classroom for 2-3-year-olds from low-income, at-risk backgrounds. Naturalistic, day-long recordings of the classroom were collected weekly over a period of one year using LENA (Language ENvironment Analysis) recorders. All thirteen infants in the class were enrolled, with an average of 10 infants present during each recording. The LENA software characterizes each infant's language environment. The primary measures of interest were LENA estimates of adult word count, infant vocalizations, peer vocalizations, and "conversational turns," the number of instances where infant and adult speech are separated by fewer than five seconds. Conversational turns can be interpreted as moments of back and forth contingent responding between an infant and adult--a defining characteristic of high quality communication. At the beginning of the study, these infants were all relatively delayed in language abilities. Expressive vocabulary information was assessed prior to data collection via teacher-report on the MCDI (M=49 words; range: 1-180). All infants were below the 30th percentile for expressive vocabulary, and 12 of 13 were below the 10th percentile and would be categorized as late talkers (< 25th percentile). Using linear mixed regression analyses with a random effect of subject, we found that the amount of language infants heard from their peers and the number of conversational turns they engaged in with their teachers predicts how much they talked both in the moment, and over the course of the school day. Infants who heard more language from their peers (or engaged in more conversational turns with their teachers) produced the most language themselves. Finally, we assessed changes in vocabulary size over the year. Our results showed that the amount of language infants heard from peers and the number of conversational turns they engaged in with their teachers positively related to larger increases in their expressive vocabulary--even when controlling for their own vocalizations in the classroom. Together, these results suggest that infants' interactions with peers and teachers have cascading consequences for their future language development. Our application of automated measurement provides new insight into the dynamics of the classroom environment and consequences for language development in at-risk and delayed infants--insights that could not be obtained without the power of big data.

S7.8vi Baby QUILS: Examining two-year olds language knowledge

Lauren Stites[1], Hannah Puttre[2], Kathy Hirsh-Pasek[1], Roberta Golinkoff[2], Aquiles Iglesias[2], Jill De Villiers[3]

[1]Temple University, [2]University of Delaware, [3]Smith College

Language is the single best predictor of later academic, social, and behavioral outcomes (Pace et al., submitted; Hoff, 2013). Thus, delays in language development can have cascading effects on later readiness skills. It is imperative that we identify children at risk for language delay as early as possible. The Baby QUILS (Quick Interactive Language Screener) meets this need by taking advantage of new touch-screen technology. We developed a tablet-based instrument that can be used by teachers or caregivers to examine budding language competencies in what children know and how they learn. Based on current work in language learning, this instrument probes for a broader swath of language items than is generally tested and uses action items that portray harder to test items like verbs and syntax. We present the first data from 80 items across 12 subtests in three different areas, vocabulary, syntax and process. The majority of language screeners for young children focus on the first two areas; vocabulary, which measures what words children know, and syntax, or what children understand about how words and sentences go together. The Baby QUILS is not only innovative in the use of touchscreen technology, but also provides a reliable way to measure the third area, process. Process refers to how well children are able to learn a new lexical item. In other words, are children able to quickly learn new (novel) words from context clues? For example, if children are told an item with a unique pattern is "wuggy", are they able to pick another item with that same pattern when asked "what else is wuggy?" While vocabulary and syntax are language products, process taps into how children learn. Here we provide descriptive data from one subtest from each of these categories; nouns (vocabulary), negation (syntax), and fast-mapping adjectives (process) that were tested on 329 children across three different sites in northeastern United States. Using Item Response Theory (IRT) analyses, we distilled the test down to 5 or 6 items per subtest and scaled these items by the item difficulty, as well as how well each item discriminated between children with differing ability (figure 1; table 1). Results not only paint a fuller portrait of early language competencies, but also show that children's language can be assessed using touchscreen technology, with children's (Mage=30.33 months) performance improving significantly with age (nouns: $\beta = .03$, $t(160) = 4.87$, $p < .001$; negation: $\beta = .36$, $t(96) = 1.78$, $p < .001$; fast mapping adjectives; $\beta = .03$, $t(89) = 3.68$, $p < .001$). In sum, the described assessment uniquely examines the products and process of children's language, giving us a reliable measure of development that is often invisible to researchers and practitioners alike. As such, we are able to use basic research in a way that benefits children in a real-world setting.

S7.8vii New Technology Leads to New Discoveries: A Case Study of Using Computational Algorithms to Understand Parent-Infant Interaction

Tian Linger Xu[1], Drew Abney[1], Linda Smith[1], Chen Yu[1]

[1]Indiana University

Every day we engage in interaction with others and perform collaborative tasks effortlessly. Social interaction often requires the real-time organization of multiple sensory-motor systems at fractions of a second. Recently, technological advances in wearable sensors have provided new opportunities to study social interaction. But researchers are presented with the challenge of finding structures in large high-density multimodal data. This talk will present new analyses to cope with this challenge. We focus on coordinated gaze between parents and infants as our case example; but the challenges and lessons are general across domains. The specific contribution is a novel method based on Cross Recurrence Quantification Analysis (CRQA) to quantify the micro-dynamics and complex temporal properties of coordinated behaviors. Critically, developmental scientists are interested in the real-time sensory-motor coordination and how this coordination, as a kind of skilled motor behavior, becomes increasingly adaptive and fluid with practice (Yu & Smith, 2016). We used head-mounted eye-trackers (Franchak, Kretch, Soska, & Adolph, 2011) to collect high-density gaze data from both parents and infants in a toy-play interaction context. 20 infants and their parents participated when the infant was 9-, 12- and 15-month-old. As shown in Figure 1, we put head-mounted eye-trackers on both participants. Their real-time gaze allocation and first-person visual input were recorded at 30 frames per second. Each dyad played with three toys in one trial. Each trial lasted 90 seconds, resulting in approximately six minutes of play over four trials. Experimenters went through the ego-centric recordings and manually annotated the gaze stream into four Regions-Of-Interests (ROIs): three toy objects and the other partner's face. The proportion of coordinated attention to an object increased significantly from 9 to 12 months (Prop9-mo=22.0%, Prop12-mo=30.3%, $t(19)=2.55$, $p<.02$). However, there was no difference between the ages of 12 and 15 months by this measure (Prop15-mo=29.4%, $t(19)=0.24$, $p=.82$). Critically, these analyses are not meaningful with respect to how coordinated behavior works or how coordination may become more complex with age. The proportion of time that two participants engaged in joint attention only measures the moments where participants looked at the same object at the same time. Real-time coordination can have more complex temporal structures and complementary properties such as systematic leads, lags or turn-taking. Accordingly, we developed a novel analytical method based on Cross Recurrence Quantification Analysis (CRQA). It is a nonlinear data analysis technique that reveals the underlying shared dynamics between

two systems, in this case parent's and infant's gaze (Marwan & Kurths, 2004). Figure 2 shows an example Cross Recurrence Plot constructed with the gaze streams from an interaction. We will explain this at a tutorial level and show how this novel approach leads to new insights. Indeed, the major contribution of this work is that the pathways through which infants and parents coordinate gaze become more complex with age. For example, we found that compared to dyads in which infants were 12 months of age, the dyads in which the infant was 15 months had coordinated attentional episodes with greater complementarity such that their joint dynamics were more complex and more functional than merely looking to the same object at the same time.

Poster Session 2, Monday 2nd July

A: Motor and Sensorimotor Processes

P2-A-1 Got Milk? Effects of different milks and milk substitutes on motor behavior in preterm human infants

Valerie Mendez-Gallardo[1], Scott Robinson[2]

[1]Pennsylvania State University, [2]Pacific Ethological Laboratories

Human milk is a stimulus of major biological significance as it provides the neonate and infant with components important for their nutrition and development (American Academy of Pediatrics, 2012). Feeding preterm infants with human milk exerts both short-term and long-term beneficial effects and improved developmental outcomes. Studies also suggest that nutrition from human milk during early development may lead to improved motor development in preterm human infants (Vohr et al., 2006). In fact, the behavioral effects of milk have been widely documented in both human and non-human infants. Human newborns tested days after birth prefer the odor of human milk over the odor of formula, and brief oral exposure to milk can reduce responsiveness to painful stimuli. Research with non-human animal fetuses and newborns has further shown that milk can elicit stereotypic behavioral responses and modulates tactile- and chemosensory-evoked aversive responses by activating the perinatal opioid system. In the NICU, the care that preterm infants receive is tailored to their needs. In some cases, mothers may express human milk for the baby, in others they may receive milk fortified with other nutrients or infant formula based on bovine milk or soy protein. Investigators typically have focused on the effects of different milks and milk substitutes on infant growth and general health; comparatively little attention has been devoted to potential behavioral effects of different milks. In this study, we explored whether different feeding regimes implemented in a NICU environment affected the motor behavior of preterm human infants. Participants were healthy preterm infants, born 25-28 weeks gestation, with no history of prenatal insult. Infants from three age groups -- 28, 32 or 36 weeks gestational age -- were included in this study. Infants were video-recorded while supine in the NICU. Recordings were initiated 30-min after infants were bottle fed with human breastmilk (BM), breastmilk plus human milk fortifier (HMF), infant Formula (premature EnfamilTM), or parenteral nutrition (NPO). From these recordings, 15-min clips were identified in which infants were visible, active and minimally disturbed. Movements of arms and legs, including events that resulted in self-directed touch (SDT), were coded from video. HR recordings synchronized with video also were used to assess HR variability

and responsiveness. Although all infants exhibited spontaneous activity, SDT, and cardiac responsiveness of SDT, we observed differences in the rates of movement and magnitude of responses associated with different feeding regimes. Differences were most pronounced in the youngest infants, at 28 weeks. Infants fed Formula showed elevated activity, including higher rates of SDT, than infants fed BM. Although activity was modestly elevated in infants that received HMF, rates of SDT were lower than in BM-fed infants. BM-fed infants also showed reduced HR variability and modest responses to SDT, in contrast to NPO infants, who showed greater HR variability and much more pronounced HR responses. Taken together, these findings suggest subtle influences of different nutritional regimes on the motor behavior of preterm human infants, and by inference, on behavioral development.

P2-A-2 Developmental changes in looking and reaching patterns in 6 and 9-month-old infants

Abigail DiMercurio[1], John Connell[1], Alexandra Romano[1], Kelly Roth[1], Alexa Stumpe[1], Greg Reyonlds[1], Daniella Corbetta[1]

[1]University of Tennessee

Younger infants differ in their reaching patterns from older infants, however little is known if looking patterns at objects prior to reaching also differs in that age range. This study aims to assess such object-directed patterns in 6- and 9-month-old infants, using objects with different properties. Fourteen 6-months-old and eighteen 9-months-old infants participated in this study. They were seated in a chair stabilizing their trunk and it was situated 60cm from an eye-tracker (Eyelink 1000 plus, sampling at 500 Hz). Objects were presented one at a time, out of reach in an open window of a theater for approximately 5 seconds of accumulated looking time, and then the object was moved towards the infants' reaching space for grasping. There were two different types of objects with differing visual properties; a drumstick (a 10 cm long rod with an added 5cm diameter sphere at one end) and a long plain rod (15 cm). The objects were presented randomly, horizontally, one at a time. Looking data were collected while the object was held out of reach. We analyzed where the infants spent time looking onto the scene (AOIs: object, experimenter's hand, and elsewhere) and where they looked on the object (AOIs: rod ends, sphere, or middle). We also coded where the first touch onto the object occurred to determine if there was a match between where infants spent the most time looking onto the object and where they first contacted it. The age groups differed in their distribution of looking onto the scene. The 6-month-olds spent more time looking around the scene than onto the

drumstick ($p < .018$), while the 9-month-olds spent comparatively more time looking at the drumstick ($p < .021$). Both groups of infants spent relatively more time looking around the scene when presented with the rod (all ps < .021). However, both groups looked at the objects similarly: their looking patterns on the plain rod were more distributed across AOIs (ns), while for the drumstick, there was more looking to the sphere. This trend for the drumstick reached significance only in the 9-month-old group ($p < .002$). The touch data for both groups showed a skewed preference for the right side of the rod (all ps < .001), and for the sphere of the drumstick, regardless of orientation (all ps < .002). Both groups matched their reach to the most looked area similarly, however matching rate remained low or at chance level: it was 34.65% and 37.31% for the plain rod, and 43.42% and 46.99% for the drumstick. This work reveals that infants' visual focus onto the reaching target increases with age. Infants' looking patterns on the object also change with age, however, this result was modulated by the shape properties of the objects. Future studies will evaluate how such changes in looking patterns on objects affect infants movement planning and movement kinematics.

P2-A-3 Sitting Skill Relates to Babbling and Word Comprehension During Infancy

Emily Marcinowski[1], Lin-Ya Hsu[2], Sally Westcott-McCoy[2], Stacey Dusing[1]

[1]Virginia Commonwealth University, [2]University of Washington

Introduction: The emergence of sitting changes how infants interact with objects in their environment (e.g., Soska & Adolph, 2013), which in turn changes how infants babble and develop language (e.g., Fagan & Iverson, 2007; Libertus & Violi, 2016). Therefore, sitting skill may predict the development of language during infancy. The purpose of this study was to identify whether sitting skill positively related to the onset of babbling and words in the 6 months following sitting emergence. Methods: Typically-developing infants 7 months or younger (n=35) were recruited at the emergence of sitting, either prop-sitting or arms-free sitting without the ability to change positions. Infants were assessed at 5 longitudinal visits across 6 months (baseline, 3 weeks later, 6-8 weeks later, 3 months later, and 6 months later) for sitting skill and parents completed two surveys of their infant's language ability (babbling survey, Communication Development Inventory (CDI)). The babbling survey comprised a parent-report checklist of which consonants (24 items) and vowels (17 items) their infants could babble. The CDI is a parent-report survey which includes questions about word comprehension and production, gestures, and grammar. The babbling variables consisted of total sum of consonant sounds (consonants), total sum of vowel sounds (vowels), and total sum of word comprehension (CDI word

comprehension). The Gross Motor Function Measure (GMFM) is a clinical assessment used to measure developmental change in gross motor skills of young children from activities in lying, rolling, sitting, crawling, and standing, up to walking, running and jumping skills. The score of sitting dimension of the GMFM was used to quantify sitting ability at all visits. Results: Preliminary analyses included the GMFM sitting dimension score, babbling (sum of vowels, sum of consonants), and CDI word comprehension (sum of words) at the first three visits (baseline, 3 weeks, 6-8 weeks). Using a multilevel longitudinal Poisson model (HLM 7), greater sitting skill predicted a greater number of vowels ($\beta 20=0.01$, $t(62)=2.24$, $p=0.03$), consonants ($\beta 10=0.03$, $t(63)=4.50$, $p<0.01$), and understood words ($\beta 10=0.06$, $t(34)=2.29$, $p=0.03$). Conclusion: Greater sitting skill at young ages predicts early babbling and word comprehension within a relatively short time following the emergence of sitting. Sitting may instigate a "developmental cascade" encouraging greater experiences interacting with objects and social partners within the environment (Libertus & Violi, 2016). Nevertheless, other domains of gross motor development may change how infants interact with their environment in a unique way from sitting (Walle & Campos, 2014). Future analyses will also include the 3- month and 6-month post baseline follow-up visits and will investigate whether sitting and general gross motor skills affect the development of infant language later in development. [IES grant (NCT02593825) -SCD, SWM; CHOR grant (647408) - SCD, ECM]

P2-A-5 Female voice influences the early manual abilities of preterm infants

Fleur Lejeune[1], Laure-Anne Brand[2], Amaya Palama[1], Johanna Parra[3], Leïla Marcus[2], Koviljka Barisnikov[1], Thierry Debillon[2], Frédérique Berne-Audéoud[2], Edouard Gentaz[1]

[1]University of Geneva, [2]Grenoble University Hospital, [3]Métropole Savoie Hospital

Premature birth is a sudden change of the sensory environment of a newborn, while their senses are still in development, especially in the stressful and noisy environment of the NICU. A previous study showed that preterm infants displayed an effective ability to memorize tactile manual information and to detect the difference between two shape features, but that this ability seems to be impaired by the concomitant exposure to an alarm sound (Lejeune et al., 2016). However, it is not clear if this result is due to the very stressful nature of the sound, to its important intensity (63dBA), or more generally to the simultaneous presentation of an auditory stimulus, independently of its nature (stressful or soothing) or intensity. The study aimed to evaluate the effect of a soothing female voice, varying in intensity, on the early tactile manual abilities of preterm infants (between 29 and 35 weeks PCA). Infants were randomly assigned to one of the three conditions:

Silence, Voice +5dBa above background noise, and Voice +15dBA above background noise. For each condition, two phases were introduced: a habituation phase (repeated presentation of the same object, prism or cylinder), followed by a test phase (presentation of the familiar or a novel object). In the Silence condition, they received the tactile habituation and test phases. In the two Voice conditions, they went through the same phases, while a recorded female voice was played in the incubator. Seventy-four preterm infants were included. Preliminary analyses were conducted. First, the Voice +5dBA group and the Voice +15dBA group did not differ significantly during the two phases. These two groups were put together as a Voice group for subsequent analyses. Second, a significantly higher proportion of preterm infants in the Voice group failed to habituate to the object after ten trials compared to the Silence group. Third, preterm infants who succeeded to habituate to the object in the Voice condition needed more time trials to attain the habituation criterion than those in the Silence condition. Finally, they all displayed discrimination abilities of the novel object. These preliminary results suggest that the ability to memorize tactile information seems to be weakened by the concomitant exposure to the voice, regardless of its intensity. However, discrimination abilities are preserved with the exposure to the voice, while they are not with the alarm sound (Lejeune et al., 2016). It indicates that the negative effect of the voice on manual abilities in preterm infants seems to be less important than the alarm sound. This study brings new insights for supporting developmental care by confirming the importance of paying attention to the sounds in NICUs.

P2-A-6 Social Relevance of Observed Actions Modulates Mirror Neuron Activity in Toddlers

Manon Krol[1], Jennifer Leano[1], Daniela Plesa-Skwerer[1], Helen Tager-Flusberg[1]

[1]Boston University

Background The Mirror Neuron System (MNS) is activated during the perception and performance of motor actions. Although, it has been proposed that this system contributes to the development of social and communicative abilities, much is still unknown about the relationship between the MNS and these abilities and how they change over time. Since foundational communication skills are acquired during early childhood, this is a relevant period to explore the development of the MNS particularly in the context of emerging communicative skills. Objectives The aim of the current study was to investigate the functioning of the MNS in toddlers. Specifically, we examined whether observation of an action that is more relevant in social contexts (i.e. pointing)

modulates the MNS activity differently than a direct action (i.e. grasping). Methods Participants 20 typically-developed toddlers (M = 42.2 months; range 25-59) participated in the study and provided quality data. Stimuli and procedure Social relevance of observed actions was manipulated by presenting video clips of grasping and pointing actions, which were performed by an actor. In addition, the toddlers were encouraged to grasp for multiple toys themselves. Thus, there were three conditions, execute grasp, observe grasp and observe point, and data were included if children provided a minimum of 10 trials per condition. First toddlers grasped approximately 20 toys, before watching ~40 video clips that randomly displayed grasping and pointing actions. During both action execution and observation, electroencephalography (EEG) data was continuously recorded, using the EGI system. As an indication of MNS activity, power in the alpha frequency band at the sensorimotor areas (C3 and C4 in the 10/20 system) was examined. Results Power reductions in sensorimotor areas were found when objects were grasped by the toddlers, indicating activation of the motor system. Interestingly, an increase in power was found when toddlers observed the actions in video clips. A stronger increase was found when grasping actions were observed compared to pointing actions. Responses were bilateral with similar desynchronization and synchronization effects in the left and right sensorimotor cortex. Conclusions MNS activity appeared to be modulated by the social relevance of observed actions, with stronger effects (i.e. increase in power) to the observation of a direct action than to a more social relevant action. One possible interpretation is that toddlers have more experience with object-directed actions and have less experience observing pointing gestures. Surprisingly, the activation patterns were in opposite directions for action execution (reduction) and observation (increase). One explanation could be that the observed actions were presented in video clips and may have been processed differently than real-life action observation would be in toddlers. Further research is needed to test this hypothesis.

P2-A-7 The LOVIS study of very preterm infants: attention as link between early motor development and withdrawn behavior at 3 years

Olga Kochukhova[1], Ylva Fredriksson Kaul[1], Kristina Persson[1], Cecilia Montgomery[1], Martin Johansson[1], Lena Hellström-Westas[1]

[1]Uppsala University

Background: According to the perspective of embodied cognition and mirror neuron system theory, early motor limitations should be expressed later in a broad range of developmental domains. Motor, perceptual motor integration problems, cognitive

deficiencies and language problems are commonly reported in children born preterm. Previous research demonstrated that perceptual motor integration correlates with degree of impaired social abilities in children with autism (Linkenauger et al., 2012). Taking into account that children and adults born preterm often exhibit a withdrawn personality (Eryigit-Madzwamuse, 2014) it can be assumed that early development of motor abilities in preterm infants can be linked to withdrawn behavior pattern later in development. The study aimed to explore if motor capacity during the first year of life predicts withdrawn behavior at 3 years of age in children born very preterm. If so, how are other neurodevelopmental parameters involved in the association? Method: We measured level of motor development at 2, 4, 6 and 10 months of corrected age in 64 very preterm infants (< 32 gestational weeks) with the Structured Observation of Motor Performance in Infants (SOMP-I). It was evaluated in relation to the children's results on the cognitive, language, fine and gross motor sub-scales (Bayley Scales of Infant and Toddler Development, BSID-III) and results on a parent-completed measure of social, emotional and behavioral problems (Child Behavior Checklist, CBCL/1.5-5) at 3 years of corrected age (CA). Results: Level of motor development at 4 and 10 months of age predicted attention problems (CBCL), cognitive, language and fine and gross motor problems (BSID-III) at 3 years of CA (Figure A). Spearman correlation coefficients ranged between .31 and .42 (p=.001-.020). Significant correlations were also obtained between withdrawn behavior and attention (ρ=.28, p=.012) and withdrawn behavior and level of cognitive, language and fine motor (ρ between -.29 and -.26, p =.01-.02), but not gross motor development (ρ=-.06, p=.33) at 3 years. As the BSID III tasks for accessing the cognitive, language and fine motor development include an attentional component (ρ between -.45 and -.32, p=.006-.001), we decided to explore if attention can possibly mediate the link between these developmental domains and parent rated withdrawn behavior. In order to explore it we ran partial Spearman correlations between results on cognitive, language and fine motor scales and withdrawn behavior, while controlling for attention. All significant correlations between the BSID III subscales and withdrawn behavior disappeared. At the same time, level of motor development at 4 and 10 months of age still predicted level of cognitive, language and motor development at 3 years of age (ρ between -.29 and -.23, p=.012-.046) (Figure B). Conclusion: In children born preterm: a) early motor development predicts level of the cognitive, language and motor development at 3 years of corrected age and b) level of attention at 3 years CA seems to mediate connection between early motor development and withdrawn behavior at this age.

P2-A-8 Infants Learn and Change Movement!

Jeongah Kim[1], Anvitha Shivakumar[1], Barbara Sargent[1], Linda Fetters[1]

[1]University of Southern California

Objective: In the US, more than 100,000 infants are born very preterm (<32 weeks gestational age) each year. These infants are at high risk for brain damage that may result in cerebral palsy. A primary motor impairment in cerebral palsy is limited selective joint movement. Selective joint movement refers to moving two joints within a limb in different directions (e.g. extending the knee while flexing the hip). Selective joint movement is important to develop motor skills, such as walking. The current project is focused on motivating selective hip-knee joint movement of infants using a learning task. We redesigned a mobile paradigm to encourage infants to generate more selective hip-knee joint movement. Our aims are to determine (1) whether infants born full-term and very preterm can learn the mobile task and (2) whether they generate more selective hip-knee joint movement during the task. The current abstract provides the preliminary data of infants born full-term. Methods: Six, 4-month-old infants born full-term participated in the mobile task for 2 consecutive days. Infants were supine under a mobile. Optotrak Motion Capture System was used to capture marker position data on the trunk and legs. Day 1 consisted of a 2-min baseline spontaneous kicking condition followed by an 8-min acquisition condition, during which the musical mobile rotated and played music when the infant lifted his foot vertically over an individually determined threshold kicking height. Day 2 consisted of a 10-min acquisition, during which the threshold increased progressively. The percent of mobile activated time (%MAT) defined learning. Infants were categorized as LEARNERS if the %MAT during the Day 2 acquisition was 1.5 times or greater than during the Day 1 baseline(%MAT ratio ≥ 1.5). For the baseline condition, the amount of MAT was computed by assuming there was a threshold. Hip-knee intralimb correlation values quantified joint movement. The more negative correlation, the more selective joint movement. Results: Four infants learned the mobile task (LEARNERS; %MAT ratios: 2.25-4.66) with more selective hip-knee joint movement (correlation decreased in 0.08-0.82) during the acquisition condition on Day 2 compared to the baseline condition on Day 1. Two infants did not learn (NON-LEANERS; %MAT ratios: 0.04-0.99) or change their joint movement (correlation increased in 0.13-0.56). Conclusion: Infants can learn the mobile task and the task motivated changes in hip-knee joint movement. Our next goal is to complete data collection in infants born full-term and very preterm. Our data will inform motor capability in early infancy that will provide foundational knowledge for developing early therapeutic interventions.

P2-A-9 Discovery in the ordinary: Mothers teaching designed actions of common artifacts

Christina Viso[1], Lana Karasik[1], Jeffrey Lockman[2], Catherine Tamis-LeMonda[2], Karen Adolph[2]

[1]College of Staten Island, City University of New York, [2]New York University

Objects of daily living--clothing, cabinets, containers, etc.--are designed with specific actions for intended use (e.g., thread, pull, twist). Object features might offer clues about where to act, but not what the designed action is or how to implement it. Thus, the designed action must be discovered. For adults, discovering the designed actions of objects is often trivial: Prior knowledge and haptic exploration lead to discovery of the action, and advanced grip strength and bi-manual coordination enables relatively smooth implementation. For children, however, learning and implementation of designed actions might pose a greater challenge, and adults might be valuable sources of information and assistance. Caregivers might encourage discovery and implementation by modeling designed actions, highlighting object affordances, and simply cheering children on to keep them on task. We examined the kinds of social information mothers offer to help children discover and implement the designed actions required to open containers. Mothers (N=96) of 12-, 18-, 24-, 30-, and 36-month-olds were asked to teach their children to open containers with "twist-off" or "pull-off" designed actions. In 7 trials, we coded mothers' behaviors in the first 3 seconds, scoring instances of explicit modeling and verbal instructions that highlighted the designed action; hands-on support and verbal instructions to assist with implementation ("twist left", "pull the corner"); and encouragement of exploration to aid discovery ("open it"). We hypothesized that mothers of older children would encourage exploration on the way to self-discovery of the designed action because their children may not need help with implementation. Whereas mothers of younger children would highlight the designed action immediately, expecting children to be inefficient in their exploration to discover the designed action independently. Alternatively, mothers of younger and older children might not differ at the start--offering the object without explanation, thereby, encouraging exploration and self-discovery--but diverge in their strategies over the session (e.g., highlighting object affordances my modeling for younger children and aid with implementation). Preliminary data from 26 mothers across 5 age groups indicate age-related differences in teaching about "pull-offs". During the first 3 seconds, mothers of all age groups encouraged exploration on the way to self-discovery. Mothers of 12-month-olds often began by ensuring infants were on task (M=33% of trials); surprisingly, some mothers discovered the designed action for themselves (M=10%)--they examined and tested out the action-

-before highlighting it for children (M=11%). With increases in children's age, mothers decreased their attempts to refocus infants on the task (M=2%) and increasingly helped with implementation (M=2% and 20%, for younger and older children). We will examine within- and across-trial differences in how mothers teach about designed actions and changes in the social information with children's age. The task of opening containers presents a rich model system for studying how children learn culturally relevant skills in a social context and the importance of adults as reservoirs of valuable information. Our findings offer insights into the available social information for guiding children's learning about the function of everyday objects.

P2-A-10 Perceptual-Motor Exploration and Problem Solving: Learning to Implement the Designed Action of Duplo Bricks

Brianna Kaplan[1], Jennifer Rachwani[1], Aida Sida[1], Aastha Vasa[1], Catherine Tamis-LeMonda[1], Karen Adolph[1]

[1]New York University

Many toys for young children are designed to be used in specific ways that are largely hidden from perception. Adults immediately recognize that puzzle pieces are meant to be arranged into a picture, because they already know how to use puzzles. But young children may not immediately recognize the designed action when encountering a pile of puzzle pieces or a finished puzzle. Many other actions are possible. For infants and young children, puzzle pieces invite mouthing, stacking, fingering, and carrying. So how do children discover the designed actions of toys? Here, we investigated the developmental progression in 61 12- to 60-month-old children's and 16 adults' use of Duplo bricks, a lightweight plastic construction toy. We presented each participant with six bricks for 2 minutes. Duplos are designed to interlock, studs to holes, to create 3D constructions. The studs and holes are visually apparent and fun to touch. But for a novice, the designed interlocking action is "hidden," and the affordance for constructing must be discovered. Results showed a developmental progression from non-designed actions (banging, sliding, etc.), to performing the designed interlocking action, to building complex 3D constructions. Younger children spent most of the session using non-designed actions to explore the bricks, as shown by the green bars in the raster plot in Figure 1. By 24 months of age, most children discovered the hidden interlocking property and used the bricks to create a structure (yellow bars on the raster plot). But their structures were simple two- to six-brick towers, with each brick flush with the one beneath it (Figure 2A). Children continued to build simple towers over the next 1.5 years. Between 42 and 48 months,

children built more complex structures, with two to six bricks interlocked asymmetrically, such as perpendicular and "dangling" arrangements. Finally, at around 54 months of age, children exhibited sophisticated spatial planning by using one brick as a "connector" to link two other bricks. Connecting requires accurate placement of the two bottom bricks relative to the third top brick. We assigned children construction scores to reflect their discovery and use of the designed action (1 = juxtaposing two bricks without interlocking, 2 = interlocking bricks into a tower, 3 = asymmetrical interlocking, 4 = using bricks as connectors). Construction scores were strongly correlated with children's age, $r(59)=.84$, $p < .001$, as shown in Figure 2B. We were surprised that only 4.5-year-olds and adults used the toy as advertised, given the manufacturers' recommended age range of 18 to 60 months, and the complex constructions pictured on the Duplo packaging. Seemingly simple toys designed for use by young children involve a prolonged process of exploration and problem solving before the toys can be used as designed.

P2-A-11 Infant self-feeding: Stabilizing mouth position during bottle transport

Wendy Jung[1], Bjoern Kahrs[1], Elizabeth Steen[1], Jeffrey Lockman[2]

[1]Tulane University, [2]New York University

Self-feeding is a fundamental adaptive skill that infants begin to master during the first year. The mouth, however, is a potentially moving target. One way to perform self-feeding efficiently is to stabilize the head so that the mouth remains in a relatively fixed position. Here we looked at how head stabilization develops during self-feeding with a bottle. To examine to what extent infants stabilize their heads during self-feeding, we presented a bottle in different orientations to 6- to 12-month-olds and tracked how much they moved their heads when bringing it to the mouth. Fifty-five infants between 6-12 months of age were presented a baby bottle at their midline for six trials. In random order, the bottle was initially presented in one of six positions: nipple facing up, toward, down, away, left, and right (Figure 1a-f). We used a 3D motion capture system (Qualisys) to track the location of the mouth while infants transported the bottle to the mouth. Three reflective markers were placed on the infant's forehead to determine the position of the mouth (Figure 1g). Markers were labeled in Qualisys Track Manager (Figure 1h) and then exported to MATLAB to measure the absolute distance the mouth moved during each trial. To examine how much infants moved (not opened) their mouths during the task, we first excluded outliers and only used trials where infants successfully brought the nipple to the mouth. The absolute distance the mouth moved was regressed onto age and bottle orientation with General Estimating Equations using a

gamma distribution with a log link function. A significant Age x Bottle Orientation interaction was obtained (Wald χ52 = 19.08, p = .002, Figure 2). Post-hoc analyses of the slopes of the regression lines indicated a significant decrease in slope for the away (b = -.005, t = .001, p < .001) and right (b = -.004, t = .002, p = .019) orientations and a marginal decrease in slope for the up orientation (b = -.004, t = .002, p = .074). With increasing age, infants move their mouth less when the bottle was presented in the away, right, and up orientations. In the away orientation, 12-month-olds move their mouth 21 cm less than the 6-month-olds. When the bottle was facing right, 12-month-olds move their mouth 12.5 cm less than the 6-month-olds. Finally, in the up orientation, 12-month-olds move their mouth 10 cm less than the 6-month-olds. These findings provide new information about the development of head stabilization during self-feeding in the infancy period. As infants become older, they moved their heads less, suggesting that they are keeping the target of the task (i.e., the mouth) in a relatively stable position. Further, for some orientations, infants show more head movement than for other orientations. We are currently collecting data with adults and older children to determine the extent to which head position stabilizes during bottle/vessel transport. Discussion will center on how the present methods may be used to assess feeding skill in infants who encounter difficulties with motor control.

P2-A-12 Testing validity and reliability of a smart garment for tracking infants' body position

Andrea Cunha[1], Ben Greenspan[2], Iryna Babik[2], Martha Hall[2], Klayton Galante Sousa[1], Michele Lobo[2]

[1]Federal University of Rio Grande do Norte, [2]University of Delaware

Introduction: Before infants can transition between positions on their own, the positions they experience (e.g., supine, prone, upright) are reliant on parents/ caregivers. Parental education for advanced handling techniques (e.g., increased time in prone or upright positions) has been shown to facilitate future motor and cognitive development (Lobo & Galloway, 2008; 2013). The Get Around Garment (GG, Figure 1), a smart garment designed at the University of Delaware to track infants' body position (prone, supine, reclined/inclined, or upright) via a small sensor (accelerometer) incorporated into an adjustable belt, provides data regarding infants' position experiences (Figure 2). Tracking infants' positions throughout the day in the natural environment could allow for the collection of important normative developmental data. Feedback from the device could also aim to alter caregiver-infant interactions. The aim of this study was to evaluate the

validity and reliability of the Get Around Garment. Methods: Seven 2-4-month-old infants (M = 3.5 ± 1.2) with typical motor development (M = 48.6th ± 20.5 percentile on the Alberta Motor Infant Scale) were assessed once at their homes or at the lab. The visit consisted of: 1) Structured Play Assessment: the infant was placed by the researcher for 15-30 seconds into each of the following 5 positions: supine, prone, inclined about 45 degrees from upright, reclined about 45 degrees from upright, and seated upright (total of 2.5-minutes); 2) Free Play Assessment: parents were encouraged to go about their daily activities and interact with their infants in their typical manner for 40-60 minutes; and 3) a second 2.5-minute Structured Play Assessment. Infants wore the Get Around Garment throughout all of the assessments. The entire visit was also video recorded. Positions (prone, supine, reclined/inclined, and upright) were coded from video using Datavyu software and were identified from sensor data using LabView programming (Figure 2). The validity of the smart garment was assessed by comparing data from the garment's movement sensor to data from behavioral coding of video. The reliability of the smart garment was assessed by comparing the garment's movement sensor data between the first and second Structured Position Assessments. Descriptive analysis of data was performed. Results: Preliminary results showed that the agreement between the video and garment data (validity of the garment data) was greater than 85%. The agreement between the garment's movement sensor data from the two Structured Position Assessments (reliability of the Garment data) was greater than 90%. Conclusions and Implications: The Get Around Garment might be a valid and reliable device to track the orientation of an infant in a natural setting. These data can better inform us about infants' typical positional experiences. Feedback from the device could potentially be used to alter caregiver-infant interactions, therefore optimizing infants' future motor and cognitive outcomes.

P2-A-13 The LOVIS study of very preterm infants: Are early gross motor skills associated with later ability to detect biological motion?

Martin Johansson[1], Ylva Fredriksson Kaul[1], Cecilia Montgomery[1], Lena Hellström-Westas[1], Olga Kochukhova[1]

[1]Uppsala University

Background Children born very preterm (VPT, <32 gestational weeks) often experience difficulties in motor and social domains. According to embodied cognition theories there is a link between developing motor skills and ability to interpret the motions of others. Several studies have investigated infant motor performance in relation to the capacity to

detect biological motion (BM) with varying results. However, few studies have investigated this association from infancy into school age. Increased understanding between early motor abilities and later social dysfunction is needed, to improve the possibility for interventions during infancy aiming at improving long-term outcomes also in social domains. A greater focus on trajectories across ages is needed in order to find timely interventions. Aim To investigate if gross motor development during infancy and toddlerhood is associated with ability to detect biological motion (BM) at 12 years. Method The study is part of an ongoing longitudinal project including VPT infants, born in Uppsala county, Sweden, between 2004-2007. Children's motor development at 2, 4, 6 and 10 months corrected age (CA) was observed with the Structured Observation of Motor Performance in Infants (SOMP-I) measuring two domains of motor performance: the motor level reached and the quality of motor performance. At a mean age of 36 months CA the Bayley Scales of Infant and Toddler Development (BSID-III) were administered including the Gross Motor sub scale (BSID-III GM). At 12 years, gaze was recorded with TobiiTX300 Eye-Tracker in 25 of the children. They watched 8 point-light men walking in different directions. BM was masked by random dot motion in condition 1: 6 dots per inch^2 and condition 2: 12 dots per inch^2. We measured the time before BM was detected. Motor performance on SOMP-I and BSID-III subscales were correlated to the children's mean time to detect BM. The children were divided into two subgroups, according to their BSID-III GM score level, with a cut off at -1SD and their mean detection time was compared. Results Significant correlations between BSID-III GM subscale and mean detection time for both BM conditions were obtained: ρ= -.468, p= .018, and ρ= -.453, p=.026, respectively. No other correlations were significant. When grouped according to BSID-III GM performance (cut off at -1SD) the children with a lower BSID-III GM score had significantly higher mean detection time in both conditions (Table 1). Discussion Results indicate an association between gross motor function at 36 months CA and BM at 12 years of age in a cohort of children born very preterm. There was no association between BM detection ability and earlier level or quality of motor performance. This supports the idea that interpretation of biological motion at 12 years can be traced back to gross motor ability at 3 years of age. Only one child had started walking at 10 months CA, which could explain the lack of associations with earlier gross motor measures. Results also indicate that gross motor performance seems to have a clearer link to ability to detect BM than other developmental aspects at 36 months CA.

P2-A-14 Foraging in the playroom: Towards a model of human infant locomotor play

Justine Hoch[1], Ori Ossmy[1], Karen Adolph[1]

[1]New York University

While foraging, a diverse set of organisms including microbes, insects, sharks, birds, and mammals, move through their environment following a specific type of random walk that can be modeled as a Levy walk (Figure 1A, left panel). This movement pattern reflects how organisms experience and interact with the environment across a wide range of ecological contexts. The Levy walk hypothesis suggests that the best strategy for searching in an unknown environment is to make successive movements in uniformly random directions (Figure 1A, middle panel) where the length of each movement is drawn from a probability distribution that is 'heavy-tailed' (Figure 1A, right panel). Thus, no direction of movement is preferred over any other, and many movements are short, but some are considerably longer. According to the Levy walk model, the probability Pr(d) that a walker performs a bout of length d is given by: Pr(d)~d^-y where 1<y<3. Here, we examined whether human infants' exploratory patterns can be characterized by the Levy walk model. To this end, we observed 15-month-old infants (N=65) playing freely in a laboratory playroom for 20 minutes. Caregivers were occupied filling out a questionnaire, so infants were free to determine their own paths. Toys were evenly distributed throughout the room. From video, coders scored bouts of walking (periods of walking flanked by stationary periods) and the number of steps per bout. We tracked infants' spatial coordinates (Figure 1B, left panel) and calculated the angle between consecutive steps using a Matlab software that allowed coders to manually digitize the location of each step from an overhead camera view. In support of the Levy walk model, we found that infants' step-to-step change in angle was uniform (Figure 1B, middle panel) and that the distribution of infant walking bouts closely resembled a heavy tailed distribution (Figure 1B, right panel). We fit a set of candidate distributions to the observed bout distances by using maximum likelihood (ML). The candidate distributions were well-known heavy-tailed distributions and other control distributions including the Levy, Weibull, Exponential, Lognormal, Rayleigh and Pareto distributions. Similar to studies with non-human animals, we also examined different cutoff criteria to determine the length of a bout when fitting each model. We found that, regardless of the cutoff criterion used to determine the length of a bout, infants' paths were best fit by a Levy walk distribution (97% of infants fit; Figure 2A,B). This is the first study to report the use of a Levy walk model as a tool for characterizing infant locomotor paths. Our findings provide evidence that infants use exploration strategies during locomotor play similar to those used by foraging animals.

P2-A-15 Infants Spend Immense Amounts of Time Interacting with Objects During Everyday Play at Home

Orit Herzberg[1], Christopher DeCamp[1], Katelyn Fletcher[1], Jacob Schatz[1], Kasey Soska[1], Catherine Tamis-LeMonda[1], Karen Adolph[1]

[1]New York University

Infants' interactions with objects provide opportunities to learn manual, locomotive, cognitive, linguistic, and social skills. However, the vast majority of research on infants' object interaction is based on structured tasks in laboratory settings, where exploration is focused and consistently high. The characteristics of infant object interactions at home--the setting where infants spend most of their time--is unknown. How often do infants interact with objects during everyday routines at home, and how do they distribute time with and without objects? We examined the frequency, duration, and temporal distribution of infants' interactions with objects at home. We videorecorded 17 mother-infant dyads during everyday activities for 1-hour, with minimal experimenter interference. We observed 12- (n=4) and 18-month-old infants (n=13). We plan to collect data from 20 infants in each age group. We defined object interaction as a manual displacement of object(s), with the onset marked by contact with any object and the offset marked by three or more seconds off all objects. Infants displayed massive amounts of time interacting with dozens of toys and household objects across the hour (Figure 1AB). Infants averaged 61.4% of each hour interacting with objects, ranging from 37.8% (22.7 minutes) to 98.8% (59.2 minutes). Most (82%) infants spent more time interacting with objects than not, signed-rank test, $p<.01$. Most object interactions were brief: Half of bouts were 10 seconds or less, and only 15% lasted 1 minute or more (Figure 2A). Consequently, infants transitioned among dozens of object interactions per hour (M=57), from 4 to 110 object bouts, for a total of 971 bouts. Breaks between object interactions were also brief, with half lasting less than 9 seconds. Infants' longest bout of object interaction (M=9.0) was longer than their longest break without objects (M=3.9), $t(16) = 2.31$, $p<.05$. Figure 2B presents the distribution of object engagement for infants during the first 10 minutes. Infants displayed tremendous individual differences in bout lengths (as shown in Figure 1A and Figure 2B). Across all data, the briefest bout of object interaction was .07 seconds and the longest bout was 34.6 minutes. For individual infants, the shortest average bout duration was 0.4 minutes and the longest was 14.8 minutes. Across all data, the shortest break of object interaction was 24 seconds and the longest was 7.87 minutes. For individual infants, the shortest average break was 11 seconds and the longest was 47 seconds. Preliminary results reflect an object-interaction schedule that is highly conducive for learning--massive amounts of time-distributed variable practice.

Further analyses will test mothers' role in infants' object interactions; children's differential use of household objects and toys; the availability of objects in the home; whether children use objects as designed; and changes in infants' object interactions across development. These analyses will illuminate the nature of infants' spontaneous interactions with objects in the home.

P2-A-16 Manual Actions and Walking: Competition or Cooperation in Infant Development?

Carli Heiman[1], Whitney Cole[2], Do Kyeong Lee[3], Karen Adolph[4]

[1]Databrary, [2]Max Planck Institute for Human Development, [3]California State University, Fullerton, [4]New York University

Infancy is a period of remarkable growth in manual and locomotor skills. Reaching, grasping, fingering, and other manual skills develop months earlier than locomotor skills such as crawling and walking. What happens as infants achieve mastery of manual skills while simultaneously trying to acquire a new skill in the domain of locomotion? A competition model predicts that newly walking infants temporarily relegate object interaction to times they are stationary so as to focus their efforts on walking, and infants do not incorporate manual skills into locomotion until they are adept walkers. Alternatively, a cooperation model predicts that infants immediately incorporate objects into locomotion from their first walking steps by transporting objects while walking. Based on the prevalence and costs of object transport in infants, the evidence supports both sets of predictions. Moreover, the possibility of concurrent object exploration and walking--the infant equivalent of texting while walking--is unknown. Of course, infants can explore objects while stationary (standing or sitting), but can they also do so while walking? We video recorded 64 sessions of infants during free play in a playroom with 7 standard toys and various "found" objects (baby's sock, mother's cell phone) that infants spontaneously retrieved. To test whether manual actions while walking change across development, we tested infants across a wide range of age (12.7-19.5 months) and walking experience (0.5-10.3 months). To estimate the cost of transport and concurrent object exploration, we compared the quantity of spontaneous walking while concurrently holding and exploring objects versus walking without objects in hand. We also analyzed the maturity of infants' gait (the playroom floor was instrumented) while holding and exploring objects versus not. Object transport was common--M=33% of walking bouts. Infants were no more likely to hold objects while standing (M=35% of bouts), a presumably lower cost form of dual-tasking, compared with holding while walking. To our

surprise, object exploration (manipulation and/or visual inspection) was also relatively common--M=25% of transport bouts. But infants were more likely to explore objects while standing (M=41% of standing bouts) than walking, $p<.001$. In support of the cooperation model, both transport and exploration were equally prevalent across age and walking experience, as were holding and exploration while standing (Figure 1). However, the gait data were less conclusive (Figure 2). Infants displayed more mature gait patterns while walking without holding objects (e.g., M step length = 23.0 cm) than while holding (M=19.7 cm), $p<.001$. But their gait was similar while walking and exploring objects (M step length = 19.6 cm) as walking without exploration (M=19.9 cm). And infants fell just as frequently while walking and holding objects as not and while walking and exploring objects as not. Apparently, infants discount any cost to incorporating manual actions into locomotion such that the two types of skills develop cooperatively. The earlier developing skills of holding and exploring objects are immediately incorporated into the later developing skill of walking. Manual actions spiral upward, becoming an integral part of locomotor actions such that development coalesces in real time.

P2-A-17 Sitting and Searching: Reliability and Validity of an Object Permanence Scale in Relation to Sitting Development

Mihee An[1], Regina Harbourne[1], Jaclynn Stankus[1], Emily Marcinowski[2], Stacey Dusing[2], Lin-Ya Hsu[3], START-Play Consortium[1]

[1]Duquesne University, [2]Virginia Commonwealth University, [3]University of Washington

Background/Objective: Understanding that objects continue to exist even when they cannot be observed, or object permanence, is considered fundamental to understanding and representing objects in the environment (Piaget, 1954). As an integral component of cognitive function, object permanence is thought to be intimately connected to perceptual-motor experience such as self-mobility (Kermoian & Campos, 1988). Because infants with motor delays have limited perceptual-motor experience, we supposed that the development of the object permanence construct may be delayed (Lobo et al., 2013). However, a scale that measures object permanence from very minimal to more advanced skill in infants was not available. Thus, we constructed a scale with items that could be accomplished in infants with motor delays or impairments, and added them to items extracted from studies on the progression of object permanence (Kagan et al., 1978; Uzgiris & Hunt, 1975, Lowe et al., 2013) to create an ordinal scale of object permanence (Table 1). The purposes of this initial study were to examine reliability and validity of the Object Permanence Scale, and examine differences between typically developing infants

and infants with motor delays using a skill-held constant design. Methods: Infants were recruited for two larger studies (START-Play and CHoR project). 56 infants with motor delays (mean age=10.3 months, SD=2.7) and 34 typically-developing infants (no history of delay, preterm birth or significant health conditions, mean age=5.4 months, SD=0.7) were involved in this study. Infants entered the study when they were able to sit propped up for at least 3 seconds but unable to get in and out of sitting (the onset of sitting emergence). The Object Permanence Scale (OPS) and Bayley Scales of Infant and Toddler Development (Bayley-III) were administered at the onset of sitting emergence. All assessments were videotaped and scored independently by blinded assessors. The inter-rater reliability was examined by two assessors scoring 30 randomly selected videos. For validity, we calculated the correlation between OPS score and the Bayley-III cognitive composite score. The OPS scores in infants with and without motor delays were compared. Results: The intraclass correlation coefficient, ICC(2, 1), was 0.92, demonstrating good inter-rater reliability. A significant correlation was found between the OPS and the Bayley-III cognitive scores ($r=0.552$, $p<0.001$). The OPS scores at onset of sitting emergence were not different between infants with and without motor delays ($Z=-1.086$, $p=0.277$). However, the typically-developing infants were approximately 5 months younger than infants with motor delays, indicating delayed development of object permanence corresponding to motor delays (Table 2). Significant and positive correlation of the OPS scores with the Bayley-III cognitive scores, and the delayed performance on the OPS observed in infants with motor delays support the validity of the OPS. Conclusions: Infants with motor delays demonstrated delayed development of object permanence, as measured by the OPS. Our findings suggest that early motor skill development prior to self-mobility may have an impact on the emergence of object permanence in young infants. Our findings support the reliability of the Object Permanence Scale, as well as concurrent and discriminative validity.

P2-A-18 Frequent Falls Do Not Deter Infants From Walking

Danyang Han[1], Hannah Borenstein[1], Shohan Hasan[1], Stephen Robinovitch[2], Karen Adolph[1]

[1]New York University, [2]Simon Fraser University

Previous work shows that infants fall a lot--on average, 17 times/hour at home, in a laboratory playroom, and outside while holding caregivers' hands (Adolph et al., 2012). However, previous work reports only the frequency of infant falls. Here, we asked whether falling incurs penalties beyond loss of balance, and if not, why not. We observed 146 walking infants (78 girls, age = 12.7-20.0 months, walking experience = 0.1-10.3 months)

during approximately 20 minutes of free play with their caregivers in a laboratory playroom filled with varied surfaces, elevations, and toys. In total, infants fell 526 times (range = 0-21 falls). To equate differences in recording time, we expressed the data as proportions or rates per hour. The number of infant falls/hour (M = 10.2, SD = 10.7) was negatively correlated with walking experience (r = -.24, p = .004). Falls occurred when infants played on elevated surfaces such as stairs, platforms, and slides (M = 12.7 times/hour, SD = 14.3), and also on perfectly flat ground (M = 8.9 times/hour, SD = 10.9), see Figure 1. On elevations, caregivers hovered nearby to catch infants when they started to lose balance, and infants never hit the floor. Nonetheless, outside the laboratory when caregivers do not adequately protect infants, falls from a height are a leading cause of accidental injury in infants (Borse et al. 2008; Borse & Sleet, 2009; Peden et al. 2008). On the floor, despite falling frequently, falls were rarely serious. After falling, infants rarely cried (2.4% of falls), caregivers rarely showed concern (4.8% of falls), and infants recovered from falling and returned to play within M = 2.6 seconds (SD = 4.5). Why were infants' floor falls so trivial? We examined the micro-details of floor falls when caregivers did not catch infants and infants' bodies impacted the floor. Most falls (78.2%) involved multiple body segments in a sequence of impacts that distribute potentially injurious forces (e.g., falling first onto hands, then onto legs), occasionally in a long string (e.g., legs, hands, arms, torso, head), see Figure 2. Falls that involved only a single body impact were all onto padded body parts such as hands (15.9%), buttocks (2.5%), and legs (2.4%). Head (3.9%) and trunk (9.2%) impacts were rare, and always occurred after first falling onto a more padded body part. Infants took 1 to 3 quick, small reactive steps in 71.1% of falls after losing balance and outstretched their hands within M = 94.4 ms (SD = 162.9) to break a fall after the first impact. Moreover, infants' short stature, low muscle tone, and springy bones mitigate the force of impact. We conclude that falling on the ground is frequent, but not particularly salient for infants or caregivers. We propose that a low penalty of error may be a feature of skills requiring immense amounts of experience, such as walking and talking, so as not to deter infants from practicing to the point of mastery.

P2-A-19 Children with microcephaly caused by Zika virus might be at environmental risk and developmental delays

Klayton Galante Sousa[1], Andrea Cunha[1], Audrei Audrei F. Miquelote[2], Thais de França[1], Silvana Pereira[1], Egmar Longo[1], Gentil da Fonseca[1], Denise Santos[2]

[1]Federal University of Rio Grande do Norte, [2]Methodist University of Piracicaba

Background: Several cases of Zika virus (ZIKV) were reported in Brazil (2015-2016) establishing a relationship between this infection in pregnancy and the occurrence of microcephaly (Chimelli & Avvad-Portari, 2017). The vertical transmission (e.g., mother to fetus) resulted in more severe manifestations and neurological abnormalities in the fetus, such as fetal loss, growth restriction, and microcephaly (Pone et al., 2017; Rocha et al., 2017). Studies has been showed that the complications of microcephaly depend on underlying brain anomalies, causing mild or severe motor and cognitive developmental delays (Schuler-Faccini et al., 2016), including clinical findings such as irritability, pyramidal/extrapyramidal syndrome, epileptic seizures, dysphagia and sleep disorders (Moura da Silva et al., 2016). Moreover, socio-demographic data revealed a higher ZIKV burden in low socioeconomic status (SES) areas (Netto et al., 2017). Then, besides the biological risk caused by the neurological impairments, these children might be also at environmental risk, which it might affect even more their motor and cognitive development (Clearfield & Jedd, 2013; Cunha et al, 2017). The purpose of this study was to identify differences in the affordances at home environment and also the motor and cognitive performance for children with microcephaly compared with children only at environmental risk. Methods: This is a cross-sectional study. Nineteen children (M=16.5±3.9 months-old) from families of low-SES were divided in two groups: children with microcephaly (n=8) and children born without any neurological condition (n=11). The affordances at the home environment were assessed by the Brazilian version of the Affordances in the Home Environment for Motor Development - Infant Scale (AHEMD-IS). Their motor and cognitive performance was assessed by Bayley Scales of Infant and Toddler Development- 3rd edition (Bayley-III, 2005) using the scaled and composite scores. Descriptive and non-parametric analyses were performed ($p<0.05$). Results: Both groups presented similar characteristics related to the birth weight [M= 3.029± 0.5 kg; (U=24.00; z=-1.65; p=0.09)] and gestational age [M= 39.3± 1.3 weeks; (U=37.50; z=-.57; p=0.57)]. Moreover, our preliminary data showed that more than 50.0% of both groups were classified as less than adequate, 35% as moderately adequate according to the AHEMD-IS. It indicates the environmental opportunities (affordances) for motor development are missing or could be improved, and these children for both groups might be at environmental risk. In relation to the their motor and cognitive performance (Figure 1 A-B), there were differences for the gross motor (U=0.00; z=-3.75; p=0.00), fine motor (U=0.00; z=-3.75; p=0.00), global motor (U=0.00; z=-3.73; p=0.00) and cognitive performance (U=0.00; z=-3.79; p=0.00). Children with microcephaly presented lower motor and cognition performance compared to children without any neurological condition and their level of motor and cognitive performance was classified as extremely low. Conclusion: The children with microcephaly presented significant motor and

cognitive delays. It is important to identify early delays to provide appropriate intervention as early as possible to these children. Early experiences and environmental enrichment should be provided for these children with microcephaly, aimed at advancing their affordances at home, motor and cognitive behaviors.

B: Developmental Neuroscience

P2-B-20 Left Hemisphere Specialization for Familiar Language at 4-months

Maria Arredondo[1], Lillian May[1], Judit Gervain[2], Manuel Carreiras[3], Janet Werker[1]

[1]University of British Columbia, [2]CNRS - Université Paris Descartes, [3]Basque Centre for Cognition, Brain, & Language

At birth, the infant brain responds selectively to speech: May et al. (2017) demonstrated specialized neural activation in neonates to both familiar and unfamiliar spoken language, but not to a whistled surrogate language. The present work extends this research to 4-month-olds, using Near-Infrared Spectroscopy (fNIRS) to measure processing to the native language (English), to a rhythmically distinct unfamiliar language (Spanish), and to a whistled surrogate language of Spanish (Silbo Gomero). Whether neural activation was lateralized to the left hemisphere was examined: while some studies show left hemisphere lateralization for speech processing at birth (Peña et al., 2003), others observe bilateral processing in neonates (May et al., 2017) with left hemisphere specialization only by 4 months and beyond (Minagawa-Kawai et al., 2010). Given infants' increased familiarity with the prosody of the native language by 4-months of age, here we predicted greater activity in left hemisphere regions for familiar language in comparison to both spoken and whistled unfamiliar language. Method: One hundred 4-month-old infants took part in the study: In Experiment 1, infants (n=52) heard forward and backward speech in both their native language (English) and an unfamiliar language (Spanish); in Experiment 2, infants (n=48) heard forward and backward speech in both an unfamiliar language (Spanish) and a rhythmically-similar unfamiliar whistled surrogate language (Silbo Gomero). Neural activation was examined in bilateral frontal, parietal and temporal regions using a Hitachi ETG-4000 fNIRS system. The setup included 24 data channels sampled at 10-Hz (12 channels per hemisphere); see Figure 1. Results: Data preprocessing was completed using +NIRS Toolbox (Huppert, 2016), and linear mixed effect models (fixed effect: conditions; random effect: subjects) were carried out to examine brain activity. Consistent with our hypothesis, preliminary results revealed a significant advantage in a left frontal channel for forward as compared to backwards speech for native, but not unfamiliar language in Experiment 1; $F(3, 87)=3.46$, $p=.02$; see Figure 2. No

other significant main effects or interactions emerged, including no differences in activation between unfamiliar spoken and whistled surrogate language. Conclusions: Consistent with previous research, the present study reveals that 4-month-old infants' left frontal region is specialized for processing familiar language, as compared to other languages used by humans to communicate (i.e., unfamiliar speech, whistled surrogate language). These findings suggest ongoing experience with the familiar language selectively strengthens the left hemisphere predisposition to respond to speech, particularly in the left frontal region, while other forms of auditory/aural language, regardless of type, are treated as unfamiliar and no longer evoke a specialized 'language' neural response. The comparable bilateral response to both Spanish and Silbo Gomero may also indicate recognition of their shared rhythmic/prosodic properties, both distinct from English. These findings inform theories of early language acquisition by revealing how experience impacts neural organization for language processing. Important questions for the future include how bilingual infants may differ in their neural specialization for two familiar languages, and whether neural responses could be a marker for later language proficiency.

P2-B-21 The neural correlates of orienting to walking direction in 3- and 6-Month-old Infants: an ERP study

Marco Lunghi[1], Elena Serena Piccardi[2], Elisa Di Giorgio[1], John Richards[3], Francesca Simion[1]

[1]University of Padova, [2]University of London, [3]University of South Carolina

The ability to detect social signals represents a first step to enter our social world. Behavioral evidence has demonstrated that 6-month-old infants are able to orient their attention towards the position indicated by walking direction, showing more efficient orienting responses towards stimuli cued by the direction of motion than towards uncued stimuli. The present study investigated the neural mechanisms underpinning this priming effect by using a spatial cueing paradigm and recording EEG (Geodesic System 128 channels) from 3- and 6-month-old infants. Infants were presented with a central point-light walker followed by a single peripheral target, randomly appearing at a position either congruent or incongruent with the walking direction of the cue. We examined infants' target-locked ERP responses and we used cortical source analysis to explore which brain regions give rise to the ERP responses. Results revealed that only for 6-month-old infants, P1 component and saccade latencies towards the peripheral target were modulated by the congruency between the walking direction of the cue and the position of the target. Specifically, P1 component was larger in response to congruent than to incongruent

targets and the parahippocampal gyrus and the anterior fusiform gyrus were mainly involved as cortical sources of this component. Overall, these findings suggest that a type of biological motion like the one of a vertebrate walking on the legs can trigger covert orienting of attention staring from 6 months of age, enabling enhancement of neural activity related to visual processing of potentially relevant information as well as a facilitation of oculomotor responses to stimuli appearing at the attended location.

P2-B-22 Repetition suppression as measured by EEG is associated with adaptive skills during the first year of life

Gabriela López-Arango[1], Inga Knoth[2], Caroline Dupont[1], Camille Noiseux-Lush[1], Amélie Damphousse[2], Fanny Barlaam[1], Sarah Lippé[1]

[1]Université de Montréal, [2]Sainte-Justine Hospital

OBJECTIF Habituation, the simplest form of learning, has been considered as a cue process to understand perceptual and cognitive abilities in infants. This behavioral response entails the construction of a memory trace and a decrease of reactivity to a repeated stimulus. Behavioral paradigms based on infant's looking times to repeated stimulus have shown a moderate correlation between cognitive development and habituation (Bornstein & Sigman, 1986; Bortfeld, Shaw, & Depowski, 2013; Kavsek, 2013). Recently, the electrophysiological correlate of habituation has been described as repetition suppression (Snyder & Keil, 2008). The purpose of our study is to investigate the relation between repetition suppression and adaptive skills during the first year of life. MATERIALS AND METHODS: We recorded high density EEG of 24 healthy infants (7 males) between the age of 3 to 8 months at the CHU Sainte Justine hospital. The experimental design consisted of a sequence of three times the vowel A (AAA) presented 64 times. Auditory presentations were supported by visual images (faces pronouncing the syllables) in order to attract infant attention (Basirat, 2014). The parent form of the Adaptive Behavior Assessment System Second Edition (ABAS-II) was used as a measure of adaptive skills. A time-frequency analysis was performed to investigate the repetition suppression response associated with the three repetitions of the stimuli (A). The slopes between the electrophysiological response associated to the first and second A and between the second and the third A were obtained as indicators of repetition suppression. Multivariate linear regression analysis was applied to calculate the relationship between the slope values and the General Adaptive Composite (GAC) of the ABAS-II, considering age as a co-variable. Two electrodes (FCz and Fz) and all frequency bands were considered for analysis. PRELIMINARY RESULTS: The GAC score was significantly explained by the slope

value between the first and second A at the level of alpha 1 (6-9Hz)(¥â= -.508, p=.008) and alpha 2(10-13Hz)(©¬= -.478, p= .015) frequency bands at electrode FCz and beta 1 (14-20Hz) frequency band in electrode FCz and Fz(¥â= -.567, p=.004 and ¥â=-.704, p<.001, respectively). Our preliminary data suggest that a high repetition suppression effect between the first and second "A" predicts better adaptive skills. Further, GAC score was predicted by the slope value between the second and third A at the level of alpha 1 frequency band (¥â=.425, p=.034) at electrode FCz. In this case, a decrease in the repetition suppression effect between the second and third "A" predict better adaptive skills. CONCLUSION: Our preliminary results show a relationship between repetition suppression and adaptive skills measured by the ABAS-II. Hence, repetition suppression can be interpreted as an important building bloc in cognitive development. Finally, repetition suppression can be a valuable electrophysiological marker of neurodevelopment during the first year of life.

P2-B-23 Ostensive-referential communication modulates action interpretation at 9 months

Christian Kliesch[1], Vincent Reid[1], Anna Theakston[2], Eugenio Parise[1]

[1]Lancaster University, [2]Manchester University

Infants readily learn from other people around them. However, observed actions are not all equally important, and ostensive-referential communication might help infants to identify relevant actions (Csibra & Gergely, 2009, 2011; Csibra, 2003). The presence of these signals does not just raise infants' attention towards actions or referred objects, but also leads to a differential encoding of communicatively presented information (Csibra & Gergely, 2011; Yoon, Johnson & Csibra, 2008). In the two experiments presented here we investigate potential learning mechanisms by looking at the electrophysiological activity of 9-month-old infants when watching actions presented in adult- vs. infant-directed contexts. In a familiarization period we presented two groups of sixteen 9-month-old infants with four actors that were either communicative (looking directly from screen, infant directed speech), or non-communicative (looking down, adult-directed speech). In experiment 1 there was no object present during the familiarization. In experiment 2 an object was present and the actor referred to it. Following the familiarization, infants saw an expectancy violation paradigm in which an action (e.g. actor holding spoon) primed either the expected outcome (spoon to mouth) or an unexpected outcome (spoon to ear). Familiarization, prime and outcome pictures were repeated in blocks of six actions. We looked at three ERP components: (1) The N400, a marker of semantic expectancy violation

(Reid et al., 2009) (2) The Pb, which has been reported in similar research on infants' integration of multimodal ostensive signals (Parise & Csibra, 2013) (3) The Nc, an infant-specific marker of attention (Reynolds, & Richards, 2017) In experiment 1, we found evidence of an N400 effect for Outcome between 700-900ms ($F(1,15)=10.03$, $p=.006$, $\eta2G=0.20$), but no Outcome x Communication interaction, or main effect of Communication (all ps>.25). There were no main effects or interactions on the Pb 200-350ms (ps>.26) or the Nc between 350-700ms (ps>.49). In experiment 2 we replicated the N400 main effect for Outcome ($F(1,15)=7.09$, $p=.02$, $\eta2G=0.15$). We also found a Communication x Outcome interaction on the Pb ($F(1,15) = 10.24$, $p=.006$, $\eta2G=0.14$), with an increased positive peak for communicative-expected ($t(28.83)=1.80$, $p=0.08$) and non-communicative unexpected outcomes ($t(28.83)=-2.25$, $p=0.03$). An ANOVA with Outcome and Communication as within-subjects factors and Study as a between-subjects factor showed a significant three-way interaction ($F(1,30)=8.86$, $p=.006$, $\eta2G=4.83$), indicating that infants' responses were reliably different between the two experiments. On the Nc, there was a marginally significant result for the Outcome by Communication interaction ($F(1,15)=4.14$, $p=.06$, $\eta2G=0.06$), and no significant main effects (all ps>.20). These results indicate that infants assess actions differently in the presence of communication, but only if the agent makes clear she is referring to a particular object. In the absence of communication, the reversed Pb-response possibly reflects an attempt to maximise learning by seeking novel information (Twomey & Westermann, 2017). These results highlight the importance of referential signals in the interpretation of actions (c.f. Hoicka, 2017).

P2-B-24 Interracial interactions hamper infants' neural detection of pupillary changes in others

Caroline Kelsey[1], Kathleen Krol[1], Mariska Kret[2], Tobias Grossmann[1]

[1]University of Virginia, [2]Leiden University

Sensitive responding to eye cues plays a key role during human social interactions. Recently, infants have been found to detect and indeed mimic observed pupillary changes in others, instantiating a foundational mechanism for eye-based social communication and the coordination of arousal. Among adults, pupil mimicry is affected by cues to group membership, such as race, and dilation mimicry facilitates trust and cooperation with own-race partners (Kret, Fischer, & Dreu, 2015). Here, we examined whether and how race impacts the neural processing of others' pupillary changes in early ontogeny. Twenty infants (8 girls, 12 boys; M [age] = 9 months, 14 days; ranging from 8 months, 23 days to

10 months, 7 days) participated in the experiment. We measured 9-month-old infants' brain responses to dilating and constricting pupils in the context of viewing own-race or other-race eye regions using functional near-infrared spectroscopy (fNIRS; see Figure 1). Our results show for the superior temporal cortex (STC) region, a region involved in processing dynamic social information, there was a significant interaction between hemisphere and pupillary movement only in the own-race context, $F(1, 19) = 5.672$, $p = .028$, $\eta 2 = .230$. Specifically, own-race pupil dilation evoked greater response than own-race constriction in the right hemisphere (own-race dilation: $M = 2.962$ µM, $SE = 2.148$, own-race constriction: $M = -2.057$ µM, $SE = 1.487$), whereas the reverse pattern was seen in the left hemisphere where own-race constriction evoked greater responses than own-race dilation (own-race dilation: $M = .145$ µM, $SE = 1.754$, own-race constriction: $M = 2.451$ µM, $SE = 2.105$; see Figure 2a). For the other-race context, there were no significant differences in STC response for pupillary movement (all p-values > .246). Moreover, when processing other-race pupillary changes infants recruited the left dorsolateral prefrontal cortex (dlPFC), a brain region linked to cognitive control functions, $F(1, 19) = 7.507$, $p = .013$, $\eta 2 = .283$; more specifically, other-race eye stimuli evoked greater responses ($M = 3.862$ µM, $SE = 1.291$) than own-race eye stimuli ($M = -2.676$, µM, $SE = 1.598$; see Figure 2b). These findings suggest that, early in development, the fundamental process of sensitive responding to pupillary changes in others is hampered during interracial interactions and that such interactions may afford a greater level of cognitive control or effort. This critically informs our understanding of the early origins of racial bias in the human brain and highlights its consequences on interracial contact.

P2-B-25 The contribution of sensory processing problems to the relationship between sleep and attention deficit hyperactivity disorder

Jennifer Keating[1], Michelle Downes[1]

[1]University College Dublin

ADHD is a highly heritable disorder. Studies have shown evidence for an influence of sleep problems and sensory processing on attention control in both children with ADHD and typically developing children. These factors may be particularly relevant to children of parents with ADHD who are already at a higher risk of ADHD diagnosis. The aim of the study was to measure attention, sleep, and sensory processing in the infants of 73 families with high-risk ADHD (at least one parent has a diagnosis of ADHD) and 73 families without high-risk ADHD (no family history). Sleep disturbances are commonly reported in children with ADHD, however there is a scarcity of studies looking at the influence of sleep on

ADHD in children younger than school age. Furthermore, little is known about how sleep and sensory processing influence the development of attention skills and ADHD symptomatology in young children. This study used the Brief Infant Sleep Questionnaire, Children's Sleep Habits Questionnaire, Infant Sleep Diary, and the Infant/Toddler Sensory Profile in an online questionnaire distributed to parents. It is expected that children at higher risk for ADHD will have poorer sleep and sensory processing reports relative to typically developing children.

P2-B-26 Fronto-temporo-parietal connectivity as a possible marker of self-awareness in 18-month-olds: a resting state fNIRS study

Chiara Bulgarelli[1], Anna Blasi[1], Carina de Klerk[1], Antonia Hamilton[2], Victoria Southgate[3]

[1]Birkbeck, University of London, [2]University College London, [3]University of Copenhagen

Introduction.Resting-state(RS) refers to the spontaneous functional connectivity that we can observe while participants are not engaged in any particular task. One of the most important networks found in adults is the Default Mode Network(DMN), composed by areas in the frontal, temporal, and parietal cortex, and it has also been linked to self-related processing(Raichle,2015). The sense of self is thought to develop around 18-month-old and it is usually tested with the mirror self-recognition task (MSR)(Amsterdam,1972). While several adult studies investigated the relationship between the DMN and the sense of self, we know very little about this relationship at the age when the sense of self is emerging. We aim to fill this gap by exploring how fronto-temporo-parietal connections are related to the development of the sense of self. RS studies are usually performed with fMRI, even though this requires toddlers to be asleep to minimize movement. However, recent studies have showed that sleep and wakefulness present different patterns of connectivity(Tagliazucchi,2014). Functional near-infrared spectroscopy(fNIRS) is a good alternative to fMRI, allowing us to test toddlers while they are awake(Lloyd-Fox,2010). In this study, we acquired RS using fNIRS to investigate whether there is a relationship between functional connectivity and self-awareness at 18-month-old. Methods.67 18-month-olds were tested with the MSR. Afterwards, they looked at a screensaver-type video with bubbles and music. Toddlers' behaviour was video-coded for movement and talking. Artefact-free time series for each channel were selected for each participant. Only participants who had at least 100secs of clean data were included. After removing channels with poor light intensity, the data were band-pass filtered and converted to concentrations of haemoglobin. Average cross-correlation matrices were calculated for each group. Results.38 toddlers were included in the RS

analyses and 17 were classified as 'recognisers'(Rec) and 21 as 'non-recognizers'(NonRec). Using independent samples t-test to compare Rec and NonRec connectivity matrices, we found that Rec showed stronger fronto-temporo-parietal connections(figure1): out of the 12 fronto-temporo-parietal connections that are significantly different between the two groups, 10 are stronger for Rec while only 2 for NonRec. In the whole brain(figure2), out of the 43 connections with a significant difference between the two groups, 33 are stronger for Rec while only for 10 for NonRec. Moreover, most of the connections that are stronger for Rec are long-range, while those stronger for NonRec are short-range. Discussion.This is the first study that investigates RS in awake toddlers with fNIRS. The stronger pattern of RS long-range connectivity between frontal and temporo-parietal areas in the Rec group suggests there is already a link between DMN and sense of self at 18-month-old. These findings support the relation between core areas of DMN and sense of self found in adults. The stronger short-range connectivity in NonRec than in Rec is consistent with previous studies showing an increase in short-range and a decrease in long-range connections in situations where self-other distinction is impaired, such as in schizophrenia(Ebisch,2014;Uddin,2010). These results suggest that fronto-temporo-parietal connectivity can be considered as a marker of the self-awareness in infancy.

P2-B-27 EEG Power of Infants as a Function of Maternal Depression and Feeding Status

Nancy Jones[1], Krystal Mize[1], Jillian Hardin[1], Melannie Platt[1]

[1]Florida Atlantic University

Infants of depressed mothers are at-risk for demonstrating brain activity corresponding to their depressed mothers' (Field, Diego, & Hernandez-Reif, 2006; Peltola, Bakermans-Kranenburg, Alink, Huffmeijer, Biro, & van IJzendoorn, 2014). However, due to infant brain plasticity, there is opportunity for dysregulated physiological patterns to be redirected. Breastfeeding has been touted as having a number of benefits for infants including being associated with superior neurobehavioral functioning (Hart, Boylan, Carroll, Musick, & Lampe, 2003).The present study examined brain activation patterns of infants across the first three months of life as a function of maternal depression status and feeding practices. 113 mother-infant dyads participated in a 1-month laboratory visit and 87 of those dyads returned at 3-months. Both groups were distinguished by maternal mood (depressed versus non-depressed) and feeding (stable breastfeeding versus bottle feeding) status. Baseline EEG recordings were obtained at the frontal, central, parietal, and occipital regions at both ages. Natural log transformations (ln) of power scores were analyzed using

a Fourier analysis, within the 3-6Hz and 6-9Hz frequency bands. A series of MANOVA analyses (with maternal mood and/or feeding group as a between subjects factors) were conducted to examine age, region and hemisphere effects on EEG power. Results revealed an age effect for the frontal region, $F(1,67) = 10.66$, $p = .002$, $\eta 2 = .16$. Analyses were conducted to examine cross-age and within-age effects in frontal region. First, utilizing scores at both 1- and 3-months and comparing feeding and depression groups separately, a main effect for age was found, $F(1,67) = 12.54$, $p = .001$, $\eta 2 = .16$, as well as a depression group X feeding group, X hemisphere X age interaction, $F(1,67) = 5.71$, $p = .02$, $\eta 2 = .08$. Notably in Figure 1, the age changes in left hemisphere scores were most meaningful for the depressed and breastfeeding group, with this group showing a shift to more left activity from 1- to 3-months. Within age MANOVAs yielded non-significant findings at 1-month, however, 3-month data revealed differences in the four groups, $F(3,62) = 3.89$, $p = .02$, $\eta 2 = .21$, as well as separately for the feeding and depression groups, $F(2,54) = 3.28$, $p = .04$, $\eta 2 = .12$. As shown in Figure 2 the depressed, bottle-feeding group showed the least left frontal activity (most power) whereas the non-depressed along with the depressed breastfeeding groups showed similar EEG activity in the left frontal region. Examination of the changes in left/right power and the shift in power were demonstrated in breastfeeding infants that also experienced risk from maternal depression. While previous research has demonstrated that infant brain activity is influenced negatively by having a depressed mother (Field et al., 2006), this study demonstrates that these dysregulated EEG patterns (hypoactivation of the left hemisphere) are not observed in infants of depressed mothers that have stable breastfeeding practices, yet remain dominant in infants whose mothers are depressed and bottle feeding. Findings are discussed from a developmental perspective, illustrating the importance of breastfeeding experience as an effective caretaking practice that positively influences infant neurodevelopmental outcomes.

P2-B-28 Infants' brains respond more strongly to less predictable stimuli: The case of sequence learning

Sagi Jaffe-Dax[1], Lauren Emberson[1]

[1]Princeton University

Prediction about upcoming events can be considered a defining feature of development (Piaget, 1952). While predictions allow infants to orient their attention towards surprising events (Hunter & Ames, 1988; Kidd et al., 2014) and facilitates learning (Stahl and Feigenson, 2015), little is known about how predictions shape the developing brain. In

adults, it is believed that predictions employ top-down modulation to compare sensory input against the prediction (Rao & Ballard, 1999; Friston, 2005). Similar to what is found in adults, recent work has suggested that predictions are evident in sensory cortices in infancy (Emberson et al., 2015; Kouider et al., 2015). However, these previous studies only investigated one type of prediction (i.e., arising from learning an audiovisual association and looking at visual prediction based on an auditory cue) and only showed the existence of prediction learning. Here, we investigate prediction in a new context, which requires integration of stimuli across longer time scales and measure the impact of prediction on neural responses in the sensory and associative (higher-level) cortices in the infant brain using fNIRS. Consistent with the framework of predictive coding, we hypothesize that neural response in sensory cortices will be attenuated for predictable stimuli, suggesting that prediction improves the efficiency of perception of these stimuli through the use of top-down information from associative cortices. Specifically, we expected to find predictability effects in sensory cortices as well as in frontal regions (Linden et al., 1999; Basirat et al., 2014). We recruited 30 typically-developing full-term infants at 6 months. We measured infant's cortical correlates of predictability by contrasting their neural response to predictable versus unpredictable sequences of audio-visual events that they learn within the experimental session. We measured infants' neural response in two conditions: Predictable and Unpredictable (Fig. 1). In the Predictable condition, the temporal order of the stimuli was constant across trials, while in the Unpredictable condition, the temporal order varied from trial to trial. Thus, in the Predictable condition, once the temporal pattern is learned, the infant would be able to predict which stimuli should appear next. Such prediction will be impossible to make in the Unpredictable condition. As hypothesized, we found that in the Unpredictable condition infants had a stronger neural response in both frontal and posterior (occipital and temporal) regions than in the Predictable condition (Fig. 2). These results suggest that predictability allows infants to perceive stimuli more efficiently. Predictions modulate neural response to stimuli, across disparate, sensory specific and cross-modal, associative brain regions and thus employs long-range connectivity: Long-range neural connectivity is crucial feature of the adult brain that supports many cognitive abilities and that has a protracted developmental trajectory. In addition, we also found a bi-lateral effect of predictability in parietal cortex, suggesting that predictability modulated the cortical activity in attention network. Ongoing work is investigating these effects in preterm infants (born < 34 weeks). Previous work has found weaker evidence for prediction in preterm infants (Emberson et al., 2017). We thus expect preterm infants to exhibit smaller differences between the Unpredictable and Predictable condition.

P2-B-29 Schizotypy and Sensory Gating during Infancy: a 6-month-old EEG study.

Eleanor Smith[1], Trevor Crawford[1], Megan Thomas[2], Vincent Reid[1]

[1]Lancaster University, [2]Blackpool Teaching Hospitals NHS Foundation Trust

The influence of a parent's personality upon a child is widely acknowledged. Across the literature, the links between specific parental psychopathology and the infant's P50 event-related potential (ERP) component have been identified. It is therefore of significant interest to investigate whether the influence of parental personality on infant development is present in the first 6-months of life. Schizotypal traits are present in the general population and are distributed along a continuum, with the clinical disorder schizophrenia found at its extremity (Claridge, 1997). Schizotypy is a dimension of personality within the general population, which is found to be elevated among schizophrenia-spectrum patients (Brosey and Woodward, 2015) and their first-degree relatives (Morenzo-Izco et al., 2015). A central hypothesis to account for the sensory deficits observed across the spectrum suggests a difficulty in the inhibition of irrelevant sensory input, such as the secondary beep in the paired-click paradigm. Sensory gating describes the pre-attentional habituation of responses to repeated sensory input, for example, auditory tones. This gating mechanism is used to distinguish between important and irrelevant information (Hall et al., 2011) and is typically explored using the paired-click paradigm and analysed using the P50 ERP component. This can be observed approximately 50-milliseconds following the presentation of an auditory stimulus and is a highly established biological trait of schizophrenia, with abnormalities displayed in the P50 component all throughout the schizophrenia-spectrum. This research aimed to observe whether the 6-month-old offspring of mothers with schizotypic traits display abnormalities in the P50 ERP component when explored using the paired-click paradigm. The paired-click paradigm was used to highlight the sensory-gating abilities of 53 6-month-old infants during 15-minutes of continuous sleep. The mother's of the infants completed the Short Form of the Oxford and Liverpool Inventory of Feelings and Experiences, which was used to determine their personality dimension scores, and identify schizotypic traits. Participants were categorized into one of three groups: infants of controls mothers, infants of intermediate mothers, and infants of schizotypic mothers. This research found a significant generalized difference between the P50 component for the paired-clicks in the right hemisphere of the brain ($F(1,51)=5.34$, $p=.025$), and a significant latency effect was observed in the frontal regions ($F(1,51)=5.41$, $p=.024$). A significant between-subjects effect was observed centrally ($F(2,50)=3.71$, $p=.031$); suggesting there are significant differences between the ways each group distinguished the paired-clicks. An interaction was observed in the left hemisphere between the paired-

clicks and each identifiable group (F(2,50)=3.45, p=.039). In addition to the P50 a significant slow wave effect was also observed across the left (F(1,51)=8.38, p=.006) and right (F(1,51)=7.81, p=.007) posterior regions; a latency effect in the left (F(1,51)=5.47, p=.023), and a distinction in mean amplitude in the right (F(1,51)=7.25, p=.010). It was predicted that the 6-month-old infants of mothers who demonstrate schizotypy scores would illustrate different amplitudes compared to those of control mothers. This was observed centrally, demonstrating that the infants' P50 amplitudes were influenced by their mothers' schizotypy status.

P2-B-30 8 and 14-month-old infants' cortisol response to strange interactions and language development

Maria Hernandez-Reif[1]

[1]University of Alabama

Physiologically, the classic response to a challenge (or stressor) is activation of the hypothalamic-pituitary-adrenal (HPA) axis. In humans, a stress response is reflected by elevated cortisol (glucocorticoid stress hormone), which can be measured in saliva. A swift cortisol increase followed by a gradual cortisol decline (i.e., cortisol reactivity) is an adaptive stress response (Erickson, Drevets & Schulkin, 2003) and has been associated with better scores on children's executive function, self-regulation and letter knowledge (Blair, Granger & Razza, 2005). In contrast, no change or chronically low or chronically elevated cortisol in response to a stressor is maladaptive, and has been associated with attention and behavioral problems and noted in children chronically stressed (Koss, Mliner & Gunnar, 2016; Koss, Hostinar, Donzella & Gunnar, 2014). The current longitudinal study examined infants' salivary cortisol responses to a friendly (and somewhat familiar) stranger and examined in relation to infants' communicative behaviors. We predicted infants would mount an adaptive stress response to a stranger interaction. We also hypothesized cortisol slopes would be associated with infants' communication scores. Participants: Thirty infants attending an accredited high quality childcare were recruited over two years. At time of recruitment, infants were 8 months old (SD = 2.58). All infants appeared to be typically developing; their mothers were Caucasian, 33.5 years old (SD = 3.74) and middle to upper middle in SES. Infants were assessed at 8 and again at 14 months of age. Procedure: Researchers spent one hour in infant classrooms prior to data collection. The researchers sat quietly in the classrooms, smiled and interacted with infants who approached them. The following week, the researchers collected three saliva samples (a, b and c) from infants at 20-minute intervals between 8:00 am and 9:00 am. The

researchers returned six months later and repeated the procedure. Thus, each infant contributed six saliva samples, three when they were 8 months (T1a, T1b, T1c) and three when they were 14 months (T2a, T2b, T2c). Saliva samples were frozen and sent to Salimetrics for assaying. The infants' teachers completed the Communication and Symbolic Behavior Scales (CSBS; Prizant & Wetherby, 2003) when infants were 8 and 14 months old. Data analyses: Three difference scores were computed for each Time period by subtracting cortisol levels a from b, a from c, and b from c. These difference scores reflected infants' cortisol responses to interactions with a stranger at 8 and 14 months. The difference scores were analyzed in relation to the CSBS. Results: At 8 months infants' cortisol rose each time they interacted with the stranger, and these cortisol levels remained elevated and correlated with symbolic understanding and object use (see Table & Fig 1). At 14 months, infants' cortisol rose during two of the three interactions with the stranger, and were correlated with infants' social, speech, and symbolic communicative behaviors (see Table 1 & Fig 1). Conclusion: Infants mount cortisol responses at 8 and 14 months when they interact with a stranger. Higher cortisol reactivity appears to be related to better communication scores. By 14 months, cortisol reactivity appears more adaptive.

P2-B-31 Accurate head models for cortical source analysis in infants at high risk of autism spectrum disorders

Maggie Guy[1], John Richards[2], Jane Roberts[2]

[1]Loyola University Chicago, [2]University of South Carolina

The aim of this study was to develop the first realistic head models for use with infants at high risk of autism spectrum disorders (ASD) and to test these head models in the source analysis of electrophysiological data collected during face processing. The optimal approach for source analysis involves using realistic head models based upon individual participants' structural MRIs, however, this is not always feasible. Careful selection of alternative head models is important to accurate source localization, and may be critical when examining infants at high-risk of neurodevelopmental disorders. Twelve-month-old participants included two high-risk groups, 21 infant siblings of children with ASD (ASIBs) and 15 infants diagnosed with fragile X syndrome (FXS), and 21 typically developing, low-risk control (LRC) infants. All participants completed a face processing ERP experiment. Structural MRIs were collected from a subset of the participants. Realistic head models were created from the MRIs; materials within the head were identified, segmented, and assigned a relative conductivity. Current density reconstruction (CDR) of the N290 ERP component was done with head models created from participants' own MRIs to examine

activation in regions of interest (ROIs) believed to be highly relevant to face processing. CDR activity was analyzed in an ANOVA including participant group, stimulus type, and ROI. There were main effects of stimulus type, $F(1, 38) = 17.01$, $p = 0.0002$, reflecting greater activation to faces than toys, and of ROI, $F(17, 646) = 20.43$, $p < 0.0001$, reflecting high levels of activation in the middle fusiform gyrus and anterior temporal brains areas. Subsequent source analyses were completed with ASIB and FXS groups to determine the impact of head model on CDR activation. We tested head models created from infants' own MRIs against those created from the average of study- and group-specific MRIs, group-specific MRIs obtained from the Infant Brain Imaging Study (IBIS; 25 FXS MRIs, 53 ASIB MRIs), and MRIs collected from TD infants. An ANOVA tested effects of head model, participant group, and ROI on CDR activity. There was a significant effect of head model, $F(3, 51) = 13.30$, $p < 0.0001$, reflecting similar CDR across own-MRI and IBIS head models, but not study-specific and TD head models. There was an interaction of head model and stimulus type, $F(3,51) = 3.88$, $p = 0.0141$, reflecting similar differentiation of responses to faces and toys in the own-MRI and IBIS head models, and less differentiation in study-specific and TD head models. An interaction of head model and ROI, $F(51, 867) = 6.23$, $p < 0.0001$, indicated that while the IBIS head model was the best alternative to infants' own MRIs, the quality of fit varied across ROI. Results indicate that head model selection is important to accurate source analysis and may be complex in high risk groups. IBIS head models proved the best match to infants' own MRIs, possibly due to greater heterogeneity in the brains of infants at high risk of ASD that was better accounted for in a model created from a large collection of group-specific MRIs.

P2-B-32 Socioeconomic Status, Parent Stress, Home Chaos, and Infant Language Trajectories

Carina Gupta[1], Natalie Brito[2], Ana Leon-Santos[1], Kimberly Noble[1]

[1]Teachers College Columbia University, [2]New York University

Background: Socioeconomic status (SES) is strongly associated with children's later academic achievement (Brooks-Gunn & Duncan, 1997; Hoff, 2003), as well as with early language, cognitive, and neural development (Noble, et al, 2015a, b; Tomalski et al., 2013). Previous studies have identified SES differences in the home language environment, with children from socioeconomically disadvantaged families exposed to less child-directed speech (Weisleder & Fernald, 2013) and lower vocabularies (Hart & Risley, 2003) relative to children from socioeconomically advantaged homes. Additionally, higher levels of chaos in the home environment are associated with poorer performance on early

language outcomes (Wachs, 1986) and development of auditory perception skills (S. Cohen, Glass & Singer, 1973). Assessments of parents' perceived stress in the home environment have also been associated with child receptive language ability (Keim et. al., 2012). The present study explores the impact of parent stress and quality of the home language environment on language skill development in the second half of the first year of life. We hypothesized that higher caregiver stress would be associated with reduced child-directed speech, as well as with lower infant receptive and expressive language skills. Methods: A socioeconomically diverse sample of infants ranging from six to twelve months of age were recruited (N = 40-57 on the various outcomes described below)(Maternal Education: M= 15.14, SD = 3.83, Range = 6-22; Income to Needs Ratio [ITN] M= 3.58, SD= 3.07, Range = 0.20-12.40). Infants were tested using the Preschool Language Scale (Zimmerman & Castilleja, 2005) to assess both receptive and expressive language development. Caregivers completed the Home Chaos (CHAOS) scale for measures of environmental confusion (i.e., potentially stressful noise, crowding, pollutant, stimulation, etc.), as well as the Perceived Stress Scale (PSS) to measure caregiver perceived stress levels. The home linguistic environment was quantified using the Language Environment Analysis (LENA) device, providing measures of average hourly adult word count (AWC) and average hourly conversational turn count (CTC). Results: As expected, AWC and CTC were highly correlated ($r = .698$, $p = .000$). Replicating past work, both measures of the home language environment were highly correlated with socioeconomic factors (AWC & ITN: $r = .420$, $p = .007$; AWC & Maternal Education: $r = .526$, $p = .001$; CTC & ITN: $r = .378$, $p = .018$; CTC & Maternal Education: $r = .470$). Contrary to hypotheses, higher caregiver stress levels were not associated with differences in the home language environment. Furthermore, caregiver stress did not predict infant language scores, and there was no moderation by socioeconomic status. Longitudinal data collection in this sample is ongoing. Discussion: Socioeconomic disparities in the home language environment are associated with child-directed speech. Preliminary data fail to find associations between parent stress and either parent-infant speech or infant language outcomes. These null effects are not moderated by socioeconomic status. Additional longitudinal data collection will help us determine the likelihood of a true null effect, or whether greater statistical power enables us to detect links among parent stress, the home language environment, and child language outcomes.

P2-B-33 Infant brain responses differentiate between optic flow patterns and motion speeds

Alyssa Pandos[1], Andrea Seisler[1], Rick Gilmore[1]

[1]Pennsylvania State University

Optic flow informs infants' perception of the geometry, speed, and motion of objects in their environment and their own movements through space. Prior research suggests that infants show larger amplitude electroencephalographic (EEG) responses to direction-reversing linear patterns of optic flow (Gilmore et al., 2007) than to radial or rotational patterns. Infants also show larger EEG responses to coherence-modulating rotational flow patterns when motion speeds are faster (Hou et al., 2009). Moreover, children 4-8 years old show larger amplitude EEG responses to fast radial and rotational optic flow (Gilmore, Thomas & Fesi, 2016), suggesting that the motion processing network undergoes prolonged development throughout childhood. To provide a direct comparison with prior child neural data, high density (128 channel) EEG responses were recorded from (n=23; 13 female) 17- to 38-week-old infants who viewed two different patterns (radial and linear) of optic flow presented at two different speeds (2 and 8 deg/s). Flow patterns were generated from white dots moving on a black background, with the degree of motion coherence varying from 100% (coherent) to 0% (incoherent/random) every 833 ms, resulting in a first harmonic (1F1) of 1.2 Hz. EEG data were cleaned and filtered before being subjected to a frequency domain analysis using a discrete Fourier transform. This analysis provided data about complex domain responses to the optic flow stimulus at low-order integer harmonics of the coherence modulating frequency (e.g., 1F1, 2F1, 3F1). At the first harmonic, infants showed a small cluster of left frontal channels that showed higher amplitude responses to translational patterns and a larger cluster over the posterior midline that showed higher amplitude and distinct phase responses to faster speeds (Fig 1). At the second harmonic (2F1; 2.4 Hz), there was a cluster of left frontal channels that showed higher amplitudes to radial motion (Fig 2), a group of left lateral channels that showed higher amplitudes to faster speeds, and a right lateral cluster that showed a pattern by speed interaction. Results from the third harmonic (3F1; 3.6 Hz) showed a small left frontal cluster of channels with higher responses to radial motion and two left and right central clusters where EEG phases, amplitudes, or both distinguished between the two speed conditions. Taken together, the results show that infant brain responses to coherence-modulating optic flow differ both from prior EEG results using direction-changing optic flows (Gilmore et al., 2007) and from those recorded in older children using identical displays (Gilmore, et al., 2016). Faster (8 deg/s vs. 2 deg/s) speeds tend to evoke larger amplitude EEG responses, consistent with predictions, but radial flows activated larger amplitude responses than linear flows, in contrast with predictions. Moreover, the spatial pattern of channels showing speed or pattern sensitivity differs between infants, children, and adults. The network of brain systems that detect and

respond to optic flow may undergo patterns of development that are more idiosyncratic or individual-specific than indicated by previous findings.

P2-B-34 Individual Differences in Infant's Visual Attention as Predictors of Toddler's Self-regulation: A Multi-Method Longitudinal Study

Sanne Geeraerts[1], Carlijn van den Boomen[1], Maja Dekovic[1], Roy Hessels[1], Jorg Huijding[1], Stefan van der Stigchel[1]

[1]Utrecht University

In the search for early markers of self-regulation, visual attention has been pointed out as an important antecedent (Hendry, Jones, & Charman, 2016). In this study, we focus on attention disengagement, fixation duration, and variation in fixation duration in infancy as predictors of two prototypical manifestations of self-regulation in toddlerhood: effortful control and compliance. In order to successfully deal with the environment, one must balance between processing as much relevant information as possible, while keeping in mind internal needs. Various attentional skills may support individuals in doing so, and thereby contribute to the development of self-regulation. Disengagement of visual attention may help in managing the amount of visual input, and prevent overstimulation due to novelty or intensity of stimuli (Johnson, Posner, & Rothbart, 1991). We therefore hypothesized disengagement to be negatively related to effortful control and compliance in toddlerhood. Our analyses regarding fixation duration and variation in fixation duration were more exploratory. Longer fixations may indicate the ability to efficiently attend to visual information (Papageorgiou et al., 2014), but also the inability to disengage, or to process information efficiently. Additionally, variation in fixation duration may indicate individual's ability to adjust attention duration when desired, for instance because of increased complexity or arousal (de Barbaro, Clackson, & Wass, 2016), but has also been associated with less cognitive control (Wass & Smith, 2014). <p>The aim of this study was to examine the predictive value of our three indicators of visual attention (disengagement, fixation duration, variation in fixation duration) in infancy (9-11 months) for effortful control and compliance in toddlerhood (26-32 months). The sample consisted of 75 children. In infancy, two eye-tracking tasks (gap-overlap task for disengagement and visual search for fixation duration and its variation; Cousijn et al., 2017; Hessels, Hooge, & Kemner, 2016) were conducted twice over two test-days. Scores for disengagement (mean time between the appearance of a peripheral target on the screen and first fixation on this target), fixation duration (median time during which the point of regard is relatively stable), and intra-individual standard deviation of fixation

duration were collapsed over both testing days in order to obtain robust estimates, and standardized to avoid problems in analyses related to large differences in variances. Parents filled in questionnaires to measure compliance and effortful control (Carter & Briggs-Gowan, 2006; Putnam, Gartstein, & Rothbart, 2006). In addition, observed compliance was coded during clean-up in parent-child interaction (Lunkenheimer, 2009), and observed effortful control was coded during a gift delay task (Kochanska, Murray, & Harlan, 2000). For both compliance and effortful control, a composite score was created. </p> Multiple regression models, using full information maximum likelihood and robust standard errors, showed that our indicators of visual attention predicted a significant amount of variance in effortful control, but not in compliance (Table 1). While disengagement was not predictive of effortful control, longer fixations, as well as less variation in their durations were predictive of better effortful control. The results underscore the importance of visual attention in facilitating effortful control development.

P2-B-35 Infant EEG Power and Coherence: Potential Indicators of Childhood AD/HD

Cassondra Eng[1], Leslie Patton[2], Martha Ann Bell[2]

[1]Carnegie Mellon University, [2]Virginia Tech

The effort to develop a laboratory test for attentional disorders has emerged using neuroimaging and electrophysiological techniques to identify characteristics that differentiate individuals with AD/HD from same-age peers. However, infant attention and the corresponding brain-behavior associations are understudied in the development of AD/HD. Retrospectively, EEG power and coherence during an attention task at 5-months of 19 infants diagnosed at childhood for AD/HD were compared to those of 19 matched control infants. Participants of this study are part of a longitudinal study examining individual differences in the development of executive function across early development. The electrophysiological and behavioral data acquired at the research lab visit at 5-months were the focus of the current study. Maternal report of a doctor diagnosis of AD/HD at subsequent lab visits (ages 6 or 9 years) was used to classify children into AD/HD and non-AD/HD categories. During the 5-month lab visit, EEG was recorded during baseline and during an attention task. For the attention task, infants were presented with a Sesame Street video clip: a task conceptualized as a behavioral and physiological measure of attentional processing (Richards, 1997). Trained assistants coded infant look duration to determine peak looking time at the stimulus. Colombo (1995) has identified individual differences in infant visual attention based upon peak look duration during exposure to a novel stimulus: infants who demonstrate brief visual fixations (i.e.,

short lookers) during stimulus exposure process information more efficiently than infants that demonstrate long visual fixations (i.e., long lookers). There were differences in attention behavior, with the AD/HD group exhibiting longer looking times compared to the control group of infants (t = -2.449, p = .004; AD/HD: m = 17.16s; No AD/HD: = 9.87s). Electrophysiological differences between groups were also found during baseline and the attention task: AD/HD subjects exhibited reduced EEG power (all p's<.03) and elevated EEG coherence (p<.002) in the alpha (6-9 Hz) frequency bands compared to the control group at frontal locations. The findings of reduced EEG power and elevated EEG coherence at 5-months emphasize deficient activity and atypical overconnectivity in the frontal region on the brain, reflecting similar patterns found in older populations of children (Murias, Swanson, & Srinivasan, 2007). The absence of a test specific for attentional disorders makes diagnosing AD/HD challenging. These findings suggest that incorporating psychophysiological measures--such as EEG--into assessments of attention as young as 5-months old, can potentially be used as early indicators of children at risk for early-onset disorders like AD/HD, and help get them on a better developmental trajectory early on.

P2-B-36 The relationship between stress and repetition suppression in infants, measured in an EEG learning task

Florence Deguire[1], Fanny Thébault-Dagher[1], Inga Sophia Knoth[1], Fanny Barlaam[1], Marc-Philippe Lafontaine[1], Sonia Lupien[1], Sarah Lippé[1]

[1]Université de Montréal

The over activation of the hypothalamo-pituitary-adrenal (HPA) axis in stress situations can negatively impact brain functioning, specifically learning and memory. For example, electroencephalography (EEG) studies have shown that alpha and theta waves decreased, and beta waves are increased under stress in prefrontal regions (Al-Shargie and al., 2016, Al-Shargie, Tang, Kiguchi, 2017, Bajbouj, 2014). Many researchers have underlined that the relationship between glucocorticoid level and learning and memory functions follows an inverted-U shape (Lupien and al., 2005). Moreover, studies have established that the repetition of a stimulus causes a diminution of the neuronal activity in the regions processing the stimuli, a phenomenon called repetition suppression (Nordt, Hoehl, Weigelt, 2016). The aim of this study is to establish how stress affects repetition suppression in infants. We hypothesized that stress effects on prefrontal brain regions affect repetition suppression. We expect a greater repetition suppression response under low to mild stress levels and inversely poorer repetition suppression response under high

stress levels. Twenty-two healthy infants (12 males) aged between 6 and 28 months were evaluated. We measured brain activity using EEG during a repetition-based learning task. The task consisted of audio-visual stimuli featuring a woman and a man alternating in the articulation of /a/ or /i/. Out of 80 trials, 75% are following a xxxY(aaaI) specific rule. Saliva samples were collected before the stressor (EEG net installation) and 20 and 45 minutes after the stressor. Cortisol levels were determined by radioimmunoassay and the area under the curve was calculated with respect to ground to assess the reactivity. To asses the brain response, ERP analysis were conducted using the amplitude of the P2 component. The P2 wave occurs between 150-200ms at anterior and central scalp sites and is followed by the N2 component. Peaks were obtained by averaging separately the first /a/, second /a/ and third /a/. Regression analyses were used to predict the effect of stress (salivary cortisol) on repetition suppression indicated by reductions in amplitude (A1-A2, A2-A3, A1-A3). There was no significant difference between boys and girls regarding cortisol levels and age. A significant quadratic function was found between the mean amplitude of the P2 component and the level of cortisol (β=- 0.030, p= 0.012, R2= 0.444). Our results suggest that under low to mild stress levels, repetition suppression is greater while high stress levels seem to decrease repetition suppression phenomenon in infants. Despite limitations of our study such as small sample size, our results confirm our hypothesis and supports the idea of an inverted U-shaped relationship between stress and learning. Since early childhood is a critical period of development, future studies should focus on trying to better understand how to promote learning in young infants while taking stress into account.

P2-B-37 Quality of maternal behavior during infancy predicts functional connectivity between neurocognitive brain networks 9 years later

Fanny Dégeilh[1], Annie Bernier[2], Élizabel Leblanc[2], Véronique Daneault[2], Miriam Beauchamp[1]

[1]Sainte-Justine Research Center, Montreal, Quebec, Canada, [2]Université de Montréal

Infants' day-to-day experiences are considered to determine to a large degree the strength and effectiveness of neural connections and fine tune the development of brain networks. As some of the most pervasive and potent relational experiences of infancy, parent-infant interactions appear to be prime candidates to account for experience-driven differences in children's brain development. Yet, current knowledge on the effect of the quality of parenting behavior on brain functional connectivity in typically developing children is restricted to cortical-limbic connectivity (Rifkin-Graboi et al., 2015; Thijssen et

al., 2017), and putative caregiving influences have not been explored in other large-scale networks. Mind-mindedness and autonomy support, two indicators of the quality of parenting behavior during parent-infant interaction, have been shown to contribute to children's executive functioning (Bernier et al., 2010), socio-emotional competence (Matte-Gagné et al., 2015), social adaptation (Joussemet et al., 2005), theory of mind (Kirk et al., 2015), and empathy (Centifanti et al., 2016), and are therefore crucial aspects of parenting with infants. Given their involvement in cognitive and socio-emotional processes, three brain networks are of particular interest in relation to mind-mindedness and autonomy support: the default mode network (DMN), the central executive network (CEN), and the salience network (SN). The progressive refinement of these networks and their interplay throughout childhood leads to gradually more mature cognitive and socio-emotional functioning (Menon, 2013). The present longitudinal study examined with 28 children whether maternal mind-mindedness and autonomy support during mother-infant interactions predict the functional connectivity of DMN, CEN, and SN in late childhood. Maternal mind-mindedness was assessed when children were 13 months old via a 10-minute free-play sequence between mother and infant. When children were 15 months old, autonomy support was measured while mothers helped their infant complete puzzles designed to be slightly too difficult for them. Videotaped mother-infant interactions were coded with high inter-rater reliability (ICCs = .87 and .86). When children were 10 years of age, they underwent a resting-state functional magnetic resonance imaging exam. Functional connectivity was assessed between key regions of the three networks (see Figure1) using ROI-to-ROI functional analyses. At the second level, multiple regression was performed between connectivity maps and each maternal behavior separately, controlling for child age, sex, and maternal education. The statistical threshold was set at $p < .05$ corrected by false discovery rate. Results revealed that higher mind-mindedness and autonomy support during infancy predicted stronger negative connectivity between DMN and SN regions at 10 years (see Figure 2). Across development, the DMN and SN become increasingly more inversely coupled (Chai et al., 2014; Sherman et al., 2014). Thus, our results suggest that brain connectivity is more mature in children whose mothers were mind-minded and autonomy supportive during infancy, and thus that positive early maternal behavior may promote DMN-SN connectivity development. The findings of this study provide rare evidence that normative variation in parenting quality during infancy may contribute to the development of functional connectivity among typically developing young children.

C: Perception

P2-C-38 The role of maternal phonetic input on their infants' speech perception ability

Minji Nam[1], Youngon Choi[1], Minha Shin[1], Sujin Kim[1], Reiko Mazuka[2]

[1]Chung-Ang University, [2]RIKEN Brain Science Institute

During the past several decades, the acoustic cues for Korean stop contrasts have been going through significant changes. Such changes could have significant consequence on the infant learners of Korean. To date, however, the relationship between the phonetic characteristics of infants' input, i.e., mothers' production of these cues and infants' development of speech perception has not been directly tested. In the present study, 7- to 9-month-old Korean infants' abilities to discriminate a stop sound pair (i.e., fortis versus lenis bilabial sound, [p*u] vs. [pu]) were tested while we also recorded their mothers' production of these and related phonemes in two speech registers: Infant-directed speech (IDS) and Adult-directed speech (ADS) style. Then, we examined the relationship between the mother's acoustic characteristics in IDS and ADS and their infant's ability to discriminate the stop sound pair. Thirty-three Korean mothers read a list of words that included three-way stop categories across three places of articulation (bilabial, alveolar, & velar), embedded in a carrier sentence (e.g., "This is pul (fire)"), five times for each item. We analyzed the differences in VOT, f0, and H1-H2 among three stop pairs in IDS and ADS, respectively. Among these mothers, 20 of their infants also participated in a visual habituation-dishabituation experiment. From these, we obtained individual infant's looking time difference (LTD) score between the same and switch trials; with greater LTD score indicative of discrimination ability. Infants' LTD scores were positively correlated with the infant's age ($r = .577$, $p = .008$), indicating infants' ability to discriminate them were increasing with age.. When mothers' IDS tokens were examined, the VOT difference between the fortis and lenis stops ($r = .507$, $p = .023$), and the VOT difference between the aspirated and fortis stops ($r = .461$, $p = .041$) were positively correlated with infants' LTD scores. No correlations were observed with ADS tokens. Furthermore, the VOT difference between the fortis and lenis stops explained additional 17.6% of variance in infants' LTD scores after controlling for infants' age (R^2 change = .176; $F(2, 17) = 8.817$, $p = .002$; $\beta = .425$, $p = .024$), suggesting that the acoustic characteristics of maternal phonetic input uniquely contribute to their infant's discrimination ability of the phonemes related to these acoustic parameters. We also found that the individual differences in mother's time spending on English book-reading (time dedicated to learning of a foreign language, not the native one) was negatively associated with the infants' LTD scores ($r = -.46$, $p = .041$), further suggesting that the amount as well as the quality of the phonetic input contribute

to the development of speech perception abilities. These results are the first set of data demonstrating the direct link between mother's phonetic input to their infants' phonetic perception abilities. Also, the findings here strongly imply that recent observation on Korean infants' delayed development of lenis-aspirated distinction (Choi et al., 2017) is closely linked to the diachronic change that has occurred to these categories in speakers of recent generations.

P2-C-39 Exploring the relations between exposure to emotion and infants' visual scanning of dynamic emotional faces

Shira Segal[1], Alexandra Marquis[1], Margaret Moulson[1]

[1]Ryerson University

Infants begin to recognize facial expressions of emotion in the first year of life. Improved recognition across the first year may be driven by increased attention to the diagnostic features of emotional faces (e.g., increased looking at the mouth of happy faces; Dollion et al., 2015). However, few studies have examined infant emotion recognition using dynamic faces--a better representation of the emotions encountered in daily life. Additionally, to date there has been little attention to how exposure to emotion predicts the development of emotion recognition in infancy. In the current study, we investigated 7-month-old infants' visual scanning of emotional faces, and linked individual differences in scanning to parent-reported positive and negative affect. Preliminary analyses include data from 14 infants, with data collection from an additional 16 infants in progress. At 3.5 months, the infant's primary caregiver completed the Positive and Negative Affect Schedule (Watson & Clark, 1994), a self-report measure of emotional experience. At 7 months, infants completed the eye-tracking task. Infants saw two dynamic female faces from the Amsterdam Dynamic Facial Expression Set (Van Der Schalk et al., 2011), each expressing anger, fear, happiness, sadness, and neutral. Each video lasted for 6 seconds, and visual fixations were recorded using an eye-tracker. For each face, we calculated two measures of fixation (number of fixations, dwell time) for two interest areas (eyes, mouth). We hypothesized that infants would show differential scanning of the emotions--specifically, increased fixation on diagnostic features (mouth region of happy faces; eye region of angry and fearful faces). We also hypothesized that parent-reported positive affect would be correlated with increased fixation on diagnostic features, whereas negative affect would be correlated with decreased fixation on diagnostic features. For number of fixations and dwell time, we ran 5 (emotion) x 2 (feature) repeated-measures ANOVAs. For both measures, we found the predicted emotion by feature interaction

(fixations: p = .008; dwell time: p < .001; Figure 1). Follow-up analyses confirmed our hypotheses: Infants showed more fixations and increased dwell time to the mouth of happy faces than the mouth of any other emotion (all ps < .05). Infants also showed more fixations and increased dwell time to the eyes than the mouth for angry, fearful, sad, and neutral faces (all ps < .05), but not for happy faces. Thus, 7-month-old infants scan faces differently depending on the expressed emotion, devoting more attention to their diagnostic features. We did not, however, find the predicted correlations between exposure to positive or negative affect and attention to diagnostic features. We did find marginally significant positive correlations between parent-reported positive affect and both fixations to the mouth (r = .46, p = .09) and dwell time on the mouth (r = .48, p = .08), but no correlations between positive affect and attention to the eyes, or negative affect and any measure of attention. It is possible that increased exposure to positive affect earlier in infancy causes an overall bias in infant looking to the mouth of emotional faces.

P2-C-40 Vestibular-visual integration in 3 month-old infants born preterm: A comparison with term infants

Michèle Molina[1], Morgane David[1], Johnny Leveneur[1], Coralie Sann[1], Bernard Guillois[2], François Jouen[3]

[1]Université Caen Normandie, [2]Centre hospitalo-Universitaire, [3]Ecole Pratique des Hautes Etudes

Study's objective: One of the major consequences of prematurity, i.e. any birth occurring before 37 weeks of gestation (Beck, Wojdyla, Say et al., 2010), besides in the modification of the sensorial environment providing neonate with very scarce vestibular stimulation (Moon & Fifer, 2017). Since the seminal work of Eviatar and Eviatar (1979) reporting an immaturity of the vestibular system from the vestibulo-ocular reflex analysis, recent studies confirm a delay in maturation of vestibulo-collic reflex observed up to 6 years of age (Wang, Chen, Hsieh, Young, 2008; Erbek, et al., 2009; Ecevit, Anuk-İnce, Erbek, Özkiraz, Kurt, Erbek, et al., 2012). Following these researches, the question remains to know to what extent ex preterm infants are able to integrate vestibular to visual information in order to assist perception of self-motion (Jouen, Lepecq, Gapenne, and Bertenthal, 2000). Methods: Fifteen preterm (8 girls and 7 boys; Mean age at birth, in weeks: 33+3, range 29-35+4; Mean age at time of testing: 12 weeks, range: 10-14) and 15 term infants (8 girls and 7 boys; Mean age at birth, in weeks: 40, range 39-41; Mean age at time of testing: 13 weeks, range: 10-14) participated in the study. Head postural adjustment consecutive to

bilateral and backward optic flow was recorded along the anterior-posterior sagittal X axis (see figure 1) by mean of an air bag transducer placed inside a semi-circular headrest positioned at level of the infant's head. The air-pressure transducer was connected to a pressure sensor continuously monitoring head pressure at a rate of 300 Hz. Visual stimulations, delivered through two monitors placed on each side of infant's head, consisted of a pattern of vertical alternating black and white stripes sustaining a visual angle of 7.81 degrees. Selected velocities were 5, 10, 15, and 20 cm/sec which correspond to angular perceived velocities of 6, 12, 18 and 24 degrees per second in x direction. Maximum of head pressure was recorded during, 1/ a pre test period during which a criterion of stabilization of the head was looked for and once reached, 2/ a test period during which optic flow was delivered for 15 sec followed by 3/ a post test period during which head stabilization was again looked for. During test period, vestibular time constant, calculated at 33% of the time to reach the maximum of head pressure, was analyzed, as it is directly related to vestibular activation. Results: Results reveals similar head postural adjustment during test period in both group of participants: maximum of head pressure varied according to velocities of optical flow, F (3, 84) = 4.90, p = 0, 003, η^2p = 0.26, head pressure increased with optical flow velocity, F(3, 84) = 2,96, p = 0, 04, η^2p = 0,09. Results reveal that vestibular time constant decrease in term infants as optic flow speed increases whereas it remains unchanged in preterm infants, F(3, 84) = 4,5, p=0,005, η^2p = 0.14. Conclusion : These results, suggesting a deficit in visual-vestibular integration in ex preterm, are discussed according to postural control consequences.

P2-C-41 Cued emotion: Top-down influence of facial expression perception in infancy

Naiqi Xiao[1], Lauren Emberson[1]

[1]Princeton University

It is well-established that learning plays a crucial role in shaping the development of perception and cognitive abilities in infancy. Learning translates experience into knowledge, which leads to adaptive changes in infants' behaviors. Previous studies suggest that infants can use learned knowledge to guide their overt attention: Six-month-olds exhibited anticipatory looking to a location based on learned patterns (Richardson & Kirkham, 2004); Ten-month-olds can use familiar context information (e.g., color, shape, and spatial layout) to facilitate their visual search (Tummeltshammer & Amso, 2017). However, it is unclear whether learning can result in top-down signals that directly shape perception in infants. The current study attempted to address this question by capitalizing

infants' knowledge of the association between emotional vocalization and facial expressions, which is learned in the first few months of life (Kahana-Kalman & Walker-Andrews, 2001). Specifically, we examined whether infants can use emotional vocalization sounds (e.g., laughing) to generate a top-down signal to augment their perception of facial expressions (e.g., happy face). Eighteen 6.5-month-olds and 18 9-month-olds participated in the study. In each trial, infants first heard a 3-second emotional vocal sound (happy/angry). We present the vocal emotional cue first to encourage infants to use this as a top-down cue for later face perception. After bringing their attention to the center of the screen, two face images were presented: one with an emotional expression (happy/angry) and one with a neutral expression. Crucially, these faces were small (2.32˚ * 5.80˚ in visual angle, 3.42% screen size) and far from the center of the screen (11.5˚ visual angle), so that it would be difficult to infants to perceive these stimuli (i.e., weak perceptual signal). The emotional sounds were either congruent or incongruent with the emotional facial expression (e.g., happy-happy or angry-happy, see Figure 1). To determine whether the vocalization biased face perception, we examined infants' initial look from the center of the screen. Suggesting that the vocalization biased their peripheral perception of the faces, infants' initial looks showed a strong congruency effect. Nine-month-olds were faster to saccade to an emotional face that was congruent with the vocalization compared to incongruent. This congruency effect was found to be significant in both the happy and angry face conditions indicating that infants are not simply biased to look at emotional faces (Figure 2). Moreover, the congruent vocalization resulted in a longer looking at the corresponding emotional face than the incongruent, which emerged emerges by 200 ms after the presentation of the faces. By contrast, none of the congruency effects were found in 6.5-month-olds, suggesting the ability to use emotional vocalization sounds to shape face perception developed after age despite their ability to match emotional faces and vocalizations. These findings provide some of the first evidence that infants can use knowledge to directly bias their perception in the absence of overt attentional shifts. This work suggests that top-down influences in perception are available early in life and might be part of the means by which experience shapes perception.

P2-C-42 Sex differences in face attention capture and holding in 2-month-old infants

Sarah Maylott[1], Krisztina Jakobsen[1], Elizabeth Simpson[1]

[1]University of Miami

Much like adults, infants quickly detect conspecific faces in complex visual environments. Six-month-old infants look more quickly and longer to human faces than other images in heterogeneous visual arrays (Jakobsen et al., 2016). Not all infants, however, show the same patterns of preferential attention to human faces. At six months of age, female infants look longer at human faces presented in complex visual displays than do males (Gluckman & Johnson, 2013). Even in newborns, females look longer to a face while males look longer to a non-face object (Connellan et al., 2000). However, little is known about sex differences in early infancy, and studies to date have only presented infants with one or two images simultaneously. Here we explored whether we could reliably track 2-month-old infants' gaze patterns with complex stimulus arrays using eye-tracking. Notably, this is the earliest age tested with this method in human infants. We examined 2-month-old infants' attention to human faces, chimpanzee faces, and non-face objects in heterogeneous image arrays (Figure 1). We predicted that 2-month-olds would exhibit faster and longer looking to human faces compared to the other stimuli, reflecting efficient attention capture and holding. Sixty-one infants (31 females) viewed a series of up to 24 arrays, each with one face (human or chimpanzee) and three non-faces for 8 seconds, while we tracked their attention with an eye-tracker. A 3 (Stimulus type: human face, chimpanzee face, non-face) × 2 (Infant sex: male, female) ANOVA revealed an interaction, $F(1,57)=9.69$, $p=.003$. Follow-up paired-samples t-tests showed that male infants were faster ($t(29)=2.11$, $p=.047$, $d=0.81$) and looked longer ($t(29)=2.11$, $p=.037$, $d=0.54$) to human faces compared to non-faces (Figure 2). Females, in contrast, were faster to look to non-faces than human faces ($t(30)=2.25$, $p=.036$, $d=0.57$) and looked equally long to human faces and non-faces ($p>.05$). There was no sex difference in total looking time overall nor any differences for chimpanzee faces ($p>.05$). Unlike previous studies (e.g., Connellan et al., 2000), we found that, for 2-month-olds, human faces capture and hold attention more in males than females. Though speculative, one possible interpretation is that male and female infants display different rates of face detection specialization, with males showing earlier attentional preferences than females. From an evolutionary perspective, given that male infants are more vulnerable than female infants (DiPietro & Voegtline, 2017), another possibility is that it may be an adaptive strategy for male infants to attend more to faces early in development to increase parental care. Alternatively or additionally, sex differences may be due to differential treatment by parents (Simpson et al., 2016). Our seemingly contradictory findings with previous studies may be due to differences in methodology. Our stimuli were more complex than previous studies and the present study is the first to successfully use eye-tracking at such an early age. It is important to replicate the present findings to ensure that they do indeed reflect a true sex difference.

P2-C-43 Infant perception of human action from visual and auditory information: an ERP study

Elisa Roberti[1], Ermanno Quadrelli[1], Chiara Turati[1], Elena Geangu[2]

[1]University of Milano-Bicocca, [2]University of York

Multisensory integration is key to action comprehension, allowing a more accurate understanding of the surrounding events than the unimodal perception. Although these multi-modal interactions have a long history of research in adults (Ryan, 1940; Van der Zwan et al., 2009), less is known about how similar mechanisms develop in the first years of life. Research in the field of action processing development has mostly used unimodal stimuli, either visual (e.g., Lloyd-Fox, Marshall & Shipley, 2009; Blasi & Elwell, 2010) or auditory (e.g., Geangu, Quadrelli, Lewis, Cassia & Turati, 2015). A wider series of studies however suggest that infants already have the means to represent objects, people and events through coherent integration of information from multiple senses (Slater & Kirby, 1998; Hyde, Jones, Porter & Flom, 2009). Our study attempts to address the knowledge gap in the issue of multisensory integration in action comprehension. Using a semantic priming paradigm we investigated whether and the extent to which action sounds are processed as being related to the corresponding visual information in 7-month-old infants. We recorded event-related potentials (ERPs) while infants heard human footsteps or hand claps sounds following congruently or incongruently by point-light displays (PLDs) depicting these actions. Preliminary analyses suggest that hearing target action sounds incongruently preceded by the PLDs elicits in infants increased attention irrespective of the condition, as indicated by the frontal Nc (350-600 ms). The N400-like (950-1200 ms) component recorded at central locations only showed sensitivity to the incongruence between the auditory and visual information for the walking action. These results suggest that, at this early stage of development, the integration between visual and auditory information related to human actions occurs at perceptual level for different types of actions, but that the sensitivity to semantic incongruity may be limited to the most familiar actions.

P2-C-44 Prosody outweighs statistics: evidence from German

Mireia Marimon[1], Barbara Höhle[2]

[1]University of Potsdam, [2]Justus-Liebig-Universität Gießen

It is well established that infants are able to segment fluent speech into words from about 7-8 months of age (Höhle & Weissenborn, 2003; Jusczyk & Aslin, 1995). Research suggests that they use at least two mechanisms: prosodic cues, especially the word stress pattern (Jusczyk, Houston & Newsome, 1999; Höhle et al., 2009), and statistical learning, i.e. transitional probabilities (Saffran, Aslin & Newport, 1996; Aslin, Saffran & Newport, 1998). However, weight of these two mechanisms has been found to differ across ages. Thiessen & Saffran (2003) found that, when prosodic and statistical cues indicated different word boundaries, 7-month-old English learning infants relied more on the statistical cues, whereas 9-month-olds relied more on the prosodic cues. Following these results, we tested German learning infants on their weight of prosodic and statistical cues in segmentation. Based on the finding of an early trochaic bias in German learning infants (Höhle et al., 2009) we expected German infants to rely more heavily on prosodic compared to statistical cues. We tested 7 (n = 24) in the HPP procedure. They were familiarized with a 2-min artificial iambic language string recorded by a German speaker, in which the prosodic and the statistical cues indicated different word boundaries: a segmentation in trochaic feet would result in bisyllabic words with lower internal TPs (prosodic words) than a segmentation based on statistical information (statistical words). After familiarization infants were presented with the prosodic words, the statistical words and non-words (bisyllabic sequences combined from syllables that never occurred adjacent in the string). Our results revealed shorter listening times to prosodic words compared to statistical ($p = .02$) and to non-words trials ($p = .02$) while there was no difference between statistical words and non-words ($p = .94$). We interpret these results as a novelty effect, showing that - unlike their English-learning age-mates - German learning infants weight prosodic information more heavily than statistical information already at an age of 7 months. This is evidence that segmentation skills are affected by specific properties of the ambient language from very early on. Furthermore, infants' later language scores was assessed with the ELFRA-1 test at 12 months of age. We found a positive correlation between the novelty effect in the HPP task and the later vocabulary scores in the ELFRA test ($r = .38$, $p = .04$), suggesting that relying on prosodic cues might be an indication for later language development. The implications of these findings will be further discussed.

P2-C-45 Visual exploration strategies in 10-month-old infants' processing of adult and child faces

Stefania Conte[1], Valentina Proietti[2], Hermann Bulf[1], Viola Macchi Cassia[1]

[1]University of Milano-Bicocca, [2]Nipissing University

There is mounting evidence that during the first 6 months of life the majority of infants' facial experience is with individuals who share the same demographic characteristics (i.e., ethnicity, age group and gender) as their primary caregiver (Rennels & Davis, 2008; Sugden et al., 2014). This biased experience allows infants to build a perceptual representation that progressively adapts to include diagnostic attributes of the more familiar face categories, and drives the attunement of infants' brain circuitries towards these categories. Accordingly, by the end of the first year of life, infants use more expert visual exploration strategies to process faces of the most familiar race in comparison to other-race faces (Gaither et al., 2012; Liu et al., 2011). The aim of our study was to extend this evidence by comparing visual exploration strategies used by 10-month-old infants in the processing of adult and child faces. Indeed, 9-month-old infants show selective brain responses (Kobayashi et al., 2016) and superior discrimination abilities (Macchi Cassia et al., 2014; Proietti et al., in press) for adult faces compared to infants or child faces. Here we investigated whether these specialized responses to adult faces are associated to the use of differential visual scanning strategies, as revealed by eye-gaze fixations. Two groups of 10-month-old infants were habituated to adult (N=22) or child (N=22) faces while their eye-movements were recorded using an ASL eye-tracker. One-sample t-tests performed on novelty preference scores during test trials confirmed earlier demonstrations of infants' superior discrimination of adult faces, as participants showed a significant novelty preference for adult faces [$p = .001$] but not for child faces [$p = .11$.] To analyze looking behavior during the habituation phase we defined four Areas of Interest (AOIs): eyes, nose, mouth, whole face (Fig.1). A 2 (habituation trial: first three, remaining trials) x 3 (AOI: eyes, nose, mouth) x 2 (face age: adult, child) ANOVA revealed a significant AOI x Face Age interaction for proportion of looking time, $F(2,84) = 3.22$, $p = .045$, and number of visits per second, $F(2,84) = 3.93$; $p = .023$ (Fig.2): the mouth region was fixated longer [$p = .03$] and more frequently [$p = .01$] in adult faces than in child faces, whereas the eyes were sampled more frequently in child faces than in adult faces [$p = .04$]. Moreover, in child face only fixations were longer and more frequent on the eyes and nose regions than on the mouth [$ps < .01$]. A 2 (habituation trial) x 2 (face age) ANOVA revealed a Face Age main effect, $F(1,42) = 8.21$, $p = .006$, indicating that the distance covered by fixation shifts performed within the whole face AOI was smaller for adult faces compared to child faces, which is suggestive of a more efficient scanning strategy for the former compared to the latter face type. Results show that infants adopt specific scanning strategies while exploring adult faces, for which the mouth is the most salient feature at an age when infants are engaged in making sense of linguistic input.

P2-C-46 Visual Analysis of Form and Contour in Infants and Adults

Clay Mash[1], Christine Wei[1], Marc Bornstein[1]

[1]NICHD/NIH

Visual stimuli containing illusory contours (IC) have a long history of use in vision research because they reveal the constructive nature of visual perception. Reliably and robustly, edges are perceived that are not actually there but whose presence instead is induced by surrounding elements. Previous studies reveal an early onset of IC detection, and suggest that perception is constructive throughout the lifespan. Investigation of the factors involved in such form construction processes is leading to important advances in understanding vision. One such factor is the role of discrete eye movements in the construction of forms, and in the extraction of edges. Do edge or form fixations differ between illusory and real conditions? The present work examined this question with a particular focus on age differences between infants and adults. Infants and adults viewed stimulus forms having either real or illusory contours while their visual scanning and fixations were measured. Sixteen healthy infants (M age = 156.3 days, SD = 8.9; 9 females) and 12 adults (M age = 26.1 years, SD = 6.0; 9 females) participated. Stimuli were Kanizsa squares composed of four circular inducing elements (Figure 1a) and Kanizsa forms modified with the addition of real contours. Both patterns were presented with white inducing elements on black backgrounds and black inducing elements on white backgrounds. A remote-optics eye tracking system was used to measure fixations for each stimulus image. Stimuli were presented on a monitor situated 60 cm in front of the participant, while visual fixations were measured with the eye tracker. Each of the 4 stimuli were presented over 16 trials for 10 s each. For infants, animated cartoon figures were presented between trials to sustain their attention to the stimulus monitor. Fixations of both induced and real inter-element contours (see Figure 1b), were taken as evidence for the extraction of edges. Fixations internal to contours were taken to reflect the detection of coherent whole forms (Figure 1b). Analysis of contour fixations revealed that infants and adults alike looked more at contours when they were illusory than when they were real, $F(1,26) = 9.95$, $p = .004$ (Figure 2a). Contour fixations and scanning are interpreted as perceivers' exploration for extraction, and thus reveal comparable effort and strategy across ages. Fixations of the forms, however, differed by age. When contours were real, infants' form fixations exceeded those of adults, $F(1,26) = 8.67$, $p = .007$ (Figure 2b). When contours were illusory, adults looked more at forms than infants, $F(1,26) = 6.40$, $p = .018$ (Figure 2b). For perceptually binding figures into forms, infants appear more dependent

on real contours than do adults. Together the findings reveal both continuity and change in the analytic and constructive perception of visual forms.

P2-C-47 Infants showing the other-race effect use different gaze patterns for same-race and other-race faces

Anna Krasotkina[1], Antonia Götz[1], Barbara Hoehle[2], Gudrun Schwarzer[1]

[1]Justus-Liebig-Universität Gießen, [2]University of Potsdam

The other-race effect (ORE) is a well-known phenomenon characterized by poorer discrimination ability for faces from other ethnicities compared to faces from one's own ethnicity (Meissner & Brigham, 2001). Although much attention has been paid to this topic in recent years, the origin of the ORE is still not fully understood. One possible explanation for the emergence of the ORE is that when growing up in a mono-ethnic environment, infants learn special gaze-patterns for examining same-race faces, which might be suboptimal for other-race faces. Thus, the aim of our study was to search for differences in gaze-patterns in infants already showing the ORE, in order to test for a connection between the ORE and gaze-behavior. We conducted an eye-tracking experiment with 62 (German) Caucasian 9 month-old- infants randomly assigned to one of two conditions: same-race female Caucasian faces, or other-race female Asian faces. We used a subject-related habituation-dishabituation procedure with a maximum of 18 trials, and a habituation-criteria of 50% from the first three trials. After habitation, infants were tested on face discrimination with sequentially presented novel and habituated faces. To calculate differences in infants' gaze behavior during habituation, we divided each face into 3 AOIs: eyes, nose, and mouth. Fixation duration was calculated as a proportion of the total fixation time towards the entire head, and fixation shifts between different AOIs were also tallied. Our results show that during habituation infants indeed used different gaze strategies for same- and other-race faces. While infants showed a high fixation-proportion on the AOI of the eyes at the start of habituation for both same- and other-race faces, as habituation continued, infants in the two condition started to display differing gaze-patterns. For same-race faces, infants maintained high fixation-proportions towards the eyes, and significantly increased fixation on the mouth. Conversely, for Asian faces, infants significantly decreased fixation-proportion towards the eyes (Table 1). Regarding fixation shifts between AOIs, infants made more shifts overall when looking at same-race faces compared to other-race faces. Specifically, infants made significantly more fixation shifts between the eyes and nose, and between the eyes and mouth when looking at same-race faces compared to other-race faces (Table 2). Together, these

differences indicate that while infants initially focus on the eye region in both conditions, infants looking at other-race faces then proceed to distribute their attention haphazardly across the whole face, while infants looking at same-race faces continue exploring the eye region throughout habituation. These differences cannot be explained by a lack of interest by the infants towards stimuli in either category, because they showed no significant differences between the numbers of habituation trials, or the time spent looking at face-stimuli during habituation across the experimental conditions. During the test trials, the same infants also showed a significant novelty preference in the same-race condition, but not in the other-race condition, clearly demonstrating the ORE. Thus, our results show that difficulties in discrimination between other-race faces could be linked to differences in the gaze patterns infants use to study same- and other-race faces.

P2-C-48 Infants rapidly detect human faces in complex visual scenes

David Kelly[1], David Meary[2], Sofia Duarte[1], Olivier Pascalis[2]

[1]University of Kent, [2]University Grenoble-Alpes CNRS

Newborn infants display a visual interest in faces (Johnson & Morton, 1991). The two-process theory of face processing asserts that a low-spatial frequency face detection system, termed Conspec, is subcortical, exists at birth, and directs foveal attention towards face-like stimuli during the first 2 months of life. A secondary system, Conlearn, is cortical, facilitates other aspects of face processing and develops as a consequence of visual input. However, there is a paucity of research investigating face detection in the first year of life; the ability to rapidly align the fovea with a face located in the visual periphery. This reflexive action is ubiquitous in everyday visual behaviour and allows us to extract social information and assess threat from our visual environment while simultaneously disregarding less relevant details. Faces seemingly represent a distinct class of visual salience for adults (Mackay et al. 2012) and they can be detected in just 100 msecs (Crouzet et al.). However, no existing infant study has investigated face detection in complex visual scenes with previous work using a binary presentation (De Nicola et al., 2003) or circular array (e.g., Gluckman & Johnson, 2013). Additionally, past studies are constrained by small sample sizes, limited age ranges and high data loss. We analysed data from 241 infants comprising four age groups (3-, 6-, 9- and 12-months), recorded eye movements at 500Hz with low data loss. Infants sequentially viewed 4 scenes that contained a face and 4 scenes that did not, each for 5 secs (See Figure 1; F1). A face was detected if the first saccadic movement post-stimulus onset was directed to the face (See Figure 2). We distinguish this behaviour from finding, which occurred if the face was

fixated at any point during a trial. Unequivocally, infants rapidly detect faces, even in visually challenging conditions. A linear age-related increase was seen for detection ($F(3, 237) = 24.085$, $p < .001$, $\eta p2 = .258$) but hugely exceeded chance for all ages groups ($t3 (22) = 11.665$; $t6 (64) = 29.780$; $t9 (82) = 38.707$; $t12 (71) = 55.903$; all $ps < .001$). An age-related decrease in Face Detection Onset ($F(3, 224) = 9.111$, $p < .001$, $\eta p2 = .109$) was found. From a maximum of 4, each age group (3, 6, 9 & 12 months) detected on average .91, 2.09, 2.46 and 2.87 faces with average saccadic latencies of 850, 600, 440 and 420 msecs respectively. In terms of face finding, rates are nearly at ceiling for all age groups. Analysis of face detection peak saccadic velocity data revealed no age related differences ($F(3, 555) = .587$, $p = .624$, $\eta p2 = .003$; See F1). Saccadic detection amplitudes (i.e. movement from the screen centre to the face) differed across images (See F1) and were highly correlated with Peak Saccadic Velocity ($r = .968$, $p < .001$; See F1). Infants consistently and accurately detected faces regardless of their visual salience, despite being unable to predict: their presence or spatial location, the small retinal size subtended, an absence of visible sclera and substantial competing visual information. We believe that this is by far the clearest, most comprehensive, and impressive demonstration of face detection ever reported in an infant population and supports the view that faces represent a unique class of stimuli. It is currently unclear whether this behaviour is driven by Conspec or a different mechanism.

P2-C-49 Variation in the influence of bottom-up and top-down features on adult-like gaze

Kellan Kadooka[1], John Franchak[1]

[1]University of California, Riverside

Eye movements when watching complex video media become more adult-like over the first two years; infants increasingly fixate the same locations at the same time as adult observers do (Franchak, Heeger, Hasson & Adolph, 2016). Both bottom-up (e.g. image salience) and top-down (e.g., faces) information predicts adult-like gaze even after controlling for effects of age; infants who spent more time looking at salient locations and at faces showed more adult-like eye movements patterns. However, because prior work tested only a single stimulus, it is unclear whether there are consistent age-related changes in adult-like gaze in stimuli that vary in content. Moreover, it is unknown whether bottom-up and top-down features would consistently predict adult-like gaze across a larger stimulus set. The current study recorded the eye movements of 104 children (6 months to 10 years) and adults while freely viewing six child-friendly media clips. Video

clips were selected to present complex, dynamic scenes that varied on several features, such as number of agents and types of actions. A single adult-like gaze score was calculated for each child for each video by measuring the spatiotemporal agreement of gaze locations between each child and a group of comparison adults; greater values indicate that children more often looked where adults looked. To measure bottom-up influences on gaze, the average rank of visual saliency for pixels within a 1.5 degree radius around the point gaze was calculated on each frame using the standard Itti, Koch, & Niebur saliency algorithm (1998). Saliency scores were averaged over the duration of each video to obtain a mean gaze saliency score, with higher scores indicating that participants more often looked at relatively salient locations. To measure top-down influences, dynamic region of interest analysis determined the proportion of time spent looking at faces when faces were in view. Across the six videos, adult-like gaze increased consistently with age, with the most rapid changes occurring during infancy (Figure 1). However, bottom-up and top-down features were inconsistent in predicting children's adult-like gaze scores across videos (Figure 2). For video 1, neither face looking or gaze saliency predicted adult-like gaze. Adult-like gaze for video 2 was predicted by face looking but not gaze saliency, whereas adult-like gaze in videos 4, 5, and 6 was predicted by gaze saliency but not face looking. Video 3 was the only video that could significantly be accounted by both face looking and gaze saliency. This indicates that bottom-up and top-down orienting to salient locations and faces are insufficient on their own to explain the development of adult-like gaze behaviors in infants and children. Most likely, mature eye movement patterns are not simply about the amount of looking towards specific types of features but also the temporal aspects about when to look. Ongoing analyses measure the temporal alignment of gaze towards faces and salient locations between different observers, which could better account for the changes observed in adult-like gaze.

P2-C-50 Behavioral Reaction of 10-month-old infants to Dynamic Facial Expressions

Alexandra Neenan[1], Emily Touchstone[1], Mariah Fowler[1], Melanie Spence[1]

[1]The University of Texas at Dallas

Previous research suggests that 10-month-old infants categorized dynamic versions of happy and disgust facial expressions (Touchstone, Spence & Atchison, 2008). Infants were shown 8 different female faces (3-s looped videos) displaying either happy or disgust expressions, followed by a novel face displaying the alternate expression (e.g., happy familiarization followed by disgust test trial or disgust familiarization followed by happy test trial). Mean fixation time to stimuli decreased across familiarization but increased to

the novel expression test trial in both conditions ($F(1, 41) = 11.26$, $MSe = 24.65$, $p = .002$) , providing support that infants categorized the facial expressions. Although the results provide evidence for perceptual discrimination and categorization based on some perceptual features of the expressions, the mean fixation data do not indicate if infants responded to the specific emotions displayed or the different valences of the expressions (e.g., positive happy vs. negative disgust). To examine if infants were sensitive to the emotional valence of happy and disgust expressions, video recordings of each infant's experimental session were coded by two blind raters. Using The Maximally Discriminative Facial Movement Coding System or MAX (Izard, 1979, 1995), facial action changes on each infant's face (n=32) were coded during the first 6 s of familiarization trials 2 and 3. MAX is based on coding facial muscle movements in 3 facial regions, and combining these action changes to identify patterns that are consistent with specific emotional expressions. This study coded each facial action pattern as reflecting a positive, negative, or neutral expression. For infants viewing happy (positive valence) expressions, 23.91% of their facial action patterns were coded as positive, 8.7% coded as negative and 67% coded as neutral, while for infants viewing disgust (negative valence), 9% of their facial action patterns were coded as positive, 46% coded as negative, and 44% coded as neutral. While this data provides some information about infants' reactions to these two different emotional expressions, additional observations of other infant movements and behaviors may contribute to interpreting infants' processing and understanding of the displayed expressions. Coding of infant behavior is currently underway and will also be presented. Behaviors that indicate engagement with the images (e.g., pointing, waving, social referencing), distraction (e.g., look away, manipulate clothing, parental contact), vocalizations (e.g., babbling, crying), and facial expressions (e.g., specific movements of mouth, eyes, eyebrows) are included in the coding scheme. This data will provide more detailed information about how 10-month-old infants may interpret dynamic happy and disgust facial expressions and contribute to interpretation of habituation results using fixation time measures.

P2-C-51 Body Processing and Attentional Patterns in Infancy

Rachel Jubran[1], Hannah White[1], Ramesh Bhatt[1]

[1]University of Kentucky

Bodies are important sources of information in social settings. Studies with adults have shown that bodies are good indicators of emotion; in fact, they are even better at conveying peak emotions than faces (Aviezer, Trope, and Todorov, 2012). Additionally,

bodies convey a person's goals and desires, sometimes subconsciously, through the use of body language (Fast, 1988). Considering the wealth of knowledge that bodies convey, it is important to understand the development of body representation. It has been found that infants as young as 3.5 months of age exhibit a preference between a body that is intact versus one that contains body parts in the wrong locations (Zieber, Kangas, Hock, & Bhatt, 2015). However, it is unknown how fine-grained this sensitivity is, or whether infants show specialized scanning patterns of normal and reorganized bodies. If infants attend to the specific regions on the body that have undergone an unnatural change, it would indicate that not only can they discriminate between normal and reorganized bodies, but also that they are sensitive to the precise nature of the distortion rather than responding to the overall gestalt of the body (i.e., seeing that something on the body is atypical, but not necessarily attending to the specific distortions). To examine this issue, five-month-olds (n = 24) were sequentially presented with images of normal and reorganized bodies displayed one at a time in the center of the screen (Fig. 1). The two types of stimuli were presented in random order, with the same type of image never being presented more than twice consecutively. Infants' looking was recorded using a Tobii Tx300 eye-tracker. Areas of interest (AOIs) were defined as a rectangle around the entire stimulus and the specific areas of manipulation, which were the joints at which limbs were attached to wrong locations (Fig. 1). AOIs were identical on both the normal and reorganized image to allow for direct comparison between the two image types. The dependent measure was the proportion of fixation duration to the joint AOIs. Increased looking to the reorganized joints would indicate that infants are sensitive enough to the typical structure of bodies to isolate the specific parts of the body that deviate from normal. A paired samples t-test revealed that infants looked proportionally more to the joints in the reorganized stimuli (M = 7.85%, SD = 5.81) than to the joints in the normal stimuli (M = 5.31%, SD = 3.99), $t(23) = 2.29$, $p = .031$ (Figure 2). Thus, we found evidence that infants at 5 months of age do attend to specific regions in body images that have been distorted, suggesting a sophisticated representation of bodies early in life. This finding is consistent with the growing body of work indicating that body representation develops early in life.

P2-C-52 Testing the developmental foundations of cinematic continuity

Sermin Ildirar[1], Tim Smith[1]

[1]Birkbeck, University of London

To make sense of moving images viewers need to perceive the continuity across film cuts. In the early days of cinema, most films filmed in a single run (no cut) from a static camera. Shortly thereafter filmmakers combined multiple shots to create more compelling visual narratives. A suite of editing conventions that allowed viewers to effortlessly perceive continuity across film cuts emerged through trial and error. Most of these conventions permeate much of visual media -including infant-directed ones- today. One of these conventions is the eye-line match between two juxtaposed shots, which is based on the premise that an audience will want to see what the character on-screen is seeing. A film sequence with an eye-line match begins with a character looking at something off-screen, followed by a cut of another object or person. From a developmental perspective, this refers to gaze following, which typically begins to emerge very early in infancy (D'Entremont et al. 1997; Farroni et al. 2004; Hood et al. 1998; Scaife and Bruner 1975). In an eye tracking study gaze following emerged between 2 and 4 months and stabilized between 6 and 8 months of age (Gredeback et al., 2010). A recent study (McClure, Chentsova-Dutton, Holochwost, Parrott, Barr, 2017) examining gaze following across video chat showed a similar developmental trajectory for gaze-following in videos as in the real-world (McClure et. al.,2017). It is not known however if the infants would still be able to follow the gaze of the others on screen if the videos were edited. As a matter of fact, adults who have never previously encountered moving images perceive film shots as individual images (Ildirar & Schwan, 2015). In the present study, we examined the role of film editing on infants' ability to follow other's gaze. Twelve-month-old Infants (N=20) and adult controls (N=20) watched videos depicting a model turning her head toward one of two objects either in a single long shot as in traditional gaze following studies or in two multiple shots edited together, one of which shows the model turning her head and the other shows the gazed-at object as in commercial infant-directed videos. Participant eye movements were recorded using a Tobii TX300. Each video ended with a still long shot showing the model and the two objects, one of which had previously been gazed-at. Analysis of gaze behavior during this test shot showed clear gaze following in the adult control group (increased dwell time on the gazed-at object compared to the other object) for both edited and unedited versions. Data collection for the infant sample is on-going but preliminary results indicate that 12 month-olds can successfully follow gaze in the unedited version but are less successful across edits.

P2-C-53 Seven-month-old Infants' Visual Preference for Real Objects Over Pictures Is Related to Their Manual Object Exploration

Theresa Gerhard[1], Jody Culham[2], Gudrun Schwarzer[1]

[1]Justus-Liebig-Universität Gießen, [2]Western University

From early in life, infants encounter real, physical objects in their environment as well as pictorial representations of those objects. Interestingly, when presented with both object formats at the same time young infants prefer to look at real objects instead of their picture versions (DeLoache et al., 1979; Gerhard, Culham, & Schwarzer, 2016), indicating a distinct visual processing of real objects and pictures. Research focusing on the relationship between motor development and perceptual capabilities has uncovered positive effects of infants' manual object exploration skills on the visual processing of various object properties. Specifically, Soska et al. (2010) provided evidence that sophisticated exploratory actions such as fingering, rotating, and transferring objects foster infants' understanding about the three-dimensional nature of objects. Therefore, it was the primary goal of the present study to examine whether 7-month-old infants' visual preference for real objects and corresponding pictures is related to their manual object exploration behavior. By using a preferential looking paradigm and measuring infants' looking times, in three 15-sec trials, 59 7-month-old infants were presented with a real toy next to its picture version. All of the infants also participated in a manual object exploration task (see Soska et al., 2010), in which they were allowed to freely explore five toy blocks. Our analyses revealed that, overall, the 7-month-olds in this study preferred to look at real objects over corresponding pictures, $F(1,51) = 6.62$, $p < .05$, partial ç2 = .115. Notably, however, this preference for real objects was dependent on infants' behavior in the manual object exploration task, $F(1,51) = 7.45$, $p < .01$, partial ç2 = .127. Infants with a high score in fingerings significantly preferred to look at the real objects, $t(28)_{\text{real objects}} = 5.04$, $p < .001$, $d = 0.93$, whereas infants with a low score in fingerings showed no preference for either of the two stimulus formats, $t(29)_{\text{real objects}} = -0.05$, $p > .05$, $d = -0.01$ (Figure 1). These results provide evidence that 7-month-olds' spontaneous visual preference for objects is affected by their stimulus format. In accordance with previous findings (DeLoache et al., 1979; Gerhard, Culham, & Schwarzer, 2016), they preferred to look at real objects when presented with both object formats side-by-side. Moreover, our findings suggest that experience with specific exploratory actions might improve infants' understanding of the differences in form regarding real objects and corresponding pictures.

P2-C-54 The role of multisensory cues in training infants to attend to object features

Natasa Ganea[1], Jiale Yang[1], Andrew Bremner[1]

[1]Goldsmiths, University of London

Selectively attending to particular properties of a perceptual event is a skill that infants acquire in their first year of life. The Intersensory Redundancy Hypothesis (Bahrick & Lickliter, 2012) argues that the presence of multisensory redundancy influences the event properties to which infants attend during an episode of exploration. In the current study, we investigated the role of spatiotemporally aligned visual and auditory cues in training infants' attention to object features in a group of 10-month-old infants. We habituated the infants to an event depicting a ball that made a translational motion behind an occluding box. The motion of the ball was presented either in silence (unisensory condition), or it was accompanied by a musical sound. The sound either appeared to be located centrally with respect to the display (non-spatial multisensory condition), or moved dynamically with the ball as it travelled across the display (spatial multisensory condition). Following habituation, the infants watched in silence the familiar occlusion event (no change), or a novel event in which the ball changed pattern during occlusion (change). The habituation condition had differential effects on the infants' looking at the two test events. The infants in the unisensory habituation condition looked significantly longer at the change event than at the no change event, while the infants in the spatial multisensory condition looked equally long at the two types of events. These results show that the presence of multisensory cues influences 10-month-old infants to attend to different properties of an occlusion event depending on whether auditory and visual cues to that event originate from the same place in space. This provides support for the proposal that intersensory reducndancy distracts infants from unisensory features of objects (Bahrick & Lickliter, 2012).

D: Communication and Language

P2-D-55 Fifteen-month-olds' identification of words containing cross-accent consonant versus vowel differences

Karen Mulak[1]

[1]Western Sydney University

To recognize and identify words, children must grasp when phonetic variation precludes a word from lexical selection (e.g., recognizing that "bat," cannot be "cat": phonological distinctiveness), but must also recognize that some variation from native productions is permissible, such as that found across accents (e.g., recognizing the Australian English [AusE] "noice" as the word "nice" in American English: phonological constancy; Best et al.,

2009). Phonological constancy does not appear to be present at 15 months. In a prior study, AusE-learning infants were shown two images on a screen corresponding to high frequency nouns (e.g., a cat and a dog). A recording either in their native AusE, or in an unfamiliar Jamaican Mesolect English accent (JaME) asked them to look at one of the images (e.g., "Look at the [dog]!"). Fifteen-month-olds looked more to the named object when spoken in their native AusE, but not in JaME, indicating failure to recognize the accented pronunciations. Nineteen-month-olds recognized the words in both accents (Mulak et al., 2013), aligning with other findings suggesting cross-accent word recognition emerges around 19-20 months (e.g., Best et al., 2009). The complementary skill of phonological distinctiveness does not seem robust until approximately 19 months, but at 15 months, infants show some success in detecting mispronunciations to consonants, but not vowels (e.g., Mani & Plunkett, 2007). The JaME accent in Mulak et al. (2013) was highly variant in both consonants and vowels relative to AusE. However, the experiment tested the effect of gross cross-accent variations, rather than specific phonetic changes within words. Infants' ability to recognize cross-accent phonetic variation to consonants and vowels may develop separately. Infants acquire their native vowels before consonants, consonants are perceived more categorically than vowels, and consonants have more of a role in lexical identity in English. Further, their ability to recognize words despite cross-accent variation may be disrupted further when a particular phonetic variant maps to a different phonemic category, rather than the same category. We tested AusE-learning 15-month-olds' word recognition in an accent containing consonant (southeast London) or vowel (Tyneside) differences relative to AusE using a similar procedure to Mulak et al. (2013). Phonetic differences in each accent were expected to map either to the same or to a different phonemic category in AusE. No word recognition was found during the first of two word repetitions, but during the second repetition, 15-month-olds recognized words containing same-category consonant differences ($p = .018$), suggesting that consonant variation may be more readily handled. In conclusion, early cross-accent perception appears to be affected by the nature and size of phonetic differences. Despite their failure in previous work when presented with global cross-accent variation, at 15 months infants recognize words that contain cross-accent differences to consonants that do not violate their native phonetic category boundaries, but fail to recognize words in the face of cross-vowel differences, mirroring results from research on phonological distinctiveness showing earlier development for consonants than vowels. Ongoing research with 19-month-olds will explore the developmental course further.

P2-D-56 Word Learning Following Speech Disfluencies in Monolingual and Bilingual 32-month-olds

Elizabeth Morin-Lessard[1], Krista Byers-Heinlein[1]

[1]Concordia University

Speech disfluencies such as "uh" are frequent in natural speech across languages (Cutler, 1981). Disfluencies are often produced before new words (Arnold et al., 2003), and can be used by monolingual (Kidd et al., 2011; Orena & White, 2015) and bilingual (Morin-Lessard & Byers-Heinlein, submitted) children during comprehension to predict that a speaker will label a novel object. Do disfluencies also play a role in word learning? One possibility is that by cueing children to look at novel objects, disfluencies may facilitate the learning of their label. Another possibility is that disfluencies might signal a speaker's uncertainty about a word's label, and children may choose not to learn words from a speaker who has been unreliable or verbally inaccurate (Brooker & Poulin-Dubois, 2013; Kim et al., 2012). We tested these competing hypotheses with monolingual and bilingual children, and investigated the role of different language experiences with disfluencies in word learning. [Participants & Procedure] In a preferential-looking eyetracking paradigm, 16 monolingual (English or French) and 16 bilingual (English-French) 32-month-old children saw trials in their native (monolinguals) or dominant (bilinguals) language. The study consisted of two consecutive blocks, each with 8 learning trials that exposed children to labels for two novel objects (moba and voopie), and 4 test trials. On learning trials, children saw two objects (one familiar, one novel), with one always labeled in a fluent sentence (e.g. "Look at the door/moba!") and the other in a disfluent sentence (e.g. "Look at the uh chair/voopie!"). On test trials, participants saw the two novel objects side-by-side, and one object was labeled twice (e.g. "Moba! Moba!"). Word learning was assessed by the proportion of looking to the target object in the 2 seconds following the first target word label. [Results & Discussion] Data was analyzed by block. In Block 1, monolinguals' looking to the target did not differ from chance (.50) on either fluent, $t = -0.23$, $p = .82$, or disfluent, $t = 1.62$, $p = .13$, trials. Looking for bilinguals was at chance on fluent, $t = -0.75$, $p = .57$, and on disfluent, $t = 1.17$, $p = .26$, trials. In Block 2, monolinguals looked at the target significantly below chance on fluent trials, $t = -2.45$, $p = .03$, and their looking was at chance on disfluent trials, $t = 1.31$, $p = .21$. Bilinguals' looking did not differ from chance on either fluent or disfluent trials, $t = -0.54$, $p = .61$, and $t = -0.98$, $p = .36$, respectively. Surprisingly, we found no evidence of word learning: Looking in both blocks was at chance on both trial types for both language groups, except for monolinguals' looking in Block 2, which was actually below chance on fluent trials. One explanation is that the speaker's hesitations may have affected children's willingness to learn any words,

even when speech was fluent. We are currently conducting a follow-up study with fluent-only trials, which will help us understand how the presence of "uhs" in speech influences children's learning of words.

P2-D-57 Cross-modal integration of meaning in 9-month-olds: an EEG study

Elena Morgan[1], Audrey Van der Meer[1], Mila Vulchanova[1], Giosuè Baggio[1]

[1]Norwegian University of Science and Technology

In recent years, many studies have tried to investigate the age of emergence of cross-modal semantic integration, which is one of the founding mechanism for later semantic composition. The present study investigates whether infants as young as 9 months, and without prior training, are able to integrate information presented cross-modally, and whether they can extrapolate meaning from information presented in this way. We used event-related potentials to test 9-month-old Norwegian monolingual infants. All participants were normally developing infants, and were recruited through local health clinics and family events. In this experiment, we presented infants with a cross-modal integration task. In this paradigm, spoken words and images were presented simultaneously, with the words being either congruous or incongruous to the images. The words were spoken in Norwegian by a female voice, and were taken from an age-appropriate list of words based on the Norwegian adaptation of the MacArthur-Bates Communicative Development Inventory (CDI). The audio words were spoken through two loud speakers, placed on each side of the infant, while the images appeared on a computer screen placed in front of the infant. The participants sat on a high chair or on the parent's lap. During the experiment, event-related potentials were recorded using a 32-channel EEG cap. The results indicate that infants at 9 months of age are able to successfully integrate information presented cross-modally. Furthermore, as shown by the N400 component, infants at this age are able to distinguish between congruous and incongruous stimuli.

P2-D-58 Child language skills before and after cochlear implant activation: input from the mother and acoustic environmental contribution

Marika Morelli[1], Marinella Majorano[1], Letizia Guerzoni[2], Domenico Cuda[2]

[1]University of Verona, [2]Guglielmo da Saliceto Hospital

Many studies have investigated the role of individual and environmental factors in language development in children with cochlear implants (CIs) (Majorano et al., 2016; Szagun & Schramm, 2016). However, few studies have provided a longitudinal description of children's language development before and after CI activation. Objective. The purpose of this study is to examine the relationship between environmental factors (the mother's input and the acoustic environment) and language skills in three children before and after CI activation. The specific aims are: 1) to investigate the relationship between characteristics of the mother's input and the child's language skills; 2) to assess the relationship between exposure to different acoustic environments and the children's language development. Methods. Three mother-child dyads were recruited from the "Guglielmo da Saliceto" Hospital in Piacenza, Italy. All the sample were implanted patients who fulfilled the following criteria: 1) CI activation before 3 years of age; 2) bilateral sensorineural hearing loss; 3) exclusive use of oral language; 4) no syndromes; 5) participation in a hearing and verbal rehabilitation program; 6) Italian monolingual normal hearing parents. Table 1 summarizes the characteristics of the sample. Mother-infant interactions were assessed twice, just before cochlear implantation and three months after CI activation. Mother's prohibitive phrases and facilitative language techniques (explanation, labelling, open and closed ended questions, directives) and children's language production were considered. Moreover, sound environment data from data logging (speech-in-quiet and speech-in-noise) were considered. Results. The children displayed different linguistic profiles. The first child increased his canonical babbling by 33% and his variegated babbling by 5%. The second child showed a 16% increase of canonical babbling, while the third child showed no production increase. Meanwhile, the mothers of the first and second child displayed a slight increase in phrases of: explanation (5% and 1%, respectively); labelling (7% and 2%); open ended questions (1% and 0,5%) and a decrease in prohibitions (4% and 7%). The mother of the third child, though, displayed a reverse profile, with fewer explanations (2%), labelling things (1%), open ended question (3%) and more prohibitive phrases (3%). The first and second child spent more time in speech in quiet (28% and 29%, respectively), while the second and the third child were more exposed to a voice in a noisy environment (35% and 45%, respectively). Table 2 shows the data of child spontaneous production, mother's input and children's time of exposure to different acoustic scenes. Conclusion. The data show that both mother's input (higher use of explanations, labelling, open and closed questions associated with a decrease in directives and prohibitive phrases) and acoustic environment characteristics (larger amount of speech in quiet) are related to the language development of children with CIs. In addition, there seems to be a co-occurrence between the quality of maternal inputs and the type of environmental acoustic exposure (higher

proportion of speech in quiet). However, this is a preliminary study and a larger sample should be observed in order to enhance our understanding of the specific contributions of environmental and individual factors. Keywords: cochlear implants, data logging, mother's input

P2-D-59 Dog, doggy, dogs: characterizing wordplay variability within and across families during infancy

Charlotte Moore[1], Elika Bergelson[1]

[1]Duke University

Speech directed to infants is rife with linguistic variability. Usually, that variability is systematic, providing cues to changes in the environment, as in plural marking (e.g. dogs = multiple instances of 'dog'). However, infants also hear variability that does not correspond to meaningful or observable differences, as in diminutivization, e.g. 'doggy' for dog (which in child-directed speech connotes familiarity rather than smallness; Savichkiene & Dressler, 2007). In such instances, both wordforms are interchangeable; we dub this wordplay. This type of variability creates a unique problem for infants: they must determine which word variants are functionally equivalent, and which differ meaningfully. To further complicate learning accounts, the amount of wordplay children hear may vary from family to family. To characterise the scope of wordplay variability, we used data from the SEEDLingS corpus, a longitudinal collection of daylong audio- and hour-long video-recordings capturing the nouns directed to or said by 44 infants from 6-17 months. For each concrete object word spoken during these recordings, RAs annotated who said it, how it was said (e.g. tooferoo) and its dictionary word form (e.g. the lemma tooth). From these annotations, we characterized the differences between dictionary forms and spoken forms, classifying words into three categories: wordplay (doggy/dog), morpheme-adding (i.e. words that only underwent linguistically meaningful changes like pluralization or noun-noun modification, e.g. coat/raincoat), and frozen words (i.e. words that only occurred in a single form in our >304,000 word corpus, e.g. dishwasher). We found that the average infant heard ~25 instances of wordplay per day, but that only some words licensed wordplay. These tended to be high-frequency words (e.g. tooth, baby): the correlation between the number of forms a word occurred in and overall frequency was 0.82 ($p<.05$). Wordplay nouns also occurred at high rates on the MCDI (33%), relative to morpheme-adding (4%) and frozen words (0.4%). Across families, we found that while all families used wordplay, the rate at which they did so was independent of that family's overall talkativeness. In other words, wordplay did not scale in families where infants heard

more nouns. Instead, it appears to be an independent characteristic, idiosyncratic to families (see Figure 1). We next linked wordplay to infants' own productions. While only 0.5-12.9% of nouns in the input underwent wordplay, the variability across families correlated with infants' volubility. That is, collapsing across age, children who heard the least wordplay produced more noun tokens overall (Spearman's rho= -0.35, p = 0.02). However, given that wordplay was heavily weighted towards high-frequency words that tended to be learned early overall (approximated using Wordbank norms; Frank et al., 2017), this did not appear to inhibit learning on a word-by-word basis. These results are consistent with the possibility that hearing words in more stable surface-level manifestations (i.e. with less wordplay) may create a clearer lexical target for infants' early productions. In short, we suggest that considering the surface-level appearance of words across and within families may provide a fruitful entry-point for understanding meaningful linguistic variability, and what infants learn from it.

P2-D-60 Adaptation of the Communicative Development Inventory (CDI) into Mandinka, a spoken language of West Africa

Bosiljka Milosavljevic[1], June Pastor Larrieta[2], Samantha McCann[3], Ousman Kambi[3], Clare Elwell[4], Sarah Lloyd- Fox[1]

[1]Birkbeck, University of London, [2]University of Bath, [3]Medical Research Council Unit Gambia, [4]University College London

The Brain Imaging for Global Health (BRIGHT) project is a longitudinal study following 200 infants in the Gambia and 60 in the UK from birth to 24-months of age. The aim of this study is to establish brain function-for-age curves in these settings to investigate the impact that malnutrition and other issues related to living in a low-resource context may have on infant development. One of the key variables of interest is the development of language ability within this sample. While the MacArthur-Bates Communicative Development Inventory (CDI; Fenson et al., 2007) has been developed to measure knowledge of vocabulary and grammatical markers among children in a multitude of languages, the measure is not available in Mandinka - the primary language spoken in the West Kiang region of The Gambia where the BRIGHT project is being conducted. The aim of the present study was to adapt the CDI by creating an inventory of words and grammatical markers to be used with Mandinka speakers. An inventory of 239 words was developed based on the standard CDI, the Malawi CDI and the Senegal CDI. Field workers in the Gambia translated these words into Mandinka and suggested appropriate words for the local dialect if words were not applicable in the West Kiang district. Subsequently

two phases of pilot testing were conducted. The initial inventory was piloted among 30 mothers of infants aged 24-48 months. In this phase, information about how many words from the inventory the child knew, grammatical markers (such as pre-fixes) and complex sentences that their child used were collected. Mothers were also asked for suggestions of relevant words not on the inventory. From these interviews, a list of words and grammatical markers was developed for piloting. Subsequently, the newly generated inventory was piloted with a second set of 30 mothers of infants aged 24-48 months. A final inventory was developed from the data collected from the younger infants aged 24-36 months in line with guidelines from CDI. The final inventory was developed by selecting 90 words across the categories for the inventory, using the following steps: (1) selecting 54 words of moderate difficulty (known by 40 to 70 % of the children); (2) selecting 18 easy words known by 70 - 100% of the children; and (3) selecting 18 more difficult words for which 10-40% of the children knew. Early evidence from pilot testing suggests that our adapted CDI for Mandinka is sensitive in detecting increasing vocabulary with age among infants aged 24-48 month and is now being implemented into the BRIGHT project. In addition to the broader aims of BRIGHT, specifically, this will allow for the development of language acquisition norms in this Gambian population. It has also been approved by the CDI Advisory Board and will be made available to researchers through their website.

P2-D-61 Does early attention affect the fluency of parent-child interactions?

Brianna McMillan[1], Lillian Masek[1], Sarah Paterson[1], Andrew Ribner[2], Kathy Hirsh-Pasek[1], Clancy Blair[2]

[1]Temple University, [2]New York University

The social interactions between a caregiver and child are foundational for children's language development. Hirsh-Pasek and colleagues (2015) found that high-quality parent-child interaction (characterized by episodes of joint engagement rich in symbols, routines and rituals, and fluid back-and-forth conversation) created a communication foundation, which predicted children's language development above and beyond the amount of language children heard. In the present study we examine whether early cognitive factors may influence the quality of the parent-child interaction. Specifically, we examine whether early attention affects the fluency of interactions between parents and children. We predict that children who are better at sustaining attention at a young age will have more fluid interactions. Methods 29 children were randomly selected from a large, ongoing longitudinal study. To assess whether children's early attention affects the fluency of their interactions with parents, children's attention was measured at 4-months

and the parent-child interaction quality was evaluated at 14-months. Attention was measured using a habituation paradigm. Children were habituated to an object across 4 trials; on the 5th trial children were presented with a new object. A median split of children's sustained attention during the habituation trials was used to categorize children as either short lookers or long lookers. Videos of the children when they were 14-months-old were coded for the fluency of parent-child interactions during a shared book reading task. The fluency and connectedness of the interaction was evaluated on a 7-point Likert scale, with 1-point indicating no conversation occurred, 4-points indicating the conversation was dominated by one partner or lacked smoothness, and 7-points indicating the conversation was fluid and balanced. Results An independent samples t-test was conducted to compare the fluency of parent-child conversations at 14 months for children categorized as short lookers and long lookers. There was a trending difference in the dyad fluency at 14 months for children who were short lookers (M = 3.5, SD = .52) and long lookers (M = 3.92, SD= .76), t(27) = , -1.78 , p = .086. Additionally, there were no significant differences in children's vocabulary scores as reported by the parents at 14 months on the MCDI Words & Gestures (Mshort = 36.13, SD = 21.01; MLong = 26.69, SD = 19.27; t(27) = 1.25, p = .22). Discussion The results from this study indicate that children who have longer looking times during habituation at 4-months have more fluent interactions with their parent at 14-months. Additionally, the fluency of the parent-child interaction was not influenced by the child's language ability. These results highlight the independent importance of attention for a child's communication foundation. The children were recruited as part of a larger longitudinal study and the coding of parent-child interaction videos is ongoing. Future analyses will examine whether this trend continues across the full sample.

P2-D-62 Song Acquisition Predicts Accelerated Speech Acquisition & Accelerated Speech Clarity

Gwendolyn McGraw[1]

[1]Retired Dept. Chair, University of Southern California

Background. While results of song acquisition research confirm that infants and toddlers can sing with discrete-pitch accuracy (Sloboda et al, 1991; Stadler Elmer, 2011; Benetti, 2017; Gudmundsdottir & Trehub, 2017; McGraw, 2017), nothing is known about associations between early tuneful singing and concurrent speech acquisition. Distinctive qualities of infant-directed-singing may scaffold infants' song acquisition (Trainor et al., 1997). Neonatal segmentation of the sung-stream but not the speech-stream predicts

expressive speech at 18-mos-of-age (Francois et al., 2017). Aim: This is the first known research on song acquisition and associations with co-occurring speech acquisition, birth to age two. Methods: Using a mixed-methods research design, an auditioned children's choir was selected as a purposive sample. Parents of 37 singers responded to questions regarding song acquisition, speech acquisition, and clarity of expressive speech in early life. A power-size test for correlations indicated the sample was larger than required to avoid Type I/II errors. Ordinal data with many tied scores (non-normal distribution) met assumptions for Goodman & Kruskal's Gamma correlation test. Results: Analyses of parents' responses to questions (surveys and follow-up interviews) indicated that 32 of 37 singers were tuneful by the age of two and had parents who consistently sang to them in early life. Associations tested by Goodman & Kruskal's Gamma correlation test follow: (1) Significant, ongoing exposure to parents' singing in early life predicts song acquisition by age two, G = .96. (2) Infants' song acquisition predicts accelerated speech acquisition, G = .82. (3) Infants' song acquisition predicts accelerated clarity of expressive speech, G = .88. Conclusions: Robust, positive associations confirmed that (a) ongoing exposure to parents' singing in early life predicts infants' song acquisition; and (b) infants' song acquisition by age two predicts both accelerated speech acquisition and accelerated clarity of expressive speech. Although pediatric milestones for speech clarity (Dosman et al., 2012) indicate a long developmental trajectory, children who are tuneful singers by age 2 have notable speech clarity early on, with incremental advances in clarity later. Implications: Benefits of musical training for aspects of language learning are well-documented, and results here extend such findings. Early vocal learning is enhanced, efficient, and enduring when the sound-stream is patterned, organized, sequential, repeated over time, demands precision (Patel, 2011), and sung. Results indicate robust relationships between emergent tuneful singing and emergent, expressive speech in early life --and suggest that language acquisition is more complex and multi-faceted than previously understood. As in language acquisition, song acquisition seems to be socially mediated. Infants' ongoing exposure to parents' infant-directed-singing scaffolds song acquisition - and 'builds bridges' that support important emergent relationships between song acquisition, accelerated speech acquisition, and accelerated clarity of expressive speech during a time of heightened neuro-plasticity.

P2-D-63 Modeling developmental changes in infants' discrimination of English vowels

Megha Sundara[1], Connor Mayer[1]

[1]University of California, Los Angeles

Infants initially discriminate native and non-native contrasts. With perceptual reorganization, discrimination of non-native contrasts reduces while the discrimination of native contrasts improves. Researchers have proposed distributional learning as a domain-general mechanism by which infants acquire phonetic categories (e.g., Saffran et al, 1999; Maye et al., 2002). Recent proposals, however, argue for an interactive mechanism where learning words concurrently supplements distributional learning of phonetic categories (e.g., Swingley, 2009; Feldman et al., 2013). Not only is this interactive mechanism available in the first year of life, its computational implementations outperform ones based on distributional learning alone (Feldman et al., 2013a; Feldman et al., 2013b). We investigated whether distributional learning models or interactive models best account for developmental changes in infant discrimination. First, we replicated and extended Feldman et al's Bayesian distributional and interactive models. Specifically, we enriched both models with additional acoustic cues known to distinguish vowel categories in English, also obtained from the Hillenbrand Corpus. These include duration, dynamic spectral cues, as well as pitch and higher formants. Like in Feldman et al., lexical frequency was obtained from CHILDES. As expected, higher dimension distributional models performed better than low dimension ones; nevertheless, interactive models consistently outperformed their distributional counterparts (Table 1). Next, we evaluated predictions of the interactive and distributional learning models against infant discrimination data. Data from 4-, and 8-month-olds (n~310), learning (a) only English (b) only Spanish or (c) Spanish and English, tested on English (i) /e-E/ (previously published in Sundara & Scutellaro, 2011), (ii) /i-I/ and (iii) /e-I/, were compared. All stimuli were produced by multiple female talkers from the Hillenbrand corpus; infants were tested using a visual fixation procedure with a habituation criterion of 50%. Listening times were analyzed using Linear Mixed Effects models. Infants discriminated all vowel pairs, except /e-I/ at 8-months (Figure 1). Discrimination results from 4-month-olds were best correlated with predictions from the high dimension distributional model (model 4), with /e-I/ being least confusable, followed by /i-I/, with /e-E/ being the most confusable pair. Discrimination results from 8-month-olds were also best correlated with predictions from a distributional model, albeit a low dimensional one (model 1). For older infants, /e-I/ was the most confusable vowel pair, followed by /i-I/, with /e-E/ being the least confusable. In contrast, interactive models outperformed infants at both ages. We are now testing discrimination of English /e-I/ by infants ranging in age from 12-18-months with a view to model discrimination performance as a function of changing vocabulary size.

P2-D-64 Developmental Changes in Infants' and Mothers' Pathways to Successful Joint Attention Episodes

Margaret Loy[1], Elise Masur[2], Janet Olson[2]

[1]Harlem Community School District 122, [2]Northern Illinois University

Joint attention (JA) episodes, involving the triadic coordination of an infant's attention with a social partner and an object or event for at least 3 seconds, have been considered foundational to aspects of social and communicative development, including vocabulary acquisition (Bakeman & Adamson, 1986; Mundy et al., 2007; Tomasello & Farrar, 1986). Combining the JA approaches of Mundy and colleagues' (2007) experimental coding of infants' specific initiating and responding acts and of Bakeman and Adamson's (1986) descriptions of mothers' as well as infants' behaviors during joint engagement, this study traces infants' and mothers' pathways to the achievement of successful JA episodes during naturally occurring interactions during infants' second year of life. Twenty-nine mothers and their typically developing infants (16 boys, 13 girls) were observed longitudinally during 6-minute toy play sessions when infants were 13 and 17 months old. Initiatives and responses by both partners were coded as focused only on the Object, only on the Partner (rare), or Combined--focused on an object while acknowledging the partner (K > .90). Interactions were then followed to determine how different behaviors led to successful JA episodes. Correlational analyses assessed whether infants' Combined initiatives and responses and numbers of successful JA episodes predicted their 17-month receptive and expressive vocabularies on the MCDI. Table 1 shows that infants exhibited both the more sophisticated Combined initiatives and the less sophisticated Object-only initiatives during these naturally occurring dyadic interactions and that all these behaviors could result in successful JA episodes. A 2 (Gender) x 2 (Age) mixed ANOVA revealed an increase over time in the achievement of JA, with dyads engaging in about 13 episodes at 13 months and about 15 episodes at 17 months, $F(1, 27) = 6.04$, $p = .02$, $\eta p2 = .18$. There were no gender differences. More important, Age by Initiative analyses revealed developmental changes in the frequencies of different initiatives, $F(1.6, 45.2$, G-G adjusted$) = 11.28$, $p < .001$, $\eta p2 = .29$, and in the origins of successful JA episodes, $F(2, 56) = 13.71$, $p < .001$, $\eta p2 = .33$. At 13 months, although infants' less sophisticated Object-only initiatives were most frequent (see Table 1A), successful episodes most often originated from mothers' Combined initiatives (see Table 1B). By 17 months, however, infants' initiating skills had advanced considerably. Infants' Combined initiatives were most frequent and led to more JA episodes than any other initiative type. Correlations with vocabulary in Table 2 demonstrated that infants who produced more advanced Combined initiatives achieved more JA episodes at both ages. Furthermore, infants' 13-

month frequencies of Combined initiatives, Combined responses, and successful JA episodes positively predicted 17-month receptive and expressive vocabularies, even with gender controlled. Infants' Object initiatives were negatively related to JA episodes and vocabulary. In the present study we traced infants' overall developmental progression and considered their outcomes at different developmental levels. By illuminating pathways to successful joint attention in typical development, the present study may help provide a foundation for future research investigating interventions with infants who do not follow the typical trajectory.

P2-D-65 Characteristics of English- and Spanish-Speaking Mother-Child Engagement During Free Play

Allyson Masters[1], Anele Villanueva[1], Diane Poulin-Dubois[2], Pascal Zesiger[3], Margaret Friend[1]

[1]San Diego State University, [2]Concordia University, [3]University of Geneva

Dual language exposed Spanish-speaking children in the U.S. show slower vocabulary growth than their English-speaking peers (Hoff, 2017), a finding unexplained by maternal education in the first two years of life (DeAnda et al., 2015, Friend et al., 2017). Two lines of evidence inform this proposal. First, quantity of language input to Spanish-speaking children is positively associated with child vocabulary (Hurtado et al, 2008; Weisleder & Fernald, 2013). Second, maternal responsiveness varies with culture (Tamis-LeMonda et al., 2014): the quality of input may contribute to explaining differential vocabulary growth in Spanish- and English-speaking children. Participants were 50 Spanish- and 50 English-speaking mother-child dyads. Exposure to the dominant language was => 80%. We present preliminary data on 10 Spanish- (5 girls, Mage=31;6, range= 28;27 to 35;10) and 10 English-speaking children (5 girls, Mage=30;15, range=29;0 to 32;27). Dyads participated in 20 minutes of free play and mothers completed the MCDI:WS. Conversations were transcribed to inter-rater agreement =.90. Following Hirsh-Pasek, et al. (2015), we assessed parent-child joint engagement: Symbol Infused, Fluency and Connectedness, and Nonspecific patterns occurred most frequently and are the focus of our analyses (see Figure 1). Symbol Infused and Fluency and Connectedness were expected to positively correlate, whereas Nonspecific language engagement was expected to negatively correlate, with child vocabulary. The English-speaking sample evinced higher maternal education and child expressive vocabulary than the Spanish-speaking sample ($t(17)=2.26$, $p=.031$ and $t(17)=3.97$, $p=.001$, respectively) but samples did not differ in the number of conversational turns (Ms =359 and 330, respectively,

p=.549) that were the basis for the analyses. We conducted hierarchical linear regression with MCDI expressive vocabulary as the dependent measure, maternal education and language entered in the first step, and three categories of joint engagement entered in the second. Joint engagement significantly improved model fit (R2?´=.35, p=.001). There were significant effects of Language and of Fluency and Connectedness. Across samples, Fluency and Connectedness was positively associated with child expressive vocabulary, (r(9)=.681, p=.022 and r(9)=.903, p=.000, respectively, see Figure 2). It was also positively associated with maternal education in English (r(9)=.664, p=.018) but exhibited a negative trend in Spanish (r(9)=-.467, p=.103). In contrast, Nonspecific engagement correlated negatively with maternal education in Spanish (r(9)=.-613, p=.04) as well as in English (r(9)=-413, p=.118). These preliminary results are a first step toward characterizing the quality of parent-child engagement in young Spanish- and English-speakers. Two results are particularly striking. First, the depression of engagement in the Spanish-speaking sample suggests fewer or lower quality patterns of engagement. Alternatively there may be compensatory language input that we have yet to capture. Second, in both samples Fluency and Connectedness emerged as a significant correlate of expressive vocabulary but differed in the direction and extent of association with maternal education. We will have analyzed 50 participants at the time of ICIS, permitting us to calculate stable estimates and to more clearly characterize the relations between maternal education, joint engagement, and child vocabulary across languages.

P2-D-66 Not all about income: Similarities and differences in children's early language environments predict vocabulary development

Lillian Masek[1], Kathy Hirsh-Pasek[1], Roberta Golinkoff[2]

[1]Temple University, [2]University of Delaware

In 1995, Hart and Risley noted that SES-related differences in early language input created differential language outcomes for children. This sparked research focusing on the consequences of SES-related differences in early language development. Recent studies, add a new dimension to this work by suggesting that the story might not be all about income. Cartmill and colleagues (2013) suggest that some aspects of high-quality language environments do not differ across SES while Hirsh-Pasek and colleagues (2015) find enormous variation within low income families, in both language input and language outcomes. This research looks at language input across a wide range of income-levels. Examining the communication foundation, the measure of parent-child interaction quality used in Hirsh-Pasek and colleagues (2015), this work begins to explore whether income

or parent-child interaction is a better metric for predicting language outcomes. Here, we examine whether the quality of the communication foundation varies by SES and whether the relationship between amount of talk, the communication foundation and later language is the same across SES-strata. Using data from the NICHD Study of Early Child Care and Youth Development, 180 children were selected across low-, middle- and high-SES backgrounds. The groups were matched on vocabulary such that in all SES-groups, there were children with struggling, average and excelling language scores. The communication foundation was assessed at 24-months using the three-box task, a semi-naturalistic play session in which parent and child interact with a book and two toys. Three behaviors, symbol-infused joint engagement, routines and rituals, and fluency and connectedness, were rated on a 1-7 scale based on quantity and quality of the behavior (See Figure 1). The average is used for the communication foundation score (Hirsh-Pasek et al., 2015). Number of words per minute was also drawn from this task. Expressive vocabulary was assessed at 36-months using the Reynell Developmental Language Scales (Reynell, 1991). First, we examined SES-related differences in the amount of talk and the communication foundation. One-way ANOVAs showed that while amount of talk varied by SES ($F(2,177)=3.523$, $p=.032$), the communication foundation did not ($F(2,177)=.660$, $p=.518$). Next, we examined whether the amount of talk and the communication foundation, predicted later language outcomes in all three groups. In a simultaneous regression across the whole sample, only the communication foundation predicted language outcomes ($\beta=.308$, $t(177)=4.098$, $p<.001$), the amount of talk did not ($\beta=.067$, $t(177)=0.889$, $p=.375$). Mediation analyses were not significant for either communication foundation or amount of talk, meaning that the relations between the early language environment and later language outcomes were the same across all three SES-groups. These findings suggest that even though children from low-income backgrounds did indeed hear fewer words than their higher income peers, the difference in input was not as predictive of their language outcomes as is the quality of the communication foundation. Surely income is a key variable predicting how often quality environments emerge. The key variable to measure if we hope to understand early language growth is not income, but rather the quality of the communication used in the parent-child interactions.

P2-D-67 The role of Pragmatics vs. Novelty in a Label Assignment Task

Hanna Marno[1], Dan Sperber[1]

[1]Central European University, Közép-európai Egyetem

Children typically apply a novel label to a novel object, rather than to a familiar object; a phenomenon called Mutual Exclusivity (Markman et al., 2003). A recent explanation is that children tend to associate novel stimuli together (Horst et al., 2011). We show that in a situation when children can also rely on their assumptions about the intended meaning of the speaker, these pragmatic factors can override novelty. In our study two-year-old children first played with a novel object together with E1, while Experimenter 1 never labeled the object. Then Experimenter 1 left the room and Experimenter 2 brought another three novel objects for the child to manipulate on his/her own (Fig. 1.). Finally, Experimenter 1 came back and requested the child to give her the 'Bitye'. Compared to the other objects, children chose significantly more frequently the first object, with which they had a common history with Experimenter 1, even though it was the least novel (Fig. 2.). This suggests that children understand a novel word by considering to which object the speaker is most likely to have intended to refer. However, it is possible that independently from the labeling episode, children chose the 'common play' object simply because they had a preference for this object. In order to control for this alternative explanation, we ran a control condition, when instead of requesting for the 'Bitye', Experimenter 1 requested for 'one toy'. Results showed that in this control condition only very few children chose the object, with which they had a common history with Experimenter 1 (Fig. 2.). Furthermore, preliminary analysis of the proportions of time children spent manipulating each object shows that object choices in the control condition were positively correlated with the amount of time children spent playing with the objects. In sum, we conclude that after hearing a novel label, infants' choices regarding the potential referent of the label was mainly guided by pragmatic factors. We additionally find that when pragmatic factors did not play a role, object choices were influenced by children's subjective preferences and interests. REFERENCES Markman, E. M., & Wachtel, G. F. (1988). Children's use of mutual exclusivity to constrain the meanings of words. Cognitive psychology, 20(2), 121-157. Horst, J. S., Samuelson, L. K., Kucker, S. C., & McMurray, B. (2011). What's new? Children prefer novelty in referent selection. Cognition, 118(2), 234-244.

P2-D-68 Amount of speech exposure early in infancy is related to receptive vocabulary size at twelve months

Ellen Marklund[1], Iris-Corinna Schwarz[1], Ulrika Marklund[1], Christa Lam-Cassettari[1]

[1]Stockholm University

The present study investigates the relation between daily amount of speech input at four, six and eight months of age, and receptive vocabulary at twelve months. Daylong recordings in the home were collected using the Language Environment Analysis (LENA) system when the children were four (n = 12; 6 girls; mean age 4.6 months; SD = 0.6 months), six (n = 19; 8 girls; mean age 6.1 months; SD = 0.5 months), or eight (n = 12; 5 girls; mean age 8.2 months; SD = 0.5 months) months of age. When the children were around one year (mean age 12.6 months; SD = 0.9 months), parents filled out the Swedish Early Communicative Development Inventory (SECDI) questionnaire (Eriksson & Berglund, 1999). The LENA estimates of FAN and MAN (total duration of female/male adult speech near the child wearing the recording device) were averaged across two recordings and then summed to obtain the measure of total daily speech exposure. The receptive vocabulary score was calculated by counting the words that the parents reported that their child understands. The receptive vocabulary scores differed between the LENA age groups, most likely because children in the three LENA age groups were not completely matched in terms of SECDI age. As such, separate analyses were performed on the three age groups, correcting for multiple comparisons (Bonferroni-corrected alpha = 0.017). Within each age group, children were divided into a high-exposure group and a low-exposure group, based on whether their speech exposure was higher or lower than the age group's mean speech exposure amount. The receptive vocabulary scores were compared between the exposure groups by means of an in¬dependent samples t-test for each age group. Although the mean vocabulary score of the high-exposure group was higher than that of the low-exposure group in all age groups, no statistically significant difference was found between groups in eight-month-olds ($t(10) = 1.111$; $p = .293$) or six-month-olds ($t(17) = -1.404$; $p = .178$). However, amount of speech input at four months of age was related to receptive vocabulary score at one year of age ($t(10) = -2.887$; $p = 0.016$), see Figure 1 and Table 1. Although these results in themselves do not imply causality between amount of speech input in early infancy and later receptive vocabulary, they are interesting to consider together with the notion that development of speech sound categories is related to frequency of the speech sounds in the input (Anderson et al., 2003), and that word learning is facilitated by stable speech sound categories (Curtin et al., 2011). It is possible that more speech exposure leads to earlier speech sound category stability, which in turn facilitates word learning and thus leads to larger receptive vocabulary. Interpreted in line with this reasoning, the present results suggest that the impact of raw input amount is highest at very early ages, and decreases already during the first year of life. It is also possible that the results can be explained by the nature of interactions captured by the LENA estimates changes in early infancy, or that underlying attitudes towards language development cause parents both to talk a lot with their infants

from a very young age and to overestimate their children's vocabulary at twelve months. Looking at parents' attitudes towards language development and a more detailed analysis of the recorded material could potentially shed more light upon these issues.

P2-D-69 Word frequency is a cue to open/closed class lexical category membership at 8 months

Caterina Marino[1], Carline Bernard[1], Judit Gervain[2]

[1]Université Paris Descartes, [2]CNRS - Université Paris Descartes

The division of labor hypothesis between function words (such as the, she, in etc.), signaling grammatical structure, and content words (like apple, listen, colorful), carrying meaning, is a linguistic universal (Fukui, 1986; Abney, 1987). In addition to their distinct linguistic functions, the two lexical categories differ in their phonological makeup and their frequency of occurrence. Functors are more frequent than content words and it has been shown that 8-month-olds prefer the relative order of frequent and infrequent words in artificial grammars that matches the basic word order of their native language(s), e.g. functor- (i.e. frequent word) initial in English, functor- (i.e. frequent word) final in Japanese. Thus word frequency helps infants build a rudimentary representation of the native word order (Morgan, 1996; Gervain, 2008). Nevertheless, whether infants map frequent words onto the lexical category of functors and infrequent words onto content words remains unexplored. Taking into account that content words come in open classes, whereas functors form closed classes (Cutler, 1993), one way to test the above question is to examine whether infants accept new items in the infrequent category, but not in the frequent one. We tested this in an artificial grammar-learning task, familiarizing infants to a structurally ambiguous artificial grammar in which frequent and infrequent words alternated (...gefofirugemufi..., ambiguous between a frequent-initial and a frequent-final parse), using the head-turn preference procedure. Infants were monolingual French, aged between 7.5-9 months. In Exp.1 (n=21), infants were tested on their preference between sequences taken from the familiarization stream that either started with or ended with a frequent word (firugemu vs. rugemufi). We expected a frequent-initial preference, as French is functor-initial (à Paris 'in Paris'). Exp. 2 (n=21) and Exp. 3 (n=21) then investigated whether infants maintain their word order preference if the infrequent or the frequent words, respectively, are replaced by novel items in the test sequences. We expected infants to maintain their preference when the changes occurred within the infrequent category, but to suppress their preference when presented with novel frequent items, as functors constitute closed classes. Additionally, in Exp. 4 (n=18), as a control for memory

effecs, we asked whether infants remembered the infrequent words from the familiarization stream by testing them on the infrequent items from the familiarization stream vs. entirely novel items. Infants tested with familiarized sequences (Exp. 1) and the sequences in which the infrequent words were replaced by novel ones (Exp. 2), showed the predicted frequent-word initial preference in the test phase, looking longer at sequences starting with a frequent word. However, when the frequent words were replaced with novel items, infants no longer showed a preference (Exp. 3). This result is not simply due to a better recall of the frequent words, as infants readily discriminated the familiarized infrequent tokens from novel ones (Exp.4). Our findings demonstrate for the first time that preverbal infants can use word frequency to establish the fundamental and universal lexical categories of content and function words and use functors as the core template for grammatical structure.

P2-D-70 Links between Spanish-language processing efficiency at 2 years and English- and Spanish-language outcomes in emerging bilinguals

Virginia Marchman[1], Vanessa Bermudez[1], Janet Bang[1], Anne Fernald[1]

[1]Stanford University

An increasing number of Latino children in the US speak primarily Spanish at home and have minimal proficiency in English when they enter school. Many Spanish-dominant emerging bilingual children are also from lower-SES backgrounds and thus, are at increased risk for poor academic outcomes. The strongest correlate of later success in school is oral language skills achieved before kindergarten (Morgan et al., 2015). A question with wide-reaching significance is whether oral language skills in a child's first language or L1 (e.g., Spanish) will transfer and support later learning in a second language, L2 (e.g., English). To capture oral language processing efficiency in very young children, we use an experimental task of real-time language comprehension, the "looking-while-listening" (LWL) task (Fernald et al., 2008). In monolingual children, individual differences in language processing efficiency in toddlerhood have been linked to later language outcomes in English (Marchman & Fernald, 2008) and Spanish (Hurtado et al., 2007). Here, we explore within- and across-language relations in emerging Spanish-English bilinguals to examine the extent to which Spanish real-time comprehension at 2 years supports language outcomes at 4½ years in both Spanish and English. Participants (n=70) were 2-year-olds from primarily Spanish-speaking families. In the LWL task, eye-movements were video-recorded as children looked at pictures of familiar objects and heard speech naming one of the pictures (e.g., ¿Dónde está el perro?). Reaction time (RT) and Accuracy

were derived. At 4½ years, children were assessed in Spanish and English receptive vocabulary (TVIP/PPVT) and expressive language (CELF-P/PLS-4). Table 1 shows that children were from primarily lower-SES families. At 2 years, children were reported to be exposed predominantly to Spanish and were performing above chance in the Spanish LWL task, $t(69)=16.9$, $p<.001$. By 4½ years, many children had increased exposure to English, but were still predominantly exposed to Spanish. Children were performing near the expected mean, on average, in Spanish receptive vocabulary, $t(69)=1.4$, $p=.18$, but lower than expected in Spanish expressive language, $t(66)=3.9$, $p=.01$. Unsurprisingly, children were performing below expected levels in English, and lower in English than in Spanish in both receptive vocabulary, $t(69)=4.0$, $p<.01$, and expressive language, $t(63)=2.4$, $p=.02$. We examined the unique contribution of Spanish-language processing efficiency at 2 years to children's language skills in Spanish and English at 4½ years, controlling for SES, age, and relative Spanish-English exposure. As expected, Spanish RT accounted for significant unique variance in later Spanish receptive, r2-ch=18.4%, $p<.001$, and expressive language, r2-ch=13.1%, $p<.001$, skills. Critically, Spanish RT was also a significant predictor of later English receptive, r2-ch = 18.0%, $p < .001$, and expressive language outcomes, r2-ch=9.3%, $p < .01$. Those children who were faster in Spanish comprehension at 2 years were those children with stronger English receptive (Figure 1a) and expressive (Figure 1b) language skills at 4½ years, controlling for amount of exposure to English and other covariates. These results suggest that children's early efficiency of real-time comprehension in their L1 strengthen critical information processing skills that support learning in their L2 as they get ready for school.

P2-D-71 Building the Bridge: Using Community-Based Participatory Research as an Innovative Approach to Develop Early Language Intervention

Rufan Luo[1], Rebecca Alper[2], Marjie Mogul[3], Yu Chen[2], Amy Pace[4], Kathy Hirsh-Pasek[2], Lauren Adamson[5], Roberta Golinkoff[6], Margaret Owen[7], Roger Bakeman[5], Lillian Masek[2], Sarah Paterson[2]

[1]Rutgers University, [2]Temple University, [3]Maternity Care Coalition, [4]University of Washington, [5]Georgia State University, [6]University of Delaware, [7]The University of Texas at Dallas

Increasingly, research highlights the critical role of early, high-quality, caregiver-child interaction for later school success. Parent-training programs that focus on improving developmental outcomes for at-risk children are proliferating (Providence Talks, 2017). However, these programs demonstrate variable outcomes. Moreover, children in the most

adverse learning environments are often the hardest to reach. Caregiver-implemented intervention requires us to develop culturally sensitive materials, create supportive, community-based networks, and conduct rigorous evaluations. This case study presents Community-Based Participatory Research (CBPR) as an innovative approach to achieve these goals, providing qualitative and quantitative evidence on how CBPR guides and strengthens the development of new interventions. CBPR is a collaborative approach in which researchers and community partners are equitably involved in study design, implementation, analysis, and dissemination (Figure 1). In our CBPR, university-based researchers partnered with a well-established community-based organization to develop, provide and evaluate an intervention in which Home Advocates helped caregivers with limited resources support the language development of 1- to 2-year-old infants. CBPR benefited the intervention in multiple ways. First, it allowed the joint team to develop evidence-based, culturally sensitive intervention materials geared to the community's specific needs. Through a highly collaborative process, the scientific principles of high-quality communication were transformed into multi-media training modules, which contain ecologically valid narrations and examples (Figure 2). While the researchers offered scientific knowledge about early communication, the community partners provided insights on the community's needs from an insider's viewpoint. Second, consistent with CBPR principles, we integrated research into a pre-existing supportive community network by training Home Advocates who were members of the community and already had established relationships with the caregivers to deliver the intervention. The exposure to intervention materials facilitated Advocates' developmental knowledge, as assessed by the Knowledge about Infant Development Inventory (MacPhee, 2002). Intervention Advocates (n=14) showed greater gains in their knowledge (Mpre=43.07, Mpost=44.64) than did advocates in the business-as-usual control group (n=12; Mpre=46.00, Mpost=44.58; TreatmentχTime interaction, $F(1, 24)=6.78$, $p=.016$). The trained Advocates will serve as a valuable resource and continue supporting high-quality caregiver-child interactions in the community after the intervention, thereby enhancing effective implementation and long-term sustainability. Finally, CBPR enabled the joint team to co-design a rigorous evaluation of the intervention that will be both data-rich and culturally sensitive. While the research team proposed research designs that met high scientific criteria, community members ensured that the measurements were valid for the culturally and linguistically diverse population served. Data on the effectiveness of the intervention will be available by the time of the conference. CBPR is an effective model to develop and strengthen community collaborations. We will present evidence, including team member interviews, intervention materials, and data from survey, observation and direct assessment to illustrate the process, product, and benefits of CBPR.

P2-D-72 Acoustic Features of Infant-Directed Speech to Infants with Hearing-Impairment and Infants with Normal Hearing

Irena Lovcevic[1], Marina Kalashnikova[1], Denis Burnham[1]

[1]Western Sydney University

It is now well-established that adults adjust their usual way of speaking when addressing young infants. This speech register is known as infant-directed speech (IDS) (Fernald & Simon, 1984). IDS has a number of distinctive acoustic features in comparison to adult-directed speech (ADS). Vowel hyperarticulation in IDS, i.e., the expansion of the acoustic space between the corner vowels /i,u,a/, is specifically proposed to play a role in promoting language acquisition, especially speech perception (Liu et al., 2003). Interestingly, the presence of vowel hyperarticulation in IDS appears to be dependent on the infant's communicative and linguistic needs (Burnham et al., 2002). For instance, it has been shown that mothers do not hyperarticulate vowels when the infant cannot hear them (Lam & Kitamura, 2012) or when infants are at risk for dyslexia (Kalashnikova et al., 2016), indicating that infants' ability to hear and process speech can influence IDS. This raises the question of whether congenital hearing impairment (HI) can be a possible factor that can affect IDS, specifically in the enhancement of features that may support early language acquisition such as vowel hyperarticulation. However, studies assessing IDS to infants with HI have lead to different conclusions. While some studies (Lam & Kitamura, 2010) found no vowel hyperarticulation in IDS to infants with HI, others found no differences in hyperarticulation between mothers of infants with HI and normal-hearing (NH) infants (Kondaurova et al., 2012; Wieland et al., 2015). The source of these inconsistencies is unknown, but it may be due to differences in the samples' chronological and hearing age, as well as the type and length of hearing device used by the infants. This study investigated the acoustic properties of IDS to HI (N=11; M age=15.18 months, SD=7.50) and NH infants (M age=15.28 months, SD=7.92). Infants were matched on chronological age. Mothers' speech to their infant (IDS) and to an adult (ADS) was recorded. Mothers were asked to use the toys sheep, shoe, and shark in their interactions with the infants to elicit productions of the three corner vowels /i,u,a/. Initial analyses demonstrated that mothers of HI and NH infants exaggerated the vowels' first and second formants, mean pitch, and length in IDS compared to ADS (all $p < .05$). Group comparisons, however, showed that in IDS specifically, mothers of infants with HI produced significantly lower second formant (F2) values for the vowel /i/ (M=1652Hz, SD=129) than mothers of NH infants (M=1797Hz, SD=115), $t(20)= -2.777$, $p= .012$. These

findings indicate that mothers of HI infants exaggerate the acoustic qualities of their speech in IDS compared to ADS. However, their infants' hearing status affects some acoustic qualities of their speech. This finding replicates Wieland et al. (2015) who also found group differences specific to the productions of the second formant of the vowel /i/. The source of these differences will be further investigated by comparing mothers' IDS to infants with HI and hearing age NH controls, as well as relating maternal IDS qualities to infants' age and early vocabulary size.

P2-D-73 Ambient-language effects: Pitch differences in the babbling of Mandarin- and English-learning infants

Shanshan Lou[1], Marilyn Vihman[1], Tamar Keren-Portnoy[1]

[1]University of York

Prior studies have identified ambient-language effects in babbling within the first year (Boysson-Bardies & Vihman, 1991; Whalen, Levitt & Wang, 1991). However, a recent study testing Chinese- and English-learning infants reported finding no such effects in pre-linguistic infant utterances (Lee et al., 2017). This study was designed to assess to what extent common lexical pitch patterns such as those used in Mandarin occur in the pre-linguistic period, and to what extent the target language exerts an influence on infant use of such patterns. Two groups of monolingual infants (N = 16, 9 in North China, 7 in York) learning Mandarin Chinese, which distinguishes four lexical tones (high level, rising, falling-rising and falling), were compared to 9 infants learning British English, which uses pitch primarily for intonation. The Mandarin-learning infants were recorded longitudinally in monthly 30-minute sessions, from age 9 to 12 months. Their babbling vocalizations were compared with those of an existing sample of half-hour recordings of monolingual English-learning infants at the same ages. All recordings were transcribed by the first author, who identified 'tone' by ear on each syllable for all 25 infants. Reliability procedures are on-going. Falling tones occurred the most frequently across all three groups. Because, overall, the infants produced more falling and level tones than any other, only the use of those tones was analysed statistically. We compared the proportion of use of each tonal pattern in the three groups. For each of the two tones (falling and level) we fitted a logistic regression model with Language and Age as fixed effects and Child as a random effect. Analysis showed that the two Mandarin groups used a significantly smaller proportion of falling tones than the English group ($p < .001$ [est. = -1.23] and $< .001$ [est. = -0.81] for the North China and York samples, respectively). The infants exposed to Mandarin made significantly greater use of level tones than did the English infants (N.

China: p < .001 [est. = 1.31], York: p < .03 [est. = 0.70]). Finally, the North China group used significantly more level tones than the York Chinese group (p = .049 [est. -0.61]). The preponderance of falling tones in all three groups is in accord with previous studies indicating that a fall in pitch reflects the natural drop in subglottal pressure over the course of an utterance (Kent & Murray, 1982; Vihman, DePaolis & Davis, 1998). The greater use of level tone in Mandarin suggests that infant production reflects this prosodic pattern in the input already in the pre-linguistic period, as level tone is essentially non-occurrent in English. Finally, the greater use of level tone in the infants living in a monolingual community in North China further suggests the same ambient language effect. Boysson-Bardies, B. de & Vihman, M. M. (1991). Adaptation to language: Evidence from babbling and first words in four languages. Language, 67, 297-319. Kent, R. D. & Murray, A. D. (1982). Acoustic features of infant vocalic utterances at 3, 6, and 9 months. Journal of the Acoustic Society of America, 72, 353-363. Lee, C., Jhang, Y., Chen, L., Relyea, G. & Oller, D. K. (2017) Subtlety of ambient-language effects in babbling, Language Learning and Development, 13, 100-126 Vihman, M. M., DePaolis, R. A. & Davis, B. L. (1998). Is there a "trochaic bias" in early word learning? Evidence from English and French. Child Development, 69, 933-947. Whalen,

P2-D-74 Emergent syntactic development in Mandarin-speaking infants and toddlers

Huei-Mei Liu[1], Chun-Yi Lin[1]

[1]National Taiwan Normal University

Introduction and purpose: The early acquisition of syntactic rules is essential for later language development.With regard to listening and speaking, the syntactic rules help children perceive the meanings of sentences and construct meaningful utterances (Shapiro, 1997). As for reading and writing, the capacity to process syntax aids children's comprehension and production of written texts (Abbott et al., 2010; Beninger et al., 2009). Researches indicated that Mandarin syntactic rules are different to that of Western languages, especially the usage of different grammatical forms. However, little is known about the early syntactic development of Mandarin-speaking infants and toddlers. For this, the present study examined the growth of emergent syntactic development in typically developing Mandarin-speaking children. Methods: Altogether 1882 infants and toddlers aged from 16 to 36 months were recruited. The "sentence and grammar" session of Toddler Form in The Mandarin-Chinese Communicative Development Inventory of Taiwan (MCDI-Taiwan), the 2-point rating assessment with 25 sentence forms, was

adopted and distributed to parents to score children's early syntactic development. The usages of 7 grammatical forms, which are important for Mandarin children, are selected: "Verbs", "Negatives", "Causes-effects sentences", Possessive/Objective/ Demonstrative", "Adverb/Adjectives", "Morphology", and "Interrogative". The mean scores of each category were calculated as the index of the participants' ability of the specific grammatical forms. Results: Overall, the mean score of 7 categories of syntactic abilities increased with ages during infancy. Significant age effects showed on the total score of syntactic development ($F=133.260$, $p<.001$), expressive vocabulary ($F=133.384$, $p<.001$), and MLU ($F=60.596$, $p<.001$). The average score of each syntactic form from high to low is as follow: "Verbs" (mean=1.21), "Interrogative" (mean=1.17), "Possessive/ Objective/Demonstrative" (mean=1.06), "Adverb/Adjective" (mean=1.01), "Negative" (mean=0.85), and "Causes-effects sentences" (mean=0.84) and "Morphology" (mean=0.71). For the correlation analysis, among 7 grammatical forms, "Negatives" is the most significantly correlated to the total score of syntax ($r=.568\sim.909$, $p<.001$) and expressive vocabulary ($r=.416\sim.734$, $p<.001$). "Possessive/Objective/Demonstrative" is most significantly correlated to MLU ($r=.311\sim.475$, $p<.001$). The regression analysis also demonstrated that "Negative" is the most predictive variable for the total score of syntax ($r2=.999$, $p<.001$) and that of expressive vocabulary ($r2=.804$, $p<.001$). "Possessive/Objective/Demonstrative" is the most predictive variable for MLU ($r2=.534$, $p<.001$). Conclusions: The patterns of syntactic development in Mandarin-speaking infants are well observed by using MCDI-T from 16-36- months. It is found that the earliest acquired grammatical forms is "Verb", and "Morphology" is the most difficult syntactic categories for acquisition. Results of correlation and regression analysis showed syntactic development is related to the vocabulary development and MLU. Although the usage of "Verb" is the earliest acquired grammatical form, the usage of "Negative" is most predictive to infant's expressive language and syntactic development. In addition, the usage of "Possessive/Objective/Demonstrative" may include more grammatical usage in sentence which may affect MLU for Mandarin infants.

P2-D-75 Pointing at 18 months in preterm infants and infants at risk for Autism Spectrum Disorder

Jessica Lee[1], Alessandra Sansavini[2], Annalisa Guarini[2], Mariagrazia Zuccarini[2], Dora Scarlatella[2], Jana Iverson[1]

[1]University of Pittsburgh, [2]University of Bologna

Background. Several factors are reliable predictors of language delay (LD). Infants with an older sibling with an autism spectrum disorder (ASD) diagnosis are at high risk (HR) for ASD and communicative difficulties such as LD (Gamliel et al. 2007). Preterm birth, and especially extremely low gestational age (ELGA), is also a risk factor for LD (Sansavini et al. 2010, 2014). Early gesture production serves important functions in early language acquisition (Iverson & Thal 1998), and delays in gesture production may have negative cascading effects on subsequent language development. The present study seeks to add to this line of research by examining frequency of pointing gesture production at 18 months of age in populations of infants with different underlying risks for LD. Methods. Two groups of infants were included: 37 monolingual Italian infants - 20 extremely low gestational age (ELGA, GA≤28 weeks; 11 F), 17 full-term (FT, GA≥37 weeks; 8 F) - and 54 monolingual American infants - 27 high risk (HR; 13 F), 27 low risk (LR; 13 F). HR infants had an older sibling with an ASD diagnosis, whereas LR infants had a typically developing older sibling. Both groups of infants were video recorded in a 30-minute play session with their mothers and age-appropriate toys. Videos were coded by an observer naive to group membership. This study focuses on observations at 18 months of age (corrected age for ELGA). For both groups, pointing was defined as a spontaneously produced, clear articulation of the index finger directed toward a proximal or distal object with the aim to share attention or request. LD was defined as scores <10th percentile on the American English or Italian versions of the MacArthur-Bates Communicative Development Inventory (MCDI) on at least two time points between 18 and 36 months. Our sample included 9 ELGA-LD and 8 HR-LD infants. Results. Rate per 10 minutes of pointing was calculated for all infants. A Kruskal-Wallis test showed a significant difference among the Italian sub-groups (p=.038). ELGA-LD infants produced pointing gestures at a significantly lower rate than ELGA no LD infants (ELGA-LD: M=1.67; ELGA no LD: M=8.27) and FT infants (M=6.65). No statistically significant differences were found among the American subgroups (p=.108), though the mean rates differed (HR-LD: M=1.75; HR no LD: M=3.79; LR: M=5.15). The rates of pointing in ELGA and HR children were z-standardized using the FT and LR children's mean and SD values (M=0 and SD=1) respectively (see Figure 1). A comparison of z-scores revealed that ELGA-LD infants' rate of pointing was significantly lower than that of HR-LD infants, while no difference was found for ELGA no LD and HR no LD infants. Conclusion. Low rates of pointing at 18 months is a marker of LD in ELGA children. Substantial interindividual variability in pointing production characterizes infants without LD in both the HR and ELGA groups. The potential implications of reduced pointing production and shared attention in mother-child interaction and characteristics of different populations at risk for LD should be considered for understanding the emergence of LD.

P2-D-76 Naming changes infants' memory for individual objects

Sandy LaTourrette[1], Sandra Waxman[1]

[1]Northwestern University

Even before infants begin to speak, naming exerts a powerful influence over their cognition. Within their first year, infants have begun to link nouns specifically to object categories. Infants attend carefully to which nouns have been applied to which objects: When the same noun is applied consistently to distinct objects, infants show an enhanced ability to form an overarching category that includes all of them (Waxman & Markow, 1995). Conversely, when different nouns are applied to distinct objects, infants expect the objects to differ from each other (Dewar & Xu, 2007, 2009) and have difficulty identifying an overarching category (Plunkett et al., 2008; Waxman & Braun, 2005). Here, we ask how naming exerts this effect. Specifically, we propose that hearing the same name applied consistently to a set of objects facilitates categorization by focusing infants' attention to commonalities among them (Althaus & Plunkett, 2015; Waxman & Markow, 1995). On the other hand, hearing distinct names for distinct objects should highlight differences among the objects, a process that promotes attention to each object's unique features and interferes with the identification of an overarching category. This proposal yields a new testable hypothesis: When objects are consistently named with the same noun, infants' success in forming an inclusive category should come at the expense of their ability to discriminate the individual objects. In contrast, when the same objects are named with distinct nouns, infants should successfully discriminate the named individuals. To test this prediction, we developed a memory task. During the learning phase, we exposed 12-month-olds to four distinct animal images (Figure 1). Infants were randomly assigned to either the Consistent Name (same novel noun applied to all exemplars) or the Variable Name (a different noun applied to each exemplar) condition. We then assessed infants' memory for these exemplars in a silent test phase. On each of four test trials, we paired an animal from the learning phase with a novel animal. If infants remember the exemplars they viewed during learning, then they should prefer to look at the novel exemplars. The results support this prediction (Figure 2). Infants in the Variable Name condition (n=17) displayed novelty preferences on three of four test trials (Trials 1 and 2, ps <.001, Trial 3, p=.06). In contrast, providing a consistent name had a different effect: Infants in the Consistent Name condition (n=11) showed no evidence of remembering the individual animals, ps>.1. Non-parametric tests revealed an identical pattern. This provides new evidence for the mechanisms underlying the effect of naming on object categorization.

Labeling a set of objects with a consistent name focuses infants' attention on commonalities among them, facilitating the abstraction of an inclusive category but interfering with memory for each distinct individual. Indeed, even on the first test trial, infants in the Consistent Name condition showed impaired memory for an exemplar they had seen mere moments before, on the final learning trial. In contrast, infants who heard distinct names showed reliable memory for individual exemplars (for converging evidence from different paradigms, see Scott, 2011; Feigenson & Halberda, 2008). Thus, from an early age, naming encourages infants to allocate their attention in sophisticated, adaptive ways.

P2-D-77 Paternal speech at 6-months is associated with receptive vocabulary at 12-months: Evidence from Australian and Swedish families

Ellen Marklund[1], Iris-Corinna Schwarz[1]

[1]Stockholm University

In the first year of life infants undergo an incredible transition from hearing language for the first time, to understanding and uttering their first words. It is well known that the quantity of speech input provided to young children has long-term influences on language development and school readiness (e.g., Hart & Risley, 1995). However, less is known about differences in the contribution of mothers and fathers speech despite increasing paternity leave entitlements and father's involvement in child care. This study uses the Language Environment Analysis System (LENA) to examine the contribution of maternal and paternal speech input to 6-month-old infants and receptive vocabulary at 12-months in a group of Australian and Swedish infants. This sample consists of 43 families (mother, father and infant). Twenty-one families were recruited through the Babylab at Western Sydney University, Australia and 22 were recruited through the Stockholm University Babylab, Sweden. Both samples are participating in a longitudinal study charting language development in the first two years of life. At 6-months infants wore a LENA recorder in a specialized vest on one day with their mother, and one day with their father, from the time that the infant awoke in the morning until they went to bed for the evening. LENA estimates of male adult and female adult word count, turn counts (adult and child vocalized within a 5-seconds interval of each other), and child vocalizations were obtained and averaged across the two recordings to provide a measure of daily speech exposure. Parent's also completed the relevant Communicative Development Inventory when the infant was aged 12-months (Australian CDI, Kalashnikova, Schwarz & Burnham 2016; Swedish CDI, Eriksson & Berglund, 1999).

Preliminary t-tests revealed no differences across languages in demographic variables including infant sex, age at recording and the overall quantity of mother/father/child speech. A multiple linear regression was calculated to predict receptive vocabulary scores based on quantity of male versus female input, turn-taking and infant vocal play. Results showed that male, but not female speech at 6-months predicted receptive vocabulary at 12-months of age (Beta = .36, p = .02). The quantity of infant vocal play at 6-months also predicted receptive vocabulary at 12-months (Beta = -.35, p = .03). Although fathers were not the primary care giver in these families, their speech input was found to be more predictive of infant receptive vocabulary. These findings indicate that providing infants with variability in their conversational partners in the first year appears beneficial to their acquisition of language. Additionally, infants that expressed a greater number of vocalizations also had larger receptive vocabularies at 12-months. This indicates that encouraging infants to engage in meaningful conversations may not only promote vocal play but also have flow on effects for language comprehension. Further work is currently underway to determine whether these relationships persist in speech input to infants at 12 and 18 months.

P2-D-78 The acquisition of agglutinating morphology in French and Hungarian infants

Eniko Ladanyi[1], Judit Gervain[2]

[1]Universite Paris Descartes, [2]CNRS - Université Paris Descartes

Previous results suggest that babies are able to decompose morphologically complex forms to a word root and a suffix relatively early (Marquis & Shi, 2012: 11-month-old French babies; Mintz, 2013: 15-month-old English babies). In this study we aimed to replicate Marquis & Shi (2012)'s findings in 15-month-old French babies with using a different suffix and to test whether 15-month-old Hungarian babies are also already able to decompose morphologically complex forms. Hungarian is a heavily agglutinating language with often up to 3-4 suffixes attached to a stem (e.g., gyerekeiknek 'to their children', in which gyerek ('child') is the word root and -ei, -k and -nek are suffixes). Word segmentation in these languages is arguably more challenging for young learners than in morphologically poor languages like English or French. However, we do not know whether this complex morphology helps babies to decompose complex forms or, on the contrary, makes it more difficult. We hypothesized that Hungarian babies decompose complex forms already at 15 months because of the high number of morphologically complex forms in their language input and based on earlier results we expected to find

decomposition also in French babies. During the experiment, 15-month-old infants were auditorily presented with sentences containing a nonsense word with a suffix (familiarization phase). In the French version nonsense words were verbs following the phonotactic rules of French and appeared together with the first person plural suffix -ons in French sentences (e.g., Nous doulons au parc 'We doul in the park'). In the Hungarian paradigm nonsense words were nouns following the phonotactic rules of Hungarian and were followed by the suffix -bAn 'in' (e.g., A kiskutyák játszanak a púrban. 'The puppies play in the púr'). In the test phase, children heard either the word root (e.g.: doule/púr; familiar trials) or another nonsense word (e.g.: fope/gál; novel trials). The Headturn Preference Procedure was used to measure looking times. According to our results neither Hungarian, nor French babies showed a preference for either condition suggesting that they were not yet able to decompose morphologically complex forms into a word root and suffix. These findings contradicts our hypotheses as well as earlier results. The difference between our results and those of Marquis and Shi (2012) might be caused by the fact that the suffix used in that study is more frequent than the one we used suggesting that decomposition might work relatively early with some highly frequent suffixes but becomes general later. In the case of Hungarian, the high number of suffixes might make decomposition more difficult instead of facilitating it, resulting in the later appearance of decomposition in Hungarian. Marquis, A. & Shi, R. (2012). Initial morphological learning in preverbal infants. Cognition, 122, 61-66. Mintz, T. H. (2013). The segmentation of sub-lexical morphemes in English-learning 15- month-olds. Frontiers in Psychology, 4(24).

P2-D-79 What Makes a Cup a Cup? Infant Generalization Abilities to Basic and Weird Referents

Blair Braun[1], Jessica Anderson[1], Morgan Szarfinski Clark[1], Sarah Kucker[2]

[1]The University of Wisconsin Oshkosh, [2]University of Wisconsin Oshkosh

Children are consistently building new connections with the language they encounter each day--organizing their vocabulary in different ways and connecting newly learned language to previously mastered vocabulary. As children are building these vocabularies, they begin to use various properties, such as the color, material, or shape, of new items to categorize words in their lexicon. Prior work has shown that while children's vocabularies are developing, shape becomes particularly helpful for categorizing. However, it has yet to be explored how children generalize known objects to basic shaped objects (i.e. only shape relevant features) and weirdly shaped (i.e. distinctive features and

function). The present investigation seeks to better understand how children generalize known referents to geon-isomorph shapes (i.e. basic-shape) and weirdly shaped exemplars of that referent (i.e. morphed-shape) (see Table 1 for an example). In this study, we examine generalization abilities of 17-36 month old children in two ways. First, in order to measure shape-based generalizations, a traditional novel noun generalization (NNG) task was utilized. Second, to measure how children generalize basic shaped and morphed shaped referents, we created a version of a known word comprehension task with both geon-isometric and weirdly shaped versions of referents. Results indicate that children in NNG will prioritize shape 70% of the time compared to the material of the object, demonstrating a robust shape bias. Likewise, this shape bias was marginally correlated with age, $r(39) = 0.28$, $p < .10$. For known comprehension, we used child's attention to shape to further understand how children use shape properties when generalizing to known referents. Overall, children with a shape bias in NNG performed well when the task included normal representations of the known referent, selecting the target 74% of the time. Performance on generalizing to both the geon-isometric (60%) and weirdly shaped (67%) versions of referents was lower than normal representations, but remained significantly above chance. Furthermore, we analyzed task performance by age categories. Figure 1 shows performance on normal, weird, and geon trials as a function of age. Overall, as age increased, accuracy on all three trial types also increased, $r(39) = 0.38$, $p = .01$. The result was highlighted by performance for geon-isometric trials, $r(39) = 0.42$, $p <.01$, indicating that as children matured, performance on geon-isometric trials increased. Interestingly, on weird trials, children up to 32 months had similar performance on task accuracy. While children 33-36 months performed at ceiling levels for generalizing to weirdly shaped exemplars of known referents. This result suggests that it is more than shape that influences generalization ability at some ages. Rather, experience might also be an influence on children's ability to generalize to weirdly shaped versions of referents. This study is a small component of understanding the complexity of how children impressively generalize words to grow their vocabularies. Results suggest even when children employ attentional resources to shape when making generalization, it is likely that experience also plays a prominent role when generalizing to geon-isometric and weirdly shaped representations of referents.

P2-D-80 Do children with hearing loss use infant-directed speech? A case study

Maria Kondaurova[1], Kaelin Kinney[1]

[1]University of Louisville

Infant-directed speech (IDS) is a special register employed by parents and non-parents, women and men, and even children as young as two years old. The most obvious characteristics of IDS are its prosodic modifications in comparison to adult-directed speech (ADS). IDS is produced with higher pitch, greater pitch variability, distinctive melodic contours, slower speech rate and shorter utterance duration as compared to ADS. However, the way IDS is manifested could be culturally, gender and geographically determined. The aim of the current study is to examine whether child hearing loss affects the modifications of prosodic characteristics in IDS relative to ADS. One hearing-impaired (HI) and one normal-hearing (NH) mother-infant dyad were recruited. The HI dyad included a NH mother who had a HI 5-year old male and a NH 17-month old female child. The HI child received bilateral cochlear implants at the age of one. The NH dyad included a NH mother who had two NH male children, a four-year old and an 18-month old. The older children in each dyad were matched by the amount of hearing experience. In the ADS condition, the older children were asked to explain to their mothers how to assemble a toy. In the IDS condition, the older children were asked to explain to their younger siblings how to assemble the same toy. Both sessions were video recorded for 15 minutes. Twenty-five utterances from each child speech sample in both conditions were extracted. For each utterance mean pitch and pitch range (Hz), utterance duration (seconds), number of syllables per utterance and speaking rate (number of syllables per utterance duration) were measured. Two-tailed t-tests were used to examine the difference scores between ID and AD mean pitch, mean pitch range, utterance duration, number of syllables per utterance and speaking rate produced by older children in the HI and NH dyads. The results demonstrated a significant difference between the HI and NH dyads in mean pitch ($t(48) = -2.21$, $p = .03$), utterance duration ($t(48) = -2.83$, $p = .006$) and speech rate ($t(48) = -3.27$, $p = .001$). These results suggest that the child with hearing loss produced higher pitch, shorter utterance duration and quicker speech rate as compared to the NH child. The results suggest that the child with hearing loss and four years of cochlear implant experience modified prosodic characteristics of his speech when addressing his younger sister as compared to his mother. The younger NH child who was matched by the amount of hearing experience with the HI child did not modify his prosody. These results extend previous findings demonstrating that children modify some prosodic characteristics of their speech when interacting with infants to a pediatric population with hearing loss. Future data collection is necessary to understand how additional variables, such as child chronological age, cognitive development, sibling gender and the type of assistive device affect modification in the ID relative to AD speech register in children with hearing loss.

P2-D-81 Cats meow more and higher to younger children: A study of sound symbolism in Korean child-directed speech

Jinyoung Jo[1], Eon-Suk Ko[2]

[1]Seoul National University, [2]Chosun University

Sound symbolism refers to the non-arbitrary relationship between sound and meaning of a word (e.g. bang). The inherent echoic relation to a referent in sound symbolism might facilitate infants' word learning (Imai & Kita, 2014), in part because sound symbolic words are acoustically more salient than conventional words (Laing, Vihman, & Keren-Portnoy, 2016). This study investigates Korean mothers' use of sound symbolism concerning the frequency and acoustic saliency as a function of age based on naturally occurring data. Our analysis focuses on expressive lengthening, onomatopoeia and word play. In expressive lengthening (e.g. khɨ::n 'huge'), an extra elongation of the vowel augments the scalar properties of the meaning. Onomatopoeic words mimic auditory impressions. The ratio of onomatopoeia in Korean child-directed speech is reported to be particularly high compared to English or Japanese (Bae & Park, 2012), which makes Korean an advantageous test bed for investigating the use of sound symbolism. Word play includes cases where mothers playfully produce nonsense sounds mainly to grab the child's attention. A total of 36 infant-mother dyads (child age: 0, 1 and 2 years old) in a 40-minute free-play session were recorded. Their speech was transcribed, in which lengthened syllables, onomatopoeia and word play were tagged using CHILDES convention. We first calculated the ratio of these target words in each mother's word tokens. Three linear regression analyses were performed with age and gender of child as fixed factors and the ratio of words with lengthened syllables, onomatopoeia and word play as dependent variables in each model. The results showed a significant effect of child age on the ratio of sound symbolism in all three categories (all p's<0.01; Figure 1), indicating a decrease in the use of sound symbolism with child age. We further investigated prosodic saliency of onomatopoeic words. Duration, mean pitch, maximum pitch and pitch range of 1460 onomatopoeic words were compared with a randomly generated sample of 1900 ordinary words whose boundaries were marked by a forced-alignment toolkit. Using the lme4 package of R, mixed effects linear regression models were constructed with word type, age and their interaction as fixed factors, and the four acoustic measures as dependent variables. Log likelihood ratio tests comparing the full and reduced model without each fixed effect of interest showed significant effect of word type in all acoustic variables (p's<0.001), suggesting that onomatopoeic words were prosodically more salient than non-iconic words. There was also a significant effect of age in all pitch measures (p's<0.05), reflecting the decrease in pitch and pitch range with child age. Importantly,

there were significant interactions between word type and age for mean pitch (Figure 2) and maximum pitch (p's<0.01), indicating that such saliency became weaker with child age. The results suggest the use of sound symbolism in child-directed speech is modulated by the child's ability to associate linguistic form with meaning. This is in line with previous studies that reported attention-grabbing function of those words is crucial only when infants are younger (Kauschke & Klann-Delius, 2007) and that sound symbolic words are not useful in making fine-grained distinction among similar concepts (Monaghan et al., 2012). The findings are thus consistent with the prediction of sound symbolism bootstrapping hypothesis (Imai & Kita, 2014)

P2-D-82 General and specific predictors of mental state language at 27 months

Irina Jarvers[1], Beate Sodian[1], Susanne Kristen-Antonow[1], Stella Grosso[1], Tobias Schuwerk[1]

[1]Ludwig-Maximilians University Munich (LMU)

Children's talk about the mind, emerging in the third year of life, is one of the first signs for an explicit understanding of mental states. Recent research findings indicate that there is more genuine reference to mental states (more specifically to knowledge states) in 25- to 33-month-olds' spontaneous speech than was previously assumed (Harris, 2016). At 30 months, mental state vocabulary correlates with level 1 visual perspective taking skills, independently of general language abilities (Chiarella, Kristen, Poulin-Dubois, & Sodian, 2013). Furthermore, longitudinal studies have shown specific predictive relations of joint attention around the age of 12 months, mental state language (MSL) at 24-30 months, and explicit TOM around the age of 4 years, indicating conceptual continuity in the mental domain (Brooks & Meltzoff, 2014; Kristen, Sodian, Thoermer, & Perst, 2011). In the present paper, we focus on mental state language at 27 months. How do domain-general (language, cognition) and domain-specific (perspective taking, metacognitive awareness) abilities contribute to the acquisition of mental state vocabulary? N = 70 children (26 female), were tested twice, at the age of 24 and 27 months for general cognitive skills (Bayley Scales III, Bayley, 2006), general language skills (SETK-2, Grimm & Aktaş, 2000), visual (VPT) and epistemic perspective taking (EPT) abilities (Gonzales et al., 2017), metacognition of own ignorance (MI) (Bartz et al., 2016) and MSL vocabulary and production (Olineck & Poulin-Dubois, 2005), measured with the parent report scale (MSLQ) and a task assessing children's understanding of 'know' and 'want'. The mean percentage of terms on the MSLQ was 40% ranging from 0-95%. 91% of the children knew at least one cognition term at 27 months, on average they knew 3.6 cognition terms, ranging from 0-16 terms. In the comprehension task, however, only 15% showed

competence for 'know' and 'don't know' (vs. 49% for 'want' and 'don't want'). 27% were competent at Level-1 VPT, and 18% at EPT. 65% of the participants showed signs of MI in a 'fake object' labeling task (Bartz et al., 2016). Understanding 'want' was significantly correlated with the MSLQ score, r = .29, p < .05; similarly, VPT was predictive of MSLQ, r=.28, p<.05. However, these correlations were not significant after controlling for general cognition and language. The MSLQ was significantly predicted by the Bayley scales, r=.40, p<.001, as well as the vocabulary r=.46, p<.001 and the sentence production scales r=.42, p<.001 of the SET-K. A linear regression analysis revealed that the MSLQ was predicted jointly by the language and cognition measures; (F(1,49)=5.34 , p<.000), with an R2 of .395. In sum, the present findings confirm the emergence of mental state vocabulary, including cognition terms, as well as some perspective taking skills and metacognitive awareness of ignorance early in the third year of life. However, relations between VPT and MSLQ were not yet significant independently of general language, nor was the MSLQ linked to metacognitive awareness at this early age. Rather, the early acquisition of mental state language appears to be initially largely driven by general language and cognitive abilities.

P2-D-83 Discovering grammatical categories from audio-visual cues during early language acquisition

Cristina Jara[1], Marcela Peña[1]

[1]Pontificia Universidad Católica de Chile

During their first year of life infants begin to construct the word repertoire of their native language. This is a challenging task, because infants need to extract words from continuous speech without clear word boundaries, associate them to visual referents and to assign them grammatical properties. Two important grammatical categories in language acquisition are nouns and verbs. Previous studies suggest that nouns are learned earlier, faster and easier as compared to verbs (see Waxman, Fu, Arunachalam, Leddon, Geraghty & Song, 2013 for a review). For instance, near 6-months of age, infants recognize common nouns like body parts and foods (Bergelson & Swingley, 2012), while verbs discrimination exploiting the most frequent lexical frame in English verbs (-ing) is observed after 7.5 months of age (Willits, Seidenberg & Saffran, 2014). The mechanisms underpinning that difference in timeline for noun and verb learning is highly unknown. This study explores whether 4-5-month-old infants have a rudimentary knowledge of these two grammatical categories. Exploring this question will contribute to a deeper understanding of the early steps of grammar acquisition. The final sample for this study

was composed by 30 healthy 4-5-month-old infants. Twelve were excluded because a strong side bias, fussiness or missing data, remaining 18 for further analysis. All infants were born as full term and with pediatric development in the norm. We familiarized infants to audiovisual stimulation. Auditory stimuli consisted in ~3 minutes of continuous speech stream composed by 4 tri-syllabic words, statistically defined. Two of those words systematically co-occurred with the static faces of two different women (for noun-like labels) while each one of the other two words co-occurred with a specific head movement (for verb-like labels). After familiarization phase, we tested if infants learn the association of the words with individuals (noun-like) and with the movements (verb-like). We presented 32 trials (16 for nouns-like and 16 for verbs-like labels). Each trial consisted in the simultaneous presentation of two faces and one word. If infants successfully learnt the association between words and images during familiarization they should look first and/or longer to the image matching the uttered word. Preliminary results show that 4-5-month-old infants did learn noun-like labels referred to static faces and verb-like labels referring to moving faces. However, most of the infants were able to learn only one type of label, that is only those referring to actions (verb-like labels) or only those referring to individuals (noun-like labels). Most infants at this age were unable to learn both categories at the same time. We conclude that from early age infants can exploit audiovisual stimulation to associate between what they hear to what they see to develop a rudimentary knowledge about grammatical categories.

P2-D-84 Are content nouns always better? Considering variable pronoun usage in children's acquisition of novel verbs

Sabrina Horvath[1], Sudha Arunachalam[1]

[1]Boston University

Given just one exposure to a novel verb, children can successfully learn its meaning when it is surrounded by content nouns (e.g., "The boy is pilking a balloon"), but not when it is surrounded by pronouns (e.g., "He is pilking it") (Arunachalam & Waxman; 2011; 2015). Here we ask whether, given multiple exposures to a novel verb, children are more successful learning a novel verb's meaning when it is surrounded by only content nouns, versus a combination of content nouns and pronouns. Given findings by Arunachalam and Waxman (2011, 2015), it is clear that content nouns are more informative to the learner. However, pronouns have demonstrated benefits in other areas of word learning. They help children to identify a novel word's boundaries (Mintz, 2003) and to use novel verbs productively (Childers & Tomasello, 2001). More broadly, variability has been

demonstrated to help the learner in a variety of language-learning tasks (e.g., Perry et al., 2010; Waximan & Klibanoff, 2000). We here compare toddlers' performance, hypothesizing that children will perform better given a combination of content nouns and pronouns. Twenty-five 2-year olds (M = 28 months, SD = 3 months, data collection in progress) participated in a novel verb learning task; we used a within-subjects design based on a previously established verb-learning paradigm (e.g., Arunachalam & Waxman, 2011; Imai et al., 2005) (See Figure 1). During Familiarization, children saw a video of an actor performing an action on an object (e.g., a girl lifting a toy truck). Simultaneously, they heard a novel verb in eight sentences: in the Same condition, the novel verb was presented with only content nouns; in the Varied condition, the novel verb was presented with both content nouns and pronouns. At test, children saw two new scenes: the target scene featured the familiarized action but a different object (e.g., girl lifting a bear), and the distractor scene featured the familiarized object but a different action (e.g., girl tipping a truck). Children were prompted to, e.g., find ziffing, and their gaze was recorded. Our mixed effects regression revealed a significant effect of condition ($t = 2.1$, $p = 0.02$), such that children performed better in the Same condition than they did in the Varied condition. We conclude that, although variability is beneficial to the language learner in some tasks, when acquiring verb meaning specifically, the benefits derived from content nouns overshadow the benefits of variable pronouns and content noun use.

P2-D-85 Exploring the link between the acquisition of words for objects and for numbers at 30 months

Peter Horn[1], Tom Fritzsche[1], Antje Ehlert[1], Flavia Adani[1]

[1]University of Potsdam

Early development of language and numeracy skills are interdependent (LeFevre et al., 2010). Like in any learning of content words, the acquisition of number words involves fast mapping and, successively, extended mapping (Carey, 2010). This study focuses on fast and extended mapping of novel words and its relation with the acquisition of number words for small integers. While the ability of fast mapping emerges around 18 months, successful retention of newly mapped labels is not detected until 30 months (Bion et al., 2013). Moreover, at 24 months the majority of children know the meaning of the word "one" but they need another six to eight months to become "two"-knowers (Carey, 2010). Both processes have been argued to involve the same mapping mechanism (Barner, 2017). Hence, we predict a positive correlation between novel word retention - a first stage of extended mapping - and children's individual comprehension of number words

at 30 months. Thirty German-learning 30-month-olds (mean: 30.1, range: 29.3-31.0, 15 girls) took part in an eye-tracking study, in which they were asked to identify the referents of familiar and novel words (for a total of 28 trials). Three experimental conditions were tested (Fig. 1): (a) Familiar word: the familiar target object is presented either with a familiar or with an unfamiliar distractor; (b) Novel word (Learning trials, first half of the experiment): the unfamiliar target object (Horst & Hout, 2016) is paired with a familiar distractor and labeled with a novel word (e.g., Farge); (c) Novel word (Retention trials, second half): the novel words are pitted against each other. Subsequently, the children completed a Give-a-N(umber) task (Wynn, 1990), in which they were asked to give one to five chips out of ten (5 trials in total). Based on the highest score, each child was assigned to a knower-level. The target looking proportions for each condition (full time course in Fig. 1) were analyzed in the window starting at the noun onset till the end of the trial. We found a significant target preference for all conditions ($p<.001$), which was strongest for familiar words ($p<.05$). In the Give-N task most of the children reached a score of 2. Moreover, the knower-level and the individual target looking preference in the Novel word (Retention trial) condition were positively correlated ($p=.05$), as shown in Figure 2. These results demonstrate that children who are higher proficient in the comprehension of number words are also more likely to retain newly-learned content words. At this point, this can be taken as an indication that similar underlying mapping mechanisms are implicated in the development of these abilities. While the concepts of objects and quantities are substantially different, our results suggest that (extended) mapping skills at 30 months may be relevant beyond the language domain, namely to the acquisition of number concepts. If this were true, we expect connections with later vocabulary development and to other mathematical competencies. We are currently following up the children at the age of 36 months and test this prediction. These longitudinal data will be available at the time of the conference presentation.

P2-D-86 Statistical learning, linguistic experience and language outcomes in infancy.

Mélanie HOAREAU[1], Henny Yeung[2], Thierry Nazzi[3]

[1]Université Paris Descartes, [2]Simon Fraser University, [3]CNRS - Université Paris Descartes

Transitional Probability (TP) computations have been shown to be a robust learning mechanism to segment words in fluent speech (Saffran et al., 1996). This ability further appears to facilitate subsequent word-object mapping (Graf-Estes et al., 2007), indicating that it is implicated in lexical acquisition. Another line of research found that maternal

speech input at 7 months modulates both infants' concurrent speech segmentation ability for natural stimuli, and later lexical ability (Newman et al., 2015). But much remains unclear about how individual differences regarding the amount of experience with the native language might influence the ability to track TPs in speech, and how TP processing is specifically related to lexical development. Therefore, the present study explored the links between infants' ability to track TPs in a speech segmentation task and both parental input and language outcomes. Thirty-two monolingual French-learning infants participated in the study. To measure speech input, we collected home recordings of speech input at 4 and 8 months of age using the LENA system and calculated the average number of adult words heard per hour. To evaluate linguistic outcome, we used parental reports to collect infants' babbling inventory at 8 months and their vocabulary size at 12 months. For TP-based segmentation, infants were tested at 8 months using the headturn preference procedure, replicating Experiment 1 of Mersad & Nazzi (2012). During familiarization, they were exposed to a 3-minute artificial language in which TPs were the only cue for word boundaries. The language was constructed by concatenating four pseudo-randomly ordered trisyllabic pseudowords (hereafter words), 2 frequent and 2 infrequent ones. At test, infants were exposed to 2 blocks of 4 lists of repeated words: the 2 infrequent words and 2 part-words that occurred with the same frequency. The part-words were constructed by concatenating the last syllable of a frequent word and the first two syllables of the other frequent word. Thus, TPs within words were higher than within part-words (1 versus .75). We compared orientation times (OTs) for words and part-words to assess segmentation, and used their difference scores (words minus part-words) for the correlational analyses. Overall, we found a trend showing that 8-month-olds can use TPs to segment words by showing the expected preference for part-words over words (novelty effect, $p=.06$), replicating previous reports (Mersad & Nazzi, 2012; Saffran et al., 1996). Moreover, 8-month-olds with larger novelty effects had higher production abilities at the same age ($r=-.42$, $p=.02$), and a trend for better lexical abilities in production four months later at 12 months ($r=-.36$, $p=.13$). This indicates a link between stronger TP-based segmentation abilities and more mature linguistic outcomes. Finally, 8-month-olds with larger novelty effects had earlier had more speech input at 4 months ($r=-.37$, $p=.03$), though input at the same age did not have this effect ($r=-.16$, $p=.37$). This establishes a link between more exposure to speech and strength in TP-based segmentation abilities. These findings shed new light regarding how the ability to extract statistical information is related to early input and later language outcomes.

P2-D-87 An exploration of early phonotactic repair by French-learning infants using ERPs

Andrea Helo[1], Leo Nishibayashi[2], Louise Goyet[3], Thierry Nazzi[4], Pierre Hallé[5], Pia Rämä[1]

[1]Universidad de Chile, [2]Riken Brain Science Institute, [3]Université Paris 8 Vincennes-Saint-Denis, [4]CNRS - Université Paris Descartes, [5]Université Sorbonne Nouvelle

Infants' learning their native language involves early developmental mechanisms that allow the acquisition of the native phonemic inventory and the rules whereby phonemes can be combined within words (phonotactic constraints). Previous studies established that infants become sensitive to some phonotactic rules by 9 months (Jusczyk et al., 1994; Nazzi et al., 2009; Gonzalez-Gomez & Nazzi, 2012) and suggest they start repairing phonotactically-illegal words by at least 14 months (Mazuka et al., 2011). The current set of experiments aims at determining when and how infants' brains have attuned to the phonotactic constraints of their native language to achieve this kind of repair. When presented with spoken utterances beginning with */dl/ or */tl/, which are illegal word-initial clusters in French, French-speaking adults repair these clusters into the permissible /gl/ or /kl/ clusters, as shown by both behavioral (Hallé et al., 1998; Hallé & Best, 2007) and ERP (Nishibayashi et al. submittedLabPhon) studies. Such robust cases of phonotactically-driven perceptual assimilation have been named phonotactic repair in Hallé et al. (2008). The present study investigated whether the brains of 7- and 11-month-old French-learning infants repair the phonotactically illegal */tl/ sequence, using an oddball paradigm based on Dehaene-Lambertz and Baillet (1998). Infants were exposed to trials of four syllables. Each trial consisted of three habituation precursor syllables followed by a dishabituation target. There were three precursor-target conditions. The target was kept constant (*/tla/) and the precursors could be either /tla/ (no-change baseline condition), /pla/ (control-change condition, as found for adults in Hallé et al., 1998), or /kla/ (critical-change condition). Event-related potentials (ERPs) were recorded using the 128-electrode EGI system. Epochs were extracted based on target syllable onset (-200 - 800 ms) and baseline corrected (-200 - 0 ms). Mean ERP amplitudes were computed over two-time windows (100-300 and 400-600 ms), and over three areas at left (10 electrodes), middle (9 electrodes) and right (10 electrodes) frontal recording sites (see Fig. 1). Seven-month-olds exhibited larger positive ERPs over the middle recording sites in response to the control-change ($p=.015$) and critical-change ($p=.010$) conditions compared to the no-change condition in the 400-600 ms window. The 11-month-olds showed a similar pattern in the 100-300ms window in both the middle (control-change vs. no-change: $p=.030$; critical-change vs. no-change: $p=.040$), and the left (control-change vs. no-change: $p=.007$; critical-change vs. no-change: $p=.055$), recording sites,

showing that at 11 months, responses are faster and start to lateralize to the left hemisphere (see Fig. 2). Our results suggest that the perceptual phonotactic repair found in French-speaking adults is not yet at work in French-learning 7- and 11-month-olds. Hence, although French-learning infants have started to learn some phonotactic rules by 10 months, they appear not to perceptually repair phonotactically-illegal sequences by 11 months. Developmental changes were nevertheless found, showing faster and more left-lateralized responses to phonemic changes, suggesting that phoneme discrimination is improving between 7 and 11 months. These changes might constitute a prerequisite for the subsequent emergence of phonotactic repair. We are currently testing 14-month-olds to test this possibility.

P2-D-88 Exploring the conceptual origin of a linguistic behavior: Event endstate representation in infancy

Angela Xiaoxue He[1], Sudha Arunachalam[1]

[1]Boston University

By 6 months of age, infants are sensitive to goals and results of actions (e.g., Woodward, 1989), and words denoting results (e.g., 'up', 'allgone') are among the earliest acquired. However, there is a puzzling paradox with older children: preschoolers allow non-completion readings of change-of-state verbs--e.g., interpreting 'fill' as if it meant 'pour' rather than something being made full (e.g., Wittek, 2002). In many domains there is a homology between the learner's conceptual system and linguistic system. Therefore, in this study, we explore the conceptual origin of preschoolers' linguistic behavior. We ask: do infants conceptualize event endstate as a critical event component, such that a change in endstate leads to a change in the event category? For example, do they perceive an event in which a particular endstate comes about (e.g., paper falls to cover a spoon) as belonging to a different event category from events in which the same event occurs, but to a different degree (e.g., paper falls and partially occludes, but does not fully cover, a spoon)? This study differs from most earlier work investigating infants' understanding of goals and changes of state because it focuses on events that (a) are naturally occurring physical events with no human agent, and (b) come to different degrees of completion, rather than completely different endpoints. In a habituation-switch study, 14-month-olds were habituated to a change-of-state event--half viewed an event with full occlusion, and the other half viewed an event with partial occlusion. When infants reached a preset habituation criterion, the test phase began. At test, those who viewed the full event during habituation were shown the partial one (Full-then-Partial Condition), and those who

viewed the partial one before were shown the full one (Partial-then-Full Condition). We expect infants to be more surprised at the change in the Full-then-Partial Condition than in the Partial-then-Full Condition, if they conceptualize endstate as a critical event component. Specifically, we hypothesized that in the Partial-then-Full Condition, upon seeing the partial event, infants would categorize it as an "occluding" event, and be unsurprised to see another occluding event at test, even though the degree of occlusion was different. In the Full-then-Partial Condition, however, we hypothesized that infants would categorize it as a "covering" event, and would be surprised to see the test event, which is not a good exemplar of a "covering" event. See Figure 1. Results (n = 18, in progress) are consistent with our prediction: infants looked longer at the test event in the Full-then-Partial Condition but not in the Partial-then-Full Condition; see Figure 2. We take this result to suggest that the difference between the full and partial occlusion events is not merely perceptual, but a conceptual one; in other words, infants categorize events on the basis of the degree to which they achieve a particular endstate. We do not, therefore, find evidence that preschoolers' linguistic behavior (e.g., interpreting 'fill' as 'pour') might be explained by event conceptualization. We interpret the results in light of hypothesized differences between linguistic and conceptual encoding.

P2-D-89 The Emergence of Voice Onset Time Contrasts for Consonant Voicing and Place of Articulation in Infancy

Rose-Milord Fleurissaint[1], Klaudia Bednarczyk[1], Gordon Ramsay[1]

[1]Emory University

Phonological contrasts for voicing and place of articulation are fundamental to the consonant systems of the world's languages. The articulatory gestures used to produce those contrasts, and the resulting acoustic correlates by which they are perceived, must be learned by infants as they acquire spoken language. Infant productions of early closants exhibit substantial articulatory and acoustic variability, and only converge later in childhood towards the stable patterns seen in the consonants of adult speech. Realization of the voicing contrast in stop consonants involves precisely coordinated timing of the laryngeal and oral gestures that control the offset and onset of voicing relative to the formation and release of a constriction along the vocal tract. The main perceptually salient acoustic correlate of this timing in adult speech is the Voice Onset Time (VOT), measured as the interval between the stop consonant burst and the onset of phonation in the following vowel. The voicing contrast is interesting from a developmental perspective because the distribution of VOT in voiced and voiceless consonants is known to vary as a

function of place of articulation as well as voicing (velar > alveolar > bilabial; voiceless > voiced) due to basic laws of aerodynamics, and infants must learn to produce and perceive the voicing contrast at the same time as they acquire contrasts for place of articulation. Infants also often fail to produce full closures, and phonation may be imperfectly voiced or devoiced, confounding traditional acoustic definitions of VOT, yet adult listeners are still often able to perceive a gestural contrast. Several previous studies have examined the voicing contrast using longitudinal VOT measurements, but we are not aware of any study to fully analyze the development of this contrast across place of articulation. Accordingly, we investigated the emergence of the VOT distinction as a function of age, voicing and place of articulation, in order to determine when mature patterns of covariation first appear. As part of a larger study, we tracked vocal development in 8 typically developing infants from birth. Using a digital audio recording device (LENA) worn all day, we made audio recordings of each child's language environment at monthly intervals from 0-36 months. We identified 10 examples of closant productions in vocant contexts for each child at 15 and 24 months, spanning the period at which the VOT contrast is thought to first develop. By identifying local minima and inflection points in the amplitude envelope, we were able to measure the point of maximum oral closure. Using inverse filtering, we were able to reliably identify the onset of vocal fold vibration relative to the closure. Adult listeners phonetically transcribed each production. We calculated the distribution of VOT values as a function of age, perceived voicing and place of articulation (Figure 1), and used Kolmogorov-Smirnov tests to identify significant differences. Consistent with previous studies, we found no significant VOT difference between closants perceived as voiced and voiceless at 15 months across place of articulation, and significant VOT differences that varied with place of articulation according to the expected pattern at 24 months. Our findings indicate that, by two years, children have already begun to acquire the gestural patterning of oral and laryngeal closures needed to scaffold the emergence of stop consonants.

P2-D-90 Intra- and Inter-Individual Variability in Maternal Contingent Responsiveness during Naturalistic Routines in the Home

Andrew Han[1], YanYin Lam[1], Yana Kuchirko[2], Catherine Tamis-LeMonda[2], Cynthia Wang[1]

[1]New York University, Steinhardt School of Culture, Education and Human Development, [2]New York University

Decades of research on maternal contingent responsiveness suggests that mothers are highly responsive to infants' communicative actions. In the context of structured tasks in

the lab, mothers respond to infants' communications in ways that are temporally and conceptually aligned with infants' actions. In the context of daily routines in the home, however, high levels of responsiveness may be implausible. Mothers are likely to attend to chores, talk on the phone, cook meals, browse the web, pausing intermittently to interact with their infants. As such, infants likely experience fluctuating contingent responsiveness, characterized by moments of high responsiveness during bouts of shared attention, and low responsiveness when mothers attend to other things. Thus, it may be the case that research using structured tasks may have overestimated levels of contingent responsiveness. To test this hypothesis, we examined if there are inter- and intra-individual differences in mothers' contingent responding to infants' vocalizations and object exploration in the context of daily routines in the home. European-American mothers and their 18-month-old infants were observed for 1 hour of during naturalistic routines in the home (N=24). Videos were coded in Datavyu for onsets of (1) maternal speech; (2) infant vocalizations; and (3) infant object exploration (durations of infants simultaneously looking and touching objects). Data were exported to GSEQ to examine the probabilities of maternal language following infants' actions within 3 seconds. Results indicated that on average, infants were more likely to hear language right after vocalizing than after exploring objects: 66% of infant vocalizations and only 48% of infant object explorations, $t(23)=3.72$, $p=.002$. Low levels of maternal responding to infants' object explorations may be functionally meaningful as bouts of joint attention can also be initiated by infants who must generate effective strategies to elicit their mothers' attentions. Results indicated a marginal correlation between the proportion of infants' vocalizations and object explorations that elicited maternal language ($r=.47$, $p=.06$). There was high intra-individual variability in frequencies of maternal responses to infant vocalizations and object explorations minute by minute (Figures 1a-b). Sequential analyses indicated that mothers' responses to infants vocalizations and object explorations were not more likely than chance, challenging assumptions of prior work that mothers are high responsive to infants' actions. These findings may be explained by high levels of maternal talk that does not follow infant vocalizations and object explorations (Figures 2a and 2b), as well as context of daily routines, where dyads go in and out of joint attention. In ongoing analyses, we are examining whether different types of daily routines (feeding, grooming, literacy, play, and unstructured) affect levels of maternal responsiveness. Additionally, we are analyzing the functions of maternal language to infants (referential and regulatory) to examine whether mothers are more likely to use one form of language over another when responding to infants' actions.

P2-D-91 Selectivity in bilingual infants' label learning

Katharine Graf Estes[1], Dylan Antovich[1], Jessica Hay[2]

[1]University of California, Davis, [2]University of Tennessee

The goal of this research was to investigate flexibility in bilingual infants' label learning. Bilinguals experience a more varied phonological environment than monolinguals because each of their languages has its own unique sound system. Relative to monolinguals, bilinguals show extended flexibility in label learning for linguistic sound contrasts that their own language does not use (Graf Estes & Hay, 2015; Singh et al., 2014). However, it is not yet clear whether bilingual openness in label learning extends to nonlinguistic sounds or whether it is specific to linguistic sounds. Thus, we examined bilingual and monolingual infants' learning of nonlinguistic object labels. We tested 14- and 19-month-olds who were monolingual English-learners (n=38) or bilingual infants (n=35) learning English and a nontonal language (e.g., Spanish, French). Infants heard a pair of nonlinguistic sounds paired with unfamiliar objects. Both nonlinguistic labels were pure tones that were manipulated to follow distinct pitch contours (rising vs. falling). The tones were associated with objects in a modified Switch task (Werker et al., 1998), a habituation-based measure of early object label learning. We found that monolingual 14-month-olds looked reliably longer during Switch test trials in which the original label-object pairings were switched (object 1/label 2) than during Same trials in which the original pairings were maintained (Figure 1; p=.01). Thus, infants can learn nonlinguistic labels in a highly simplified label-learning context. This finding is notable because similarly-aged infants have previously only learned nonlinguistic labels in tasks with rich referential cues (e.g., Woodward & Hoyne, 1999). However, monolingual 19-month-olds did not look longer on the trials that violated the original label-object pairings (p=.26). This suggests that they did not learn the labels, although a follow-up experiment (n=16) indicated that infants this age can readily discriminate the rising versus falling nonlinguistic tones (p=.02). Compared to younger infants, older infants were more selective about the types of sounds that they accepted as labels. Bilingual infants showed a different pattern of performance from the monolinguals. Figure 1 shows that neither the bilingual 14- nor 19-month-olds differentiated the Same vs. Switch trials, and therefore exhibited no evidence of learning the object labels (ps >.6). For nonlinguistic sounds, the bilinguals seemed to be more constrained in label learning than monolinguals. Given the prior evidence that bilinguals have an extended period of openness in label learning (Graf Estes & Hay, 2015; Singh et al., 2014), these findings are somewhat surprising. Our interpretation is that bilingual infants show greater selectivity in their label learning for sounds that they interpret as nonlinguistic because they have substantial experience with

the range of acoustic forms that words can take. The variation in word forms across two languages may encourage openness in interpreting some dimensions of word forms (i.e., tone, phonotactics), but may also help infant to reject sound forms that clearly do not fall into this broad distribution of linguistic sounds. Although bilinguals may accept some linguistic forms that monolinguals reject, at a young age they also rule out some nonlinguistic acoustic forms that young monolinguals are willing to accept.

P2-D-92 Asymmetrical vowel discrimination is affected by native language experience: Crossing language boundaries in vowel perception

Antonia Götz[1], Anna Krasotkina[1], Gudrun Schwarzer[1], Barbara Höhle[1]

[1]Justus-Liebig-Universität Gießen

During the first year of life, infants´ perception of native speech and non-native speech seems to develop in different directions: while the ability to discriminate native contrasts increases, it decreases for non-native contrasts. For vowels, a recent meta-analysis by Tsuji and Cristia (2014) showed that infants between 6 and 10 months develop enhanced perceptual sensitivity for native vowel contrasts but that a decline of the initial sensitivity is not evident for all non-native vowels. Most of the previous studies focused on the discrimination of either native or non-native contrasts, less is known about how infants can discriminate a native vowel from an acoustically similar non-native vowel. Vowel discrimination can be asymmetrical: a switch from vowel A to vowel B may be easier to detect than vice versa (Polka et al., 2005). Two models have been proposed to account for these asymmetries. According to the Natural Referent Vowel Framework (NRV; Polka & Bohn, 2011), vowels with extreme articulatory-acoustic properties act as natural referent vowels. The perception from a central to a more peripheral vowel is better than reverse. The NRV framework predicts a universal, language-independent vowel asymmetry. Contrastingly, the Native Language Magnet model (NLM) (Kuhl & Iverson, 1995) predicts a language-specific asymmetry. Discrimination from a non-prototypical to a prototypical native exemplar is better than reverse. Thus, the present study has the aim to compare the predictions of these models with respect to the reorganization of vowel perception during infancy. We tested 6-, and 9-month-old German-learning infants on their discrimination of the Polish /ɨ/, phonetically described as [ɘ̟], vs. the German /ɪ/ vowel. This contrast allowed us to make model specific predictions. Taking /ɪ/ as the more focal vowel, better discrimination is predicted from /ɨ/ to /ɪ/ according to the NRV. Due to the proposed language universal nature, this asymmetry would be expected across all age groups. Following the NLM, the same asymmetry is predicted, but this asymmetry should

only emerge with infants' attunement to their native language. All infants were tested in a habituation procedure. Half of the 9-month-olds were habituated on the Polish vowel and half on the German vowel. So far, the 6-month-olds were only habituated with the German vowel. In line with the perceptual reorganization, we observed an age-related decline in infants' vowel discrimination. Our results revealed that 6-month-old infants discriminated the German-Polish contrast in the direction from the German to the Polish vowel ($\beta = 0.31$, $SE = 0.14$, $t = 2.22$, $p = 0.03$), whereas infants at 9 months did not ($\beta = 0.07$, $SE = 0.13$, $t = 0.53$, $p > .05$, see Figure 1). Interestingly, the 9-month-old infants discriminated after habituation to the Polish vowel ($\beta = 0.34$, $SE = 0.11$, $t = 2.97$, $p < .01$, see Figure 2). Our preliminary results suggest that infants, as soon as the perceptual reorganization sets in, start to perceive vowels asymmetrically. Our findings so far support the language-dependent NLM model.

P2-D-93 Exploring Infants' Ability to Understand Abstract Words

Katrina Martindale[1], Hope Hodgson-King[1], Nayeli Gonzalez-Gomez[1]

[1]Oxford Brookes University

During language development, infants have to learn labels referring to physical things, such as "cat" or "table" (i.e., concrete words), but they also need to learn labels referring to things not having physical or concrete existence, such as "love" or "gone" (i.e., abstract words). Previous research has mainly focused on the age at which infants begin to understand concrete words. Different studies have demonstrated that infants as young as 6months are able to understand some concrete words including body parts, food-related words, and other common nouns (e.g., Tincoff & Jusczyk, 2011; Bergelson & Swingley, 2012). However, it is not until 10-to-13 months of age that infants have been found to begin understanding some abstract concepts such as "eat" and "all gone" (Bergelson & Swingley 2013). The present study explored the age at which infants begin to understand abstract words for feelings (e.g., happy or sad). Using a Tobii eyetracker TX300, we recorded 9-to-18-month-old infants' eye movements while they were watching videos showing two faces each displaying one of five different emotions (i.e., happy, sad, scared, angry and surprised) or a neutral face. In each video the two faces were presented side-by-side and started moving synchronously in a vertical way, while an audio said: Look! [target word], s/he is [target word]!. Preliminary results (N=21) analyzing the proportion of target looking revealed that infants as young as 9 months of age were able to understand abstract words referring to emotions. Taken together these results suggest that infants begin to understand some abstract words later than concrete words. This is

in line with research showing that concrete words are processed faster than abstract words (Paivio, 2013), given than concrete words are processed by both the verbal and non-verbal systems, while abstract concepts only use the verbal system.

P2-D-94 Word learning in bilingual 14 month-olds: Now you see it, now you don't

Ana Maria Gonzalez-Barrero[1], Krista Byers-Heinlein[1]

[1]Concordia University

Word learning is a key process for language acquisition. Previous studies have shown that at 14 months, monolingual (Werker et al., 1998) and bilingual (Byers-Heinlein, Fenell, & Werker, 2013) infants are able to learn novel words presented in isolation. For slightly older monolingual (Fennel & Waxman, 2010) and bilingual infants (Fennell & Byers-Heinlein, 2014), sentence frames enhance minimal pair word learning. Sentential context might be particularly relevant for bilinguals, who can use this to determine which language a word is from (Byers-Heinlein, 2014). In the present study, we examined different sentential conditions that might either facilitate or challenge word learning in bilingual 14-month-olds. In 2 eyetracking experiments, 14-month-old French-English bilinguals were familiarized with 2 novel word-object pairings presented in a sentence frame. In Experiment 1 (N = 15), one word was presented in the infants' dominant language (e.g., "Look, it's the kem!"), and one in their non-dominant language (e.g., "Regarde, c'est le bos!"). In Experiment 2 (N = 14), both words were presented in the dominant language. Experiments included 8 familiarization trials per word presented in a quasi-random order, followed by 4 preferential looking test trials where both novel objects were presented onscreen, and the target words were produced in isolation (e.g., "Kem! Kem!"). To examine whether infants learned one or both words, one-sample t-tests compared the proportion looking time at the target object compared to chance (.50). In Exp. 1, bilinguals learned the word presented in their dominant language (M = .56, t(14) = 2.26, p = .040), while there was no evidence of learning the non-dominant language word (M = .49, t(14) = -.21, p = .839). Surprisingly, in Exp. 2, bilinguals did not appear to learn either of the words, even though both were presented in their dominant language (Word 1: M = .56, t(13) = 1.38, p = .190; Word 2: M = .53, t(13) = .73, p = .481). Overall, these findings reveal an unexpected pattern of results, which suggest that word learning in sentential contexts might be challenging for young bilingual infants. Indeed, our findings contrast with previous research showing that monolingual 14-month-olds successfully learned novel words presented in a native and a foreign sentence frame using an identical procedure (da Estrela & Byers-Heinlein, 2016). Bilinguals in our study failed

to learn any words when both were in their dominant language (Exp. 1), and only learned one word (the one presented in their dominant language) in a situation where both of their languages were used (Exp. 2). One possibility is that language alternations in Exp. 2 somehow allowed infants to focus their attentional resources on the dominant language word, although this contrasts with previous findings suggesting that language mixing challenges processing in bilingual infants (Byers-Heinlein et al., 2017). Another possibility is that word learning in bilinguals is fragile at this age, and the high levels of individual variability could produce spurious patterns of results. Additional experiments are being conducted in our lab to test these different possibilities.

P2-D-95 Predicting language development from speech perception in early childhood.

Jolanta Golan[1], Katie Daubney[1], Haiko Ballieux[2], Przemyslaw Tomalski[3], Rachel George[1], Melanie Vitkovitch[1], Derek Moore[4], Elena Kushnerenko[1]

[1]University of East London, [2]University of Westminster, [3]University of Warsaw, [4]University of Surrey

The ability to integrate the auditory and visual information in speech perception is crucial for language development. Research shows that in infancy individual differences in audio-visual speech integration are associated with language proficiency (Burnham & Dodd, 2004). The longitudinal perspective on speech perception may highlight developmental trajectories of both the perceptive and expressive communication. Our team investigated the early behavioural indicators of language proficiency at five years of age. Eye-tracking data, i.e., fixations to the eyes and mouth of the speaker, were collected from a sample of 183 infants aged between six and nine months and again (96 participants) at two years of age (Ballieux, et al., 2016). The children participated in an audio-visual speech integration task, which was a modified version of the McGurk paradigm (McGurk & MacDonald, 1976). Finally, 74 families visited the lab, when the children were five years old. The sessions at the time involved specialised language assessments, including subtests of NEPSY 2 (Korkman, at el., 2007). Linear regression analysis revealed the link between fixations to eyes and mouth of the speaker in infancy and toddlerhood and the communication outcomes at five years. These included receptive language, such as phonological processing and comprehension of instructions and expressive communication, such as repetition of nonsense words and word naming. Our findings suggest that early speech perception may predict language proficiency in childhood. Specifically, focusing on the eyes and the mouth of a speaker may be an indicator of the

development of specialised speech processing mechanisms. This highlights the importance of early screening in speech perception, with the aim for intervention before basic language mechanisms are consolidated.

P2-D-96 Physiological Measurements of Prosodic Topographies in Children with ASD Related to Vocalization Type using Electroglottography

Shweta Ghai[1]

[1]Emory University

Atypical voice quality is a common and immediately recognizable feature of autism spectrum disorders (ASD), and so are their deficits in social interaction. In the speech science literature, scientists have shown acoustic features of a speaker's voice to capture information about their emotional state. However, a means of quantifying atypicality in voice production in individuals with ASD that can also be used to test any etiological association between atypical voice features and the core social communication impairment in autism is still lacking. Electroglottography (EGG) provides non-invasive physiological measures of vocal fold function, which may therefore provide us with better information about the origin of voice disorders in autism. The goal of this study is to explore the association of prosody with quality of social interaction in individuals with and without autism by comparing their voice quality (VQ) measures obtained using EGG for different vocalization types. We test the hypothesis that atypical voice quality characteristics in individuals with autism are attributable to physiological differences in their motor function rather than to their deficits in social interaction. As part of our initial pilot study, we recruited in total 10 low-risk children with no family history of autism and high-risk children with older siblings diagnosed with ASD. We collected high-quality EGG and microphone recordings of each child at 2-3 years of age. Clinical assessments were carried out on each child at the same age to determine their diagnostic outcome. From EGG recordings, we hand-labeled and extracted sequences of utterances containing clean child vocalizations and calculated the mean and standard deviations for four VQ measures for each child: the fundamental frequency (F0), the open quotient (OQ), the return quotient (RQ), and the speed quotient (SQ). We then compared the VQ characteristics of children in each diagnostic category and their relation with their type of vocalization. The two types of vocalizations that were considered for this analysis are: 1) conversational vocalizations, which were generated in response to and in reference to a caregiver's initiated vocalization, 2) non-contextual vocalizations, which were voluntarily made by the child with no reference or caregiver initiation. 2-sample Kolmogorov-Smirnov test was

used to estimate statistical significance of differences in distribution of measures for all speakers in each diagnostic category. Our final sample consisted of 5 typically developing (TDX) children and 5 children diagnosed with ASD. All of the four objective VQ measures showed significant group differences between TDX and ASD (Table 1). Also, TDX children exhibited more conversational vocalizations than non-contextual vocalizations while the converse was true for children diagnosed with ASD. However, no significant differences were evident in the prosodic characteristics of the two types of vocalizations for any diagnostic group (Figure 1). Preliminary results suggest that physiological measurements of VQ are different for TDX children and those with ASD but are unaffected by their type of vocalizations. Considering these measures as proxies for motor function and social interaction, present findings hint that VQ disorders in autism may associate with comorbid speech motor deficits rather than impaired social interaction. These observations and results are currently being verified on a larger cohort.

P2-D-97 Lost in the mix: Infants encode fewer phonetic details from novel words presented in mixed sentences

Charlene Fu[1], Denis Burnham[2], Leher Singh[1]

[1]National University of Singapore, [2]Western Sydney University

Language mixing is a common feature of bilingual speech, and has been documented in adults' speech (e.g. Heredia & Altarriba, 2001) and even children's speech (e.g. Redlinger & Park, 1980; Lindholm & Padilla, 1978). Crucially, within the context of bilingual families, parents also produce mixed language utterances in speech to their children, and families vary in the extent to which mixed speech is used (e.g. Goodz, 1989). For instance, some families may purport to adhere to a strict policy of language separation (as in the case of so-called "one parent one language" homes), whereas words and phrases from both languages may be used simultaneously within single utterances in other homes. There is currently no consensus on how language mixing influences language acquisition. While Byers-Heinlein (2013) reported that greater parental language mixing to be associated with smaller vocabularies, Bail, Morini, & Newman (2015) found no such disadvantage. More recently, Byers-Heinlein, Morin-Lessard, & Lew-Williams (2017) reported that in a familiar word recognition task, both bilingual adults and infants were less efficient in processing mixed utterances than single-language utterances. These studies represent a nascent line of research to investigate young bilinguals' abilities to process and learn from mixed speech. This remains a significant gap in current theories of language development, which are dominated by studies that have examined monolingual language development

(e.g. Werker & Curtin, 2005), or have tested bilingual infants' language abilities in each of their languages in isolation (e.g. Singh, Poh, & Fu, 2016). The goal of the current study was to compare infants' abilities to acquire novel word-object association from mixed or single-language input, which is a crucial skill that infants must master in the second year of life, and underlies subsequent vocabulary acquisition. In Experiment 1, we tested 18-month-old English-Mandarin bilingual infants (N=24) using a version of the Switch paradigm. All infants sat through a mixed task, which was created by embedding a distinctly Mandarin target word (the syllable was only phonotactically possible in Mandarin, and also carried a distinctly dipping Mandarin lexical tone) within English phrases (e.g. "Look at the __"). Infants also sat through a Mandarin-only task that used Mandarin naming phrases and a Mandarin target word. During each task, infants were habituated to simple naming phrases accompanied by a novel object (Fennell & Waxman, 2010). Subsequently, they were presented switch trials at test, during which the vowel and tone of the target word was changed. Results indicate that infants detected vowel and tone switches in the Mandarin-only task, but not the mixed language task (see Figure 1). The findings of Experiment 1 were replicated with the use of disyllabic target words (Experiment 2), which were hypothesized to provide more obvious phonotactic cues (see Figure 2). Together, the current findings demonstrate that infants encode fewer fine phonetic details when learning novel words from mixed input than single-language input, in turn pointing to mixed language input posing greater learning challenges for young bilinguals. Future studies will explore if and how these challenging learning circumstances may be overcome.

P2-D-98 Input variability in learning novel object-label pairs: How specific are beneficial effects?

Barbara Höhle[1], Tom Fritzsche[2], Adamantios Gafos[2]

[1]Justus-Liebig-Universität Gießen, [2]University of Potsdam

Two realisations of a word are never identical in natural speech even if they are produced by the same speaker. This variability is typically seen as an obstacle to the language learner by obscuring phonemic categories and the fact that acoustically different signals may be mapped onto the same lexical representation. However, variability could also aid in establishing phonemic categories by making systematic relations between phonetic cues, which signal the corresponding phonemic categories, better detectable (e.g. VOT and F1). Following this argument, Rost and McMurray (2009) showed that 14-month olds are able to learn minimally distinct novel object labels like /buk/ and /puk/ if speaker variability is

added. The goal of the current study was (1) to replicate this finding with German-learning children and (2) to shed more light on the nature of the beneficial role that variability plays in word learning. To address the first goal, we probed the effect of acoustic token variability on the word-learning ability of 34 fourteen-month-old German-speaking children using the habituation-switch paradigm. During habituation two novel objects were presented, each with a pseudoword as its auditory label (Fig. 1). Half of the children listened to only one token for each word chosen from a single speaker (no variation group), whereas the other half listened to 54 different tokens produced by 18 different speakers (variation group). After habituation three test trials were presented, one with a correct object-word pairing (same), one with an incorrect pairing (switch) and one containing a completely novel object with a label from the habituation (novel). As per the variability is beneficial hypothesis, longer looking times were predicted for switch trials compared to same trials in the variation group, indicating the detection of a phonological change. The results (Fig. 2) showed no effects of test trials for the no variation group ($p's > .48$) while the variation group showed a marginally significant increase in looking time to switch vs. same trials ($p = .07$) as well as an increase for novel vs. same trials ($p < .001$). In line with the findings by Rost and McMurray (2009) this results suggests that talker variability helps the learners to focus on the acoustic dimensions that mark the relevant voicing contrast. However, another explanation could be that a higher degree of variability in the stimuli presented during the experiment leads to a higher attention level on the side of the infants and thus to higher achievements in word learning. Following up on this, we are currently investigating the effect of visual variability on word learning using basically the same materials and procedure as in the previous experiment. While only a single token for each acoustic label was presented, the novel objects slightly varied with respect to some properties. Data collection is under way and findings will be presented at the time of the conference to address the question whether it is specifically phonetic or non-phonetic variability that boosts performance in word learning tasks with children.

P2-D-99 Top-down influences on phoneme acquisition: data from Spanish-Catalan bilinguals

Camille Frey[1], Nuria Sebastian-Galles[2]

[1]Universitat Pompeu Fabra, [2]Pompeu Fabra University

When learning their native language, one of the first challenges infants are faced with is the establishment of the phonetic categories. It has been proposed that infants acquire these phonetic categories by computing the distribution of speech sounds in the acoustic

space (Maye, Werker and Gerken, 2002). Around the same age as the perceptual reorganization takes place, infants acquire their first words (Bergelson and Swingley, 2009; Tincoff and Jusczyk, 1998). However, the possible top-down influence of word-level information on the phonetic reorganization process has been poorly investigated. One potentially interesting group of learners to investigate this question is that of bilinguals learning typologically close languages, such as Spanish and Catalan. These languages share a high number of cognates among their translation equivalents. Moreover, cognates differ mainly in their vowels, inducing a high vocalic variability in the speech stream (for instance "pOrt@" vs. "pwerta" or "xukulat@" vs. "tʃokolate") and incrementing the number of minimal pairs in the stimuli. Feldman et al (2012) proposed that the non-minimal pairs present in the speech stream may help separate an overlapping vocalic category by providing a clearer word context. They explored the influence of word-level information on the discrimination of a native overlapping vocalic contrast with both adults and 8 month-olds. Using a corpus of pseudo-words containing the vocalic contrast, they familiarized their participants according to two word-context conditions: the Minimal Pair (MP) condition where the vocalic contrast appeared in all the pseudo-words and the Non-Minimal Pair (NMP) condition where the contrast appeared in distinct word-context. Analyzing the two test blocks, they found that adults who have been familiarized with the NMP condition tended to assign the test syllables to different categories more often than the participants familiarized with the MP condition. Similar results were found in 8 month-olds with a Head-turn Preference Procedure. We want to address the possible impact of bilingualism/cognateness in the establishing of phonetic categories by comparing Spanish-Catalan bilinguals and monolinguals. We adapted Feldman and al. (2012) procedure to test both adults and infants on their discrimination of a difficult to perceive non-native vocalic contrast (British English /ɒ-ʌ/ contrast). We have tested so far 46 adult participants, comparing exposure to minimal pairs (MP group) and to non-minimal pairs (NMP group) in a discrimination task. We calculated their sensitivity to the /ɒ-ʌ/ contrast (d'). As Feldman et al (2012), we analyzed the exposure and block interaction and added the language variable (mon vs. Bil). The analysis yielded a triple interaction of language group, exposure and block ($p=0.003$) and a main effect of block ($p<0.01$) (see figures). The analysis of the first block showed that exposure to NMP increased sensitivity in monolinguals ($p= 0.02$) but not in bilinguals (ns). Infant data collection is currently underway. Adult monolingual results replicate the pattern reported by Feldman et al (2012). Bilinguals seem to behave differently from the monolinguals but more data is needed before firm conclusions can be drawn.

P2-D-100 How monolingual and bilingual infants learn from the eyes or the mouth of a talking face

Mathilde Fort[1], Nuria Sebastian-Galles[2]

[1]Universite Grenoble Alpes, Gipsa-lab, [2]Pompeu Fabra University

To probably overcome the challenge of learning two languages at the same time, infants raised in a bilingual environment pay more attention to the mouth of talking faces than same-age monolinguals. Here, we examined the consequences of such preference on monolingual and bilingual infants' ability to perceive additional information coming from the eyes or the mouth region of talking faces. In a previous study using the same paradigm, we showed that at 15-months of age, both monolingual and bilingual 15-month-olds could detect the apparition of a visual cue appearing in the eyes region but only 15-month-old monolinguals and 18-month-old bilinguals could learn to anticipate its appearance during the sentence phase. One possible explanation for this result is that at 15 months of age, bilinguals, as compared to their monolingual peers, need to rely more on the cues provided by the mouth region of the speaker to cope for their challenging language environment. Using the same paradigm (Figure 1), we tested whether at a younger age (12-month-olds), both monolingual and bilingual infants, who are less expert to process their native language (and may thus rely more on the mouth region of the talker), fail to anticipate the visual cue in the eyes (Eyebrow-raise movement) as opposed to the mouth region (Lip-protrusion movement). Growth curve analysis was used to analyze the evolution (over the course of the 19 trials) of the Proportion of Total Looking Time to the eyes minus the mouth region of the speaker, during the last 50% of the Speech Event (Figure 2). Surprisingly, contrary to our previous results, bilinguals in the Eyebrow-raise condition (N=20), as opposed to the ones in the Lip-Protrusion condition (N=20), significantly anticipated the apparition of the Eyebrow-raise movement by increasing their looking time to the eyes region of the speaker ($p < .05$). However, no similar change was observed in same-age monolinguals (N=20 per condition, $t < 1$). We are now gathering new data with infants aged between 12 and 18 months of age to explore the respective role of vocabulary growth and maturation of attention to explain these different developmental trajectories.

P2-D-101 Learning in Social Contexts: The Role of Temporal Structure in Infant Communicative Development

Melissa Elston[1], Jennifer Schwade[1], Michael Goldstein[1]

[1]Cornell University

During interactions with their infants, parents provide structure that plays a vital role in organizing infant attention, increasing predictability, and facilitating learning. As a result, structure in interactions has immediate and long-term influences on many domains in child development. For example, parental sensitivity (the appropriateness of parental responses) has been associated with improved infant language acquisition (Tomasello & Todd, 1983), and parental contingency (parental responses given promptly after infant behavior) supports infant phonological learning (Goldstein & Schwade, 2008). However, little is known about the mechanisms by which parental sensitivity and contingency contribute to infant learning across developmental time. Thus, the present research aims to explore how the structure of parent-infant interactions from moment to moment translates to infant learning and communicative development. In a longitudinal design, we observed 42 infants at 5 and 9 months in free play with a parent. During naturalistic parent-child interactions, we observed contingent parental responses to infants (responses that occur within 3 s after an infant behavior) and the types of parental responses given. Parental sensitivity assessed the prevalence of parental responses that were congruent with the infant's attentional focus; parental redirectiveness assessed parental responses that were incongruent with the infant's attentional focus. At 5 months, we also implemented a still-face paradigm to assess whether infants had learned that their vocalizations elicit parental responses. We observed changes in the rate of infant vocalizations when parental responses suddenly ceased, thereby extinguishing parental contingency. Previous research has shown that infants respond to an extinction of parental contingency by increasing their rate of vocalizing (Goldstein et al., 2009). Preliminary analyses show positive correlations between parental contingency and both the frequency of sensitive and redirective responses to infant vocalizations during naturalistic play (Figure 1). However, redirective responses to infant vocalizations negatively predicted infant vocal learning during the still-face task; sensitive responses did not (Figure 2). Further, overall redirective parental behaviors did not predict infant vocalizations during the still-face period ($r(20)=-0.007$, $p=0.975$). Together, these results suggest that parents exhibiting higher levels of contingency may also exhibit high levels of redirective responses, which may reduce infant vocal learning. Only parental responses that were contingent on infant vocalizations predicted infant vocal learning, which suggests that the moments following vocalizations provide salient opportunities for learning. Specifically, only redirective contingent responses to vocalizations predicted infant vocal learning, which further emphasizes the increased disruptiveness caused by redirections that occur directly after infant vocalizations, and thus their impact on infant development and learning. The data to be presented will further demonstrate how levels

of parental sensitivity and contingency fluctuate over developmental time, and how the prevalence of these forms of structure predict infant vocal and phonological learning and subsequent measures of infant language acquisition. Together, the present study aims to illustrate a longitudinal network of socially embedded learning and communicative development.

P2-D-102 Maternal Input and Vocabulary Learning in Brazil and the United States

Chantal Ramirez[1], Catharine Echols[1], Poliana Goncalves Barbosa[2], Cláudia Cardoso-Martins[3]

[1]University of Texas, [2]University of Alberta, [3]Universidade Federal de Minas Gerais

Specific relations between child directed speech (CDS) and vocabulary development are well documented for English-speaking children in the United States. However, fewer studies compare these relationships cross-linguistically. Brazilian Portuguese (BP) is a particularly interesting comparison: not only does it permit subject dropping, but omissions of objects and other grammatical elements are pervasive. This raises the question of whether relations between CDS and children's vocabulary development would be similar in BP to those observed for English. This question is explored in a series of analyses from a short-term longitudinal study with 35 BP-speaking mother-child dyads in Brazil and 18 English-speaking dyads in the U.S. Dyads were video-recorded in their homes during semi-naturalistic play sessions when children were 9, 13, and 18 m old; vocabulary was assessed using the MCDI. In this paper, we focus on relations between characteristics of maternal input at 13 months and children's vocabulary at 18 months. We first evaluated the degree to which CDS in BP does, in fact, contain omissions. Indeed, 61% of BP child-directed utterances contained omissions (with only 13% being grammatical subject droppings) whereas only 16% of utterances in the U.S. sample did so. Analyses of relations between CDS and vocabulary in BP revealed that children's noun vocabulary at 18 m was positively related to mothers' use of copulas at 13 m ($p < .01$) and negatively related to their use of imperatives ($p < .05$). Similarly, the U.S. mothers' 13 m imperative use negatively predicted their children's 18 m noun vocabulary ($p = .05$). Thus, despite the frequent omissions in BP, the relations between CDS and vocabulary development are similar between the Brazilian and U.S. samples. The relations also are similar to those observed previously for English (e.g., Newport et al., 1977). A high level of omissions might be expected to promote word learning, because it would result in more single words utterances and/or because words could appear more frequently in salient sentence-final positions. Alternatively, it might disrupt word learning because it

would result in reductions in the predictability of noun and verb contexts (e.g., frequent frames; Mintz, 2003). However, neither of these possibilities were supported in the data: Neither the frequency of omissions in BP nor the frequency of single word utterances was associated--either positively or negatively--with children's vocabulary growth. Indeed, in an analysis similar to Mintz (2003), frequent frames were extracted from both the English and BP samples. When hierarchical cluster analyses were used to evaluate similarity of grammatical categories within frames, frequent frames were highly reliable in distinguishing grammatical categories for both the English and BP samples. These findings suggest that, despite large differences in the frequency of grammatical and ungrammatical word omissions in English and BP, the support provided by CDS is remarkably similar. They also suggest that, despite these differences, the language structures that disrupt word learning (i.e., imperatives) also are consistent.

P2-D-103 Family socio-economic status (SES) influences early perception of turn-taking violation by 6-month-old infants

Virginie Durier[1], Alice Rabiller[2], Nicolas Doillon[3], Alban Lemasson[3], Stéphanie Barbu[3]

[1]CNRS - Université Paris Descartes, [2]Université de Rennes 1, [3]Université de Rennes - CNRS

In everyday life, a number of communication skills are compulsory for a conversation to take place and hold. Turn-taking is a major one. Indeed, in a conversation, speakers and listeners alternate smoothly their roles, avoiding overlaps and extensive gaps between turns (Sacks et al., 1974). A child needs more than 3 years to handle simple turn-taking situations (Question-Answer) with timing not yet close to adult-like characteristics (Casillas et al., 2016). Still, alternated behaviors with the mother can be observed within the first month of life and alternated vocalizations with his/her parents, emerging around 3 to 4 months of age, become predominant around the age of 9 months (Ginsburg & Kilbourne, 1988; Jasnow & Feldstein, 1986). Our experiment aimed to assess the ability of 6-month-old infants to perceive a breach of turn-taking characteristics: namely overlap. Four- to six-month-old infants are sensitive to temporal contingency in their interactions with an adult (Hains & Muir, 1996). Therefore, they should be able to detect a violation of a socio-temporal characteristic such as an overlap rather than a turn-taking in a conversation. Fifty-one infants (mean age = 6 months 9 days, range 5;29 - 6;23) watched videos of three sketches in which two women spoke to them. Three different situations were presented to each infant: 1) one woman speaks, stops and turns towards the second woman to allow her to speak (= Giving turn); 2) one woman speaks, stops and the second woman starts speaking (= Taking turn); 3) one woman speaks and the second woman

starts speaking before the first speaker has finished (= Overlapping). The pictures of both speakers were presented side by side before and after each sketch. We measured the looking time toward each speaker before and after each sketch. The analysis was performed offline, using The Observer Noldus ©. Overall, the infants looked longer at the second speaker after she overlapped the first one in the conversation while they did not show any preference in the other two situations. Family SES influences the observed responses. Infants from High-SES families reacted differently to the 3 situations with an increased looking time to the speaker who overlapped. On the contrary, infants from Low-SES families reacted similarly in the 3 situations: they always focused slightly more (not significantly) to the last speaker whether she respected the turn-taking rule or not. To conclude, six-month-old infants are able to discriminate between situations where a major conversational rule, i.e. turn-taking, is respected or violated. However, this ability is not widespread as only infants from High-SES families looked longer at the second speaker after she overlapped the first speaker in the conversation. Infants' social environment influenced their responses to the different contexts. Therefore, overlap perception by infants emerges around 6 months, that is, even before they are able to alternate smoothly their vocalizations with their parents. Our results highlight the need to attach greater importance to inter-individual variability and socio-demographic characteristics in infants studies.

P2-D-104 Effects of Birth order on Temperament and Language

Kelsey Rookstool[1], Kelsey Long[1], Lauren Driggers-Jones[1], Wallace Dixon, Jr.[1]

[1]East Tennessee State University

Birth order effects have been the subject of considerable research in the developmental literature. One aim of the present investigation was to explore links between temperament and birth order. Temperament should be linked to birth order. Because infant temperament is related to maternal stress during pregnancy (Huizink et al, 2002), and because mothers caring for children while pregnant presumably experience more stress, laterborn children could have different temperamental profiles than earlier-born children. Research has also shown reliable links between birth order and vocabulary size in infancy; with second born children demonstrating significantly larger vocabularies at 21 months (Oshima-Takane et al., 1996). However, to our knowledge, no studies have investigated the relationship between birth order and gestural productivity. Because gestural production is linked to language development (Iverson & Goldin-Meadow, 2005), it stands to reason that birth order should also be linked to gestural production. Thus, our

second aim was to evaluate the relationship between birth order and gestural production. Eighty-three children (32 girls) visited the lab at M = 15.45 months (SD = 1.92 months). Caregivers completed the Infant Behavioral Questionnaire-Revised (IBQ-R), the MacArthur-Bates Communicative Development Inventory: Words and Gestures (MCDI-WG), and a demographic questionnaire assessing family size and birth order. The IBQ-R produced three overarching superdimensions: surgency, negative affectivity, and effortful control. Gestural productivity was derived from the MCDI-WG. In line with our first aim, we evaluated correlations between infant temperament and birth order. These analyses revealed a significant and positive relationship between later-born status and temperamental negative affectivity ($r = .27$, $p = .03$), indicating that later-born children were rated by mothers as temperamentally more negative in affective expression. Neither other temperament superdimension was related to birth order. Follow-up analyses revealed that sadness was the only subdimension of negative affectivity to be associated with later-born status ($r = .31$, $p < .01$). To investigate whether birth order was related to gestural production, we analyzed correlations between birth order and the MCDI-WG categories of "performing actions with objects" and "imitation". Positive and significant associations between birth order and both gestural production measures were found (performing actions with objects, $r = .30$, $p = .03$; and imitation, $r = .35$, $p < .01$). Although these results were in line with our expectations, they remain to be supported by replication. In the meantime, these results suggest interesting findings for both temperament and language researchers. First, later born children appear more at risk for temperamental difficulty. The source of this risk could include heightened maternal prenatal stress during pregnancy. But the source could also be postnatal, perhaps exacerbated by later-borns spending proportionally less time with caregivers, or more time sharing with siblings. Secondly, the gestural production results suggest that later born children are at a particular advantage. This advantage may be due to the fact that later born children, by virtue of their larger families, have more mode

P2-D-105 Early Language Development and Joint Attention in Low-Income, Ethnically Diverse Children

Amy Dominguez[1], Elly Barrow[1], Natasha Link[2], Samantha Brown[1], Sarah Watamura[1]

[1]University of Denver, [2]University of Maryland Baltimore County

Objective: Experiencing poverty can significantly hinder young children's early language skills (Vernon-Feagans et al., 2012) and eventual school readiness (Engle & Black, 2008). Moreover, experiencing poverty in the first five years of life is more detrimental to

development than in later childhood or adolescence in part due to heightened neural plasticity during this period (Brooks-Gunn & Duncan, 1997; Knudsen, 2004). Many studies have investigated the effects of poverty on early language, but relatively few have explored the role of joint attention, a posited precursor to language development (e.g., Charman et al., 2000; Rowe & Goldin-Meadow, 2009), or explored communication discrepancies in ethnically diverse populations. Indeed, existing research investigating early language and social communication overwhelmingly focuses on monolingual, English-speaking samples. The current study expands this literature by examining the relationship between poverty, early language, and joint attention among low-income English- and Spanish-speaking families. Methods: Participants were 130 infants ages 5 to 36 months (M=23.17 months, SD=8.53) and their families enrolled in a larger study. Families were primarily low-income (76.86% at or below the poverty line) and identified as an ethnic or racial minority (63.1% Hispanic, 23.8% Minority Race, 11.5% Caucasian, 1.5% Biracial). Approximately half of the children were Spanish-speaking (47.7% Spanish-speaking, n=62), and just under half were female (42.3% female, n=55). The Preschool Language Scales, 5th Ed. (PLS-5; English and Spanish protocols) were used to assess children's receptive and expressive language. An examiner also administered the Early Social Communication Scales (ESCS), a play-based social interaction designed to elicit gestures and verbal communication. In addition to reported income, families' experience of economic hardship was assessed with 5 questions about their capacity to cover basic household needs (e.g., rent, gas, electricity bills). Results: Regression analyses indicated that infants whose families were experiencing greater economic hardship had lower total language scores on the PLS-5, $F(1,68)=16.37$, $p<.001$ at baseline, but not less responsivity to joint attention. Looking longitudinally, response to joint attention during the ESCS administered at baseline predicted language scores on the PLS-5 approximately 6 months later, $F(1,42)=5.38$, $p<.05$. Conclusions: Results indicate that economic hardship may meaningfully contribute to infants' early language development in an ethnically and racially diverse sample. Further, joint attention may be an important precursor of language development in toddlers. However, it is important to note that we did not find differences in joint attention perhaps because of limited variability within this young, typically developing sample. Taken together with previous work linking joint attention skills to later language development, these results also suggest that interventions targeting joint attention may support early language acquisition in diverse samples. Future research should investigate the possible causal relationship between joint attention and language development in diverse and economically disadvantaged children. These results also underlie the need for diverse samples of children in research, as trajectories of infants

from underrepresented groups can be drastically different from those of infants in resource-rich environments.

P2-D-106 Stress Exposure Impacts Child Vocalizations and Parent-Child Interactions in the First Year of Life

Lara Pierce[1], Emily Reilly[1], Charles Nelson[1]

[1]Boston Children's Hospital, Harvard Medical School

A robust association has been observed between socioeconomic status (SES), the quantity and quality of language input to which children are exposed, and myriad language outcomes from early childhood through adulthood (e.g., Hart & Risley, 1995; Hoff, 2003; Weisleder & Fernald, 2013). While SES-related disparities in language outcomes are typically not observed until the second year of life, there is evidence that the very early language environment, within the first year, is critical for infants to establish foundational elements of language that support later language learning. Exposure to high levels of chronic stress, which is often associated with low-SES status, might influence the way that both parents and infants interact within the early language environment and might therefore a) uniquely account for some of the variability in language outcomes typically observed in low-SES populations, and b) reveal very early differences in the nature of the early language environment and early language behaviors that might underlie SES-based differences in language outcomes that emerge later in development. To test these questions the present study used the Language Environment Analysis (LENA) system to record full day (up to 16 hour) natural language samples from 6-month-old infants (n = 16) from a predominantly low-income sample with a range in exposure to early stressful experiences (e.g., parental unemployment, financial and housing insecurity, exposure to community violence). Samples were processed to remove naps, distant noise, and electronic speech, resulting in recordings that were 10.14 hours in length, on average (range: 7.86 - 13.5 hours). Adult word counts, child vocalization counts, and conversational turn counts per hour were calculated for each child. Demographic information (e.g., income, education) was collected from families and maternal stress was assessed by maternal-report on the Perceived Stress Scale (PSS) and by the number of stressful life events reported on a Recent Life Events Questionnaire (RLEQ). Number of stressful life events during pregnancy and after the birth of the child were negatively correlated with child vocalizations (during: $r = -0.56$, $p < 0.05$; after: $r = -0.59$, $p < 0.05$) and conversational turns (during: $r = -0.58$, $p < 0.05$; after: $r = -0.57$, $p < 0.05$) when infants were 6 months of age (Figure 1). Maternal perceived stress was also negatively correlated with 6-month

child vocalizations ($r = -0.74$, $p < 0.01$) (Figure 2). In a linear regression model, maternal PSS scores negatively predicted child vocalizations above and beyond family income, suggesting a unique contribution of stress on infants' early communicative behaviors. Notably, maternal reports of stress were not predictive of adult word counts, suggesting that stress exposure does not impact quantity of maternal speech in general, but rather child behaviors and parent-child interaction. We are continuing to follow these infants at 12 months to establish the stability of this pattern over time, and to examine whether characteristics of the early language environment predict infants' later receptive and expressive language outcomes.

P2-D-107 Associative word learning in infancy: A meta-analysis of the Switch task

Angeline Sin Mei Tsui[1], Krista Byers-Heinlein[2], Christopher Fennell[1]

[1]University of Ottawa, [2]Concordia University

Associative word learning, the ability to pair a concept to a word, is an essential mechanism for early language development. One common method by which researchers measure this ability is the Switch task (Werker, et al., 1998). In its classic version, infants are first habituated to two novel object-word pairings and then experience two trials: a Same trial where an object-word pairing from habituation is presented and a Switch trial where a pairing violation is presented (e.g., Object A-Word B). If infants learned the word-object associations, they will detect the violation and look longer to the Switch over the Same trial. Researchers have primarily used the Switch task to investigate factors that enhance or dampen the underlying mechanisms of infants' word-object associative ability, and studies have manipulated a multitude of experimental variables (e.g., the use of similar- or dissimilar-words, different populations). As a result, the current Switch literature markedly contains mixed findings: both successes and failures. To clarify the nature of infants' associative word learning, we meta-analytically summarized 141 Switch studies involving 2723 infants of 12 to 20 months to estimate the task's average effect size and identify how key experimental factors moderate this basic language learning skill. The average effect size was low to moderate ($d=0.32$). As for moderators, infants learned target words better when words were: dissimilar-sounding [$\beta=0.18$, $p<0.01$], had forms typical of infants' native language(s) [$\beta=0.14$, $p<0.01$], or presented with facilitative cues - both perceptual (e.g., more coarticulatory information) and conceptual (e.g., presenting words in rich naming phrases) [$Q(2)=20.52$, $p<0.01$]. Our findings therefore demonstrated that infants make use of their detailed native-language knowledge to learn words, and they equally exploit lower-level and higher-level information in word learning.

Surprisingly, age alone did not predict performance [β=-0.01, p=0.6], but did interact with some moderators: younger, but not older, infants' performance improved when provided with facilitative cues. This is predicted by models such as the PRIMIR framework (Werker & Curtin, 2005) and the Emergentist Coalition Model (Golinkoff & Hirsch-Pasek, 2006), which posit age-related changes in infants' attention to different types of cues in word learning tasks. However, we did not find that infants' learning of dissimilar-sounding words (i.e. minimal pairs) was not moderated by age, contrary to PRIMIR which posits a qualitative change in infants' ability to access phonetic detail in word learning tasks. Another surprising finding was that bilinguals outperformed monolinguals in associative word learning [β=0.21, p=0.02]. Together, while our results confirm some aspects of current theories of word learning, they also invite some revisions. Lastly, there was evidence for atypical distributions of reported effect sizes (i.e., asymmetrical funnel-plot), which may indicate a reporting bias. Additional analyses revealed that this bias was not likely due to selective publication of significant findings (i.e., the File Drawer Effect; Figure 1), but may be related to questionable research practices (e.g., one-tailed p values with marginally significant results). After adjusting for this bias, the overall effect size (0.20) remained significantly different from zero [ps<0.01], confirming the robustness of infants' associative word learning.

P2-D-108 Relationships between Receptive Language and Motor Skills in Toddlers with Autism Spectrum Disorder

Hsiao-Ching Huang[1], Jung-Mei Tsai[1], Yu-Ching Yang[1], Yen-Tzu Wu[1]

[1]National Taiwan University

Background Past studies have noticed that many children with autistic spectrum disorder (ASD) have notable difficulties in motor and language development from early stage, yet the connection between two developmental domains is still poorly understood. Motor skills are potentially relevant to language development/acquisition, particularly in communication development involving complex sensorimotor transformations such as vocal or facial expression imitation. Methods This study investigated the relationships between language and motor abilities in 30 toddlers with ASD and 15 typically developed (TD) toddlers aged 23-36 months. Toddlers with ASD were divided into two subgroups with impaired (called ASD-iR, n=14) and unimpaired receptive language abilities (called ASD-nR, n=16), using the Receptive Language (RL) Scales in the Mullen Scales of Early Learning (MSEL). All participants were evaluated for motor functions using the 5 subscales (Stationary, Locomotion, Object Manipulation, Grasping and Visual-Motor Integration

Scales) in the Peabody Developmental Motor Scales, 2nd Edition. (PDMS-2). The standard scores of 5 subscales are summed up and converted to the Total Motor Quotient (TMQ). The summed standard scores of Stationary, Locomotion, Object Manipulation Scales were converted to the Gross Motor Quotient (GMQ); and the summed standard scores of Grasping and Visual-Motor Integration Scales were converted to the Fine Motor Quotient (FMQ). The differences of motor scores among three groups were analyzed using the Mann-Whitney U test, and the relationships between motor and language scores within each group were analyzed using the Pearson correlations and linear regression analysis. Results The Results revealed that ASD-iR and ASD-nR groups performed worse on both motor and language tasks than did TD toddlers group (all p's < 0.05), whereas GMQ, Locomotion, Grasping, and Visual-Motor Integration standard scores were significantly lower in the ASD-iR group than in the ASD-nR group (all p's < 0.05). Furthermore, we found that several motor scores (e.g., GMQ, FMQ, TMQ, Stationary, Locomotion, Grasping, and Visual-Motor Integration scores) were positively correlated to the RL scores in the ASD-iR group, whereas no correlations were found in the other two groups. Discussion and Conclusion The results revealed that toddlers with ASD performed different degrees of motor and language delay in the early childhood. The positive relationships of motor and language abilities found in the ASD-iR group indicated the potential connection between early onset of motor and speech-language deficits in toddlers with ASD. The pattern of associations may have implications for developing motor-based interventions targeting language and social communication in toddlers with ASD.

E: Attention, Memory, and Learning

P2-E-109 In a heartbeat: Infant memory for a stressful social event at 4-months.

Isabelle Mueller[1], Nancy Snidman[1], Jennifer DiCorcia[1], Akhila Sravish[1], Erin Duffy[1], Ed Tronick[1]

[1]University of Massachusetts Boston

Exposure to early life stress shapes further development and affects later mental health outcomes. Paradoxically, those early life events seem to be rapidly forgotten and despite the central role of early experience, our understanding of early memories is limited. In the absence of language, it is difficult to ascertain the emergence of certain forms of memory, such as infant memory for a social event. Animal studies successfully solve this challenge using changes in behavior and physiology to infer recollection. Here we use the still-face paradigm, a paradigm that elicits a well-documented behavioral and physiological stress response, to test whether infants can remember a single stressful event. To fill this gap,

80 mother-infant dyads were observed in the lab on two consecutive days. Infants in the experimental condition (n=40) were exposed to the FFSF paradigm on day one. The paradigm consists of 1) a typical play episode, 2) a still-face episode where the mother stops interacting with her infant and sits expressionless, and 3) a reunion play episode. In an effort to improve the likelihood of memory, the intensity of the social stressor was increased by utilizing a double FFSF paradigm which included an additional still-face and reunion episode. Infants in the control group (n=40) completed a time-matched episodes of typical play on day one. Mother-infant dyads from both groups returned to the same lab 24-hours later and participated again in only a typical face-to-face play episode. Changes in behavior (positive and negative affect), physiology (heart rate), and salivary cortisol, compared to the first play episode on day 1, were evaluated and used to evaluate memorial effects of experiencing the stress on a positive event. Infants in the experimental condition showed a significant decrease in positive affect and an increase in HR on day 2 during the play episode, compared to controls. The change in infant HR was independent of maternal HR which did not differ between day 1 and day 2 or between groups. The groups did not differ in salivary cortisol on day 2. Findings suggest that a previous stressful experience elicits behavioral and physiological stress responses in infants to a non-stressful event in the same context in which they first experienced the stress 24-hours later. Our results imply that infants can encode and retrieve information about a stressful interaction at 4-months. More precisely, the effect 'spilled over' from the stressful experience on day one into the normal play-episode on day two, an experience typically experienced as positive. This suggest that stress reactivity is not restricted to the triggering stressful event but affects infants' experience to future events in the same context. The results could have implications for further research on stressful and traumatic events in early childhood.

P2-E-110 Successful updating of object-location bindings in Visual Working Memory in 20- and 25-month-olds

Chen Cheng[1], Zsuzsa Kaldy[1], Sangya Dhungana[1], Erik Blaser[1]

[1]University of Massachusetts Boston

Infants consistently engage in dynamic information processing that requires updating information in Visual Working Memory (VWM). However, our knowledge of the developmental trajectory of this ability is scarce. Prior studies of verbal updating showed that 22-month-olds could update their representation of an absent object that underwent a property change (Ganea et al., 2007). More recently, in an eye-tracking task, infants as

young as 16 months were able to use testimony to update information in VWM about an object's location (Ganea et al., 2016). The present study used a Delayed Match Retrieval (DMR) paradigm (Kaldy et al., 2016) to test whether infants could update object-location bindings held in VWM, by measuring anticipatory gaze responses in an eye-tracking task. Twenty 18- to 22-month olds (mean age: 20.1 months) and twenty 23- to 27-month olds (mean age: 25.1 months) participated. Abstract geometric objects were presented on the faces of virtual cards. First, two face-down cards entered the screen and took positions in the upper corners of the screen. The two cards were then flipped face-up, revealing the objects, then flipped back face-down and moved to the bottom corners(see Figure). After that, a third face-up card entered the center of the screen, showing an object that matched one of the previously-shown cards. After a 2 s delay period, during which anticipatory eye movements were measured, the matching card was revealed, accompanied by an engaging reward animation. 12 trials were presented, with the side of the matching card counterbalanced. In order to succeed in the task, participants both needed to maintain information about 'what was where' object-location information during the delay, but also actively update these locations. Our dependent variable was the percentage of trials where the first anticipatory look during the delay period was toward the (face-down) match card. Results showed that, overall, 25-month-olds performed significantly above chance (65%, $p<0.01$), while 20-month-olds did not. We then analyzed changes in VWM performance over the 12-trial. We found a significant learning trend in 20-month-olds, and in the last three trials their performance was significantly above chance (69% correct, $p<0.05$). To rule out the possibility that 20-month-olds' low performance was caused by limitations in VWM capacity rather than the ability of updating, a separate group of 20-month-old infants (range: 18-22-months, mean age: 20.0 months, $N=15$) were tested in a standard DMR task where the cards remained stationary during the delay. VWM performance was significantly above chance in this group (64% correct, $p<0.05$). In sum, we found that 25-month-olds could readily update their representations in a dynamic VWM task, while 20-month-olds needed more exposure to succeed in this task. Our findings show that during the second half of the second year, infants are able to track objects while occluded and update object-location bindings stored in VWM.

P2-E-111 Habituation Reliability and Stability Revisited: Differences as a Function of Fixation and Habituation Criterion Definitions

Wayne Mitchell[1], Rachel Monroe[1], Amber Gillenwaters[1], Abigail Van Nuland[1], Stacy Francis[1], Derby Davis[1]

[1]Missouri State University

The visual habituation-dishabituation paradigm has been used for decades to assess infants' cognitive and perceptual competence. Moreover, infant visual attention measures derived from the habituation paradigm, have been found to be somewhat reliable and stable within and between ages; and predictive of subsequent developmental outcomes. The infant-controlled procedure has been the primary habituation method employed by researchers. However, there has been wide variability among researchers regarding definitions of visual fixation and habituation criterion calculations. In the following study, the reliability and stability of various derived fixation time measures (e.g., Total Fixation Time (TFT), Peak Fixation (PK), 1st Fixation (1stF), Mean of the 1st Two Fixations (M1stTF) were examined employing a Experimenter Defined (ED) fixation definition (1 sec onset with 2 sec offset) versus an Infant Defined (ID) fixation (any look duration as onset with any sec look away as offset). It was hypothesized that fixation definitions, in concordance with criterion calculations, can have a direct effect on the reliability and stability of habituation measures. Participants: Thirty-four 3-month-old infants were recruited for this study. Procedure: Infants were tested in an enclosed, darkened testing booth while sitting on the mother's lap facing a translucent rear-projection screen. Two habituation tasks were assessed within one visit to the lab. The stimuli were two black and white abstract patterns, equated on evoked visual attention, were used to assess habituation. The order of the two stimulus presentations were counterbalanced between infants. Infants were shown the visual stimulus until they reached a habituation criterion of two consecutive fixations at or below 50% of the mean of their two previously longest fixations (a floating-point criterion) with a valid fixation of 1 sec or longer. A fixation was terminated when the infant looked away for 2 sec or longer (an ED Definition). Concurrently, any fixation onset and fixation offset was also recorded whereby ID fixations could be derived. Results: Employing a Floating-Point criterion, no significant difference was found between the ED vs ID definitions for TFT. However, there were significant differences in the PF ($p < .05$); the ID PF times were significantly less than the ED. And moreover, there were no significant differences between the reliability estimates of ED and ID definitions (see TABLE 1). It should be noted that these reliability estimates tend to be greater than those typically reported for 3-month-old infants. In TABLE 2, the correlations between ED and ID measures within each stimulus are presented. Overall, there was high concordance between the ED and ID definitions for TFT and PF (r ranging from .77 to .95); whereas, the concordance between the 1stF and the M1stTF were significantly weaker (r ranging from .37 to .62). Discussion: Given these findings, it is the contention of the authors that ED definitions are not necessary when using a Floating-Point criterion; however, if habituation

is calculated using a 50% decrement from the 1stF or M1stTF, accurate estimates of infant visual processing may be comprised.

P2-E-112 The small set of repeating voices and tunes in infants' daily music

Jennifer Mendoza[1], Caitlin Fausey[1]

[1]University of Oregon

Babies acculturate to their soundscape over the first year of life (e.g., Hannon & Trehub, 2005; Werker & Tees, 1984). Music is part of this soundscape, yet we know almost nothing about what real-life opportunities it provides as babies begin learning sounds, melodies, rhythms, and words. Here, we detail distributional properties known to shape learning - repetition and variability - in a first-of-its-kind corpus of everyday musical content throughout full days of sounds captured in infants' homes. We find that babies encounter nearly an hour of cumulated music per day. Across a day, babies hear many different voices and tunes. Within this range, however, the bulk of infants' everyday musical content consists of a restricted set of repeated voices and tunes. Infants (N=35; ages 6-12 months) wore a lightweight audio recorder (LENA; Ford et al., 2008) at home for up to 16 hours (Median=13.13 hours, SD=2.06). Everyday music was identified in two passes: musical bouts and musical content. All coders were first trained to criterion for each coding pass, exceeding .90 agreement with a standard coder on bouts across a 13-hour file (293 bouts) and on voices and tunes across 100 minutes of music (152 bouts, 26 unique voices, 103 unique tunes). Coders identified musical bouts: uninterrupted live and/or recorded singing, instrument playing, and vocally produced pitched, rhythmic patterns (e.g., humming). Next, they identified each bout's specific tune, listing a standard title when possible (e.g., ABCs; Stop, Think, and Choose!) or an invented one (e.g., "short whistle #1"). Coders also determined if each musical bout contained a voice; if so, they identified the voice (e.g., Mom; Daniel Tiger). All infants encountered music over the course of their day (Median=55.2 minutes, distributed across 127 bouts; Median bout duration=13 seconds). Within a day, infants encountered many unique tunes (Median=55 unique tunes, range: 15-296). Infants also encountered many unique voices (Median=10 unique voices, range: 1-83). Critically, within the range of tunes and voices encountered across a day, individual infants encountered some musical content repeatedly. Each infant's top three most frequently encountered tunes accounted for a quarter of their tune tokens (Median=.25, range: .07-.58). The top three most frequently encountered voices accounted for over three-quarters of their voice tokens (Median=.77, range: .21-1.0). In fact, babies encountered the same voice in nearly half of the vocal music tokens throughout their day.

Thus, infants experienced a mix of music including short ditties from toys, people whistling, radio songs, and caregivers' playsongs, and a small set of these repeated over the course of the day (e.g., Fig. 1). Recent evidence suggests that repetition amid variability is a robust property of the input available to young learners in the natural statistics of many kinds of content (Clerkin et al., 2017; Fausey et al., 2017; Jayaraman et al., 2015). We will discuss how this sweet spot may work together with other known indices of high quality sound input (e.g., live, vocal, and infant-directed; Weisleder & Fernald, 2013) to potentiate the remarkable auditory learning observed over the first year of human life.

P2-E-113 Exploring whether attention getters influence infants' information processing

Tyler McFayden[1], Robin Panneton[1]

[1]Virginia Tech

In infant research, various events are used as attention getters to orient the infant to a screen to prepare for their detection, discrimination, and/or recognition of subsequent information. Attention getters are usually visual, and sometimes presented with sound. The influence of attention-getters on infants' performance has rarely been systematically evaluated, even though these attention cues could be acting as primes. That is, the ability of information to influence a perceiver's response to a target (either through speed and/or recognition) is well documented in the adult literature. Do attention-getters in infant research act in a similar fashion? Here we report preliminary findings on priming effects on 12-15-month-old infants' preferences for infant-directed speech (IDS) compared to adult-directed speech (ADS). Two priming conditions were compared: a non-social prime (geometric form with chime sounds; n=7) v. a social prime (female speaker saying "Hi baby!"; n=8). Before the start of each trial, the prime was presented and remained on until the infant had attended to it for 2 consecutive seconds. An infant-controlled preference trial (either IDS or ADS) then ensued accompanied by a multi-colored checkerboard. Sixteen total preference trials were presented (8 IDS/8 ADS). The main hypothesis was that infants in the social prime condition would show a stronger IDS preference than those in the nonsocial prime. To date, a total of 15 infants (Mage = 14.73 months, SD = 2.82) have participated. Preliminary analyses indicate significant main effects of speech type ($F(1,14) = 14.47$, $p = .002$) and block ($F(1,14) = 10.82$, $p = .006$), and significant speech x block interaction ($F(1,14) = 8.42$, $p = .012$), but no significant speech x prime interaction ($F(1,14) = .000$, $p = .985$). Infants listened more to IDS than ADS ($t(14) = 3.941$, $p = .001$),

particularly in block one (first 8 trials; $t(14) = 4.992$, $p < .001$), compared to block two (second 8 trials; $t(14) = 1.858$, $p = .084$). However, the type of attention getter did not affect infants' speech preferences. No priming effect was evident even when just comparing attention on first IDS and first ADS trials ($F(1,13) = .027$, $p = .871$). On the basis of these preliminary findings, it looks as though the nature of the attention getter does not readily influence preference for speech. However, it is possible that the nonsocial and social primes were equally arousing, and/or that preference for IDS is so robust as to be impervious to the priming effect. Given the myriad of possible design changes, we will discuss ways to manipulate the primes, ways to manipulate the information to be processed, and whether infants need to participate in both priming conditions in order to better reveal the effects of attention getters on infant information processing.

P2-E-114 Where the Wild 2- to 3-year-olds Are: Novel Methods Assessing Developmental Trajectory of Statistical Learning Across Modalities

Carolyn Mazzei[1], Inbal Arnon[2], Lauren Emberson[1]

[1]Princeton University, [2]Hebrew University

Statistical learning (SL) is an implicit sensitivity to patterns or statistical regularities in sensory input. SL is present across multiple sensory modalities,3,4 and from infancy3,4 through elder adults.5,6,7 While SL exists across modalities, the mechanisms of SL seem affected by perceptual modalities in adults.2,6,7 Similar effects have recently been demonstrated in development. Raviv and Arnon (2017) examined 5-12 year olds and found that the effect of age on performance was affected by modality: while visual SL improved with age, auditory SL did not, with visual SL being better overall. Emberson, Misyak, Schwade, Christiansen and Goldstein (under review) examined SL from 8-10 months and found a reverse pattern: a positive effect of age in the auditory modality but not the visual one, and overall superior learning in the auditory modality. These studies suggest that modality differences in SL are present early on and may change with time. However, this conclusion is limited since SL effects have only been studied in infancy and later childhood. No study to date has examined if age differentially affects SL abilities across the visual and auditory modalities during the pivotal developmental time between two and six years. Moreover, this age range has been rarely tested for SL abilities regardless of modality: It is methodologically challenging to test this age range since neither established infant methods (e.g., looking time) nor child methods (e.g., explicit responses) are appropriate (for instance, 5-6 year old did not show significant learning in Raviv and Arnon (2017). The present study aims to introduce a novel method to measure

and compare the SL abilities of 2-6 year olds across auditory and visual modalities. Here, we focus on the more challenging auditory version of the task. Using a touch-screen tablet, children are introduced to alien friends who speak a different language. After passive exposure to a language statistically similar to that of Saffran et al. 1996, we utilize a completion method, novel for this age group, where participants are first presented with two syllables of the target word and then asked to select the correct completion. Specifically, the top alien (color red in Figure 1) states the first syllables of the triplet (e.g., AB), then the bottom two aliens complete the triplet- one alien presenting the target choice (C), then the other presenting the foil (E). Order and location of target were counterbalanced. To ensure that the child understands the testing procedure, children were trained using age-appropriate, already known triplets of words (Table 1, left) and, importantly, training and test interfaces are identical (Figure 1). The first 4 training trials are completed together with the experimenter with correct response feedback, then the participant completes the remaining 4 training trials alone without feedback. We find that by the age of 4 children can reliably complete the training procedure indicating that one can use this method to probe auditory statistical learning knowledge. At present, we are concluding data collection of the auditory condition and extending the paradigm to the visual condition.

P2-E-115 Microstructural analysis of parent-infant coordination and social attention among infants at risk for autism

Gina Mason[1], Emily Jones[2], Teodora Gliga[2], BASIS Team[3]

[1]Cornell University, [2]Birkbeck, University of London, [3]www.basisnetwork.org; Centre for Brain and Cognitive Development, Birkbeck, University of London

For human infants, sharing attention with others is critical for various social and communicative skills (Tomasello & Farrar 1986). Regarding how infants learn to share attention, current work suggests that attention sharing can arise through multiple pathways during social exchanges between infants and caregivers (Deák et al. 2014). In particular, one pathway recently described involves infant attention towards caregivers' object handling (objects that parents are holding or touching), coupled with caregiver responses that align in form and timing (i.e., are sensitive and contingent) with infants' focus (Deák et al. 2017; Goldstein et al. 2010; Yu & Smith 2017). In autism spectrum conditions (ASD), impairments in social attention and communicative development are often reported (Dawson et al. 2004; ICD-10). While prior paradigms have investigated early differences in face processing and gaze following among infants with high familial

risk of autism (HR infants; Elsabbagh et al. 2013, Jones & Klin 2013), less is known about HR infants' attention sharing in more naturalistic contexts, including whether HR infants attend to caregivers' object handling. To address this, we explored 6-10 month old HR infants' visual attention dynamics during parent-infant play, focusing on infant looking towards parent-held objects. We also identified microstructural patterns of parental contingency, sensitivity, and redirectiveness (attempts to shift infants' focus), in a preliminary assessment of parent-infant coordination among HR dyads. Methods: In a multisite collaboration assessing infant siblings of children with autism, researchers digitally recorded forty-six 6-10-month-olds and their parents as they engaged in 6 minutes of free play in a naturalistic playroom. Following data collection, a separate coder identified infant fixations frame-by-frame using the following focal categories: parent-engaged or static objects (toys), parent (face and upper body), parents' hands, undirected areas (wall, ceiling, floor), and uncodable. Observers also identified parent behaviours, including vocal (n=43), manual and multimodal actions. Contingent responses (within 2 sec following infants' behaviour) were categorised as sensitive when they shared infants' focus, and redirective when they attempted to shift focus. Preliminary Data: In line with typical infants (Deák et al. 2014), HR infants at 6-10 months showed significant looking preferences for parent-engaged objects during parent object handling compared to static objects, infants' next preferred looking category ($t(45)=10.52$, $p<0.001$; Fig. 1a). Individual variation was also observed (Fig. 1b), and future analyses will explore whether such variation predicts ASD outcomes. Parents of HR infants also exhibited variation in levels of contingent sensitive and redirective responding (Fig. 2), though they provided more sensitive than redirective responses as a group ($t(42)=15.42$, $p<0.001$). Future Directions: Overall, 6-10 month old HR infants show naturalistic looking preferences that align with those reported in typical infants (Deák et al. 2014), though individual variability is present. In a pre-registered analysis, we will next assess whether later autism outcomes (ADOS scores at 3 years) can be predicted by: 1) variation in HR infants' looking preferences; 2)differences in HR infants' attention shifting to parents' social prompts; and, 3)variation in parents' contingent sensitive and redirective responding.

P2-E-116 Temperament and behavior in toddlers born preterm in comparison to full-term counterparts

Carolina Beatriz Savegnago Martins[1], Rafaela Cassiano[1], Cláudia Gaspardo[1], Maria Beatriz Linhares[1]

[1]University of São Paulo

Preterm birth is a risk factor for the survival of children. Surviving babies have an increased prevalence of health and development problems in relation to the general population and the full-term. The aim of the present study was to examined temperament and behavior indicators in preterm toddlers in comparison to full-term ones. The sample consisted of 100 toddlers at 18 to 36 months of age, who were divided into groups differentiated by gestational age, as preterm birth (PT, n=50, age mean=25 months [± 5]) and full-term birth (FT, n=50, age mean=29 months [± 6]). The preterm toddlers were admitted in a Neonatal Intensive Care Unit (NICU) after birth with developmental care program routinely. In addition, they were attended at multidisciplinary follow-up program in a tertiary university hospital. At toddlerhood, the mothers were interviewed using the Early Childhood Behavior Questionnaire (Putnam, Gartstein, & Rothbart, 2006), for temperament assessment, and the Child Behavior Checklist 1 $^{1}/^{2}$-5 years (Achenbach & Rescorla, 2000), for behavioral and emotional assessment. The statistical descriptive analysis, MANOVAs, ANOVAs (analysis of variance), multiple linear regression analyses and interaction effects between the predictors and group (PT or FT) were performed (SPSS, version 23.0, Chicago Il, USA). The level of significance of the study was $p \leq 0.05$. The results showed that, regarding the temperament, the toddlers born preterm presented higher scores on Surgency factor in comparison to full-term counterparts (PT = 5.4 [±0.5]; FT = 5.0 [±0.5]; $p \leq 0.006$) and its dimensions of Positive anticipation (PT = 5.1 [±1.1]; FT = 5.0 [±0.9]; $p \leq 0.003$). In addition, compared to toddlers born full-term, the preterm toddlers presented more Discomfort (PT = 3.3 [±1.1]; FT = 3.0 [±1.2]; $p \leq 0.008$), Perceptual sensitivity (PT = 5.8 [±0.9]; FT = 4.7 [±1.2]; $p \leq 0.001$). Regarding the behavioral problems, there was no statistical significant differences between groups in Total (PT = 53 [±11]; FT = 56 [±9.9]; $p = 0.27$), Internalizing (PT = 51 [±11.8]; FT = 55 [±10.3]; $p = 0.12$) and Externalizing behavioral problems (PT = 54 [±10.1]; FT = 54[±9.9]; $p=0.9$). The regression analyses showed that the Total behavioral problems, as well as Externalizing and Internalizing behavioral problems, were predicted by temperament with less Effortful control and more Negative affectivity that was moderated by the brith status (PT and FT). The present findings suggest that the toddlers born preterm, in comparison to full-term counterparts, had temperament with more dispositional traits of Surgency and Negative Affectivity. The findings were relevant to support preventive interventions in the longitudinal follow-up programs for preterm children after the discharge of the hospital.

P2-E-119 Behavior problems in children born preterm from toddlerhood to preschool age

Maria Beatriz Linhares[1], Cláudia Gaspardo[1], Marília Branco[1], Ana Claudia Castro[1]

[1]University of São Paulo

The prematurity is associated with a higher risk for developmental problems, demonstrating the impact of the organism's immaturity in the neonatal phase on later developmental outcomes (Mansson & Stjernqvist, 2014). Children born preterm present more behavior problems in comparison to children born full term (Cassiano, Gaspardo & Linhares, 2016; Hornman, de Winter, Kerstjens, Bos, & Reijneveld, 2016). However, the stability of these problems over time is few studied (Arpi & Ferrari, 2013). The aim of the longitudinal study was to compare the behavior problems in children born preterm in two different phases in development, at 18 to 36 months of age and 4 to 5 years of age. The sample included 98 children born preterm (gestational age mean = 30 weeks [± 2]), at 18 to 36 months of age (mean = 26 months [± 4]) in the first assessment, and 4 to 5 years of age in second assessment (mean = 56 months [± 5]), and their respective mothers. These children, after hospital discharge, were attended at a multidisciplinary follow-up program in a tertiary university hospital. The mothers were interviewed using the Child Behavior Checklist 11/2 - 5 years (Achenbach & Rescorla, 2000) for behavior problems assessment. The statistical descriptive analysis and within-group comparison (Wilcoxon test) were performed (SPSS, version 23.0). The level of significance of the study was $p \leq 0.05$. The results showed that the toddlers presenting mainly normal behavior profile; 68 (69%) of children at 18 to 36 months of age, and 73 (74%) of children at 4 to 5 years of age presented normal behavior. In comparison to 18 to 36 months of age, children born preterm at 4 to 5 years presented lower scores of total (first assessment, mean = 55 [± 10]; second assessment, mean = 52 [± 10]; p = 0.01), externalizing behaviors (first assessment, mean = 57 [± 11]; second assessment, mean = 53 [± 10]; p = 0.001), aggressive (first assessment, mean = 58 [± 9]; second assessment, mean 56 [± 7]; p = 0.001), and attention behavior problems (first assessment, mean = 58 [± 8]; second assessment, mean = 56 [± 7]; p = 0.007). The findings showed a decreasing of total and externalizing behavior problems, especially aggressive and attention problems, at preschool age in comparison to toddlerhood. These findings indicates the developmental behavioral self-regulation, which is completed around five years old. Additionally, these children participated in a multidisciplinary longitudinal follow-up program for children born preterm, which may have acted as a protective factor buffering the negative impact for behavior problems.

P2-E-120 Developmental pattern of toddlers born preterm differentiated by risk for cerebral palsy

Maria Beatriz Linhares[1], Renata Zorzenon[2], Cláudia Gaspardo[1], Juliana Rodrigues[1]

[1]University of São Paulo, [2]USP

The prematurity is associated with a higher risk for developmental problems, demonstrating the impact of the organism's immaturity in the neonatal phase on later developmental outcomes (Mansson & Stjernqvist, 2014). The early micro-context of the Neonatal Intensive Care Unit (NICU) is a relevant protective environment for survival of these vulnerable infants. Paradoxically, NICU represents a risk factor for infants' development because of multiple painful and stressful procedures inherent to the intensive treatment (Anand, Stevens & McGrath, 2000). The aim of the present study was to compare the development profile among groups of toddlers born preterm according to the risk for cerebral palsy. The sample included 67 toddlers born preterm, who were admitted after birth in a NICU with a developmental care protocol, including a non-pharmacological management for pain relief and using oral sucrose prior to acute painful procedures. Of these, 43 (64%) toddlers presented early high-risk factors for cerebral palsy (RCP), and 24 (36%) did not present these risk factors (NRCP). The risk for cerebral palsy were grade III and IV intracranial hemorrhage, and leukomalacia. Neonatal characteristics were evaluated through the analysis of the medical records. The toddlers were attended in a multidisciplinary follow-up program in a tertiary public university hospital, and were assessed using the Bayley Scales of Infant Development - BSID-III (Bayley, 2006) for cognitive, language, and motor outcomes at 18 to 36 months of age. The statistical descriptive analysis and the t-test for between groups comparison were performed. The level of significance of the study was $p \leq 0.05$. The results showed that there were no differences between groups about the development outcomes, presenting mainly average developmental profile. The composite score means for the groups of RCP and NRCP were cognitive scale (RCP = 94 [±16]; NRCP = 92 [±13], p = 0.63), language scale (RCP = 92 [±18]; NRCP = 91 [±13], p = 0.83), and motor scale (RCP = 96 [±20]; NRCP = 98 [±16], p = 0.67). The findings showed that toddlers born preterm presented similar pattern of development, independently of the early high-risk for cerebral palsy. The implementation of developmental care protocol and sucrose management for neonatal acute pain relief during NICU hospitalization could be a protective factor to later development of preterm infants. Beyond that, the follow-up program for toddlers born preterm and their families could to offer positive parenting educational practices and rehabilitation, targeting to strengthen the developmental process of these vulnerable toddlers.

P2-E-121 Does the storyline matter? Eighteen-month-olds' memory for movies

Trine Sonne[1], Osman Kingo[1], Peter Krøjgaard[1]

[1]Aarhus University

In a recent visual-paired comparison (VPC) study (blinded, 2015) we showed that 18-months-olds remembered a short movie (30sec) with a simple storyline after two weeks. At Encoding, participants saw one of two movies, and at Test we found a familiarity preference. Vocabulary analyses suggested that the infants' understanding of the movie storyline affected their memory. However, an alternative interpretation might be that the infants simply remembered the movie due to the distinct perceptual details (e.g., color or luminance). Here, to disentangle these interpretations we compared 18-month-olds' (n=64) memory for short movies either with a meaningful storyline (as above) or with perceptually equivalent movies without such meaning. Infants were assigned to a Normal Condition, replicating the design from the recent study (blinded, 2015) or to a Pixelated Condition (98% pixilation). Pixilation ensured that while making the agents, objects, actions, and settings unintelligible, the overall color scheme, movement, duration, and luminance was preserved (Fig. 1). Proportional Looking-time to the familiar and novel movie was compared to chance level. For the Normal Condition we replicated our previous findings (blinded, 2015) as eye-tracking data revealed a familiarity preference (see Fig. 2). For the Pixelated Condition, however, no memory was indicated since proportional looking-time never differed from chance (all ps > .4). However, infants may have remembered the movies in the Normal Condition because of the static conceptual information (i.e. scenarios, agents or objects), and not because of the storyline. To disentangle these two interpretations, we are currently conducting a control experiment (n=32): The two movies are broken down to 1sec segments and presented in randomized order. Consequently, the storyline is disrupted while preserving the static conceptual information. Results are pending, but will be available for the conference. Regardless of the outcome, the results will shed light on which aspects of the movies that are crucial for remembering.

P2-E-122 Neural Markers of Predictive Models in 9-Month-Old Infants

Ezgi Kayhan[1], Marlene Meyer[2], Jill O'Reilly[3], Sabine Hunnius[4], Harold Bekkering[4]

[1]Max Planck Institute for Human Cognitive and Brain Sciences, [2]University of Chicago, [3]University of Oxford, [4]Radboud University

Violation of expectation paradigms have been used for decades in infancy research (Aslin, 2007). Although infants' surprise responses are considered to reflect an internal model about how events should unfold, the link between infants' surprise and their internal models remains unclear. In this study, we investigated whether 9-month-old infants adjust their internal models to represent a dynamic experimental environment. Specifically, we examined whether they dissociate and thus modulate their predictive models dependent on differential types of unexpected events. In an audio-visual electroencephalography (EEG) paradigm, we presented infants with a continuous sequence of stimuli which followed a predictable pattern (i.e. same stimuli were repeated for several trials; "expected" trials). Two types of cues (i.e. "update" and "no-update") were interspersed among the expected trials. They differed in terms of whether or not they signaled a future change in the sequence. Following the "update" cue, the predicted pattern was altered, whereas the pattern remained the same after the "no-update" cue (Figure 1). Infants could thus adjust their predictions about the upcoming targets based on the update cues; however, they were expected not to change their predictions following the no-update cues. We predicted that the two types of unexpected cues initially would both elicit an amplified negative central (Nc) response in contrast to the expected stimulus, if infants indeed perceive them as unexpected. As hypothesized, data revealed that both in the "update" (md = -3.89, SE = 1.17, p = 0.003) and the "no-update" trials (md = -5.68, SE = 2.18, p = 0.017), infants showed significantly stronger negativity in comparison to the expected trials. There was no significant difference between "update" and "no-update" trials in the early stages of processing (md = 1.79, SE = 2.03, p = 0.390). Based on our hypothesis on updating, we tested whether later in the processing stream infants dissociated between the two unexpected cues as reflected in a larger positive slow wave (PSW) in "update" trials as compared to the other trial types. These analyses revealed that participants showed more positivity in response to both "update" (md = 2.82, SE = 0.88, p = 0.004) and the "no-update" trials (md = 4.18, SE = 1.65, p = 0.020) as compared to the expected trials. This finding suggests that the unexpected information modulated infants' responses also in later stages of processing; however, no differential response to the two types of cues was observed at later stages of processing. To explore the nature of the internal models infants might have generated throughout the experiment further, we investigated infants' neural responses to the stimuli following the "update" and "no-update" cues. The analysis showed that infants associated unexpected cues with future changes in the sequence. Interestingly, only when a predicted change was absent (i.e. following the "no-update" cues) a prominent neural response was observed in the early

components indicating a top-down modulation of early sensory processing in infants. Our study corroborates emerging evidence suggesting that the basic machinery to build predictive models might already be functional early on in life.

P2-E-123 Is transitional probability more resilient to decay in memory than syllable frequency?

Ferhat Karaman[1], Jessica Hay[1]

[1]University of Tennessee

Acquiring a new language involves the complex task of extracting potential word-like units from speech and linking them to meanings. A number of studies (e.g., Graf Estes et al., 2007; Hay et al., 2011) have suggested that infants may be able to track syllable co-occurrence patterns (aka transitional probability, TP) in continuous speech to extract candidate object labels which are available to be mapped to meaning. However, infants may hear speech during times when objects or concepts being referred to may not be in infant's immediate environment. Thus, remembering the recently extracted words may be crucial for future learning opportunities. Since statistical word learning has been typically tested immediately after familiarization with an artificial or a natural language, it is not clear whether infants tracking statistical regularities in a language are also able to remember the representations of those sound sequences following a delay. Here, we examine the availability of statistically defined words as object labels immediately (Experiment 1) and 10-min (Experiment 2) after familiarization with an Italian corpus. In Experiment 1, thirty-two 22- to 24-month-old English learning infants were first familiarized with Italian sentences that contained 4 embedded target words - 2 words had high TP (HTP, TP=1.0) because their syllables never occurred anywhere else in the corpus and 2 had low TP (LTP, TP=.33) because both their first and second syllables occurred many time throughout the corpus-- and immediately after familiarization they were trained and tested on four novel word-object pairings using a Looking-While-Listening paradigm (Fernald, Zangl, & Marchman et al., 2008). Importantly, labels were the HTP and LTP words from the corpus. Results showed that infants successfully learned both the HTP, $t(31)=4.99$, $p<.001$ and LTP object labels, $t(31)=2.45$, $p=.02$, as evidenced by above chance looking to the target following label onset (see Figure 1). We suggest that HTP and LTP words may have been mapped to meaning for different reasons - learning of HTP words may have been supported by strong co-occurrence statistics, whereas high syllable frequency may have driven learning of LTP words. To investigate how these two types of statistics (i.e., sequential statistics and syllable frequency) are represented in infants'

memory, we replicated Experiment 1 but inserted a 10-min delay between familiarization and referent training/testing. If infants remember the both HTP and LTP words following a delay, they should show comparable word learning performance across experiments. Preliminary results (n=14) revealed successful learning of HTP, $t(13)=4.14$, $p<.001$, but not LTP object labels ($p>.8$). Further, infants were significantly more accurate on HTP ($M=.61$, $SD=.34$) than LTP trials ($M=.51$, $SD=.30$), $t(13)=2.50$ $p<.05$, suggesting that HTP words made better object labels than LTP words following a 10-minute delay. Taken together, our findings suggest that while sequential statistics are maintained in memory and remain available to support learning of word-object associations, syllable frequency information may decay more quickly. The results of this study will help us to better understand the contribution of statistical learning to an important real-world problem facing infants - remembering words.

P2-E-124 Application of pivotal response training in a home service program for Taiwanese children with autism spectrum disorder

Tian-Ai Yang[1], Yen-Hsun Huang[2], Jui-Yun Tsai[2], Sarah Rieth[3], Yen-Tzu Wu[1]

[1]National Taiwan University, [2]Taipei City Psychiatric Center, Taipei City Hospital, [3]San Diego State University

Background Previous studies have shown that early intervention for children with autism spectrum disorder (ASD) is associated with positive cognitive, adaptive and communication development. Pivotal response training (PRT), based on the principles of applied behavioral analysis, is an evidence-based, naturalistic, behavioral intervention for children with ASD. Studies demonstrate that PRT significantly improves functioning of children with ASD and supports skill acquisition. However, little is known about the effect of PRT on Eastern children with ASD. The current study evaluates a home service program adapted from PRT for Taiwanese families affected by ASD. Objectives The objectives are: 1) to train parents in using PRT skills at home; and 2) to evaluate the program's effectiveness by measuring changes in child's developmental performance and behaviors. Methods 1)Thirteen families who have a child diagnosed with ASD, aged 2-6 years, were enrolled in the study. 2)The participating families received a home service program that involved 12 sessions of intervention (one session per week) over the course of 3 months. 3)Two research clinicians taught parents the following PRT skills in the context of social interaction: gaining children's attention, offering clear and appropriate instructions, incorporating both easy and difficult tasks, sharing control, encouraging responsivity to multiple cues for broadening attention, providing direct reinforcement, focusing on

contingent consequences, and reinforcing children's attempts. 4)Program efficacy and effectiveness were measured by the changes between enrollment (baseline) and the last at-home session (post-intervention) in: a)Child's developmental status and adaptive behavior, as measured by the Mullen Scales of Early Learning (MSEL) and the Vineland Adaptive Behavior Scales (VABS). b)Child's problem behaviors, as measured by the Child Behavior Checklist 1.5-5 (CBCL/ 1.5-5). c)Parental satisfaction with the intervention, including their opinion of the training materials, intervention procedures, and clinicians' expertise. d)Non-parametric Wilcoxon signed-rank test was used to compare each measured score between pre- and post-intervention. Descriptive analysis was used to explore the results of parental satisfaction. Results 1)The ages of participating children were between 29 to 67 months old (mean: 49.1, SD:12.8) at enrollment. 2)Children's receptive and expressive language scores on the MSEL demonstrated significant improvement after intervention (Table 1). 3)Children's adaptive behaviors, as measured on the VABS, showed significant improvements in the full scale and several subscales after intervention (Table 1). 4)Children's externalizing problems decreased after intervention, as demonstrated by significantly lower scores in the CBCL/ 1.5-5 (Table 1). 5)All parents were satisfied with the intervention, with the average over 3.8 on a 1-5 scale. More than 70% of parents reported high satisfaction with their child's and their own improvement, overall training program and clinician's expertise (Figure 1). Conclusion Our preliminary findings revealed encouraging evidence for PRT as supporting children's development. The home service program delivered here could become a preliminary model for efficiently and effectively providing an evidence-based behavioral intervention to the families affected by ASD in Taiwan.

P2-E-125 The Role of Action Effects in Rational Imitation: Action-Effect Binding or Frequency Learning?

Chi-Tai Huang[1], Yue-Ju Yang[1]

[1]Chengchi University

There is a debate about the mechanism underlying selective imitation in infancy. In the seminal work by Gergely, Bekkering and Kir¨¢ly (2002), infants imitate an adult by using their head to turn on a lamp more often when the demonstrator deliberately produces the unconventional manner (by placing the free hands on the table) than when she rationally use the head (the hands occupied by holding a blanket). Although it has been suggested that infants use the situational constraints to interpret the actor's intention, recent evidence shows that selective imitation could be interpreted alternatively as action-

effect coupling guided by an ideomotor principle. In this paper, we delineated the roles of action-effect binding and teleological reasoning by examining the causal efficacy and frequency of observed actions. The two theories make different predictions about whether to imitate stochastic causal actions. While the ideomotor principle maintains that stochastic causal actions decrease imitation response tendencies, the teleological reasoning theory holds that probabilistic information about action effects is sufficient to allow infants to understand the goal (function) of an artifact. In Experiment 1, 18-month-old infants (N = 64) watched as the adult touched the light box with the forehead in either the hands-free or hands-occupied condition. The demonstration was repeated four times. In each condition, some children saw the actions always activate the light (deterministically effective), and some saw the light only half of the time (stochastically effective). When deterministically effective actions were modeled, 63% of infants in the hands-free condition imitated the head touching compared to 25% of infants in the hands-occupied condition, ¦Ö2(1, N = 32) = 4.75, p < .05, as was shown in previous research. However, there was no condition difference when stochastically effective actions were demonstrated (25% and 38% in the hands-free and hands-occupied conditions, respectively), ¦Ö2(1, N = 32) < 1. It is worth noting that infants who received the stochastic models observed the head touching and light effect co-occur twice, while infants in previous research saw the complete action repeated three or four times. In Experiment 2, we tested the possibility that infants showed decreased proclivity to imitate stochastic actions in the hands-free condition because of insufficient frequency of exposure to the full action. Infants (N = 40) participated in either the hands-free or hands-occupied condition. In each condition, the model provided six stochastically effective demonstrations (illuminating the box three times). The results indicated that when the frequency of exposure to the full action increased, 65% of infants in the hands-free condition imitated the stochastic head touching compared to 20% of infants in the hands-occupied condition, ¦Ö2(1, N = 40) = 8.29, p = .010. The pattern of findings suggests that rational imitation is mediated, not by the strength of associations between an action and its effect, but by the frequency of exposure to effective actions.

P2-E-126 I'll have what she's having: Infants' preferences for female faces extends to female-referenced objects

Alison Heck[1], Rachel Jubran[1], Ramesh Bhatt[1]

[1]University of Kentucky

Young infants utilize social cues from adults to adjust their behavior. Although many studies have explored infants' behavior towards objects that have been associated with particular emotions (e.g., Vaillant-Molina & Bahrick, 2012), less is known about how infants respond to objects as a result of other social cues, such as the gender of the person interacting with a novel toy. Infants with female primary caregivers exhibit a preference for female faces (Quinn, Yahr, & Kuhn, 2002); thus, we expected that 7-month-olds would extend this preference to novel objects that were positively referred to by female models over those referred to by male models (Experiment 1). An additional question we investigated was whether explicit referencing through directed gaze is required to show this preference or if a mere association with a female face would be sufficient (Experiment 2). In Experiment 1, 7-month-olds were familiarized to novel objects paired with male and female faces (i.e., Female Face-Object A; Male Face-Object B) in eight trials. To increase generalizability, prototypical male and female faces, created through averaging, as well as unaltered male and female faces were used in this study. All faces were initially neutral and in profile, and the objects were not visible. After one second, the object appeared and the face shifted to a smile (see Figure 1a). This was done to approximate some level of contingent interaction between the model and the object. In Experiment 2, the same procedure was used, but the faces were directed away from the objects (see Figure 1b). In both experiments, familiarization was followed by test trials in which the female-paired object and the male-paired object were presented side-by-side simultaneously. The dependent measure was the proportion of time spent on the female-paired object, which was then compared to chance (50%). Forty-eight 7-month-olds participated in Experiments 1 and 2, with half in each condition. Infants in Experiment 1 fixated significantly longer on the female-paired object ($M = 57.79\%$; $p = .04$) compared to what would be predicted by chance. Therefore, when novel objects are being referred to by female and male models, 7-month-olds prefer the object referenced by the female model. In contrast, infants in Experiment 2 showed no significant preference for the female-paired object ($M = 51.61\%$; $p = .65$), which indicates that it is not enough to be merely associated with a female face; some level of explicit referencing is required. Overall, this study demonstrates that 7-month-olds are sensitive to social cues, such as gender, and use that information to make decisions about how to interact with novel objects in their environment. In this case, infants preferred objects that were positively referenced by female models; however, they did not automatically prefer objects that were simply paired with female models, as they did not show this preference when the face did not explicitly reference the object through directed gaze. Therefore, early in life, infants show relatively sophisticated behavioral responses based on socially-relevant cues provided by adults around them.

P2-E-127 The natural statistics of naps and language in everyday infancy

Sabrina Haskinson[1], Jennifer Mendoza[1], Christine White[1], Heather Anderson[1], Caitlin Fausey[1]

[1]University of Oregon

Naps and overnight sleep play a critical role in infants' memory consolidation (Hupbach et al., 2009). Though we know a lot about how often infants sleep (Wooding et al., 1990), we know much less about the specific kinds of input that occur right before sleep - input that may be especially available for memory consolidation (e.g., Tambini et al., 2010). The daily rhythm of language input together with naps likely shapes infants' early language learning trajectories. Here, we combine daily nap logs and language input captured at home to describe "input-nap" rhythms in infants' everyday experience. Is there something special about pre-nap language input in everyday experience? One possibility is that the activities prior to naps consist of linguistically rich content, such as singing (Trehub & Schellenberg, 1995), reading (Williams & Horst, 2014), and other social caregiver-infant interactions. Another possibility is that pre-nap input does not differ from other periods throughout the day, but its impact on learning may be especially potent. To begin to understand these possibilities, we captured the day-long auditory input available to infants, determined when naps happened, identified pre-nap periods, and examined their linguistic quantity and quality. Infants (ages 6-12 months) wore a lightweight recording device (LENA; Ford et al., 2008) on three days within one week. Caregivers logged when their infant was sleeping each day. We report on a subset of families (10 infants, 30 recorded days) who participated as part of a larger study (Trio Corpus; Fausey & Mendoza, in prep). LENA software automatically estimated the number of adult words, as well as conversational turns between adults and infants, in each 5-minute segment of infant-available speech (Xu et al., 2009). Caregivers recorded for the full day (Median=16 hours, SD=1.75 hours). Infants took 1 to 3 naps per day (M=1.77, SD=.73), sleeping just over 2 hours total (Median = 138.03 minutes; SD= 55.06 minutes). These values are typical of infants this age (Gomez & Edgin, 2015). Adults used between 293 and 2511 words per hour (Median = 940.19, SD=621.13), calculated by including all hours in the day except the naptimes. In pre-nap hours, adults used 1180.50 words per hour (Median, SD=1281.74). The hourly rate of conversational turns was 19.27 (Median, SD=11.25); in pre-nap hours it was 29 (Median, SD=23.69). Figure 1 shows the daily input-nap rhythms for two example infants. We note two observations that will guide future work: 1) Most, but not all, caregiver-reported naptimes coincide with moments throughout the day in

which no adult speech was estimated. We will present results comparing multiple forms of caregiver logs to assess ease of accurate nap reporting. 2) Some infants' day-to-day lives are characterized by stable nap and language rhythms while others are more variable. Does this predictability interact with the potency of pre-nap input? The pre-nap quantity and quality of language use, as automatically estimated by LENA, does not appear to dramatically differ from other one-hour periods throughout the day. Ongoing work will reveal what caregivers actually said and did during these periods, in order to give insight into the pre-nap input that young learners encounter in everyday infancy. This work was completed with support from the ICIS Summer Fellowship.

P2-E-128 Generalization and Abstract Representations of Non-Adjacent Dependencies in Infants

Ileana Grama[1], Frank Wijnen[1]

[1]Utrecht University

Infants of 18 months can detect non-adjacent dependencies in language: when exposed to simple artificial grammars of the form aiXbi (e.g. tep wadim lut), they subsequently discriminate between familiar aiXbi strings and minimally distinct, but unfamiliar aiXbj strings (Gómez & Maye, 2005). The stimuli of this artificial grammar are simple strings, read out in lively, child-friendly voices. Non-adjacent dependency-learning has been suggested to support the acquisition of morpho-syntactic dependencies (The princess IS gently kissING the frog) in natural languages. However, in natural languages, morpho-syntactic dependencies are instantiated between functional morphemes, which are often perceptually less salient than lexical morphemes (Selkirk, 1996; Monaghan, Christiansen & Chater, 2007). Furthermore, in order to learn these dependencies productively, infants must be able to generalize them to novel contexts (i.e. unfamiliar intervening elements). In two experiments (modeled after Gómez & Maye 2005), we tested 18-month-olds' ability (1) to learn dependencies between perceptually non-salient units, and (2) to generalize dependencies to novel contexts in two separate experiments. In Experiment 1, 40 18-month olds (20 females, M=18m15days, age range 18m2days - 19 m) were exposed to an aXb language in which the a/b elements had the prosodic properties of functional morphemes, while X elements have the properties of lexical words in Dutch. After familiarization, a short contingency training prepared participants for the contingency between looking behavior and sound that will occur at test (Mintz 2013). At test, infants heard 4 trials consistent with the familiarization language (aiXbi strings), and 4 inconsistent (aiXbj strings). Results showed no overall discrimination of consistent and

inconsistent trials, but infants' preferences in test trials 2-8 varied as a function of the first test trial: there was a significant preference for the test trials that were consistent with (showed the same dependencies as) the first test trial ($F(1, 195.192) = 7.408$, $p = .007$). This is in line with Gómez, Bootzin & Nadel (2006), who argued that infants only retain an abstract representation of a_b dependencies from familiarization, and subsequently use the first trial to refamiliarize themselves with the item-specific ai_bi pairings. Furthermore, girls showed a more marked learning effect than boys in this sample. In the second experiment, 31 18-month-olds (16 females, M=18m16days, range 18m4days - 19m) were exposed to an aXb language similar to Gómez & Maye (2005), but tested on their discrimination of novel, aiYbi versus aiYbj strings. No significant learning effects were observed. While the first experiment suggests that infants may not retain item-specific information (but a more abstract representation) about dependencies when they are established between perceptually non-salient stimuli, the second experiment suggests that familiarity with the intervening material may be crucial to the recognition of an aXb dependency. (Word count 458) References Gómez, R., & Maye, J. (2005). The developmental trajectory of nonadjacent dependency learning. Infancy, 7(2), 183-206. Gómez, R. L., Bootzin, R. R., & Nadel, L. (2006). Naps promote abstraction in language-learning infants. Psychological Science, 17(8), 670-674. Mintz, T. H. (2013). The segmentation of sub-lexical morphemes in english-learning 15-month-olds. Monaghan, P., Christiansen, M. H.,

P2-E-129 Infant's attention at play: maturation and maternal engagement effects

Shir Komforti[1], Alin Peri[1], Maor Gidron[1], Ronny Geva[1]

[1]Bar-Ilan University

From birth, infants are exposed to complex environments. The development of the attention networks enables focusing on target stimuli, and executes controlled action while being distracted by other events. The transitions between the ability to settle orienting on an object to exert executive attention and then to executive control while attending to multiple tasks are considered key. Yet, little is known on the factors that support these attentional level transitions. We postulated that as infants grow older they achieve higher levels of attention, and that adaptive parental engagement rather than a controlling engagement would serve a role in these transitions. Eighty-four mother-infant dyads (younger infants group mean age= 9.08±.45 months, 30.2% female; older infants mean age=10.45±.52 months, 34.1% female) played together during a 5-minute free play in a controlled setting. Attention and maternal engagement were coded during the

structured play interaction. Three levels of attention were coded- (1) settled orientation (i.e. attentional focus on one stimulus bound with no physical engagement); (2) executive attention (i.e. conscious awareness of the object and attending to a single goal); and (3) executive control (i.e. attending to two different goals while executing a controlled action). Overall, during play infants in both age groups were mostly in executive attention (M=63.16±1.96%), spending less time in settled orientation (M=28.28±1.96%) and exhibited the ability to achieve executive control for short periods of time (M=6.01±1.00%). As hypothesized, the older infants had longer durations of executive control ($p<0.02$), accompanied by shorter durations of executive attention ($p<0.001$). Moreover, mother engagement effect on attentional states yielded a 3-way interaction ($p<0.02$). Post-hoc analysis showed that young infants of mothers with adaptive maternal engagement had higher executive attention durations compered to young infants in controlled-engagement dyads ($p<0.02$); while older infants of mothers with adaptive maternal engagement had higher durations of executive control compared to all others ($p<0.001$; see figure). Results indicate a maturational trend for attentional levels and that the parental behavior, specifically adaptive engagement parenting during play is key for supporting transitions between attentional states to higher levels of control.

P2-E-130 NEONATAL CHARACTERISTICS, CLINICAL HEALTH STATUS, AND DEVELOPMENT IN TODDLERS BORN PRETERM

Cláudia Gaspardo[1], Juliana Rodrigues[1], Ricardo Faciroli[1], Guilherme Furini[1], Maria Beatriz Linhares[1]

[1]University of São Paulo

A lower gestational age is associated with a higher risk for developmental problems, demonstrating the impact of the organism's immaturity in the neonatal phase on later developmental outcomes (Mansson & Stjernqvist, 2014). The early micro-context of the Neonatal Intensive Care Unit (NICU) is a relevant protective environment; paradoxically, NICU represents a risk factor for infants' development because of multiple painful and stressful procedures inherent to the intensive treatment (Anand, Stevens & McGrath, 2000). The aim of the present study was to compare the development profile among groups of toddlers born preterm according to level of prematurity, and presence of preterm birth complications. The sample included 24 toddlers born preterm, who were admitted after birth in a NICU with a developmental care protocol, including a non-pharmacological management for pain relief using oral sucrose prior to acute painful procedures. Of these, 16 (67%) toddlers born very preterm (VPT - < 30 weeks of

gestational age), and 8 (33%) toddlers born moderately preterm (MPT - between 31 to 36 weeks of gestational age). Besides, 11 (46%) have developed bronchopulmonary dysplasia (BPD) and 18 (75%) have developed retinopathy of prematurity (ROP). Neonatal characteristics were evaluated through the analysis of the medical records. The toddlers were attended followed in a multidisciplinary follow-up program in a tertiary public university hospital, and were assessed using the Bayley Scales of Infant Development - BSID-III (Bayley, 2006) for cognitive, language, and motor outcomes at 18 to 36 months of age. The statistical descriptive analysis and the Man-Whitney test were performed. The level of significance of the study was $p \leq 0.05$. The results showed that there were no differences between groups on the development outcomes, presenting mainly average developmental profile. Taking into account level of prematurity, the composite score means were cognitive scale (VPT = 92 [±13]; MPT = 92 [±14]), language scale (VPT = 90 [±14]; MPT = 94 [±12]), and motor scale (VPT = 96 [±16]; MPT = 101 [±18]). When the toddlers were split by presence of BPD (PBPD) vs. absence of BPD (ABPD), the means were cognitive scale (PBPD = 89 [±9]; ABPD = 94 [±16]), language scale (PBPD = 86 [±10]; ABPD = 95 [±14]), and motor scale (PBPD = 94 [±10]; ABPD = 101 [±20]). When the toddlers were split by the presence of ROP (PROP) vs. absence of ROP (AROP), the means were cognitive scale (PROP = 91 [±10]; AROP = 95 [±22]), language scale (PROP = 91 [±10]; AROP = 90 [±20]), and motor scale (PROP = 96 [±14]; AROP = 103 [±22]). The findings showed that toddlers born preterm presented similar pattern of development, regardless of the level of prematurity and the other clinical characteristics. The implementation of developmental care protocol and sucrose management for neonatal acute pain relief during NICU hospitalization could be a protective factor to later development of preterm infants. Beyond that, the follow-up program for toddlers born preterm and their families could to offer positive parenting educational practices strengthening the developmental process of these vulnerable toddlers.

F: Cognitive Development

P2-F-131 Looking patterns differ as a function of temperament

Esther Reynolds[1], Amanda Rosales[1], Bret Eschman[1], Shannon Ross-Sheehy[1]

[1]University of Tennessee

Visual learning is an important component of early cognitive development, and visual behaviors total looking and mean fixation durations are often used to assess speed of processing. For example, short fixation durations are typically associated with faster processing (Colombo, Richman, Shaddy, Follmer Greenhoot, & Maikranz, 2001; Sonne,

Kingo, & Krøjgaard, 2016). Importantly, these behaviors may also be related to infant temperament. For example, infants who are high in surgency (i.e., high levels of positive affect coupled with high extroversion) typically demonstrate shorter mean FDs than infants who are low in surgency (Papageorgiou et al., 2014). In addition, infants who are high in attentional control and self-regulation typically show longer total look durations (Sheese, Rothbart, Posner, White, & Fraundorf, 2008). However, it is currently unclear if this relationship reflects general physiological differences associated with a particular temperamental style (i.e.,physiological reactivity), or if temperamental style interacts with the content of the stimulus, biasing attention. To address this question, we assessed infant temperament using the Revised Infant Behavioral Questionnaire, then measured infant visual scanning behaviors in response to social and non-social scenes. If the physiological aspects of temperament produce qualitatively different patterns of looking, we expect this to manifest regardless of content (social or non-social). However, if temperament biases attention toward or away from social/emotional stimuli, we might expect distinct fixation patters that vary by social content. 8-month-old infants were tested in a visual scanning task (N=51). Infants were shown 6 visual images that varied in their degree of complexity (3, 6, or 9 items) and social content (social or nonsocial, Fig 1). Gaze was assessed continuously using a Tobii TX300 eyetracker. Parents additionally completed the Revised Infant Behavior Questionnaire (IBQ-R), and responses were used to calculate three temperament scales: Surgency (extroversion and high sensory perception), Orienting and Reactivity (attention and emotional regulation), and Negative Affectivity (distress, fear, and sadness, Gartstein & Rothbart, 2003). Results suggest both TFD and # of fixations are related to temperament. Specifically, infants High in Negative Affectivity had longer TFDs for the non-social stimuli, and shorter TFDs to the social stimuli than infants Low in Negative Affect, $F(1,114)=6.84$, $p=.002$ (Fig 2). High Surgency infants showed significantly longer TFDs than Low Surgency infants for non-social objects in complex scene, and social objects low complexity scene, $F(2,112)=3.237$, $p=.043$. Additionally, High Surgency infants had significantly more fixations regardless of complexity or content, $F(1,51)=8.454$, $p=.005$. Taken together, results support both a biased attention, and physiological reactivity account of temperament. Specifically, High Negative Affect may influence looking by biasing attention away from social stimuli, whereas High Surgency may influence looking by increasing overall look durations and fixation counts.

P2-F-132 Executive Functioning in 7-Month-Old Non-Crawling Infants Enhanced by Robotically-Assisted Locomotion

Nancy Rader[1], Sharon Stansfield[1], Judith Pena-Shaff[1], Carole Dennis[1], Helene Larin[1]

[1]Ithaca College

Executive functioning involves regulatory processes associated with inhibitory control, cognitive flexibility and the planning and initiation of voluntary actions (Diamond, 2000). Koziol and Lutz (2013) have suggested that executive function development is closely tied to motor system control. While some researchers have examined the relationship between crawling and cognitive development, these studies have tended to be limited by the use of a correlational design and dependency on motor skills. To avoid these pitfalls, we randomly assigned 5-month-old non-crawling infants to a locomotor or non-locomotor condition and used measures based on eye movements. Self-guided locomotion was made possible for infants in the locomotor condition through the use of a robotically-assisted device. Infants in both groups came to the lab for 12 play sessions over a period of two months. The play sessions were identical for both groups except that the locomotor infants could navigate to toys while the non-locomotor infants were presented with toys within reach. At seven months, following the twelve play sessions, infants viewed a video that consisted of five segments designed to assess executive functioning skills. Eye tracking was carried out using an ASL system. Two of these tasks will be reported on here - a switch task and an A-not-B object permanence task. The switch task consisted of 18 trials in which a puppet appeared for half the trials on the right followed by the remaining trials on the left. For this task, infants had to learn to look to the right and then switch their expectations to the left. Anticipatory looks to either side were recorded and scored. For the A-not-B task, infants viewed a scene that began with one dog house in position A and a dog that moved from the center of the screen into the dog house. The infant could get the dog to appear again by looking at the dog house. After the first phase, an additional dog house appeared in position B. The dog ran into the dog house in position A for the first two phases and then to the doghouse on the right for the remaining two phases. Infants' looks to the correct dog house were scored. We hypothesized that infants who received robotic-assisted locomotor experience would perform better than the infants in the non-locomotor group on both the switch task and the A-not-B task. For the switch task, data were analyzed for 25 infants, 13 in the locomotor condition and 12 in the non-locomotor condition. An independent t-test found a significant difference between the two groups, $t(21.2)=2.07$, $p=.025$; locomotor Infants showed better anticipatory attention to the puppet's location. For the A-not-B task, data were analyzed for 28 infants, 14 in each condition. An independent t-test found a significant difference between the two groups, $t(26)=2.386$, $p=.013$, with higher scores for the locomotor group. (See Table 1 for means and SDs.) These results support theories that posit that self-guided locomotion contributes to the development of executive functioning, particularly the ability to switch from an established response to a new one.

P2-F-133 Cognitive capacity in infancy: How is it linked to bilingualism?

Sadaf Pour Iliaei[1], Krista Byers-Heinlein[1]

[1]Concordia University

There is significant evidence that bilingualism enhances cognitive control in children and adults (Bialystok, 2007). In a pioneering study, Kovacs & Mehler (2009) found evidence for improved cognitive control in 7-month-old bilingual infants, however there are some preliminary reports of non-replications of this effect (e.g., Molnar et. al, 2014). Moreover, other results have found bilingual advantages in infant tasks largely unrelated to cognitive control, such as memory generalization (Brito and Barr, 2014) and habituation (Singh, 2015). This study presents a new replication of Kovacs & Mehler (2009), with the goal of clarifying the existence, robustness, and nature of the bilingual advantage in infancy. Twenty-five 7-month-olds (18 monolinguals and 7 bilinguals learning French and/or English) have completed the study to date (target = 20 infants/group). On an eye-tracker, infants saw a visual cue (a colourful shape), followed by a visual reward on one side of the screen during 9 pre-switch trials. Infants are expected to learn that the cue predicts the reward, and anticipate its appearance by looking towards the trained side before the reward appears. During a 9-trial post-switch phase, the reward switched sides. To successfully anticipate the reward, infants need to inhibit the previous response and produce a new response to look to the other side. Following Kovacs & Mehler (2009), trials were grouped in blocks of three (first/middle/last) separately for the pre-switch and post-switch phases. During the pre-switch phase, the interaction of block and language group was marginally significant ($F_{2,15} = 2.53$, $p = 0.09$), with no significant main effects. On the first block, bilinguals ($M_{block1} = .83$, $p = .02$) but not monolinguals ($M_{block1} = .52$, $p = .84$) were significantly above chance (.5). On the second block, monolinguals ($M_{block2} = .76$), $p < .01$), but not bilinguals ($M_{block2.} = .64$, $p = .30$) were significantly above chance. On the third block, bilinguals were significantly above chance ($M_{block3} = .90$, $p < .01$), while monolinguals were marginally above chance ($M_{block3} = .73$, $p = .052$). In the post-switch phase, block again interacted with language group ($F_{2,14} = 4.71$, $p = 0.02$). While unsurprisingly both groups began by looking more towards the previously trained side, bilinguals significantly improved from the first to the third block ($M_{block1} = .30$; $M_{block2} = .30$; $M_{block3} = .61$; $p = .05$), while monolinguals showed no evidence of learning from the first to the third block ($M_{block1} = .36$; $M_{block2} = .45$; $M_{block3} = .31$; $p = .25$). Our results confirm an early-emerging cognitive advantage for bilingual infants. Yet, we found monolingual-bilingual differences in both the pre- and post-switch phases,

which leaves open the possibility that this may be driven by differences in learning, rather than in inhibitory control. This would be consistent with other reports of learning advantages in bilingual infants (Brito & Barr, 2014; Singh, 2015). Additional data will be needed to better understand what drives bilingual advantages in infancy, and how this changes across development.

P2-F-134 Towards compositionality of meaning and thought. Twelve-month-olds? understanding of complex noun phrases

Barbara Pomiechowska[1], Erno Téglás[1], Ágnes Kovács[1]

[1]Central European University, Közép-európai Egyetem

The principle of compositionality (PC) is at the heart of our language competence: the meaning of complex expressions (e.g., "green apple") is derived by the language users from the meaning of simple constituents (e.g., "green", "apple") and the structure of the expression. Here, we explored whether preverbal infants apply the principle of compositionality to compute the meaning of complex noun phrases composed of a familiar common noun and a newly learnt numeral. Experiment 1 demonstrated that 12-month-olds (N = 20) were able to learn two distinct proto-numerals denoting a singleton and a pair. The task consisted of 6 training trials and 4 generalization trials. Each training trial comprised a presentation phase, introducing the novel numerals paired with nouns, immediately followed by a test phase, in which we enquired about one of the numerals, referring either to the singleton or the pair. Presentation scenes depicted the target referents: e.g., one duck placed in one location and two ducks placed in another location. Both referents were subsequently pointed at and named with two different pseudo-words for the singleton (e.g., moxi) and the pair (e.g., dax). At test, infants were shown the referents in new locations and were enquired about one of them. Generalization trials had a similar structure to the training trials, but did not include presentation phase. Three object kinds were used in the training trials and two different object kinds were used in the generalization trials. Our results showed that infants looked longer at the referent that was named (e.g., dax duck - two ducks) than at the distractor (e.g., one duck), suggesting that they mapped the novel words onto concepts depicting a single item v. a pair of items. This pattern of performance was observed both at training and generalization trials. In Experiment 2 we investigated whether infants can compose the meaning of these proto-numerals with the meaning of novel kind labels. We predicted that if infants were capable of computing the meaning of complex expressions by combining the meanings of their constituents. To test this prediction, we used the same training as in Exp. 1 followed by a

compositionality assessment (4 trials). The compositionality test involved three potential referents (e.g., one ball, one car, two balls), one of which was named. If infants derive the meaning of noun phrases according to the PC, they should orient to the target satisfying the meaning of both constituents (e.g., one ball) over the distractors satisfying the meaning of the constituents separately (e.g., two balls, one car). We observed the predicted pattern of results on the first out of four test trails, suggesting that infants might be computing the meaning compositionally. Importantly, our training trial results replicated those of Experiment 1, providing additional evidence for the infants' readiness to learn proto-numerals. Currently, we are conducting Experiment 3. Our goal is to address potential confounds identified in Exp. 2 (e.g., different number of objects at singleton, n = 4, v. pair, n = 5, compositionality trials) and to potentially corroborate its results. The findings suggest that 12-month-olds have access to conceptual structures that contribute to learning of the number words. Ongoing work aims to provide evidence for infants' compositional ability in the domain of language.

P2-F-135 Do infants represent faces of different genders as distinct 'kinds'?

Charisse Pickron[1], Erik Cheries[1]

[1]University of Massachusetts, Amherst

What are the socio-cognitive representations infants form for the faces they experience in their environment? By 10 months infants seem to represent human faces as a separate 'kind' from non-human animal faces (Bonatti et al., 2002). However, it is unclear if and when infants represent social categories of human faces, such as those based on gender or race, in the same way. The current project addresses this question by testing two age groups in two different variations of a classic kind-individuation task. First, we determined whether infants will use the contrast between human and non-human faces to represent a certain number of individuals as existing in an event. Second, we assess infants' same individuation judgments in response to faces that differ by gender. The current study tested 12- and 24-month-old subjects in an individuation box reaching task (e.g., Van de Walle et al., 2000). Infants were familiarized to the sequential presentation of one or two faces from within a box. Faces were either non-human, male, or female (see figure 1). The number of faces being hidden was ambiguous during each trial, as infants never saw two faces appear side-by-side. After finding one face, we assessed infants' representation of whether the box was completely empty by recording the duration of additional reaches. If infants perceived the contrasting facial features as indicating distinct individuals, they should expect to find two faces hidden within the box and complete additional reaches.

If instead, infants perceive such facial differences as non-diagnostic of identity, they may expect that only one face was hidden and display relatively subdued reaching after finding the first face. First, we assessed whether infants represented human faces as distinct from non-human faces by comparing their reaching behavior after finding the first of either one or two faces from within a box. Both 12- and 24-month-old infants displayed greater reaching following the presentation of two faces compared to one. Infants' reaches were significantly longer when they could not find the second hidden face. Second, we assessed whether infants represent more specific types of human faces by comparing their performance on the same task using male and female faces (see figure 1). Once again, we found that subjects from both age groups reached longer when the box was empty after seeing a male and female face be placed inside compared to when they only saw one face go inside of the box. These results both replicate and extend previous human-kind individuation studies (e.g., Bonatti et al., 2002) by providing evidence that infants use face information alone to construct representations of new individuals. The final component of our poster presentation will compare this finding to on-going work testing infants' individuation judgments based on other perceptually salient dimensions, such as race. The present work begins to strengthen our understanding of possible connections between early perceptual processes of faces to higher-order representations that define social groups later in development.

P2-F-137 Slithering vs. Walking: do infants look longer at threat-relevant biological motion?

Helene Mottier[1], David Meary[1], Olivier Pascalis[1]

[1]University Grenoble-Alpes CNRS

Rapid detection of snakes may reflect an evolutionary fear for threat-relevant stimuli (Öhman, Flykt, & Esteves, 2001; Öhman & Mineka, 2001). It has been suggested that it was innate so should be observed early. Threat-relevant stimuli are quickly visually detected by adults and young children (Brosch & Sharma, 2005; LoBue & DeLoache, 2008). It has not been found, however, that infants orient faster their gaze towards picture of snake than flower(Bertels, Bayard, Floccia, & Destrebecqz, 2017) or frogs and caterpillar (LoBue, Rakison, & DeLoache, 2010) before 7- to 11-months of age. This late detection might be the consequence of using static pictures. Infants are sensitive to biological motion and slithering is a specific physical attributes of snakes that differ dramatically from human motion. We hypothesized that if slithering is a critical feature of snakes, infants will look longer at a moving snake than to a walking human. Infants from 3-to-24-

months (N = 80) were presented, in a classic visual preference task, to 2 eight-second presentation of paired PLD of slithering snake versus walking human in one condition (n = 39) and walking chicken versus walking human in a control condition (n = 41). We find only a marginal preference for the walking human PLD compared to the slithering snake PLD ($t = -1.76$, $p = .09$, $d = .3$) but a strong preference for the walking chicken PLD compared to the walking human PLD ($t = 3.06$, $p < .01$, $d = .5$). These preliminary results suggest that there is no specific visual attraction for slithering in infants and we discuss it in the context of threat detection.

P2-F-138 Discrimination between morphed face and novel face in infancy

Hiroshi Nitta[1], Kazuhide Hashiya[2]

[1]Kyushu University, [2]Keio University

Background: Facial resemblance to self affects on social decisions and evaluations in adult. Among preschoolers, they prefer self-resemble faces to other faces. In regard to infancy, looking behaviors toward faces are differed based on whether the face is their own or other infants' face, and whether direct or averted head and gaze direction. However, it is unclear how infants respond to a self-resemble face with different direction of head and gaze. Aim: We examined whether infants' looking behaviors would differ between their own face from self-resemble faces, and if so, which face among their own face, other's face, and self-resemble faces they would prefer to look at. Method: Participants were infants at 10-12 months of age (n=11). Additional 5 infants were excluded from final analyses due to the lack of looking duration. Images of neutral faces with both direct and averted head and gaze postures were taken for each infant prior experiment. Photographs of each infant and another infant were morphed together to produce a face consisted of 50% of a participant's face and 50% of another infant's face ("Self50%"). Thus, 6 images in total (i.e., infants' own face("Self100%"), the Self50%, and another infant's face ("Self0%") with direct and averted head/gaze postures) were prepared for each individual. Participants were presented a pair of faces side by side with the following 6 pairs of stimuli: (1) Self100% versus Self50%, (2) Self100% versus Self0%, (3) Self50% versus Self100%, (4) Self150% versus Self0%, (5) Self0% versus Self100%, (6) Self10% versus Self50% with each direction of head and gaze. Each trial was presented for 10 seconds. The order of the 12 test trials and the side on which a face presented are random and counterbalanced across participants. Infants' eye movements were measured by using a Tobii TX-300 eye tracking system (Tobii Technology, Stockholm, Sweden). Results: The non-parametric Friedman test for all participants revealed that infants looked significantly longer at another infant's

face than the Self50% both with the direct and the averted direction. There were no significant differences between other comparisons. Discussion: Our findings indicated that infants at 10-12months of age detected differences between the morphed face and another infant's face. This result is consistent with the results of a previous research in chimpanzees. The results also suggested that infants might prefer novel face than morphed face. The current study provides further understandings of the development of infants' ability to discriminate between their morphed face and the novel face by the latter part of the first year of life.

P2-F-139 Maternal scaffolding during play with 12 to 24-month-olds: stability over time and relations with emerging effortful control

Dave Neale[1], David Whitebread[2]

[1]University of Delaware, [2]University of Cambridge

There is evidence that parents influence the development of their children's effortful control in infancy through social interaction. Playful interactions in infancy often involve scaffolding, i.e., the parental provision of support and modelling for problem-solving and learning during play. However, previous research has found little consistency over time in this type of parental scaffolding behaviour with infants. The present study had two aims. The first aim was to use a new, tiered coding system to assess the consistency of maternal scaffolding across toys (at the same time point) and over time. The second aim was to assess whether features of parental scaffolding related to concurrent or future measures of child effortful control. Thirty-six mother-child dyads engaged in joint play when children were 12, 18 and 24 months old. The following inhibitory/effortful control tests were administered: The Grasping Task, an object-retrieval task using a spoon laden with food at 12 months; and two delay of gratification tasks (Snack Delay and Gift Delay) at 24 months. The Bayley Scales of Infant Development Cognitive Scale was administered at 18 months. Maternal propensity to scaffold was the scaffolding behaviour that showed most consistency across toys and over time. Maternal contingency at 12 months predicted children's effortful control at 24 months. Sequential analysis indicated that maternal contingent interventions leading to children's successful actions could be the mechanism of development underpinning the relationship between contingency and effortful control. Maternal behaviour during play may lay the foundations for the strategic regulation of cognition and behaviour.

P2-F-140 Using goal-directed action to guide causal exploration across development: Evidence from 1- to 3-year-old children

Paul Muentener[1], Amy Bu[1]

[1]Tufts University

Previous research has shown that children engage in causal reasoning early in infancy and that, at least by age two, children hold a belief in causal determinism - a belief that all events have causes (Muentener & Bonawitz, 2017; Schulz, 2012). However, relatively little work has investigated the cues that guide children's causal exploration as it emerges across infancy and early childhood. The current study investigates how the goal-directedness of actions - a cue that has been shown to influence children's own actions in their environment (Hamlin, Hallinan, & Woodward, 2008) - guides the emergence of causal exploration between one and three years of age. In Experiment 1, 96 one-, two-, and three-year-old children (n = 32/age group) were familiarized to a videotaped causal event. At the start of each event, children saw a novel toy connected to two buttons (Figure 1). Children then saw two hands simultaneously enter and contact the buttons - one hand engaged in a goal-directed action (ie., rigid arm, palm facing down) while the other hand engaged in a non-goal-directed action (ie., relaxed arm with palm facing up). Immediately upon contact with the buttons, the top of the toy spun and lit up. Following the 4 familiarization trials, the experimenter presented children with an inert version of the toy (ie., pressing button did not activate the toy). The experimenter encouraged children to play, but did not direct them to cause the outcome. Children's button preference, looking behavior, and number of actions within the first 60 seconds of play were coded. For 2-year-old children only, the study subsequently included a non-causal control condition, showing children during familiarization that the novel toy lit up and turned off prior to the hands contacting the buttons. Four main findings emerged from our analyses. First, children were more likely to explore multiple causes with age. While 1-year-old children's initial actions on the toys were directed towards a single button, 3-year-old children were significantly more likely to interact with both buttons simultaneously ($p<.05$). Second, only 2-year-old children's actions were influenced by goal-directed actions. Only when 2-year-old children, but not 1- or 3-year-old children, acted on only one button, they preferred to intervene on the button paired with the goal-directed action ($p<.05$; binomial test). Third, only 2- and 3-year-old children's actions reflected causal exploration: only these children made predictive looks towards the inert toy following their actions ($p<.05$). Fourth, results from Experiment 2 showed that disrupting the causal nature of the events eliminated 2-year-old's button preference and decreased their tendency to make predictive looks ($p<.05$). These results provide insight

into the emergence of causal exploration and how it is guided by goal-directed actions. The results suggest that children's causal inferences become more complex with age and that, as children begin to make causal predictions, they use representations of goal-directed actions to guide their inferences. Current research is underway to replicate and extend these findings. The research will be discussed as it relates broadly to the interaction between causal exploration and goal-directed action across development.

P2-F-141 "Touching!!": An AR system for unveiling face topography in very young children

Michiko Miyazaki[1], Ryoko Mugitani[2], Tomohisa Asai[3]

[1]Otsuma Women's University, [2]NTT Communication Science Laboratories, [3]Advanced Telecommunications Research Institute International

Introduction Previous studies have shown that children aged around 2 years have limited knowledge of their body topography. Using a repetitive sticker placing task, Brownell et al. (2010) showed that 20-month-olds could locate only two to three body positions, whereas 30-month-olds could locate four to five. However, task difficulty and complexity may have prevented them from revealing their potential knowledge about their body structure. Young children cannot understand verbal instruction fully nor keep themselves motivated, and therefore cannot repeat trials. In this study, to overcome these problems and to unveil body (especially face) topography in young children, we used gamification with the technique of augmented reality (AR) and 3D face tracking technology. The new task was named "Touching!!" We tested whether they could touch the position on their face corresponding with the one on the image of their face and stay motivated for task repetition. Method Twenty 2.5-year-olds participated in this study. The final sample had 12 toddlers (6 females). We presented participants with their projected image on the screen accompanied by famous cartoon characters (digital image) located on their face (nose, right/left cheek, lower/upper forehead, and chin). In the experiment, toddlers were asked to touch their real face by referencing their image with the projected digital images. If participants correctly touched the part corresponding to that of their real face, an encouraging visual reward was presented through the experimenter's manual key press. To track participants' face in 3D, motion sensing input devices (Microsoft, Kinect v2) were used. The program of presenting digital image was written in Processing3.0 and Kinect v2 for Processing library. To assess their motivation for task repetition, we prepared relatively more trials with a maximum of 37 trials (1 example + 6 face places x 3 characters x 2 blocks). The experiment continued until participants stopped participating. We analyzed

error patterns in their first touches. Results The executed trials ranged from 3 to 37. Nine participants executed more than 89% of all trials; four of them executed all 37 trials. To explore toddlers' face topography, we summarized the error rates in the first touch in each face position in Figure 1. ANOVA was conducted for error rate in each face position. Weak main effect of face position was found ($F(5,55)=2.13$, $p<.10$). Multiple comparisons (LSD) showed that the error rate of upper forehead was higher than that of other face positions (left/right cheek, chin, and nose; $p<.05$ each). Next, we analyzed error patterns in each position. Figure 2 summarized the first touch pattern of each face positions in heat maps. Darker color indicated higher touching rate errors. For cheeks, more errors occurred along the horizontal axis. For nose and foreheads, more errors occurred along the vertical mid-spinal line. The participants possibly did not make random errors, but rather systematic errors. Discussion We found that the "Touching!!" task is applicable for toddlers because 2.5-year-olds showed a high achievement rate in it. This task could help reveal the characteristics of face topography in young children.

P2-F-142 Differential Forms of Biological Susceptibility to Family Income During Infancy: Predictions to Executive Functioning at 5 Years

Henry Lininger[1], Jeffrey Measelle[1], Elizabeth Loi[1], Jennifer Ablow[1]

[1]University of Oregon

Introduction: The development of executive functions (EF), or the various cognitive capacities employed in the control of attention, behavior, and emotion, are shaped by the interaction of biological and environmental processes across early development1-2. In the present study, we sought to investigated the extent to which different facets of infants' neurobiological response to stress predicted later EF scores. Specifically, we examined the degree to which 18-month-olds' autonomic and neuroendocrine reactivity to and recovery from stressful tasks anticipated EF capacities when they were 60-months-of-age. By applying a biological susceptibility framework, we tested the extent to which profiles of early stress response made children differentially susceptible to socioeconomic adversity. Given prior evidence that early forms of poverty shape EF development3, we were interested in how differing forms of biological sensitivity might interact with socioeconomic adversity during infancy, and how these processes together might lay the foundations for later EFs. Method: 105 primiparous women (M annual household income = $9,682, SD= $1,309) were recruited through WIC during their third trimester of pregnancy (mothers' M age = 24.2 yrs). At 18-months postpartum, infants (53% female) completed a series of LabTab tasks (fear task; frustration task; 4) during a visit to our

laboratory. Infants' respiratory sinus arrhythmia (RSA) was monitored continuously throughout the session. As well, infants' hypothalamic-pituitary adrenal (HPA) output (salivary cortisol levels) was assayed at 5 points during the same laboratory visit to model HPA response and recovery curves. In addition to household income, family SES was measured via the Family Resource Scale5. Finally, children's EF skills were measured when they were 60 months using a number of well-validated tasks. We computed estimates of "cold EF" (visual attention; working memory; planning), "hot EF" (delay of gratification), as well as overall EF factor score to index global capacities. Results & Discussion: Piecewise linear models (Mplus 7.1) are being used to model RSA and HPA axis reactivity (slope of initial levels to peak response) and recovery (slope of peak response to final, recovery level). Individual's various intercept and slope estimates are then read out and analyzed using standard regression models. Although we find a significant main effect of family income at 18 months and children's global EF at 60 months (ß = .58, p = .037), we also see clear evidence of interaction patterns that differ by the type and form of physiological susceptibility. As shown in Figure 1, infants who show little RSA reactivity appear immune to the effects of family income. However, infants with high RSA reactivity and high RSA recovery exhibited close to the highest EF scores, despite low family income. In contrast, infants from low income households with high RSA reactivity and low recovery performed the worst on our global measure of EF. A similar approach to HPA is underway as are analyses to investigate cross-system coordination. Results will be discussed in terms of convergent and divergent forms of biological susceptibility and their implications for executive control systems in the context of early socioeconomic adversity.

P2-F-143 Eye Tracking Lateralized Spatial Processing in Infants and Toddlers

Eloise West[1], Sara Hameed[1], Zofia Trujillo[1], Ekaterina Sufiyarova[1], Koleen McCrink[1]

[1]Barnard College, Columbia University

When encoding their environment, infants and Westernized adults preferentially process information (especially information of a numerical nature) from left to right. Adults and children in cultures whose language is scripted from right-to-left do not exhibit this spatial bias. Here, we examine the age at which the left-to-right spatial associations found in infancy shift to culture-specific spatial biases, for both numerical and non-numerical information. This experiment tests the theory that toddlers are temporarily spatially 'agnostic', exhibiting no directional bias while absorbing the spatial norms of their culture. There are few studies which capture this transitional period for spatial cognition. To address this issue, and test the above theory, 70 1-, 2-, and 3-year-olds were tested within

an eye-tracking paradigm which required only passive viewing of a short video (N = 26 1s, 24 2s, 21 3s.). This video presented a spatial transposition task, adapted from the non-human animal literature. During the first three trials, one object was hidden in a consistent location within a vertical array comprising five locations (the second location from the bottom). On the fourth trial (the vertical test trial), a delay was introduced in which a narrator asked where the object was hidden, before the object was revealed. On the final trial (the horizontal test trial), the array was covered with an occluder, surreptitiously rotated 90o, and uncovered. (Fig. 1.) The narrator prompted the child to visually search by asking them where the object was during a 5-second delay. The object was then revealed. Participants were assigned to either the Numbered condition (in which the narrator labeled each of the locations with 1, 2, 3, 4, or 5 during vertical training; n = 38) or Unnumbered condition (the locations were labeled as Dax, Zif, Blick, Mot, or Wug; n = 32). Overall, children successfully learned the vertical location of the object; they actively searched more on the bottom half of the array during the vertical test trial than the top half (5.6 vs. 3.0 fixations, $p < .001$), and this tendency did not significantly differ with age. To quantify horizontal visual search strategies, a repeated-measures ANOVA was conducted with number of fixations to each screen side post-transposition (left, right) as a within-subjects factor, and age and condition as between-subjects factors. There was no main effect, or interactions with, condition. There was no overall effect of side of screen (6.7 fixations left, vs. 5.5 right, $p = .27$). However, screen side interacted significantly with age ($p=.02$). 1- and 2-year-old children did not search the left side more frequently than the right (5.5 fixations L vs. 3.9 fixations right for 1 y.o., $p = .34$; 5.1 L vs. 8.1 R for 2 y.o., $p = .12$), but 3-year-olds did (9.6 L vs. 4.5 R, $p = .02$, all comparisons Bonferroni-corrected). (Fig. 2.) Further, a marginally significant quadratic trend of age on the L/R fixation difference scores ($p = .07$) suggests the presence of a dip in left-to-right processing at the age of 2 years, as children recede from infantile spatial biases before exhibiting childhood spatial biases.

P2-F-144 Investigating Temporal Priority Understanding in Toddlers

Pingki Mazumder[1], Emma Tecwyn[2], Daphna Buchsbaum[1]

[1]University of Toronto, [2]Cardiff University

The temporal priority principle states that causes must precede their effects. Adults have a robust understanding of this principle (Burns & McCormack, 2009), and infant looking-time results suggest temporal priority may be an innate or early developing causality cue (Mascalzoni et al., 2013). However, findings based on children's verbal judgments are

mixed. While some studies suggest successful use of the principle in children as young as 3-years-old (Bullock & Gelman, 1979), others suggest that consistent use may not develop until 4-5 years, or even later (Shultz & Mendelson, 1975; Sophian & Huber, 1984; Rankin & McCormack, 2013; Lohse et al., 2015). No study has investigated temporal priority in children younger than 3 years. Since previous studies used verbal judgments about causality, linguistic ability may have played a role in younger children's mixed performance (Rankin & McCormack, 2013). In the current study, we investigate whether 12-35-month-old toddlers (N=83) can use temporal priority to guide their causal reasoning, using a non-linguistic behavioral measure. Consistent with previous work in older children (Bullock & Gelman, 1979; Rankin & McCormack, 2013), we used an A-Effect-B paradigm, where action A precedes an effect that is then followed by action B. The effect was the ejection of a sticker from a machine, while A and B were two actions (e.g., a dial and a lever) on either side of the machine's dispenser. Participants were randomly assigned to one of two between-subject conditions, connected or disconnected, manipulating the spatial relation between the temporally prior action and the effect (Figure 1). The disconnected condition pitted spatial cues against temporal cues and was consequently a more stringent test of temporal priority, which 3-5-year-olds have previously performed well in (Bullock et al., 1979, 1982). In the connected condition, both actions were spatially contiguous with the effect. In both conditions, participants watched an adult perform the sequence A-Effect-B twice. The demonstrator then left the testing area and the toddler was encouraged to interact with the machine and obtain up to five stickers of their own. Toddlers' first action was on the temporally prior action A significantly more often than action B on their first sticker (binomial test, connected: 29/41, $p=0.01$; disconnected: 29/42, $p=0.02$; Figure 2a), and across all five stickers (single-sample-t-test, connected: $M=0.81$, $SD=0.39$, $t(40)=7.20$, $p<0.0001$; disconnected: $M=0.78$, $SD=0.41$, $t(41)=7.55$, $p<0.0001$; Figure 2b). Moreover, toddlers touched A first equally often in the connected and disconnected conditions, on both their first sticker (Fisher's exact test, $p=1.0$) and across all five stickers (independent-t-test; connected: $M=0.81$, $SD=0.39$; disconnected: $M=0.78$, $SD=0.41$; $t(81)=0.51$, $p=0.31$), preferring the temporally prior action even when it was spatially disconnected from the effect. By inferring causal reasoning through participant behavior rather than verbal judgments, we were able to demonstrate that children as young as 12 months seem to grasp the temporal priority principle, and that this cue to causality dominates spatial contiguity in this age group. Previously reported failures of older children to understand temporal priority were likely due to the additional cognitive demands of making explicit verbal judgments.

P2-F-145 The effect of labeling on infants novel object exploration.

Marina Loucaides[1], Gert Westermann[1], Katherine Twomey[2]

[1]Lancaster University, [2]Manchester University

Children learn their first object names by associating the items they see with words they hear. Understanding how children link words with objects offers important insight into cognitive development (Yurovsky, Smith, & Yu, 2013). One significant aspect of learning word-object associations is the way in which children interact with objects in a dynamically complex everyday environment (Pereira, Smith, & Yu, 2014). For a full understanding of infants' object exploration it is important to explore where children look during labeling and non-labeling events, whether they use different exploratory styles during physical interaction or passive observation, and whether language level affects the learning of new labels. This study used head-mounted eye-tracking to investigate how children at 24 months (N=24) interact with novel objects. Infants sat on a chair at a table across from the experimenter and next to their parent. They were assigned to a physical interaction group, in which they handled objects for 30 s each, and to a non physical interaction group, in which only the experimenter handled the objects. Within each of these groups half of the novel objects were labeled by the experimenter with novel labels, (e.g., Look, a blicket!), and half of the objects were unlabeled. Following this session and a five-minute break, the experimenter tested children's retention of label-object mappings by presenting the labeled objects and asking children for each in turn (e.g., Which one's the blicket?). Parents also completed a vocabulary inventory (UK-CDI). It was found that participants looked significantly longer at the objects in the non physical interaction than in the physical interaction condition. There was no significant difference between looking times to the labeled and the unlabeled objects for either interaction condition, thus there was not a main effect of labelling. In the physical interaction condition participants showed a range of exploratory styles by looking at the experimenter's face and hands, the parent's face and hands and their own hands. In contrast, the participants in the non physical interaction looked at the experimenter's face and hands but not at the parent's face and hands or their own hands. In the physical condition, a significant effect of labeling was found for looking at the experimenter's face. The participants looked longer at the experimenter's face when the object was labeled than when the object was not labeled. Furthermore, the number of switches between the objects and other areas of interest during the physical condition was significantly higher when a novel object was labeled than not labeled. Productive vocabulary scores, the looking time at the labeled objects and switches during looking time at the labeled objects were not found to predict the retention of the novel words in both physical and non-physical conditions. This research

helps to enhance our understanding of early cognition by demonstrating how different environmental settings and labeling of novel objects can influence toddlers' interaction with objects, and how this affects their word learning.

P2-F-146 How Absolute Distance from a Landmark Impacts Young Children's Understanding of Relative Proximity

Megan Lorenz[1], Ashley Buksa[1], Jodie Plumert[1]

[1]University of Iowa

Speakers often refer to location information as a means of disambiguating identical objects. For instance, if a child asks which of several cups is hers, her mother may say, "It's the one closer to the sink." The latter example demonstrates how a speaker may distinguish identical objects (i.e., cups) by using their relative proximity to a landmark (i.e., the sink). Previous research has explored how young children comprehend and produce directions involving the proximity of a single object to a landmark (e.g., Plumert, Ewert, & Spear, 1995), but no work to date has addressed how parents communicate to their children about the relative proximity of two objects to a landmark. In three experiments, we examined how the absolute distance between a pair of identical hiding locations and a landmark influences how mothers give directions to young children about relative proximity and how well children follow those directions. The first two experiments were identical except that the distance between the two identical hiding locations and the landmark was smaller in Experiment 1 and larger in Experiment 2 (Figure 1). Mothers gave their 30-month-old children directions for finding a toy hidden in one of the two containers and then the children searched for the hidden toy. There were four trial types that varied the relative location of the target container to the mother/child and the landmark (Figure 1). We coded mothers' use of person (relative to mother, child, or both) and landmark reference frames, and children's search success. Mothers' reference frame strategies differed depending on the absolute distance between the containers and the landmark. When the distance was smaller, mothers typically used the landmark as a reference frame to describe the location of the target container. Conversely, when the distance was larger, mothers often used multiple reference frames within a single set of directions, including references to the order of the containers (e.g., "the first one"). In turn, children's search performance differed strongly across experiments. In Experiment 1, children searched at above-chance levels for all trial types except TT1. However, in Experiment 2, children's search performance did not differ significantly from chance for any of the trial types. We therefore conducted a third experiment to determine whether

children's decline in search success was a function of mothers' mixed directions or increased absolute distance. An experimenter instructed mothers to give directions about the target container in reference to the landmark for TT1, TT2, and TT3 and in reference to themselves for TT4. As in Experiment 2, the results revealed that children never searched at levels significantly different from chance. Collectively, manipulating absolute distance while maintaining relative distance impacted how mothers gave and how successfully children followed directions. Increasing absolute distance led mothers to use inconsistent reference frames. Importantly, Experiment 3 demonstrated that children's decline in search performance was a function of the increase in absolute distance and not mothers' inconsistent directions. These findings suggest that children's understanding of relative proximity is not all-or-none. Rather, their understanding depends on absolute distance to a landmark.

P2-F-147 Can Nonlinear Dynamics Shed More Light on the Visual Scanning of Infants at High Risk of Autism Spectrum Disorders?

Alicja Radkowska[1], Joanna Raczaszek-Leonardi[1], Przemyslaw Tomalski[1]

[1]University of Warsaw

Introduction Recent studies have suggested that atypical visual perception and social skills are related during early development of infants at high familial risk (HR) of Autism Spectrum Disorder (ASD) (Gliga et al., 2015). However, adaptive mechanisms happening later in life might mask these initial perturbations in brain functioning (Johnson et al., 2015). Some studies have used measures of visual scanning to extract information foraging atypicalities early in development. For instance, higher autism symptoms at 24 correlated with higher revisitations to previously fixated areas at 8 months but not at 14 months (Gliga et al., 2015). Similarly, the amount of looking toward faces during a pop-out task was a predictor of later face recognition at 8 months, but not at 14 months (deKlerk et al., 2014). However, these studies did not investigate the temporal structuring of visual scanning in typical and atypical development. Nonlinear methods, such as Recurrence Quantification Analysis (RQA), have successfully characterised the temporal dynamics of fixation coordinates in eye-tracking data (Anderson et al., 2013). Therefore, we apply RQA to measure the temporal sequencing of fixations in a visual search task in typical and HR infants. Methods 19 infants (8 HR and 11 low risk (LR) controls) participated in a face pop-out task at 10 and 14 months of age. The stimuli consisted of 8 circular arrays of 5 coloured objects from different categories on a white background (faces, mobiles, birds, cars and scrambled faces). Fixations were extracted using a noise robust 2

k-means algorithm (Hessels et al., 2016). Later, RQA was used to analyse the spatiotemporal characteristics of fixation sequences using the centre of recurrence mass (CORM) (Anderson et al., 2013). CORM measures the temporal distribution of fixation recurrences. Higher values are related to more revisitations to previously fixated areas. The CORM was later normalised using fixations durations (Anderson et al. 2013). Results No significant differences were found in the degree of similarity between heat maps between HR and LR at 10 ($F(1,17) = 0.078$, $p = 0.78$, $d = 0.11$) and at 14 months ($F(1,17) = 0.60$, $p = 0.44$, $d = 0.34$). Despite the lack of risk group differences, temporal dynamics of scanning at 10 months, but not at 14 months predicted autism symptoms. There was a significant correlation between ADOS scores at 24 months and CORM at 10 months ($r = -0.48$, $p = 0.037$), but not at 14 months ($r = -0.110$, $p = 0.63$). Discussion We showed that RQA can be used to characterise the temporal dynamics of visual scanning in HR infants and predict later symptoms of ASD, despite not showing early risk group differences. Consistently with previous reports (Elsabbagh et al., 2013), heat maps showed a clear preference for faces and high similarity in the scanning patterns between LR and HR infants at 10 months of age. Additionally, also consistent with previous studies (Gliga et al., 2015) we showed that temporal distribution of fixation recurrences (CORM) at 10 months, but not at 14 months, is significantly correlated with autism symptoms at 24 months. Therefore, we believe that RQA can shed some light on the visual scanning properties of infants in more complex settings such as visual search tasks. Acknowledgements The analyses were funded from the EU H2020 MSC grant #642996 (BRAINVIEW). The data was collected thanks to the Polish National Science Centre grant No. 2012/07/B/HS6/01464 to PT.

P2-F-148 Cognitive Dissonance in One-Year-Olds

Rita Loiotile[1], Aimee Stahl[2], Alex Silver[1], Lisa Feigenson[1]

[1]Johns Hopkins University, [2]The College of New Jersey

Individuals holding multiple incongruous beliefs are said to experience cognitive dissonance (Festinger, 1957); this often results in discomfort, and a consequent effort to reduce the dissonance by reconciling the opposing beliefs. One method of studying cognitive dissonance is the free-choice paradigm (Brehm, 1956), in which individuals first choose between two initially equally liked options A and B. When later given a choice between the unchosen option B and a new option C, they are less likely to choose B, apparently because of the need for a consistent, non-dissonant interpretation of their own choice history ("I must not like B very much, I guess"). Previous research demonstrates

cognitive dissonance in adults (Brehm, 1956), in 4-year-old children, and in capuchin monkeys (Egan et al., 2007; Egan et al., 2010). However, it remains unknown whether human infants also exhibit cognitive dissonance, leaving unclear the origins and development of this phenomenon. Infants are unlikely to have metacognitive representations of themselves as internally consistent agents. Therefore, if infants exhibit cognitive dissonance, this would suggest that cognitive dissonance can affect choices from early in the lifespan, prior to having a developed sense of self. Here we asked whether 10- to 20-month-old infants exhibit cognitive dissonance in a free-choice paradigm. In Experiment 1 we let infants (n=21) choose between two similar toys (A and B), then gave them a second choice between the previously unchosen toy (B) and a similar but novel toy (C). If they experience dissonance, then during the second choice, infants should disproportionally reject the previously unchosen option (B). Indeed, we found that infants dis-preferred the previously unchosen object (B): 16 of 21 infants chose novel object C, p=0.03). However, rejection of option B in favor of C could reflect factors other than cognitive dissonance, including actual preference for the novel object. Therefore, in Experiment 2 the initial choice between A and B was dictated by the experimenter, who handed infants (n=29) option A, then let them choose between options B and C. Because infants themselves did not choose between the A and B options, they should not experience cognitive dissonance. Therefore no observed preference between options B and C would suggest that Experiment 1's result was driven by cognitive dissonance, not novelty. As predicted, infants showed no preference between the experimenter's unchosen object (B) and novel object (C): 16 of 29 infants chose novel object C, p=.71. Finally, we asked whether this lack of preference merely reflected decreased motivation due to infants receiving fewer choices overall. Infants in Experiment 3 first chose between options A and B-- but the objects' identities were concealed in opaque boxes, and only revealed after infants had chosen. When later given the unchosen B versus novel object C, infants again showed no preference: 25 of 43 chose C, p=.36. Apparently, dissonance relies on having first evaluated two known options. Our results suggest that one-year-olds exhibit choice-induced cognitive dissonance. Human choices thus appear to be guided by factors other than intrinsic liking, even from the first year of life.

P2-F-149 21-month-olds rapidly learn the meaning of the word four

Yi Lin[1], Renée Baillargeon[2], Daniel Hyde[1]

[1]University of Illinois at Urbana-Champaign, [2]University of Illinois

Why is learning the meaning of number words so difficult for young children? According to learned accounts, young children lack an understanding that would allow them to represent exact numbers (e.g., exactly 4); this understanding is gradually constructed, resulting in deep conceptual changes. According to innate accounts, in contrast, some understanding of exact number is innate and universal, but young children lack clear-cut contrastive evidence for determining which concepts are intended (e.g., the word "four" means exactly 4 as opposed to not 3, more than 3, less than 5, and so on). In the present research, we tested one prediction of the innate accounts: very young children might rapidly learn the meaning of a number word if provided with appropriate contrastive evidence. We attempted to do so by teaching 21-month-old infants the word "four in a novel, computer-animated training task. The training task was followed by a standard 4-vs-2 cracker-choice task to measure potential transfer from training. In the training task, infants received 10 training trials; half were 4-vs-3 trials and half were 4-vs-5 trials. Each 4-vs-3 trial started with two identical sets of 3 objects (e.g., ducks); one object was then added to one of the sets to create a set of 4. Next, in the anticipatory period, infants heard, "Four! Where's four?" followed by a paused scene. At the end of the anticipatory period, the set with 4 objects was highlighted, and infants heard, "Four, four!" The 4-vs-5 trials started with identical sets of 4 objects, and one object was added to one set to create a set of 5. The order of trials was randomized with constraints. Objects and the location of the set of 4 varied across trials. Infants' eye-gaze during the anticipatory period revealed a training effect. In the first four trials (learning phase), infants looked about equally at sets of 4 versus sets of 3 or 5. In the next six trials (post-learning phase), however, infants looked significantly more at the set of 4, suggesting that they had learned the meaning of the word. In the subsequent 4-vs-2 cracker-choice task, 75% of the trained infants chose 4 crackers (over 2), significantly greater than a control group without training (52% chose 4 over 2). Further analyses revealed that infants' learning in the training task was related to their performance on the cracker-choice task. On 4-vs-5 trials in the post-learning phase, infants who chose 4 crackers looked more at the set of 4, but infants who chose 2 crackers or failed to make a choice did not. Thus, it appears that only infants who learned the precise meaning of "four" were able to use their newly formed concept in the cracker-choice task. At 21 months of age, infants can rapidly learn the meaning of the word "four" when provided with contrastive evidence that pinpoints exactly 4 as the intended concept. These results thus demonstrate that infants can readily form concepts such as exactly 4 and, as such, support the innate accounts of exact number.

P2-F-150 Six-month-olds' ability to use cues selectively to recognize actions as goal-directed

Yoonha Lee[1], Isu Cho[2], Hyun-joo Song[1]

[1]Yonsei University, [2]Western University

Infants begin to interpret others' pointing actions as object-directed between 9 and 12 months of age (Woodward & Guajardo, 2002). Recent research has demonstrated that 7-month-old infants, but not 6-month-olds, can understand others' pointing actions as goal-directed when a label is provided (Cho & Song, 2014; Lee, Kim, & Song, 2012). The current research examined whether 6-month-olds can also interpret the goals of others' pointing actions when additional communicative cues are provided. In the current experiment using the violation of expectation paradigm, 6-month-old infants in the experimental condition watched familiarization events in which an actor looked at one of two novel objects on the apparatus floor, uttered a novel label "mido," and then pointed at the object. After six familiarization trials, the positions of the objects were switched. Then, each infant was shown two test events: one in which the actor pointed at the new-goal object which was located where the old object used to be (new-goal event), and another in which the actor pointed at the old-goal object in its new location (old-goal event). The stimuli and procedures of the control condition were identical to those of the experimental condition, except that the actor uttered an exclamatory expression "wow" instead of uttering a novel label during the familiarization trials. The preliminary results suggest that the infants in the experimental condition looked at the new-goal events significantly longer than at the old-goal events. In contrast, the infants in the control condition looked at the two events for about an equal amount of time. These results suggest that even six-month-old infants can understand the goal-directed nature of others' pointing actions when some communicative cues such as linguistic and gazing information are available.

P2-F-151 Every rose has its thorn: Infants' behavioral responses to visible plant threats

Aleksandra Wlodarczyk[1], Claudia Elsner[1], Alexandra Schmitterer[2], Annie Wertz[1]

[1]Max Planck Institute for Human Development, [2]German Institute for International Educational Research

Infants differentially attend to and learn about threats such as dangerous animals and angry faces (LoBue et al., 2010, Barrett & Broesch, 2012). Little is known, however, about infants' reactions to ancestrally recurrent dangers in broader naturalistic contexts. Although they may seem harmless, plants produce toxic chemical defenses against herbivores, some of which can be quite dangerous to humans. Further, there are no visual cues that reliably indicate the presence of such toxins. Accordingly, prior studies by Wertz & Wynn (2014) showed that infants are reluctant to touch benign-looking plants compared to other entities. This behavioral strategy would minimize infants' physical contact with unknown plants and therefore reduce their exposure to potential plant dangers. Although benign-looking plants can be dangerous, there are some plants that have easily observable threats (e.g., thorns). Therefore, the current study examined (i) whether infants' behavioral avoidance strategies are influenced by the presence of visibly threatening pointed features (e.g., thorns), and (ii) whether infants' responses to pointed features depends on the context in which they are presented (i.e., as part of plants compared to other types of objects). To investigate these questions, we presented 8- to 18-month-old infants (N = 42) with a series of 12 stimulus objects. The stimulus set consisted of plants, novel artifacts matched to features of the plants, and familiar artifacts. Half of the stimulus objects in each category had sharp looking pointy-shaped elements, while the other half did not (see Figure 1). The pointed elements on the plants and novel artifacts were made of child-safe modeling clay to look like thorns. The two pairs of familiar objects were similar looking overall with one object in each pair having pointed parts (e.g., a mirror and a hairbrush). The stimulus objects were placed one at a time in a randomized order in front of the infants. The sessions were recorded on video and coded in ELAN. Infants' latency to touch each object, and the frequency and duration of their subsequent touches, were coded. The data were analyzed using linear mixed-effects models (Bates et al., 2014). The results showed that infants took longer to reach out and touch plants compared to the other object types, replicating previous findings (see Figure 2). Further, after making initial contact with each object, infants spent less time touching plants compared to novel and familiar artifacts. Interestingly, there were no differences in infants' touch latencies or touch durations for plants with and without thorns, suggesting that infants treat all plants as potentially dangerous whether or not they possess visible indicators of threat. Finally, infants touched the thorny parts of plants less frequently than either the thorny or non-thorny parts of any of the other object types. These results suggest that in addition to the initial delay to touch plants, infants' behavioral avoidance strategy also includes minimizing their subsequent physical contact with plants. The presence of selective behavioral responses to plant threats broadens the existing literature on responses to threat in infancy.

P2-F-152 Knowing who knows: Infants' selective social learning is linked to metacognitive skills

Olivia Kuzyk[1], Shawna Grossman[1], Lauranne Gendron-Cloutier[1], Diane Poulin-Dubois[1]

[1]Concordia University

Children actively engage in selective social learning (SSL), which enables them to trust reliable relative to unreliable sources of information (Poulin-Dubois & Brosseau-Liard, 2016). However, little research is dedicated to understanding how this selectivity occurs (Heyes, 2016). There is considerable disagreement among researchers over the mechanisms underlying early SSL. According to one account, SSL strategies in infancy rely on low-level cognitive abilities (e.g., causal learning) to detect patterns in events and to help children develop causal representations of their world (Sobel & Kirkham, 2006). Other researchers maintain that higher-order abilities are at play. Infants' ability to make inferences about others' knowledge has been shown to facilitate SSL in infants (Crivello et al., 2017). The capacity for metacognition is also thought to enable successful learning, such that individuals adjust their learning strategies based on their own state of knowledge. It has recently been shown that infants are capable of using metacognitive judgments to guide future behavior (Goupil et al., 2016). The present study explored the psychological mechanisms at the origins of infants' SSL by examining causal learning and metacognitive abilities. The sample consisted of a total of 42 infants (M = 18.38, SD = .87). First, participants were exposed to a speaker who accurately or inaccurately labeled familiar objects (Brooker & Poulin-Dubois, 2013). Following this, infants' willingness to learn from the speaker was examined. Infants then participated in a causal learning task that required them to play with a "magic box" that lit up and played music when a block was placed on it (Sobel & Kirkham, 2006). Children watched a demonstration by the experimenter and were then asked to activate the detector. A metacognitive task was administered, wherein a toy was hidden in one of two identical boxes and infants were asked to retrieve the toy after a delay of several seconds (Goupil et al., 2016). Importantly, the toy was secretly hidden in a pocket inside the box, so that it made it impossible for the child to find. The amount of time the child searched the box where he/she believed the toy was hidden was recorded as an index of infants' decision confidence. It was anticipated that more perseverance suggests more decision confidence. Preliminary results indicate that infants are more likely to learn a novel word from a reliable speaker, $F(1,40) = 4.37$, $p = .04$. Findings also indicate that infants in the reliable group are more willing to learn from the speaker if they demonstrate less decision confidence on correct

trials, r(14) = -.51, p = .04, and incorrect trials, r(14) = -.65, p = .007. No association was obtained between infants' willingness to learn from a reliable speaker and performance on the causal learning task, r(15) = -.20, ns. Finally, no significant associations were observed in the unreliable condition. These results offer preliminary evidence for infants' ability to use metacognitive judgments to guide their selective learning. Specifically, it appears that infants may be more willing to learn from a reliable source when uncertain about their own knowledge.

P2-F-153 The effect of words and sounds on conceptual representations for preverval infants

Louah Sirri[1], Vincent Reid[1], Eugenio Parise[1]

[1]Lancaster University

Lupyan and Thompson-Schill (2012) have shown that adults recognize faster a target image (e.g., cat) when it is preceded by a verbal cue, such as a spoken word, compared to when it is preceded by non-verbal sound (e.g., meowing), indicating that in adults, concepts are activated more effectively via verbal means compared to non-verbal means. Recent studies have shown that infants possess a small receptive vocabulary (Bergelson & Swingley, 2012; Parise & Csibra, 2012), but whether words activate conceptual representations in infants remains unclear. The present study aimed to replicate the adult findings and extend it to young infants. Fourty-four 9- (20 girls; mean age: 9 months) and 38 (21 girls; mean age: 12 months) 12-month-old infants participated in a primed intermodal preferential (IPL) task in which they listened to either a word (e.g., cow) or sound (e.g., mooing) followed by an image on the eye tracker screen and illustrating two objects (e.g., cow - telephone), a target and a distracter. In addition, 31 adults (21 females; mean age: 28y and 84d) completed a visual identification task during which we recorded reaction times for matching and mistmatching target images primed by either a word or an associated sound. We successfully replicated Lupyan and Thompson-Schill (2012) adult findings showing faster reaction times to the target image when primed by matching than mismatching word or sound (F(1,29)=65.95; p=.00) with shorter reaction times in the word (575 ms) compared to the sound (590 ms) condition. Upon hearing the auditory cue, both groups of infants (n=22 9-month-olds and n=20 12-month-olds) did not shift faster their gaze to the target image compared to the distractor (F(1,22)=3.67; p=.07; F(1,19)=0.04, p=.85, respectively), neither in the word nor in the sound condition. Looking times (n=29 9-month-olds and n=29 12-month-olds) to the target image compared to the distractor (F(1,28)=4.65, p=.04; F(1,28)=13.64, p=.00), however, were longer in both the word and

sound conditions, demonstrating a congruency priming effect. Older infants, in general, looked longer at the target image compared to the younger group (1303 ms versus 1185 ms). Our preliminary findings do not support the hypothesis that words activate conceptual representation more efficiently compared to non-verbal sounds in infants. Our paradigm, however, was highly demanding for infants in terms of attentional resources. At present, we are testing another group of 12-month-old infants and adults with a modified version of this experimental design.

P2-F-154 Getting a grip on infants' event representations: participant number in TAKE and PICK-UP

Tyler Knowlton[1], Laurel Perkins[1], Alexander Williams[1], Jeffrey Lidz[1]

[1]University of Maryland

Events of taking are related to a taker, something taken, a location, a manner of taking, and so on. But presumably when we represent an event as a taking not all of these relationships are equally salient. This is perhaps suggested by the fact that only some of them are expressed as arguments of the verb take. Building on this intuition, we show that number of participants plays a particularly important role in infants' event perception and categorization. Specifically, 10-month-olds differentiate 3-participant TAKING from perceptually similar 2-participant PICKING-UP and respond to this conceptual change more than a visually salient manner of motion change. Gordon (2003) showed that 10-month-olds are surprised when the gift is removed from givings, but not when the same object is removed from huggings. This suggests that infants represent that giving video - but not the hugging video - under a concept that entails something given. Wellwood et al. (2015) provide evidence that some roles entailed by the concept under which children view a scene are moreover psychologically foregrounded. They found that infants are surprised when a girl switches from opening a box with a lever to opening it with her hand, but not when she switches from opening it from the left side to opening it from the right side, despite the perceptual salience of this change. The instrument role is thus more psychologically potent than direction of opening, suggesting that it holds a privileged status. Here we extend this line of work to other event concepts, namely TAKE and PICK-UP. In a habituation-switch paradigm (Werker et al. 1998), 28 infants aged 9;21 to 12;15 (mean=10;23) were first shown various silent videos of a girl picking up a truck in a rainbow-motion while a boy looks on (Fig 1). Once they habituated, they were tested on one of two conditions. The "manner" group saw the girl slide the truck toward herself instead of moving it in an arc. The "participant" group saw her pick it up in the same

rainbow-motion, but with the boy - now a participant - gripping it. We hypothesized that infants would represent the first video under a PICK-UP concept but that the same motion would no longer count as a picking-up once the boy was added as a participant. Rather, it would be viewed under a TAKE concept. We predicted that this conceptual distinction would thus lead to greater dishabituation than the perceptual distinction (rainbow vs. slide), which doesn't alter the participant structure of the concept. These predictions were borne out (Fig 2) as we observe a significant interaction between phase and condition ($F(4,26)=4.24$, $p<.05$). Aside from shedding light on infants' event representations, these findings have potential implications for language acquisition. Knowing which roles are privileged in infants' TAKE concept is a necessary first step in understanding how they learn the relation between this concept and the verb take. If infants' TAKE concept privileges the taken-from role, theories of syntactic bootstrapping advocating one-to-one role-argument mapping (e.g., Fisher et al., 2017) face a potential challenge: take is often used in clauses that don't mention that role at all (e.g., "she took the truck").

P2-F-155 Towards an early marker of atypical neurocognitive development in resource poor settings: an ERP study in the rural Gambia

Laura Kischkel[1], Maria Rozhko[1], Sam McCann[2], Saikou Drammeh[3], Ebrima M'Bye[4], Luke Mason[5], Clare Elwell[1], Sarah Lloyd- Fox[5], Michelle de Haan[1]

[1]University College London, [2]Medical Research Council Unit, The Gambia, [3]Medical Research Council Unit Gambia, [4]Medical Research Council, The Gambia, [5]Birkbeck, University of London

A large proportion of young children in low- and middle- income countries show compromised neurodevelopmental outcomes at school age (McCoy et al., 2016). To date there is a lack of early neurocognitive markers of atypical development in these populations, impeding the implementation of early identification and intervention. The current study assesses neural correlates of deviance detection in infant cohorts in the UK and The Gambia, West Africa at 1 and 5 month of age. This work forms part of the Brain Imaging for Global Health (BRIGHT) project which investigates markers of cognitive development in Gambian and UK infants from birth to 2 years. The ability to detect novel stimuli in the environment is a fundamental process of early cognitive development, the neural correlates of which have been extensively studied across infancy and childhood using event- related potentials (ERP). We used an auditory oddball ERP paradigm in which infants are presented with frequent standard tones, and two types of deviant stimuli, infrequent but repeated pure tones and a range of trial-unique novel sounds. Past

research has shown a developmental change in the amplitude of P3 ERP responses to these deviant stimuli in the first six months of life, with an increase in P3 amplitude to novel stimuli and a decrease in amplitude to infrequent but repeated deviant stimuli (Kushnerenko et al., 2013). This has been interpreted as an increase in novelty preference. Figure 1 shows group average ERPs for both age points and study cohort. We performed a repeated measure mixed effect model to test the effects of age, condition and study cohort on P3 amplitude. A main effect was found for condition ($p<.0001$). Interactions were found for condition x age ($p=.0001$), condition x age x site ($p=.003$). When collapsing across cohorts, we see the expected decrease to infrequent and increase to novel tones between 1 and 5 months. This change is, however, primarily driven by the UK cohort. In the Gambian cohort, we see a less pronounced developmental change between time points (Figure 2). We also see reduced amplitudes to infrequent and novel sounds at 1 month and a trend for less pronounced differences between conditions. Notably, there was no discrimination in the Gambian cohort between standard and the novel sounds. These findings indicate a reduced developmental change in auditory novelty processing in the Gambian cohort between 1 and 5 months. Using responses to each condition as a classifier in a binary logistic regression model, we found that magnitude of the novelty response as well as the difference between novel and standard tones predicted whether data was collected in the UK or The Gambia. The definition of these features forms the basis in defining early markers of atypical neurocognitive development within the Gambian cohort. By relating these markers to future cognitive and behavioural outcomes, we will be able to assess their utility in making predictions for individuals, to guide early intervention and counteract negative outcomes later in life.

P2-F-156 Understanding others' false beliefs involving numerical identity mistakes in 14-month-old infants

Dora Kampis[1], Ildiko Kiraly[1], Josep Call[2], György Gergely[1]

[1]Central European University, Közép-európai Egyetem, [2]University of St Andrews

Young infants individuate and track objects in their surrounding, primarily via spatiotemporal information. If spatiotemporal information is unavailable, an observer has to rely on other cues such as feature/kind information (as indicated by the appearance of an object) to make judgments about numerical identity. Appearance information, however, may mislead one's individuation in at least two ways. One may mistakenly infer that two distinct appearances indicate two entities (such as Superman and Clark Kent), while in fact these two appearances belong to the same exemplar. On the other hand, one

may mistakenly identify an entity that looks the same as a previously seen one, as the same, while in fact they may be two distinct entities (such as identically looking twins). Crucially, understanding such mistakes from someone else's perspective requires appreciating the fact that they may have a different perception of the external environment (e.g. Mary may know Superman is Clark Kent, but Steve may not, and therefore receiving information on one will not lead him to apply that knowledge to the other). Representing others' false beliefs involving such identity mistakes involving aspectuality has been proposed to posit a challenge to infants' Theory of Mind abilities (e.g. Butterfill & Apperly, 2013; Perner, Mauer, & Hildenbrand, 2011). Previously Kampis & Kovacs (in prep.) found that 14-month-old infants are sensitive to an agent falsely believing that two appearances indicate two different entities, when infants knew that the two appearances belonged to the same object. In the current study we presented 14-month-old infants (n=34) with numerical identity mistakes of the reverse type: infants received information indicating two objects in a scene, while another person believed there is one object only. First, an experimenter (E1) showed infants and another experimenter (E2) the content of a kinder-egg, which was then closed and put in a box. Subsequently they both saw that the (closed) egg was taken out. Then while E2 was present (True Belief trial - TB) or absent (False Belief trial - FB), but always visibly to the infant, the egg's content was revealed. Crucially, the egg's content was always different from the one demonstrated before hiding, suggesting that there were in fact two eggs. Therefore infants (and E1 in TB) had reasons to believe an egg still remained in the box, whereas E2 in False Belief mistakenly thought the box was empty. We measured infants' search duration in TB and FB trials. We hypothesized that if infants represent E2's belief in the two scenarios, and as previously found the other's belief modulates infants' own search duration, then infants should search less in FB trials. Results show an interaction between order (TB first/FB first) and belief (TB/FB), $F(1,30)=4.32$, $p=.046$. Infants in the TB first group searched longer in TB trials (M=6.32s) than in FB trials (M=3.23s), $F(1,14)=5.22$, $p=.04$; while the FB first group did not show a significant difference. These results are consistent with infants' search duration being influenced by the other's belief, in combination with a tendency to search longer on the first trial.

P2-F-157 The heuristic thinking that makes inference of word meanings possible: An inverse inference bias in 5-month-old infants

Masato Ohba[1], Chizuko Murai[2], Michiko Miyazaki[3], Hiroyuki Okada[4], Kazuhide Hashiya[1]

[1]Keio University, [2]Seika Women's Junior College, [3]Otsuma Women's University, [4]Tamagawa University

Introduction Humans are biased thinkers. One prominent bias is an "inverse inference bias," in which people infer, having learned that the contingency in one direction, the contingency is held true even when the direction of the contingency is reversed. For example, if someone said that he would come to the party if he finished his work but did not show up, people naturally infer that he could not finish the job. Although this bias often leads to logically erroneous conclusions, it gives us fast and efficient learning and thinking. More important, the bias could be a prerequisite for word learning, as understanding word meanings requires symmetrical relation between a symbol and a referent object. Animal studies have shown that non-human animals, including chimpanzees, would not make the inverse inference. Possibly because of the lack of the bias, chimpanzees do not show understanding of the symmetrical relation between a symbol and a referent (e.g., Tomonaga et al., 1991; Dugdale & Lowe, 2000). In human infants, does the inverse inference bias emerge as a consequent of language learning, or is it present prior to it? The present study examined whether 5-month-old infants possess the inverse inference bias on a match-to-sample task. Methods Nineteen 5-month-old infants (M=5.7months) participated in the study. There were two stimulus sets, each of which consisted of a sample (A1), a target (B1), and a distractor. The object served as a distractor in Set1 was the target in Set2 (B2) and vice versa (Figure1). In the training phase, infants learned the associations between the sample and the target for both sets. The sample was shown at the top of the monitor, while the target and the distractor stayed visible at the bottom. The sample (A1) fell down and hid behind the screen. The target (B1) then moved with a sound effect for 5.4 seconds; the distractor (B2) stayed unmoved. At test, infants saw the target (B1) fall down and hid behind the screen. The sample object associated with the target during the training (A1) and the sample from Set2 (A2) were shown at the bottom, but neither object moved. If infants have the inverse inference bias, they would generalize the sample-target association to the reversed contingency at test: they should look at the sample (A1) associated with that target (B1) during training, anticipating to see the movement of A1. Results and Discussion The infants' anticipatory looking time at test was measured for the 5.4 seconds from the time the target object (B1) hid behind the screen. The infants looked longer at A1 than A2 (or vice versa for Set2), $t(32) = 2.30$, $p < .05$, $d = 0.72$, suggesting that they anticipated that the sample object would move when they observed the target object falling behind the screen, even though the contingency they had learned between the two objects was the other way around. We conclude that the inverse inference bias is present before infants start active word learning. We propose the possibility that this bias is one of the prerequisites for uniquely

human heuristics-based inference, upon which inference of word meanings would be possible.

P2-F-158 Longitudinal development of attention and inhibitory control during the first year of life

Karla Holmboe[1], Arielle Bonneville-Roussy[2], Gergely Csibra[3], Mark Johnson[4]

[1]University of Oxford, [2]University of Roehampton, [3]Central European University, Közép-európai Egyetem, [4]Birkbeck, University of London

Executive functions (EFs) are key abilities that allow us to control our thoughts and actions. Research suggests that two EFs, inhibitory control (IC) and working memory (WM), emerge around 9 months of age. However, little is known about whether IC develops earlier in infancy and whether basic attentional processes form the 'building blocks' of emerging IC. In the present study, we investigated these questions longitudinally in 104 infants. Infants were tested behaviorally on two screen-based attention tasks at 4 months (the Gap/Overlap task (Hood & Atkinson, 1993) and the Visual Expectation Paradigm (Haith et al., 1988)), and on IC tasks at 6 and 9 months (the Freeze-Frame task (Holmboe et al., 2008) and the A-not-B task (Diamond, 1985)). Participants were also assessed on the Mullen Scales of Early Learning (Mullen, 1995) at 9 months, to control for the possible effect of general cognitive development. Using path analysis within a structural equation modelling framework, we tested the hypotheses that early basic attention abilities would predict later IC, and that stability in IC would emerge earlier than 9 months of age. We also predicted that stability and coherence in IC would be independent of general cognitive development. The model, including all paths (significant and non-significant), is presented in Fig. 1. Results provided no evidence that basic attention formed precursors for IC. However, there was full support for coherence in IC at 9 months and partial support for stability in IC from 6 months, independent of general cognitive development. These findings suggest that IC emerges earlier than previously assumed, constitutes a specific cognitive ability, and encourages further research into IC development starting already during the middle of the first year of life.

P2-F-159 Young Children's Perception of Ingroup and Outgroup Members - Individuation and Categorization

Jonas Hermes[1], Marie Lammel[1], Laura Böttcher[1], Tanya Behne[1], Gil Diesendruck[2], Hannes Rakoczy[1]

[1]University of Göttingen, [2]Bar-Ilan University

Social group categorization involves many cognitive biases. One such bias, the so-called outgroup homogeneity effect (OHE), is that we tend to represent individuals quite differently depending on their group status: We conceptualize ingroup members primarily as individuals that differ from each other on various dimensions, but in contrast tend to see outgroup members as exemplars of a category with much less assumed variation between individuals. Although much investigated in adults, little is known about the development of the OHE. Is it a higher-level bias that requires cultural input and teaching and thus emerges in protracted fashion? Or is it a more basic and fundamental bias that emerges in tandem with earliest forms of group categorization? To address these questions, we bring together research paradigms from social cognition and object individuation. The underlying rationale is that one consequence of an OHE should manifest itself in specific patterns of individuation of people (less fine-grained individuation of outgroup compared to ingroup individuals). Infants (N = 20, range = 16-30 months) encountered several individuals of varying group status, and their preferences for and categorization of these individuals were investigated. Group status was manipulated via a food preference paradigm previously used by Mahajan and Wynn (2012): Children chose between two food options (peas and crackers), and were marked with a color according to their preference orange for crackers, green for pea-eaters). Preference task: Subsequently, children chose between two puppets, one with the same food preference (ingroup), the second with the opposite food preference (outgroup), each wearing the corresponding color. To test for an ingroup preference, children chose between the two puppets. Categorization/individuation task: The OHE was tested via an established object individuation task with searching as dependent measure (Feigenson & Carey, 2003, Van de Walle et al., 2001). Children participated in one ingroup-trial and one outgroup-trial (see Figure 1). In the ingroup-trial, children saw a puppet wearing the child's ingroup color disappear in a box. Then a different puppet wearing the same color was retrieved from the box before children were allowed to search in the box. The outgroup-trial was the same except both puppets wore the outgroup color. The OHE predicts that ingroup members should be individuated more sensitively than outgroup members since outgroup members tend to be perceived more qua exemplars of a category. Thus, more children should notice the change in identity and expect the first puppet to still be inside the box in the ingroup-trail than the outgroup-trial. Consequently, they should search longer in ingroup- than outgroup-trials. The main results were the

following: First, children's preference for ingroup vs. outgroup individuals was exactly at chance level. The original findings by Mahajan and Wynn (2012) could thus not be replicated. Second, there was also no difference in search times on the individuation task. The latter finding is not surprising, though, given the former and in light of the fact that the preference measure serves as a manipulation check. These results highlight the importance of replication studies, and the need for robust paradigms for the induction of in- and outgroups in toddlers. In follow-up studies we test extended and modified procedures for the induction of social groups.

P2-F-160 Implicit Understanding of Epistemic Language and Uncertainty Monitoring in 27-month-old children

Stella Grosso[1], Beate Sodian[1], Irina Jarvers[1], Tobias Schuwerk[1], Susanne Kristen-Antonow[1], Nivedita Mani[2]

[1]Ludwig-Maximilians University Munich (LMU), [2]University of Göttingen

The third year of life is a transitional period from an implicit to an explicit Theory of Mind. While there is evidence for the production of epistemic terms in the third year of life (Harris, 2015), no systematic studies have addressed to date the comprehension of 'know' and 'think' at this early age. In the present study, we developed an eye tracking task based on a paradigm for older children by Moore et al. (1989) to investigate the implicit differentiation of 'know' and 'think' in 27-month-old children. The final sample consisted of N=28 children (19 female). In a behavioral familiarization phase, children were acquainted with a hiding game in which an experimenter hid a sticker in one of two boxes and two monkeys helped the child to retrieve the object. After four practice trials, children watched animated cartoons in which two monkeys sequentially indicated the location of the sticker, each followed by a voiceover saying "The monkey knows (thinks) that the sticker is in there". Children were prompted at the end of each trial by a further voiceover asking "Where is the sticker?" after a fixation screen period paced by the experimenter. Looking patterns were recorded at each of the monkeys and each of the sticker locations in the two seconds intervals following stimulus onset (i.e. the voiceover uttering the critical mental term) across eight trials. Children's proportional looking time to the target (the monkey that knows) compared to the distractor (the monkey that thinks) was calculated across trials. 60.7% of the participants reliably distinguished between 'know' and 'think', looking longer at the agent who 'knew' where the sticker was. Children's preference for the agent showing the higher degree of certainty during the first utterance correlated with a picture naming task (Bartz, Rowe, & Harris, 2015) assessing verbal and non-verbal

indications of uncertainty in response to familiar and unfamiliar pictures (r = .474, p = .012). The bivariate correlation remained significant after controlling for age. These results suggest that an implicit understanding of degrees of certainty in epistemic language is connected with the beginning ability to monitor one's own uncertainty in response to unfamiliar objects. Further research is needed to explore the role of such an early implicit awareness of degrees of certainty in Theory of Mind development.

P2-F-161 Descending into chaos: Numerical cognition in Infants vs. Pirahã

Peter Gordon[1], Erin Kirby[1], Jean Tang[1], Lauren Schiller[1], Eli Zaleznik[2], Roseanne Milman[1], Ronchal Fabharwal[1]

[1]Teachers College Columbia University, [2]University of Massachusetts, Amherst

Adults in the Pirahã tribe lack exact number words, but show evidence of small-number exact representations (1-to-3) and approximation for larger quantities (Gordon, 2004; Frank et al., 2008, Everett & Madora, 2012). Children in counting cultures (CCs) lack a full number lexicon but differ in many obvious ways from the Pirahã both developmentally and culturally. CC-children can normally recite extensive count-number sequences that do not map consistently onto appropriate quantities (Gelman & Gallistel, 1978) and they go through number-knower stages prior to full numerical competence (Wynn, 1990, 1992). We assessed toddlers (2-4 years of age) on their number-knower status (give-a-number tasks), and tests from the Pirahã battery including: Parallel vs. Orthogonal 1-1 mapping tasks (tests of unit alignment vs. spatial transformation) and nuts-in-a-can task (memory for numerosity after objects are hidden). We also elicited a rote count from children noting their highest number and count conventionality and consistency. Finally, we tested children on the ascending versus descending object count procedure developed by Frank et al. (2008). In their adult Pirahã data, in the ascending object count (1-10), all adults used the term hói (= roughly ~1, falling tone) for singular quantities only. Across Pirahã adults, hoí (= roughly ~2,rising tone) was used to name quantities from 2 to 10 (frequencies ramping down), and ba'agiso (= many) named quantities 3 through 10 (frequencies ramping up). On the descending count, they started using ba'agiso for 10 through 5 (ramping down), hoí (~2) was used for quantities 8 - 2 across subjects, and hói (~1) kicked in at 4 through 1. We asked whether this asymmetry in the ascending vs. descending count sequences also existed for the CC-children, and whether this asymmetry was predicted by their number-knower status. Preliminary data were collected from 6 participants (age 2;2 - 3;9) (final N will be 40, ages 2-5 years). Early trends indicate that most children's ascending counts reflect their rote-counting limits, whereas

descending counts reflect their number-knower status. For example, several children could count from 1-10 in the ascending count (reflecting their rote-count), but were random in the descending count until they reached their number-knower point at 3,4 or 5 at which point, their counts were accurate. Hence the up-down asymmetry exists in infants and young children as in the Pirahã adult populations, but with a different basis for limitations. In the rest of the Pirahã battery, children generally performed much better on the parallel 1-1 task than the orthogonal version, relying heavily on visual-spatial matching to facilitate accurate responses on parallel 1-1 trials above their number knower level. However, children struggled to apply this approach to the orthogonal 1-1 task. They generally performed well in the nuts-in-a-can task for numerosities within their number-knower limit and again struggled beyond their number-knower limit. The current data suggest that rote counting supports the ascending count whereas semantic mapping to quantity supports the descending count and tasks requiring memory and spatial transformations. Comparisons of CC-infants to adult Pirahã suggest some common but distinct roles for number words and number meanings in numerical cognition.

P2-F-162 Bear or ball, what will she grab? Infants' comparison, prediction, and imitation of others' goal-directed actions

Charlotte Findlay[1], Sarah Gerson[1]

[1]Cardiff University

Previous research has shown that infants begin to understand and predict the goals of observed actions within the first year of life. Several mechanisms have been proposed to underlie this initial understanding, including action experience (Sommerville et al., 2005) and cues within the observed stimuli (e.g., teleological or pedagogical cues; Csibra & Gergely, 2006). Despite evidence that these different factors are beneficial, each has its limitations in terms of the breadth of action perception (e.g., Gerson & Woodward, 2014). This research examines when and how infants learn about the goals of novel actions via comparison with familiar actions that share the same goal. We will also investigate whether individual differences in action experience (as measured by performance and parental report) relate to action prediction of the novel actions. In a comparison condition, infants view videos with matching goal relations (between an agent [hand] and her goal [car]) carried out in three different manners (hand-pull, cloth-pull, magnet-pull; Figure 1a). In the control condition, infants see repeated examples of one of these actions (e.g., cloth-pull), thus not encouraging a comparison of matching goal relations. Following these videos, both groups of infants participate in an identical eyetracking paradigm. During

three familiarisation trials, infants see a variation of the Woodward paradigm (1988) whereby the actor retrieves one of two toys using a claw tool (Figure 1b). In test trials, the placement of the toys is swapped, and a hand enters the screen without acting on either tool or toy. As a measure of action prediction, we code which side of the screen the infants look to after looking at the hand during test trials (trials whereby the child did not look at either side of the screen were excluded ["no anticipation"; Figure 2]). Predictive fixation trials during which infants looked to the side of the goal-object from familiarisation (blue boxes; Figure 1b) were considered consistent predictions. We have piloted the comparison condition of this experiment with eight 12-month-olds (mean age 12.3 months). Figure 2 shows a descriptive trend such that infants are anticipating the consistent goal-object more than the non-consistent goal-object. Based on previous research (Cannon & Woodward, 2012), we expect 12-month-olds without training will not make accurate predictions. This would suggest that comparisons between familiar and unfamiliar actions helps infants generalise action predictions to never before performed actions. In ongoing research, following the eye-tracking task, infants will undergo an action performance session, whereby they can attempt each of the three reaching actions shown in familiarisation. We hypothesise that the more efficient reachers when not using a tool will make more consistent goal-predictions in the comparison condition (during eyetracking test trials), whereas more efficient tool-users will make more accurate predictions in the control condition. Parent report of infants' action experience will also be assessed. A larger sample size, testing of infants in the control condition, and the addition of the action performance session, will allow us to more closely examine the relations between infants' action experience and action predictions in these different conditions.

P2-F-163 Infant Surgency, Preschool Noncompliance, and Middle Childhood Executive Function

Tatiana Garcia-Meza[1], Ran Liu[1], Martha Ann Bell[1]

[1]Virginia Tech

Ratings of temperamental surgency in early and middle childhood are concurrently related to negative social interaction behaviors (e.g., aggression, noncompliance; Berdan, Keane, & Calkins, 2008; Braungart-Rieker, Garwood, Stifter, 1997; Hawley, 2002). Temperament is evident from infancy and is part of the foundation for later socioemotional and cognitive development (Rothbart & Bates, 2007); thus, we wanted to know if surgency during infancy is related to problem behaviors (such as noncompliance)

in early childhood. Furthermore, problem behaviors (PB) in early childhood are concurrently linked with executive function (EF) deficits (Schoemaker, Mulder, Dekovic, & Matthys, 2013). Other studies suggest that children with low EF tend to display more BP during subsequent years (Hughes & Ensor, 2008). Because of our interests in early behavioral regulation and later EF, and thus the ability of preschool BP to predict difficulties in cognitive processes associated with school success (i.e., EF; Masten et al., 2012), we also focused on preschool BP and middle childhood EF in our study. Thus, we examined links between surgency during infancy, BP in early childhood, and EF in middle childhood. Participants were children and mothers who were part of an ongoing longitudinal study of early cognition-emotion integration. Data for these analyses came from the 10-month, 3-, 4-, and 6-year lab visits and included 180 typically developing children (half females; wide range maternal education). Mothers completed the Infant Behavior Questionnaire-Revised (IBQ-R) for the 10-month visit (Gartstein, Rothbart, & Leerkes, 2014) and the surgency/extraversion factor was used in the analyses. Children's noncompliant behaviors were coded during lab visits at ages 3 and 4 as mothers and children sat together and played with puzzles. Scores ranged from 0-4, with 0 indicating no noncompliant behaviors and 4 indicating greater noncompliance. EF tasks at the age 6 lab visit included backwards digit span, Dimensional Change Cart Sort, and number Stroop. An EF composite score was created by standardizing scores on each task and then averaging the standardized scores. Path analysis was used and fit indices were indicative of a good fitting model, X2 (2, N = 180) = 2.68, p =.26, RMSEA = .04, CFI = .981, and GFI = .942. All direct paths were significant ($p < .05$). Infant surgency predicted 3-year noncompliance; 3-year noncompliance predicted 4-year noncompliance; and 4-year noncompliance predicted age 6 EF. Regarding indirect effects, 3-year non-compliance had a significant indirect effect on age 6 EF through 4-year non-compliance ($p < .05$). There was no indirect effect of infant temperament on later EF. The combination of direct and indirect paths from noncompliance to later cognition suggests that noncompliance at different ages in early childhood has the potential to affect cognition during the early elementary school years. Our results also suggest early surgent temperament is a foundation for later noncompliant behaviors and, thus, a potential area of focus in future studies of both PB and EF.

P2-F-164 Three-year-old children predict others' action based on their beliefs regarding the efficiency of a tool

Paula Fischer[1], Ágnes Kovács[1], Erno Téglás[1]

[1]Central European University, Közép-európai Egyetem

Research from the past decade investigating early Theory of Mind (ToM) abilities revealed that infants from very early on can track other's belief regarding simple scenarios, mostly limited to cases involving the location of a single object. This performance, prone to lower level explanations, was frequently challenged by proposals that before age of 4 children do not even operate with proper belief representations. Importantly, our everyday social interactions are often organized around more complex contents, and what others think or believe cannot be limited to locations of entities. In the current experiment, we aim to investigate whether young children's belief attribution capacities are efficient enough to integrate different pieces of information that go beyond tracking objects in space. Specifically, we ask whether young children can attribute beliefs regarding the efficiency of tools. Attributing beliefs about efficiency may require richer representational contents than beliefs about an object location since efficiency representation conveys information about the relation between a cause and an outcome. In the current experiment, 3-year-olds were familiarized with three distinct tools, a long, efficient stick, a bound, semi-efficient stick and a short, inefficient stick operated by a character. After a few demonstrations of the tools' relative efficiency, the character placed the efficient tool in an opaque box in the vicinity of the goal objects with only the handle visible (identical for each stick), and the semi-efficient tool to the opposite side in full view. During the false-belief condition, in the absence of the character, the efficient tool was replaced with an inefficient one. Since only the handle of the stick was visible, in the false belief condition the character could not infer the exchange. In contrast, in the true belief condition, this exchange took place in character's presence. We tested whether children can predict the character's action based on his false and true belief. Specifically, in the true belief where he knew there was the inefficient stick in the box, he should chose the semi-efficient one, while in the false belief she should chose the inefficient one, as he was not aware of the exchange. Both implicit and explicit measures were collected: children's implicit answers were scored based on their first look towards the locations of the sticks, and explicit answers were based on which stick they indicated the character will choose, upon his return. Preliminary results indicate that children looked at (N=36, p=.0039, Fisher's exact-implicit measure) and pointed to or verbally indicated (N=39, p=.0007, Fisher's exact-explicit measure) different sticks depending on whether the character had a false or true belief about the efficiency of the stick in the box. Specifically, children in the true belief condition predicted that the character would choose the semi-efficient stick over the inefficient stick, whereas in the false belief condition they were more likely to indicate the inefficient stick, taking into account the character's false belief. Overall, the current data

suggest that it is likely that young children can track beliefs involving various contents with a complexity higher than previously expected.

P2-F-165 Dysfunctions in infants' statistical learning are related to subthreshold autistic social impairments in their parents

Roberta Bettoni[1], Valentina Riva[2], Chiara Cantiani[2], Elena Riboldi[2], Massimo Molteni[2], Viola Macchi Cassia[1], Hermann Bulf[1]

[1]University of Milano-Bicocca, [2]IRCCS Eugenio Medea

Statistical learning (SL) allows us to detect statistical regularities distributed among space and time (Saffran et al., 1996). SL is already available from birth (Bulf et al., 2011), and is involved in the acquisition of later emerging linguistic, communication, and social skills (e.g., Romberg & Saffran, 2010). Recent evidence suggests that visual SL is impaired in children with autism spectrum disorders (ASD; Jeste et al., 2015), a neurodevelopmental disorder characterized by a deficit in social and communication skills (APA, 2013). Here, we explored whether visual SL could be identified as an early marker for ASD. The most common approach to identify early markers for later ASD is to run prospective studies with infants at high risk because of having an older sibling with a diagnosis of ASD (i.e., Ozonoff et al., 2011; Messinger et al., 2013) We adopted a different approach by investigating infant offspring of (non-diagnosed) adults who show high autistic traits. Autistic traits are defined as subthreshold social/communicative impairments similar to those seen in ASD individuals (Constantino et al., 2006), and are highly hereditable (e.g., Robinson et al., 2011). We tested visual SL abilities in two groups of 7-month-olds, one (HAT, N=20) composed of infants whose parents showed high autistic traits (> -1 SD), the other (LAT, N=20) composed of infant whose parents showed low autistic traits (≤ -1 SD), with parental autistic traits measured by self-administered questionnaire for parents, the AQ questionnaire (Baron-Cohen et al., 2001). Procedure was modelled after Kirkham et al. (2002): infants were habituated to sequences of shapes that contained high (1.0) or low (.33) transitional probabilities, and subsequently presented with familiar and novel sequences (6 trials). Familiar sequences contained the structure showed during habituation, whereas in the novel sequence shapes were presented in a random order. A 2 (group: HAT vs. LAT) x 2 (first test trial: novel vs. familiar) x 3 (test pair: first vs. second vs. third) x 2 (test trial type: novel vs. familiar) mixed ANOVA revealed a Group x Test pair x Test trial type interaction, $F(2,72) = 3.90$, $p = .025$. To explore this interaction, two separate 2 (first test trial) x 3 (test pair) x 2 (test trial type) mixed ANOVAs were run, one for each group of infants. The LAT group showed a main effect of test trial type ($p = .014$)

and a Test pair x Test trial type interaction (p = .031), due longer looking times toward the novel test sequence (M = 11.27 s; SEM = 2.05) than to the familiar ones (M = 6.31 s; SEM = 0.96) in the first test pair. No significant effects were found in the HAQ group. These results show that LAT infants dishabituated to the novel sequences, while HAT infants failed to discriminate between familiar and novel test sequences. These findings are the first to be reported suggesting that early impairments in visual SL mechanisms in infancy may be related to subthreshold autistic social impairments in adult parents.

G: Social Development

P2-G-166 Dancing together: The nature of infant-mother locomotor synchrony

Ori Ossmy[1], Justine Hoch[1], Shohan Hasan[1], Whitney Cole[2], Karen Adolph[1]

[1]New York University, [2]Max Planck Institute for Human Development

Infants' and mothers' face-to-face interactions are sometimes so beautifully synchronized and coordinated that researchers have referred to their joint behavior as a "dance". Here, we examined whether infants and mothers continue the dance on the floor while locomoting during free play (Figure A-B). We observed 30 infant-mother dyads playing together for 20 minutes in a laboratory playroom. From coding and manual digitizing of video, we identified periods when each partner was stationary or locomoting, the number of steps and distance traveled per bout of locomotion, their step-to-step location in the room, and the distance between partners at each moment. First, we explored infant-mother locomotor synchrony at the session level. We independently grouped mothers and infants based on accumulated measures of locomotion (steps, bouts, distance, time in motion, area covered) using density peak clustering. Mothers and infants independently formed the same high, medium, and low activity groups. We found that infants took more steps than their mothers, and that more active infants had more active mothers at the session-level (Figure 1C-D). We then focused on the partners' moment-to-moment spontaneous locomotor activity. To test spatial synchronization, we asked whether one member of the dyad could be identified from their partner's spatial path. Using dynamic time warping, we showed that that each infant's moment-to-moment path was most similar to his or her own mother's path (Figure 2A). Moreover, infants and mothers were usually a meter apart throughout the session (roughly arms' reach; Figure 2B). We also tested moment-to-moment synchrony in time. We identified periods when both members of the dyad were in motion and determined whether one partner was more likely to take the lead and the other to follow. A multivariate Granger-causality analysis showed that when dyads were not seamlessly coordinated, infants were more likely to take the lead

(Figure 2C). Finally, we described how the relation between infants' and mothers' locomotion is related to walking experience by applying a statistical moderation analysis. Using a moderation analysis and the Johnson-Neyman technique, we showed that dyads had higher synchrony when infants had less walking experience. Results from this novel approach support the notion that freely mobile infants and their mothers are temporally and spatially coordinated as they "dance" through the playroom.

P2-G-167 The association between toddlers' empathy and aggression is moderated by inhibition

Malou Noten[1], Kristiaan van der Heijden[1], Stephan Huijbregts[1], Stephanie van Goozen[1], Hanna Swaab[1]

[1]Leiden University

Objective: Impaired empathy has been shown to be a risk factor for aggression in children, adolescents and adults, but results have been contradictory in the pre-school period (Lovett & Sheffield, 2007). Deficits in inhibition have been proposed to explain these contradictory effects (Eisenberg, 2010; Eisenberg et al., 2010; Gill & Calkins, 2003). Possibly, a lack of inhibition leads to impulsive responses (e.g. approaching the other) to both empathy -and aggression-evoking events in toddlerhood (Gill & Calkins, 2003). Therefore, deficits in inhibition would result in a positive association between empathy and aggression. High levels of inhibition would result in negative associations between empathy and aggression, as described by the violence inhibition mechanism (Blair, 1995, 2006). However, studies that focus on both empathy and inhibition, as well as their interaction in relation to aggression in the preschool period are currently lacking. Therefore, this study examined the interaction of empathy and inhibition on physical aggression in toddlerhood. Methods: Data were collected as part of the Mother Infant Neurodevelopment Study - Leiden (MINDS-Leiden). 92 primiparous women, recruited during pregnancy, were included in the current study. During a lab visit 30 months post-partum, maternal reports of physical aggression were obtained, inhibition was examined by a gift delay task and behavioural observations as well as physiological measures (heart rate [HR] and respiratory sinus arrhythmia [RSA]) of empathy were obtained during simulated distress by the experimenter. Behavioural observations of empathy included both self-oriented (personal distress) and other-oriented (empathic concern) empathic behaviour. Results: Hierarchical regressions revealed interactions between physiological measures of empathy and inhibition in the prediction of aggression (HR: β = -.344, t = -2.826, p = .006; RSA: β = -.266, t = -2.025, p = .048). No significant interactions between

behavioural measures of empathy and inhibition were found (self-oriented empathic behaviour: β = -.185, t = -1.042, p = .136; other-oriented empathic behaviour: β = -.202, t = -16.677, p = .098). Post hoc analyses indicated negative associations between empathy and aggression for toddlers with high inhibition. Positive associations between empathy and aggression were found in toddlers with low inhibition. Conclusion: Although, higher levels of empathy are associated to lower levels of aggression in toddlers with high inhibition, this is not the case for toddlers with low levels of inhibition. In these toddlers, higher levels of empathy were associated to higher levels of aggression, reflecting impulsive responses to both empathy- and aggression-evoking situations. Therefore, differences between previous studies in the proportion of children with inhibition deficits might explain the contradictory results on the association between empathy and aggression in toddlerhood. Since empathy and inhibition develop rapidly during toddlerhood, this would be a particularly interesting period for future studies to investigate the effects of interventions aiming to reduce or prevent aggression by targeting empathy and inhibition.

P2-G-168 Testing a child effects model of infant still-face response predicting future maternal behavior

Jessie Northrup[1], Julia Ridley[2], Katie Foley[1], Alison Hipwell[1]

[1]University of Pittsburgh, [2]University of Pittsburgh School of Medicine

Introduction: Typically developing infants respond to the "still-face" perturbation, whereby a mother adopts a neutral, still expression while continuing to face her infant (Tronick et. al. 1978), by turning away and displaying an increase in negative affect and a decrease in smiling. This pattern of behaviors is thought to reflect a violation of the infant's expectation for interactions with his/her mother (Mesman, van Ijzendoorn, & Bakermans-Kranenburg, 2009). Most studies examining individual differences in infants' still-face response have focused on the unidirectional effects of maternal behavior (e.g. sensitivity) on infant behavior, and little attention has been paid to child effects on future maternal behavior. Taking a transactional view of the mother-infant relationship, we hypothesized that mothers of infants who displayed a more typical still-face response at 4 months would show more positive parenting behaviors, fewer negative parenting behaviors and a greater tendency to interpret infant's mental states in interaction at 6 months, independent of parenting behaviors at 4 months. Methods: Young primiparous mothers (N=141), mean age 20.38 years (SD=1.23, range = 18-23) were recruited with their infants (55% female) from a population-based, longitudinal study of

psychopathology in girls that began in childhood. Mothers were filmed with their infant during two "interactive" periods (warm-up & toy play), and a "still-face" period, when infants were approximately four (M = 4.14) and six (M = 6.76) months of age. Videos were coded independently by trained researchers for "positive" parenting (warmth, involvement, and sensitivity), "negative" parenting (hostility, intrusiveness), and maternal "mental state" talk, and three measures of infant behavior: negative affect, positive affect, and social referencing (i.e. orienting to mother). Change scores were computed by subtracting scores for infant behavior in the interactive period from scores in the still-face period. Three linear regression models were run with each maternal behavior (positive parenting, negative parenting, mental state talk) during interaction at 6 months as the Dependent Variable (DV). Infant change scores at 4 months were included as predictors in each model, while also controlling for concurrent maternal behaviors at 4 months. Results: Decreased infant positive affect from interactive to still-face periods at 4 months predicted more positive parenting behavior two months later (β= -.11, p = .01), and was also marginally related to less negative parenting behaviors (β= .08, p = .06), after accounting for concurrent maternal behavior. When maternal mental state talk was examined as the DV, increased infant social referencing during the still-face, relative to the interactive, period predicted higher levels of maternal mental state talk in the future (β=.14, p = .02). Conclusion: These results indicate that the typical infant response to the still-face paradigm predicts increasing levels of positive parenting behaviors, highlighting the importance of examining child effects on future maternal behavior. The results also suggest specific effects of infant social referencing behavior during the still-face stressor on subsequent maternal mental state talk, a proxy for 'mind-mindedness'. Future work will test the full transactional model in order to understand the mutual influence of mother and infant effects.

P2-G-169 Differences between Rural and Urban Families: Mother-infant Interactions, Child Temperament, and Parenting Stress

Alyssa Neumann[1], Eric Desmarais[1], Sydney Iverson[2], Maria Gartstein[1]

[1]Washington State University, [2]University of Arizona

Infant temperament has been demonstrated to confer risk or protection for the way individuals respond to adverse life events later in childhood and beyond. Early interactions between parents and children were also shown to predict social-emotional outcomes (Seifer et al., 2014). Importantly, greater levels of parent sensitivity in early childhood predicted more secure attachment, reduced fearful reactivity, and greater effortful control

(e.g., Kochanska, Murray, & Harlan, 2000). Parenting stress is an important corollary, linked with infant temperament and able to directly affect parent-child exchanges (Oddi, Murdock, Vadnais, Bridgett, & Gartstein, 2013). The impact of macro socio-cultural factors on child and family functioning have also been studied, including comparisons between urban and rural contexts. Geographic regions differ in resource accessibility, economic characteristics, socio-cultural factors, and common child-rearing practices, all of which may shape developmental pathways and trajectories. For example, rural families have demonstrated lower levels of parental warmth and responsiveness and utilize fewer educational materials (e.g., Sheridan, Koziol, Clarke, Rispoli, & Coutts, 2014). Lower socio-economic status (SES) has been associated with more controlling, restrictive parenting and more difficult infant temperament (e.g., Jansen et al., 2009), and thus represents a potentially important covariate in comparing rural and urban families. It was hypothesized that rural children would demonstrate significantly more challenging temperament profiles. Additionally, sensitivity and reciprocity were both expected to be higher in the context of urban parent-child interactions. Analyses concerning stress in the parental role are considered exploratory. Existing data collected for two independent projects were used in this secondary analysis: urban sample (N=68) from the San Francisco bay area and a rural sample (N=120) from adjacent towns in the inland Pacific Northwest (<20,000 permanent population). Differences in infant temperament were assessed using the Infant Behavior Questionnaire-Revised (Gartstein & Rothbart, 2003), and parenting stress examined using the Parenting Stress Index (PSI; Abidin, 1995). Sensitivity and reciprocity were coded from observations of mother-infant interactions, as previously described (Gartstein, Hancock, & Iverson, in press). No significant differences existed between the groups on race or SES; in contrast, urban mothers were significantly older than rural mothers. Thus, groups were compared via analyses of covariance (ANCOVA), controlling for infant age, sex, and maternal age. Rural mothers rated their children significantly higher on Negative Emotionality and the distress to limitations subscale. Urban mothers demonstrated significantly more sensitivity and reciprocity with infants. There were no significant differences in parenting stress. Although SES is typically considered a key contributor to differences between urban and rural samples, in this study maternal age accounted for considerable variance, and should be examined further. Urban risk factors have been the focus of developmental science, yet distinctions between rural and urban mother-infant dyads in this study indicate potential risk for the rural sample. Rural ecology presents a constellation of adversity (Hirsch & Cukrowicz, 2014) that should be examined more closely in the context of child social-emotional development.

P2-G-170 Longitudinal study on the influence of maternal depressive distress on toddlers' sociability and shyness: Beyond autonomy support

Laurence Morin[1], Julie C. Laurin[1], Sophie Laniel[1], Rachel Perrier[1]

[1]Université de Montréal

Background: Current research are beginning to show a keen interest on the influence of maternal depressive symptoms on specific dimensions of temperament that may be affected in children (e.g. social dimensions), as well as the parental factors influencing this interaction (Babineau et al.,2015; Milne, Greenway, Guedeney, & Larroque, 2009; Potharst, Aktar, Rexwinkel, Rigterink, & Bögels, 2017; Putnam et al., 2006). Moreover, parental autonomy support is associated with social skills competence in school-aged children (Joussemet, Koestner, Lekes, & Landry, 2005), yet these results have not been replicated with toddlers (Laurin & Jousemet, 2017). As such, no study has evaluated the specific influence of maternal depressive symptoms on the social dimensions of temperament in this population longitudinally. Objectives: The aim of this study is to examine the temporal influence of maternal depression symptoms on the social dimensions of toddlers' temperament in the context of autonomy-supportive parenting. H1) Autonomy support will promote long-term social skills competence in toddlers. H2) Regardless of optimal parenting, depression will have a long-term negative effect on child's shyness and sociability temperamental dimensions. Method: There were two data collection waves. When toddlers were 2-year-old (T1), mothers (N = 51) completed the Beck Depression Inventory (BDI-II, Beck, Steer,& Brown, 1996) and the sociability and shy subscales of the Early Childhood Behavior Questionnaire (ECBQ, Putnam, et al., 2006). Mother-toddler dyads were also observed during a clean-up task ("Do", Kochanksa & Aksan, 1995) during which autonomy-supportive parenting was coded. When toddlers were 3.5-year-old (T2) mothers completed both ECBQ subscales again. Results: A hierarchical multiple linear regression was conducted. After controlling for family income, ethnicity, mother's education and employment, the child's gender, sociability and shyness at 2-years (T1), autonomy supporting practices did not predict an improvement in sociability ($p = .77$) and shyness ($p = .07$) when children were 3.5 years old, which is evidence against our first hypothesis. However, the analysis shows that higher maternal depressive symptoms at T1 (2-years) predicts a decrease in sociability ($\beta = -.27$, $p < .05$) and an increase in shyness ($\beta = .29$, $p < .05$) at T2 (3.5 years), while controlling for all sociodemographic covariates, autonomy-supportive parenting as well as sociability and shyness at 2-years (T1). Thus, these results suggest that regardless of toddlers' initial level of sociability and shyness as well as autonomy-supportive parenting, higher maternal depressive symptoms diminishes sociability and promotes shyness 1.5 years later in toddlerhood. Discussion:

These results are concerning as social aspects of a child's temperament are known to remain stable between the age of three and seven (Durbin, Hayden, Klein, & Olino, 2007). In addition, shyness and lack of sociability are temperament characteristics that negatively affect long-term psychological adjustment (Frenkel, Fox, Pine, Walker, Degnan, & Chronis-Tuscano, 2015). This study also supports the importance of further research on the influence of maternal depression on toddlers, which highlights the importance to develop interventions that go beyond parental coaching and are more centered on negative consequences associated with maternal depressive symptoms.

P2-G-171 Division of parental labor is associated with maternal relationship satisfaction

Melanie Miranda[1], Andrew Ribner[1], Clancy Blair[1], NewFAMS Investigators[1]

[1]New York University

Background The stresses of parenthood on a relationship in the U.S. has been widely studied and suggests that parenthood can negatively affect relationship satisfaction (Mitnick et al., 2009). As a couple become parents, there are new stresses on their relationship that can affect the quality of that relationship. A new stress added on to the relationship of parents, is deciding who does what in terms of taking care of the infant. The present study investigated whether division of parental labor is associated with maternal relationship satisfaction. Method Parents (N=129) were recruited prenatally from hospitals and classes in New York City. All parents recruited were cohabitating couples in heterosexual partnerships expecting their first child, and all families were middle- to upper-class and were highly educated (median education=Master's Degree). Data were collected when moms were in their third trimester of pregnancy, and again when their child was 4 months old. Parent survey responses for relationship satisfaction (Couple Satisfaction Index; Funk & Rogge, 2007; Kimmes, Bercik, Edwards, & Wetchler, 2014) and division of parental labor (Who Does What; Cowan & Cowan, 1988) were collected as part of a larger study. The relationship satisfaction scale included 16 items, such as "How rewarding is your relationship with your partner?". The measure demonstrated adequate internal consistency at both time points (prenatal: α=.74; 4 month: α=.80). Division of parental labor was measured on two scales each with 11 items, such as "Feeding the baby". Moms rated items 1 to 9 where "1" indicated "mom does everything" and "9" indicated "dad does everything," such that "5" indicated "we split it equally." Moms rated both, how labor was actually divided or how she thought labor would be divided at the prenatal time point. The scale demonstrated reasonable internal

consistency prenatally (α=.70) and at 4 months (α=.80). Results At 36 weeks, moms rated that she expected parental labor to be nearly equal (M=4.30; SD=0.61). At 4 months of infant life, mothers reported she was doing more work than originally anticipated (M=3.92; SD=0.98), paired-sample t(74)=4.18, p<.001. Relationship satisfaction also decreased over time from prenatal (M=3.43; SD=0.38) to 4 months (M=3.26; SD=0.50), paired-sample t(110)=5.23, p<.001. Bivariate correlations reveal a positive correlation between maternal relationship satisfaction and paternal involvement both within and across time (rs=.24-.28, ps<.05). Furthermore, mothers who reported a greater difference between prenatal expectations of division of labor and actual division of labor at 4 months also experienced a greater decrease in relationship satisfaction (r=.21, p=.067). Discussion & Next Steps These data suggest maternal relationship satisfaction can be maintained, or increased, if fathers are more involved in caring for their infant. At presentation time, data will be extended to include mothers from a low-income, mostly Spanish speaking sample. Further research can investigate whether these findings can be found in same-sex couples or in parents outside of the U.S.

P2-G-172 Perspective-taking development, inhibition of imitation, and inhibitory control

Marlene Meyer[1], Natalie Brezack[1], Amanda Woodward[1]

[1]University of Chicago

Learning to understand other people, and especially that others' perspectives can differ from one's own, is a cornerstone of social cognition. The development of perspective-taking (PT) undergoes marked changes in the first three years of life: Children pass level 1 PT tasks at 24 months and level 2 PT tasks at 36 months (Moll & Tomasello, 2006; 2011). Yet open questions remain regarding the underpinnings of PT skills and how PT is used in social interactions. In particular, inhibitory control, a component of executive functioning (EF), has been studied in relation to PT. Recent adult findings, however, suggest that inhibition of imitation predicts PT skills more strongly than general inhibitory control (Santiesteban et al., 2012). Thus, the current, pre-registered study examines how individual differences in young children's explicit and implicit level 1 visual PT skills relate to inhibition of imitation and general inhibition skills. We hypothesized that children with greater ability to inhibit imitating would also demonstrate higher PT abilities and that this relation would be stronger than a potential relation with general inhibition. Here, we assess 36-month-olds' behavior in novel tasks measuring communicative level 1 visual PT, inhibition of imitation, and general inhibition (Go/No-Go) (Figure 1). In the PT task,

children choose one of two identical toys to give to an experimenter sitting across from them. Both toys are visible to the child but one toy is hidden from the experimenter's perspective. On each trial, children are asked to give the toy the experimenter "can see" or "does not see." Children's PT skills are quantified using their overt response (percentage of trials choosing the correct toy) and their implicit response (eye gaze: first look to target/distractor toy). In the inhibition of imitation task, children push a button matching the color of the presented image. Analogous to other stroop-like tasks, the images have an irrelevant dimension: the person in the images pushes the same (congruent), opposite (incongruent), or no button (neutral). The Go/No-Go task involves pushing a button when seeing a Go-Stimulus and withholding a response when seeing a No-Go-Stimulus. Participants' inhibition of imitation and inhibitory control performance is assessed by their accuracy. As illustrated in Figure 2, results of ten pilot participants (4 female) show that 36-month-olds systematically chose the correct toy when their perspective matched another's ("Can See" trials: mean = .65, SE = .09) but not when their perspectives differed ("Does Not See" trials: mean = .50, SE = .11). In contrast, children's implicit responses suggested they do account for another's perspective when it differed from their own (first look on "Does Not See": mean = .82, SE = .08). Moreover, pilot results indicated a relationship between greater skill inhibiting imitation and PT performance (R^2=0.43). While the same relation was found for general inhibition ability (R^2=0.35), this effect was smaller than the relation between PT and inhibition of imitation. Data collection is currently ongoing. Results will have implications for understanding the developmental trajectory of and individual differences within early PT skills.

P2-G-173 Talking to Babies: Parent language input at 3 months predicts child vocalizations at 18 months

Myriah McNew[1], James Todd[1], Kasey Soska[2], Elizabeth Edgar[1], Lorraine Bahrick[1]

[1]Florida International University, [2]New York University

Children's linguistic environments are important predictors of their later language development and children from more language-rich environments have larger, faster-growing vocabularies and greater school readiness (Hart & Risley, 1992; Weisleder & Fernald, 2013). However, the role of children's vocalizations in this developmental process has received little attention (c.f. Caskey et al., 2011; McNew et al., 2017). Children's vocalizations (words, non-words) not only provide practice with the sounds of their native language, but also provide opportunities for social responsiveness, conversational turn-taking, linguistic input, and shaping productive speech (e.g., Warlaumont, 2014; Goldstein

& Schwade, 2008). The primary goal of the present study was to assess, longitudinally, the effects of parent language input in early development at 3 months on the amount of child vocalizations in later development, at 18-months. Data on parent language input are typically collected in the home, requiring laborious recordings and coding. However, recent work has demonstrated stability in individual variation in the amount of parent input across naturalistic and structured play contexts in mother-infant dyads at 13-months of age, suggesting that lab-based interactions are a viable context for indexing individual differences in children's typical language environments (Tamis-Lemonda, et al., 2017). Thus, a secondary goal was to examine if there are also stable individual differences in the amount of parent input across longitudinal samples of a short, structured lab-based interaction from 3-18 months. Twenty-two infants were tested at 3 and 18 months (13 female, 9 male) in a brief lab-based parent-child free-play interaction. Counts of adult words and child vocalizations were obtained using the Language Environment Analysis (LENA) system and converted to per-minute rates. Parents produced an average of 42.1 words per minute at 3mo (range=0-166.5; SD=42.2) and 49.4 words per minute at 18mo (range=0.98-118.6; SD=28.6). Children produced an average of 0.4 vocalizations per minute at 3mo (range=0-1.2; SD=.3) and 0.7 vocalizations per minute at 18mo (range=0-3.0; SD=.7). Neither parents nor children showed significant mean differences in their rate of vocalizations across age, ps>.1. Adult words per minute (AW) at 3mo were highly correlated with AW at 18mo, r=.58, p=.004 (Figure 1A), and child vocalizations per minute (CV) at 18mo, r=.85, p<.001 (Figure 1B). CV at 3mo were unrelated to all other variables (ps>.2), and excluded from analyses. Regression analyses revealed that AW at 3mo remained a significant predictor of CV at 18mo, even after controlling for AW at 18mo, b=.011, p<.001. Surprisingly, AW at 3mo and 18mo together accounted for 81.3% of the total variance in CV at 18mo. Results indicate that the quantity of parent language input to 3-month-old infants has large downstream effects on the quantity of child vocalizations at 18 months. This exciting finding may implicate child vocalizations as a mediator of the relation between parental input and children's later vocabulary and cognitive development. Additionally, findings demonstrate previously-undocumented stability of individual differences in the amount of parent language input across a 15-month timeframe, and highlight brief face-to-face interactions as fruitful contexts for assessing children's language exposure and vocal production.

P2-G-174 Infants' socio-moral preferences for prosocial agents: A meta-analysis

Francesco Margoni[1], Luca Surian[1]

[1]University of Trento

In the last decade, a host of studies have been conducted to investigate whether infants prefer prosocial agents (who, for example, provide help and comfort or show fairness in distributive actions) to antisocial agents (who, for example, harm others or are unfair). The current work presents a meta-analysis of the results reported by published and unpublished studies on infants aged 4-32 months (26 studies that reported a total of 61 effect sizes). Overall, it shows that approximately two infants out of three (0.68, 95% CI [0.64, 0.72]), when given a choice between a prosocial and an antisocial agent, choose to manually reach the prosocial agent (Figure 1). We also found that the strength of the preference is not affected by infants' age and it is consistent across the levels of other factors, such as whether infants were presented with cartoons or real events, or whether they were encouraged to selectively reach for one agent or help one agent. These results suggest that the effect is generalizable across different tasks and stimuli, and also that social input to which infants are exposed and general changes occurring between 4 and 32 months of age do not play a role in shaping the ability to express this kind of preferences in manual tasks. However, we found that some other factors do influence the effect size estimation: For example, presenting infants with cases in which someone gives or takes some resources belonging to others increases the magnitude of the effect size compared to cases in which someone helps or hinders. Moreover, further analyses showed evidence of a publication bias, which suggests that the average effect size of the retrieved studies is likely inflated. In fact, a calculation performed by accounting for the publication bias returned an average proportion of infants who choose the prosocial agent equal to 0.64, 95% CI (0.60, 0.69). To conclude, the current meta-analysis shows that infants' preference for prosocial agents is an ability that emerges early in life, but it also suggests caution in interpreting the data from the current literature.

P2-G-175 Are Infants Fairness Preferences Rooted in Preferences for Fair Outcomes or Fair Intentions?

Kelsey Lucca[1], Tianyi Zhou[1], Jessica Sommerville[1]

[1]University of Washington

The ability to reason about fairness plays a defining role in the development of morality. Thus, it is critical to reveal when and how a sensitivity to fairness first develops. Here, we examined the developmental trajectory of one particularly important marker of fairness sensitivity: the ability to use fairness information in selecting social partners. While prior

work has shown that infants prefer fair, over unfair, individuals, data describing the developmental unfolding of this preference has been lacking. Thus, in the current study we assess infants' preference for fair individuals at two previously unstudied age groups: 13 and 17 months. Moreover, we investigated whether infants' fairness preferences are rooted in a preference for fair outcomes or fair intentions. As adults, we form social evaluations of others based on the intentions that underlie behaviors, not just the outcomes of those behaviors themselves. In a second study, we assess whether infants also incorporate information about intentionality in their social evaluations. In Study 1, we used an experimental paradigm that combined pre-recorded stimuli with an active behavioral measure to test whether 13-month-olds (N = 14) and 17-month-olds (N = 16) prefer to socially engage fair or unfair individuals. Infants watched two videos of an actor distributing cookies equally to two individuals (3:3) and two videos of a different actor distributing cookies unequally (5:1). Both actors then appeared on screen and simultaneously offered infants a toy. Infants were then given the opportunity to socially interact with (i.e., take the offered toy from) one of the two actors. Both 13- and 17-month-olds selectively chose a toy from the fair actor (24 out of 30 infants), p = .001, 95% CI = [.61 - .92; Fig 1]. Study 1 demonstrated that infants prefer individuals who have a history of acting fairly compared to unfairly. However, actors' intentions always matched their behaviors, making it impossible to tease apart whether infants preferred fair individuals because the outcome of their behavior happened to be fair, or because they valued the fair intention that drove their fair behavior. Thus, in Study 2 we pit fair intentions against fair outcomes. In Study 2 (data collection ongoing) infants watched a series of videos with one actor distributing cookies fairly and a second actor distributing cookies unfairly (Fig 2). The distributor left the screen after distributing the cookies, and a new actor emerged and changed the original distribution (i.e. switched a 3:3 distribution to 5:1 or vice versa). As in Study 1, infants were then given the opportunity to take an offered toy from one of the two actors. If infants systematically choose to take a toy from the actor who intended to be fair, but was unsuccessful, over the actor who intended to be unfair, but was unsuccessful, it will demonstrate that infants' preferences for fairness are not simply based on a preference for fair outcomes. Rather, it will demonstrate that, similar to adults, infants understand and value the fair intentions that underlie fair behaviors. Together, these findings will fill in key gaps in the developmental timeline of infants' ability to use fairness information in their consideration of potential social partners. The early-emerging ability to both reason about and use fairness information may play an influential role in the development of complex prosocial behaviors related to morality more broadly.

P2-G-176 Distress and Disengagement in Response to Distress in Adult and Infant Strangers: How Empathic Concern Comes into Play

Hung-Chu Lin[1], Nektar Altintoprak[1], Nicholas Barker[1]

[1]University of Louisiana at Lafayette

Emerging capacity to differentiate the self from others during toddlerhood supports the progression in modulating self-focused distress into other-focused empathy when witnessing others in affliction (Hoffman, 1975). It remains unclear as to how distress and empathy are related and jointly associate with behavioral responses to others' suffering. This study described preschoolers' responses to distress in adult and infant strangers, focusing not merely on prosocial responding but also personal distress and unresponsiveness. Preschoolers (36 boys, 23 girls, mean age = 44 months, SD = .94) were observed in a laboratory. All children encountered a female adult stranger feigning stomach ache followed by an infant manikin emitting increasingly intense cry sound in a bassinet (each lasting approximately 4 min). Behaviors were coded for: 1) other-oriented behaviors (concerned expressions, cognitive inquiry, and helping actions), 2) personal distress, and 3) disengagement. Duration of a behavior was indexed by proportion of time spent in the entire simulation. The mean inter-observer reliability kappa values was .95. Across conditions, preschoolers spent 46.55 (SD = 26.01), 37.32 (SD = 15.87), and 13.08 (SD = 18.55) percent of time in disengagement, other-oriented behavior, and personal distress, respectively (all were significantly different from one another). Duration of personal distress in response to adult (M = 15.22, SD = 24.72) was significantly longer than infant (M = 10.51, SD = 17.77), t (58) = 1.75, p = .0423. The other two behavioral categories did not differ between the two conditions. Notably, personal distress in response to adult and infant was positively correlated with concerned expressions, r = .30, p = 0.0190, and r = .61, p < 0.0001, respectively, and negatively correlated with disengagement, r = -.46, p = 0.0002, and r = -.36, p = 0.0057, respectively. For both adult and infant conditions, concerned expressions were negatively correlated with disengagement r = -.58, p < 0.0001, and r = -.44, p = 0.0006, respectively. Regression analysis revealed an interaction effect between personal distress and concerned expressions on disengagement from the adult stranger, b = .19, SE = .08, t = 2.46, p = .0166, with concerned expressions attenuating the association between distress and disengagement (Figure 1). When disengagement from the infant was regressed on both distress and concerned expressions, the relation between distress and disengagement became non-significant, b = -.14, SE = .15, t = -.97, p = .3370, suggesting a mediation role of concerned expressions, indirect effect = -.21, SE = .09, CI = [-0.39, -0.04] (Figure 2). Although prosocial responding was evident, preschoolers spent plenty of time in

disengagement, which was paradoxically inversely associated with personal distress. This inverse link may be illuminated by the counterintuitive finding that, despite being qualitatively distinct, personal distress and empathic concern covaried in the same direction. Presumably, as argued by Hornstein (1991), distress espoused by others' misfortune was inseparable from concern for others, which was contrary to disengagement in response; thus the moderating and mediating roles of concerned expressions observed. The findings carry implications for understanding insensitivity towards the needs of others.

P2-G-177 Predictors of father involvement during infancy: A multifactorial and multi-measurement approach

Catherine Levesque[1], Alexane Baribeau-Lambert[1], Amélie Bolduc-Mokhtar[1], Célia Matte-Gagné[1]

[1]Université Laval

Background : An increasing number of studies suggest that father involvement has positive outcomes on child social and cognitive development (McWayne, Downer, Campos, & Harris, 2013). Unfortunately, few countries implement policies aiming to increase fathers' involvement in child rearing (Sarkadi, Kristiansson, Oberklaid, Bremberg, 2008). Improving father involvement with adequate intervention programs and policies requires a better understanding of the factors that foster or hinder it. Most of the studies that have investigated the predictors of father involvement used frequency scales measuring the number of times fathers are involved in caregiving activities (frequency of father involvement) without taking into account the actual amount of time fathers spent with infants (temporal involvement). Moreover, little research has been concerned with understanding how child and parental characteristics may differentially affect fathers' frequency of involvement and fathers' temporal involvement. Aims and methods: Using a multifactorial and a multi-measurement approach, the aim of the present study was to investigate the predictors of two indicators of father involvement: 1) the average number of hours spent with the infant each day (temporal involvement) as measured by a time diary (McBride et Mills, 1990), and 2) the frequency of involvement in infant care and play activities as measured by a self-reported questionnaire (Beitel & Parke, 1998). This study involved 94 fathers and their 6-month-old infants. Four well-known determinants of parenting were investigated in relation with father involvement: child gender, parental stress (Abidin, 1995), parental alliance (Abidin & Brunner, 1995), and maternal gatekeeping attitudes (Allen & Hawkins, 1999). Results: Parental alliance was found to be

positively associated with father involvement as measured by both the amount of time spent with the infant per day ($r = .34$, $p < .01$) and the frequency of involvement in infant care and play activities ($r = .33$, $p < .01$; see Table 1). However, parental alliance did not remain significantly associated with the amount of time spent with the infant ($\beta = .09$, $p > .05$) when maternal gatekeeping ($\beta = -.31$, $p < .01$) and parental stress ($\beta = -.32$, $p < .01$) were controlled for. In contrast, parental alliance was found to be the unique significant predictor of the frequency of father involvement ($\beta = .34$, $p < .05$). While the four predictors explained 24% of the variance in father's temporal involvement (see Table 2), they explained only 12% of the variance in father's frequency of involvement. Discussion: This study suggests that different aspects of paternal involvement may have different sets of determinants and thus, highlights the importance of using a multifactorial and a multi-dimensional approach in order to increase our understanding of the factors that might promote or hinder paternal involvement and its different facets. Moreover, the results suggest that policies and intervention programs that want to promote the frequency of father involvement in infant care and play activities should foster the parenting alliance between mothers and fathers, whereas programs that want to promote fathers' temporal involvement with their infants should target maternal gatekeeping attitudes and paternal stress.

P2-G-178 Infants expect emotions that convey danger to be more generalizable

Diane Lee[1], Zoe Liberman[1]

[1]University of California, Santa Barbara

Infants are robust social learners--they take information from other people in order to decide how to act themselves (e.g., Carpenter, Call, & Tomasello, 2005; Hanna & Meltzoff, 1993). Some research suggests that infants may have an early emerging negativity bias: they may attend to, and learn more from, negative information than positive information (Vaish, Grossmann, & Woodward, 2008). Indeed, recent work on how infants reason about food choice shows that they may learn more from negative information. Infants generalize disgust towards a food more broadly than they generalize food preferences: they expect friends (but not non-friends) to like the same foods, but expect even non-friends to dislike the same foods (Liberman et al., 2016). Is infants' propensity to generalize disgust more broadly than liking due to a general negativity bias, whereby negative information is seen as more truthful or universal? Or, are infants instead adept at picking up on signals that something is dangerous, which may lead them to expect everyone to avoid a potentially contaminated food? In the current study, we used a violation-of-expectation looking-time

method to ask whether 16- to 19-month-old infants generalized negative information from one actor to another, and whether negative emotions indicating danger were more salient. Infants watched a familiarization video where an actor engaged with an object and expressed one of three negative emotions: fear, pain, or anger. Two of these emotions, expressing fear towards the object or pain when touching the object, signal that the object itself might be dangerous. However, the third emotion, anger towards the object, does not necessarily cue danger, but instead may indicate the actor's personal feeling about the object. After familiarization, infants watched test trials where a second actor alternated between expressing positivity towards two objects: the same object that the first actor engaged with negatively, and a novel object. If infants learn that the object is negative or dangerous, then they should find it unexpected (and therefore look longer) when the second actor responds positively towards the same object that the first actor interacted with negatively. Preliminary results suggest that infants in the fear and pain conditions show this response. They look longer when the second actor likes the object the first actor feared or found painful. On the other hand, infants in the anger condition don't show this same pattern, they instead look for similar amounts of time at both types of test trials (Figure 1). Thus, infants don't attend to all negative emotions equally. Rather, they may expect negative emotions that indicate possible danger to be universally shared more broadly than negative emotions that are unrelated to danger. Overall, our results indicate that infants prioritize learning about what might actually harm them (or other people), not just what is good or bad, or what people around them don't like.

P2-G-179 Toddlers selectively request help from prosocial over antisocial others

Sandra Lasry[1], J. Kiley Hamlin[2]

[1]Ecole Normale Superieure, [2]University of British Columbia

As young children are inherently limited in knowledge and skills, they often need help. Although adults mostly anticipate their needs, providing help without direct requests, in other cases children must actively request help from those around them. Previous studies have demonstrated that toddlers can identify situations in which they need help (e.g, Gweon & Schulz, 2011), and selectively request help from those who previously have behaved competently, as presumably these individuals will be best able to help them (e.g., Cluver et al., 2013). But do infants consider whether or not someone is willing to help? Even preverbal infants selectively prefer those who have helped others (Hamlin & Wynn, 2011); the current studies explore whether toddlers incorporate information about others' past helpful acts into their own help-seeking. In the current studies (N=129), 22-month-

old toddlers were placed in a situation in which they required help (to activate a broken toy), and we examined whether they were more likely to approach and request help from one individual over another. Across studies, the two candidate individuals from which toddlers could request help had either performed helpful versus unhelpful behaviors (Study 1; gave versus took; Hamlin & Wynn, 2011), received helpful versus unhelpful behaviors (Study 2; given to versus taken from), or demonstrated the same versus an opposing food preference to the toddler (Studies 3 and 4; Mahajan & Wynn, 2012). Thus, in Study 1 we examined whether toddlers selectively approached and requested help from nice over mean characters, in Study 2 we examined whether selectivity in Study 1 was due to approaching any character involved in a nice versus a mean act, and Studies 3 and 4 examined whether toddlers selectively request help from anyone they prefer, irrespective of benevolence information. Toddlers were provided with a broken object and given the opportunity to discover that it was broken. An experimenter presented two puppets and asked toddlers whether one of the characters could help them. Selective behaviors were recorded during 3 sub-phases, in which the puppets were slowly moved within reach. For each sub-phase, toddlers were assigned a selectivity score of -2 to +2, indicating their level of help-seeking and to whom it was directed: 0 for no active/selective behaviors, +/-1 for pointing and/or touching one or the other puppet, and +/-2 for active toy assistance requests toward a puppet. Toddlers directed more selective behaviors and actively requested significantly more help from prosocial over antisocial puppets in Study 1, indicating that inferences about others' benevolence informs toddlers' selectivity - in favor of benevolent others - in help-seeking. Critically, no significant differences were observed in studies 2-4, suggestive that toddlers' selectivity in Study 1 did not rely either on simple association between individuals and positively valenced actions (Study 2), or on simple approach mechanisms whereby toddlers in need approach any individual they happen to like (Studies 3/4). These results add to previous work demonstrating adaptive and selective help-seeking in toddlerhood, by showing that toddlers in need selectively approach and request help from benevolent others.

P2-G-180 Joint attention at 9-15 months predicts parent reported reciprocal social behavior at 18 and 24 months

Carolyn Lasch[1], Jed Elison[1]

[1]University of Minnesota Twin Cities

Background/Objectives: A number of studies have documented longitudinal associations between joint attention behaviors and later language function. The objective of this study

was to examine the predictive association between individual differences in responding to joint attention (RJA) measured between 9 - 15 months of age and reciprocal social behavior measured at 18 and 24 months. Designed to function as a downward extension of the Social Responsiveness Scale (SRS), the Video-Reference Rating of Reciprocal Social Behavior (vrRSB: Marrus et. al., 2015) was used to quantify individual differences in reciprocal social behavior at 18 and 24 months. The vrRSB is a 50-item parent-report questionnaire and includes 13 items in which a parent directly compares her/his child's reciprocal social behaviors against those of an exemplar observed in a short video. A higher score indicates less reciprocal social behaviors. The Dimensional Joint Attention Assessment (DJAA; Elison et al., 2013) was used to characterize individual differences in RJA. The DJAA is a naturalistic, play-based interaction between an administrator and infant participants. It includes four series of four presses, presses that include progressively less subtle (more redundant sensory information) bids for joint attention with the infant. Methods: Between the ages of 9 and 15 months (M= 12.29 months, SD= 2.14), 60 infants (26 males, 34 females) completed the Mullen Scales of Early Learning and the DJAA as part of a larger study. Parents completed the vrRSB online at 18 months (M= 18.25 months, SD= 0.33) and then again at 24 months (M= 24.54 months, SD= 0.72). Hierarchical regressions were executed to examine the predictive association between DJAA performance and later vrRSB scores at 18 and 24 months, while controlling for age and Verbal Developmental Quotient (VDQ). Results: The zero order correlation between 9-15 month DJAA scores and later vrRSB scores were both statistically significant (18 months: $r = -0.311$, $p = .016$; 24 months: $r = -0.283$, $p = .033$). The zero order correlation between 18 and 24 month vrRSB was $r = 0.773$, $p < .001$. Four hierarchical linear regressions were carried out with vrRSB total score at 18 months or 24 months as a dependent variable, and with either DJAA mean score or DJAA coefficient of variance (CoV) as a predictor variable. All models had initial steps including variables controlling for VDQ as measured by the Mullen and age of initial visit. DJAA mean score and CoV accounted for a significant portion of unique variance in each model (see Table 1). The result remains the same when we control for the Early Learning Composite from the Mullen instead of verbal developmental quotient. Conclusion: DJAA mean score and COV, measured between 9-15 months of age, accounted for unique portions of variance in reciprocal social behavior at both 18 and 24 months. These data extend findings from the extant literature documenting the developmental importance of RJA.

P2-G-181 Infant Social Referencing with Mothers, Fathers, and Older Siblings

Jennifer LaBounty[1], Rosa Brotherton[1], Ashley Cox[1], Makayela Johnson[1], Anna Lyubinina[1], Mikayla Parsons[1], Ani Somers[1], Laura Travis[1], Hannah Zelcer[1]

[1]Lewis & Clark College

Infants pay close attention to their parents' expressed emotions toward novel situations and use that information to guide their own behavior (Vaish & Striano, 2004). The majority of the research on these 'social referencing' behaviors has focused exclusively on infants' interpretation of their mothers' emotions (Mumme, Fernald, & Herrera, 2008). The few that have compared infant social referencing with mothers and fathers have at times demonstrated that infants use emotional information from mothers and fathers equally (Dickstein & Parke, 1988), while others have shown more infant responsiveness with fathers (Moller, Majdandzic, & Bogels, 2014). The current research assessed social referencing in 12-month-old infants (M = 11.8, SD = 2.2 MOS; M = 28, F = 26) with mothers (N = 46), fathers (N = 16), and older siblings (N = 10). The study took place in the infant area of a science museum and was part of the national "Living Lab" program (NSF grant # 0714706). Family members were asked to positively or negatively emote toward novel toys that moved on their own. Novel toys and emotions were counterbalanced. Infant social referencing behaviors were coded live and included the number of times the infant approached, withdrew or touched the toy, and whether or not the infant played with the toy. Using within-subjects t-tests, we found that infants approached ($t(45) = 2.93$, $p = .01$) the toy more when the mother showed positive rather than negative emotion. Infants were more likely to touch the toy when mothers ($t(45) = 2.46$, $p = .02$) and fathers ($t(14) = 2.65$, $p = .02$) were positive. Infants withdrew from the toy more when both mothers ($t(44) = -4.52$, $p = .00$) and fathers ($t(14) = 2.23$, $p = .04$) negatively emoted toward the toy. With the McNemar test we found that infants were more likely to play with the toy when mothers ($N(45)$ $p = .01$) and fathers ($N(15)$ $p = 0.06$) showed positive emotion. However, when compared directly, infants did not respond in a significantly different way to mothers and fathers on any of the target social referencing behaviors. Infants were more likely to withdraw from the toy when siblings showed negative emotions ($t(8) = -1.9$, $p = .09$) and touch the toy when the siblings were positive ($t(8) = 1.89$, $p = .09$), although not significantly. Finally, infants were more likely to avoid touching a toy when older siblings showed negative emotion as compared with mothers ($t(7) = 2.38$, $p = .04$). Our study was the first to assess the effect of mothers, fathers and siblings on infant social referencing. We showed that both mothers and fathers are important sources of information about the world and their emotions are equally likely to affect infant behavior. Our results for sibling effects on social referencing are more preliminary, but provide intriguing evidence for differences in how infants use sibling

emotions to guide their behavior. Specifically, infants may be warier of new objects or novel situations when siblings show fear than when parents show fear.

P2-G-182 The developmental continuity and predictive power of JA skills during social interaction in infancy and toddlerhood

Susanne Kristen-Antonow[1], Beate Sodian[1], Irina Jarvers[1]

[1]Ludwig-Maximilians University Munich (LMU)

While research has looked at the development of joint attention (JA), mostly in experimental settings, across infancy (e.g., Mundy et al., 2007), less is known about the predictive relations between variability in JA during social interaction with caretakers in infancy and inter-individual differences in children's JA during social interaction with caretakers in toddler age. There is also a lack of longitudinal research examining the predictive power of early JA in regard to preschoolers' teachability and compliance. Thus, in this study, N = 50 mother-child dyads (28 girls) were applied age-appropriate measures of JA in interactive contexts with caretakers at 7 and 24 months. JA at 7 months was assessed during free play (Bakeman & Adamason, 1984) and JA at 24 months, along with other measures of responsiveness during picture book reading, was measured during a picture book task (Fletcher et al., 2005). Further, children's teachability and maternal teaching skills were assessed in a joint activity task (Bornstein, Putnick, & Suwalsky, 2017) at 48 months of age. As control measures we assessed children's working memory skills at 7 months and their verbal and non-verbal IQ at 48 months. There was considerable variability in children's JA at both time points. Further, children's frequency of JA at 24 months was specifically related to the early emergence of coordinated JA skills at 7 month, independent of working memory skills ($r(df = 47) = .32$, $p < .05$). Only children's JA skills at 24 months were positively related to child persistence ($r(df = 32) = .52$, $p < .001$) and negatively related to child noncompliance in a preschool teaching task ($r(df = 32) = -.48$, $p < .01$), even after controlling for general aspects of children's cognitive development and maternal influences. The results are discussed in terms of conceptual continuity in the social domain and the relevance of JA beyond infancy.

P2-G-183 Investigating the Concordance Between Action Prediction and Imitation Abilities in Infancy

Eugene Kim[1], Bennett Bertenthal[2]

[1]Indiana University--Bloomington, [2]Indiana University

Theoretical accounts of action understanding suggest that the ability to represent and predict others' goals during action observation are supported by the same neural mechanisms and motor representations underlying action production (Longo & Bertenthal, 2006). Anticipatory gaze shifts to action goals are an inextricable component of such motor representations (Flanagan & Johansson, 2003), making eye-tracking measures of real-time goal prediction particularly useful in quantifying infants' action understanding abilities (Hunnius & Bekkering, 2014). Substantial empirical evidence also suggests a bidirectional relationship between infants' visual anticipation of others' action goals and their contemporaneous action experience (Kanakogi & Itakura, 2011; Gredeback & Falck-Ytter, 2015). Consistent with this notion, infants' imitation of observed actions is also considered to reflect their understanding of others' goals and intentions (Meltzoff, 1995), in that both successful imitation and visual prediction of observed actions depend on a common internal representation of the task-relevant goals required for their execution. If this is the case, there should be strong concordance between infants' performance on imitation tasks and their goal prediction abilities. Specifically, we hypothesize that infants who reproduce a modeled action sequence with greater fidelity and effectiveness should also be better able to visually predict the goals of the same action sequences during observation. We tested 21- to 26-month-old infants in two behavioral assessments: an imitation task and subsequent action observation test. In the imitation tasks, infants interacted with two novel containers that could only be opened by manipulating three distinct components in a specific order (Figure 1). After a baseline period of free play-used to ensure that they could not solve the task without first observing another-the experimenter then demonstrated the correct action sequence and opened each apparatus. After each demonstration, infants were given 30 seconds to imitate the modeled action sequence. Two independent coders used a standardized scoring system to quantify the degree to which infants' own behavioral strategies matched the task solutions modeled by the experimenter. All infants then completed the eye-tracking protocol where they watched video recordings of the same action demonstrations presented during the imitation task. We quantified infants' action observation performance in two ways: 1) the mean proportion of actions correctly anticipated, and 2) the mean latency of infants' gaze shifts to the correct action targets. This is, to our knowledge, the first study to examine real-time eye tracking measures of goal prediction in relation to behavioral performance measures on an imitation task consisting of multiple, unique action goals. In addition, our imitation scoring technique is particularly advantageous because it provides a single continuous value that represents both the number of target actions infants imitated as well as the duration of their

performance. With a more sensitive performance measure, we can investigate how subtle qualitative differences in action production relate to fine-grained patterns of visual attention during action observation. Preliminary data analyses reveal patterns which suggest that both the imitation of goal-directed actions and the visual anticipation of others' action goals may share a common underlying mechanism.

P2-G-184 Don?t Hurt the Bunny: Toddlers? Selective Harm Avoidance

Aleksandra Petkova[1], Nicole Aguilar[1], Claire Le Gall[1], Lauren Dundore[1], Ellie Ruhl[1], Alicia Dawdani[1], Celia Brownell[1]

[1]University of Pittsburgh

Avoidance of interpersonal harm and initiation of prosocial behavior toward others are complementary, integrated aspects of mature morality, grounded partly in concern for others' welfare (Hoffman, 2000). Children begin to exhibit prosocial behavior in the second year of life (e.g., Warneken & Tomasello, 2007). Still earlier, in the first year of life, infants prefer agents who enact "prosocial" or helpful actions over those who exhibit "antisocial" or hindering actions (Van de Vondervoort & Hamlin, 2016). Yet, these preferences are not reflected in young children's own behavior. At the same age as they begin to exhibit prosocial behavior, toddlers frequently hit, kick, bite, or push others even when it is unprovoked and causes distress in the other person (Dahl, 2015; Hay, Castle, & Davies, 2000). Indeed, toddlers sometimes take pleasure in hurting others (Dunn, 1988), and physical aggression is at its peak in the toddler years (Hay, 2005). So there seems to be a disconnect between young children's preferences for others' positive, prosocial behavior over antisocial behavior and their own prosocial and antisocial behavior. This disconnection between prosociality and harm aversion suggests that infants and toddlers may not yet understand that their own hurtful actions are wrong. In the current study we compared one-year-olds' willingness to enact positive, kind actions versus negative, hurtful actions toward another. Using animate surrogates, we varied the degree to which the recipient of the child's acts resembled a live agent versus a toy. We hypothesized that children would be more likely to enact positive actions and to inhibit negative actions toward an agent that appeared to be alive. In a within-subjects design, 28 children (15-23 mos; Mage =17.5 mos; 15 girls) participated in an elicited imitation procedure with 3 different recipients (see Figure 1): a stuffed teddy bear; a Mickey Mouse doll; a "bunny" (furry, autonomously animate toy that vocalized). An experimenter modeled 4 nice actions (hug; feed with a spoon; give a drink with a cup; wash with a cloth) and 4 complementary hurtful actions (throw; poke with a stick; bop with a hammer; whap with a cloth), giving

the child an opportunity to enact the same action after each demonstration. Each action was modeled up to two times. Children were scored 2 points if they imitated after the first demonstration; 1 point if they imitated only after a second demonstration; 0 if they refused to imitate. Overall, toddlers were as willing to imitate negative actions (M=12.2) as positive ones (M=13.2). However, they imitated proportionally more positive actions and fewer negative actions on the "bunny" than they did on either the stuffed bear or the Mickey Mouse doll (see Figure 2). Thus, although young toddlers do not yet generally avoid harming others, they are beginning to do so for animals. Discussion will focus on when children begin to understand the meaning and import of "nice" and "mean" behaviors, including their normative force, and to behave accordingly, along with possible mechanisms underlying this development and future research directions.

P2-G-185 The Moral Roots of Fairness: Young Children's Enforcement of Fairness Norms Is Related to Their Prosocial Behavior

Anja Kassecker[1], Marco Schmidt[1]

[1]Ludwig-Maximilians University Munich (LMU)

Past research has shown that 3-year-old children not only have descriptive expectations about equal resource distribution, but also have normative ones as suggested by their enforcement of fairness norms as unaffected bystanders (Rakoczy et al., 2016). But what is the motivational source of these early agent-independent normative expectations about fairness? We predicted that these expectations not only have a conventional dimension (e.g., social regularities, authority dictates), but also a moral dimension in that they are, at least in part, driven by an altruistic interest in, and sympathetic concern about, others' desires and welfare (Decety & Yoder, 2015; Schmidt & Sommerville, 2011). In three experiments, young 3-year-old children (N = 84) were given a third-party fairness task (which varied across the experiments), two prosocial tasks (a costly sharing task, and an emotional sharing task in which children could help, or share with, a sad person), and a verbal IQ task. In Experiment 1, children protested and corrected unequal (but not equal) allocations, performed by one distributor to herself and a recipient. In addition, children's tendency to intervene against unfairness was positively related to their emotional sharing behavior controlling for verbal IQ (GLM, $\chi^2(1) = 6.46$, $p < .05$). In Experiment 2, we assessed whether children's normative expectations about fairness have a moral dimension. Children observed a distributor who followed (unequal condition) or violated (equal condition) an authority's command to allocate resources unequally (between herself and a recipient). Despite the authority's command (cf. Turiel, 1983), children protested more

against unequal versus equal allocations. Again, we found a positive relation between children's protest behavior and emotional sharing (GLM, $\chi^2(1) = 6.99$, $p < .01$; Figure 1). In Experiment 3, we were interested in whether children enforce fairness norms by altruistic punishment of unfair behavior. We assessed children's explicit judgment of whether an unequal distribution is good or bad, and their costly punishment (i.e., investing one's resources to reduce the outcome of the distributor). We found a positive relation between children's costly punishment of third-party unfair behavior and their own costly sharing behavior, controlling for verbal IQ (GLM, $F(1) = 5.22$, $p < .05$; Figure 2). These findings suggest that young children's normative expectations about fairness are closely interrelated with their own prosocial behavior. More generally, this work may help better understand to what extent the ontogeny of fairness norms can be characterized as moral in that it is associated with children's developing concern for the welfare of others in different contexts.

P2-G-186 Parental Depression, Early Interaction, and Infant Outcomes

Maria Kalpidou[1], Anna doCurral[1], Regina Kuersten-Hogan[1], Kristina Deligiannidis[2]

[1]Assumption College, [2]University of Massachusetts Medical School

Approximately 15% of mothers and 3-5% of fathers experience postpartum depression (DelRosario, 2013). Current literature suggests a negative association between maternal depression and infant development but little is known about paternal contributions. Maternal anxiety but not depression is associated with an increase in odds of having an infant with difficult temperament at 4 and 6 months (Austin, et al., 2004). Field (2010) found that mothers with depressive symptoms at 4 and 8 weeks postpartum reported frequent infant nighttime awakenings and less sleep during the night. Depressed mothers also reported more eating difficulties and lower infant weight gain than nondepressed mothers did (Gress-Smith, 2012). Moreover, infants of depressed mothers expected maternal unavailability and made less effort to engage the mother during the still face experiment (Cohn & Tronick, 1983). In this study, we examined both maternal and paternal depression and their association early interaction and indices of infant development at 3 months postpartum. Participants were 26 expecting couples and their infants. Expecting mothers were screened for any psychiatric diagnosis and medication. The STAI (anxiety) and EPDS (depression) were administered at that time. Eligible mothers then scheduled a prenatal visit. A second visit was scheduled when the infant was 3 months old. Both visits took place at the participants' home or the laboratory. At both times, the parents completed CES-D to assess mood changes (CESD; Radloff, 1977). At 3 months, either

parent completed questionnaires about temperament, milestones (ASQ), and feeding and sleeping habits. Infants and mothers also participated in the still face experiment (play for 3 minutes, still face for 2 minutes, recovery for 3 minutes). Results indicated continuity in maternal and paternal depression but no relationship between maternal and paternal depression at either time. Anxiety and depression were also strongly correlated (Table 1). Based on parental depression and anxiety scores we classified infants as low or high risk for development. High risk infants took longer to fall asleep at night, weighed more, and had mothers who perceived more sleep problems and negative affect in them. During the still face, low risk infants engaged in more self-comforting behaviors and looked at objects less during the play phase. Mothers of high risk infants hovered over their infants, thus overwhelming them, made more vocalizations in their attempt to engage them and tended to look more at objects than the baby. During the reunion phase, mothers of low risk infants touched their babies more perhaps as way to comfort them. When comparing interactional synchrony, mothers and infants of high risk tended to look at objects more so than low risk dyads did who tended to engage in more mutual gaze. Regression analyses showed that parental depression explained 24% of the variance in synchronous object attend during the still face experiment. Altogether, the findings demonstrate prenatal and postnatal contributions of bother parents to multiple infant outcomes three months after birth, highlighting the need for longer longitudinal studies.

P2-G-187 The Influence of Maternal Depression on 12-Month Mother-Infant Attachment

Peter Rehder[1], Kirsten McLaughlin[1], Guan Wang[1], Alison Stuebe[2], Roger Mills-Koonce[1]

[1]University of North Carolina at Greensboro, [2]University of North Carolina at Chapel Hill

Background Maternal depression in infancy is an important public health concern, as it has been associated with negative developmental outcomes for children, including internalizing and externalizing psychopathology, cognitive deficits, and poor socioemotional competence (Tharner et al., 2012). One early-life mechanism through which maternal depression may lead to these problematic outcomes is through disruptions in the formation of mother-infant attachment relationships. Maternal depression has been linked with attachment insecurity, but findings have been somewhat mixed across studies (Atkinson et al., 2000; van Ijzendoorn, Schuengel, & Bakermans-Kranenburg, 1999). The current study examined the links between maternal depressive symptoms among mothers at several points throughout their infants' first year as a predictor of attachment security at 12 months of age. We hypothesized that greater

depressive symptoms across the first year would be associated with classifications of insecure attachment among mother-infant dyads, and that this association would be more pronounced among boys than girls. Method Participants were 222 mothers with varying depression and anxiety diagnosis histories and their infants. Eighty-seven (39%) mothers had a current diagnosis of depression or anxiety, 64 (29%) had a past diagnosis, and 71 (32%) had no history of depression or anxiety. Eighty-four percent of mothers were white, 12% were black, 9% were Hispanic, 5% were Asian, and 2% were Native American. The sample was highly educated, with 45% having postgraduate degrees, 30% having four-year college degrees, and 25% having less than four years of college. Mothers completed a baseline lab visit in the 3rd trimester, monthly phone interviews, and 3 lab visits with their infants at 2, 6 and 12 months postpartum. Throughout the first year, mothers reported monthly on their depressive symptoms using the Edinburgh Postnatal Depression Scale (EPDS; Cox, Holden, & Sagovsky, 1987). At 12 months, dyads completed the Strange Situation Paradigm, which was coded by trained observers to assess attachment security (Ainsworth, Blehar, Waters, & Wall, 1978). Results and Discussion Univariate repeated measures ANCOVA analyses were conducted to assess the association between maternal depressive symptoms throughout the first year of life and attachment security (secure vs. insecure) at 12 months. Child sex was included as a moderator in order to examine differences between girls and boys in the association between depressive symptoms and attachment security. Covariates included child race, family income-to-needs ratio, and maternal education level. Results indicated that mothers in insecurely attached dyads showed more depressive symptoms across the first year of life, $p = .03$. As illustrated by Figure 1, we found a significant interaction between depressive symptoms and child sex, with greater depressive symptoms being associated with insecure attachment with girls, but not with boys, $p = .04$. These preliminary findings extend the existing literature by suggesting that maternal depression has greater negative impacts on mothers' attachment relationships girls than boys, possibly resulting from mothers' different behavioral manifestations of depression with girls than boys in the context of repeated mother-infant interactions. Mechanisms that may explain these differential effects of depression on early attachment security will be discussed.

P2-G-188 17-month-old infants expect lucky individuals to share their gains with ingroup (but not outgroup) individuals

Kyong-sun Jin[1], Hyeon Jeong Kim[1], Jewan Park[1], Hyun-joo Song[1], Renée Baillargeon[2]

[1]Yonsei University, [2]University of Illinois

Ingroup favoritism (IGF) refers to the tendency to treat ingroup members prosocially, positively, and preferentially. Recent research (Jin & Baillargeon, 2017) indicates that 17-month-old infants expect an individual to provide help to an ingroup member in need of instrumental assistance, but hold no particular expectation about the provision of help to an outgroup member. These and other results support the proposal that IGF reflects in part an abstract sociomoral expectation of ingroup support. Here we examined whether 17-month-olds might also demonstrate IGF in another prosocial context. Infants first saw a scenario in which chance events resulted in one individual receiving resources and another individual receiving none. We asked whether infants (a) would expect the lucky individual to donate part of her gains to the unlucky individual when both belonged to the same minimal group, but (b) would hold no particular expectation when the two individuals belonged to different groups. Infants in Experiment 1 watched videotaped interactions involving four women and received four group-induction, one group-comparison, and two test trials. In two of the group-induction trials, A1 and A2 wore blue sweatshirts and dotted headbands and built a tower together; in the other two trials, B1 and B2 wore yellow sweatshirts and giraffe headbands and read a book together. In the group-comparison trial, the two group-induction videos were played side-by-side to highlight the differences between the groups. The test trials differed between the ingroup and outgroup conditions. In the ingroup condition, two women from the same group (e.g., A1 and A2) sat at a table; centered between them was a stack of two identical boxes. A1 picked up the top box and brought it in front of her, and A2 did the same with the bottom box. Next, the two women opened their boxes, whose contents then became clearly visible. One woman (e.g., A1) got two strawberries and announced, "Strawberries!" The other woman (e.g., A2) got nothing and announced, "No strawberries!" Next, A1 picked up one of her strawberries and either put it in A2's box (share event) or returned it to her own box (no-share event). Infants in the outgroup condition saw similar events except that the two women belonged to different groups (e.g., A1 and B1). Infants in the ingroup condition looked significantly longer at the no-share than at the share event, whereas infants in the outgroup condition looked equally at the events. Thus, infants expected lucky A1 to share her gains with unlucky A2, but held no particular expectation as to whether lucky A1 would share her gains with unlucky B1. Experiment 2 was identical except that infants received only the test trials. Results were the same as in Experiment 1, suggesting that infants could establish the women's group memberships based solely on their outfits. Together, our results provide new evidence for early IGF: Infants expect a lucky recipient to share her gains with an unlucky recipient when the two belong to the same minimal group, but view such sharing as optional when they belong to different groups.

P2-G-189 Facial Trustworthiness Influences Gaze-Cueing in 7-Month-Old Infants

Sarah Jessen[1], Tobias Grossmann[2]

[1]University of Luebeck, [2]University of Virginia

When adults encounter another person for the first time, they reliably and automatically make a number of judgments about that person based solely on facial features. One aspect of these judgments is facial trustworthiness; without any knowledge of prior behaviour, a person is perceived as more or less trustworthy exclusively based on facial appearance (Oosterhof & Todorov, 2008). Importantly, this perception can influence the observer's social behaviour, both in a laboratory setting but also in real life (Rezlescu et al., 2012; Ert et al., 2016). While recent studies demonstrate that perception of facial trustworthiness is rooted in early development and can already be observed in 7-month-old infants (Jessen & Grossmann, 2016), it remains unclear whether infants are only sensitive to variance in facial trustworthiness, or whether this variance also influences subsequent processes linked to social behaviour such as gaze cueing. We therefore conducted an event-related potential (ERP) study, inviting 31 7-month-old infants to participate in a gaze-cueing paradigm. Participants were presented with faces that were either high or low in perceived trustworthiness, first looking at the infant and then shifting gaze to either the left or the right side. Simultaneously, a toy appeared to one side of the face, either in a position congruent or incongruent with the direction of gaze. Afterwards, the toy was presented in isolation. ERP responses were analysed during the presentation of the toy in isolation. We observed an enhanced late slow wave (LSW) response in the mismatching when compared to the matching condition ($F(1,24) = 4.34$, $p = .048$, çp2 = .15, Figure 1) at occipital electrodes, suggesting a gaze cueing effect irrespective of facial trustworthiness. Furthermore, our results revealed an interaction between facial trustworthiness and gaze matching on the frontocentral Nc, showing a smaller Nc response to toys previously paired with an untrustworthy face gazing away from the object compared to toys previously paired with a trustworthy face gazing away from the object ($t(24) = -2.307$, $p=.03$, $r=.43$, Figure 2, right). In contrast, we found no difference in the Nc response to toys previously paired with faces gazing at the toy ($t(24) = -0.007$, $p=.99$, $r=.001$, Figure 2, left). This pattern of results suggests that while gaze cueing at occipital sites occurs for both, trustworthy and untrustworthy faces, allocation of attention as indicated by variance in Nc amplitude varies as a function of trustworthiness. Taken together, our results show that infants' responses to facial trustworthiness go beyond a

basic sensitivity to such facial features by showing that signs of facial trustworthiness impact gaze cueing processes.

P2-G-190 Interrelations between Maternal Cognition and Aggression, Parenting, and Child Cognition and Aggression

Stephan Huijbregts[1], Ismahan Azrioual[1], Dide Van Adrichem[1], Kristiaan van der Heijden[1], Stephanie van Goozen[1], Hanna Swaab[1]

[1]Leiden University

Background: Many studies have shown associations between aspects of cognition and physical aggression both intra-individually and within family systems (e.g. Dubow et al., 2009; McMurran et al., 2002). Parenting style has often been suggested to mediate inter-generational transfer of both cognitive abilities and physical aggression (e.g. Hughes & Ensor, 2006; Van Bakel & Riksen-Walraven, 2002). It is not yet clear whether this is indeed the most evident mediation pathway. Objective: To examine (a) whether maternal cognition and aggression are related to child aggression, and whether the relation between maternal cognition and child aggression is mediated by maternal aggression, (b) whether the relation between maternal cognition and child aggression is mediated by child cognition (Theory of Mind (ToM-) precursors and language abilities) and/or maternal parenting practices (sensitivity and intrusiveness) and (c) whether the relation between maternal aggression and child aggression is mediated by child cognition and/or maternal parenting practices. Method: The sample consisted of 210 mother-child dyads (53% males). Mean age of the infants was 20.4 months (SD = 0.71) and mean age of the mothers was 24.9 years (SD = 2.27). Maternal cognition was represented by an IQ-estimate from the Wechsler Adult Intelligence Scale. Maternal aggression was assessed with the Aggression Questionnaire and child aggression with the Physical Aggression Scale for Early Childhood. Child ToM-precursors were measured with an imitation task and a discrepant desires task. Child language ability was examined using a receptive and expressive language task. Maternal parenting behavior was assessed during a free play task. Mediation models were tested using the four-step regression analyses described by Baron and Kenny (1986) and the SPSS macro PROCESS designed by Preacher and Hayes (2008), using 5000 bootstrapped samples. Results: Maternal cognition was negatively related to maternal aggression ($r = -.20$, $p = .008$) and child aggression ($r = -.28$, $p < .001$), and the relation between maternal cognition and child aggression was mediated by maternal aggression (PROCESS Indirect Effect Value (IEV) = -0.07, 95% CI -0.02, -0.01). Positive relations were found between maternal cognition and child imitation ($r = .18$, p

< .05), child receptive language (r = .15, p < .05) and maternal sensitivity (r = .26, p < .001). A negative relation was found between maternal cognition and maternal intrusiveness (r = -.25, p < .001). The relation between maternal cognition and child aggression was mediated by child imitation (IEV = -.02, 95% CI = -0.02, -0.00) and receptive language skills (IEV = -.02, 95% CI = -0.01, -0.00), but not by maternal sensitivity or intrusiveness. No mediation was found in the relation between maternal aggression and child aggression. Conclusions: Maternal traits (cognition and aggression) and child traits (receptive language and imitation) are related to early child aggression, and mediation effects are observed in this context. Specific child rearing practices could not explain these relations, thereby confirming a more prominent role for different types of mediators. However, roles for different types of parenting practices in the intergenerational transfer of cognitive abilities and aggression cannot be ruled out either.

P2-G-191 Infant ANS Coordination as a Function of Attachment

Sienna Howells[1], Jeffrey Measelle[1], Ana Hernandez[1], Jennifer Ablow[1]

[1]University of Oregon

Background: Multiple aspects of our stress response system contribute to socioemotional adaption. However, most research has explored the functioning of single elements of our stress biology (e.g., HPA, ANS, or immune system markers), despite clear evidence that the overall success of our capacity to manage stress depends on the coordination of multiple elements, including, the sympathetic and parasympathetic branches of the autonomic nervous system (ANS). In addition, although it is clear that our stress biology takes shape early in life within the context of our closest relationships; a focus on the interpersonal dynamics that might shape the development and function of infants' stress biology has been slower to emerge. To address this important area of developmental psychobiology, the present study examined individual differences in infant's sympathetic ANS and parasympathetic ANS as a function of their attachment classification as measured by the Strange Situation Procedure. In the present study, we utilized Bernston and colleagues (2008) measures of cardiac autonomic regulation (CAR), which indexes a person's full regulatory capacity, and cardiac autonomic balance (CAB), which indexes patterns of sympathetic and parasympathetic coactivation vs. coinhibition. Our central question: does an infant's attachment classification account for individual differences in CAR and CAB values, which jointly provide evidence of an infant's ability to deal adaptively with emotionally stressful interpersonal context. Method: A sample of N = 105 low-SES mother-infant dyads, recruited through Women Infant Child (WIC) program from the

Eugene, OR area, were followed prospectively across the perinatal period. Physiological data, specifically, respiratory sinus arrhythmia (RSA) and skin conductance levels (SCL), were measured continuously during the Still Face Procedure (SFP) when infants were 5 months of age. Measures of CAR and CAB were derived by averaging RSA and SCL levels (separately) during the reunion phase of the SFP and then either summing (to index CAR) or subtracting (to index CAB) RSA and SCL values for each infant. At 17-months, infants and their mothers returned to our laboratory to participate in the Strange Situation Procedure. Results and Conclusion: Working backwards, classification of infant attachment on the Strange Situation Procedure yielded the following classifications: Insecure-Avoidant (7.8%); Secure (65.6%); Insecure-Resistant (6.3%); and Disorganized (20.3%). Our initial physiology analyses focus on a contrast between secure and disorganized infants. As shown in Figure 1, we do not see a significant difference in infant CAR scores by attachment classification. In contrast, we find a significant difference in secure vs. insecure infants' CAB scores. Specifically, infants classified as disorganized have low CAB scores, which is reflective of high sympathetic and low parasympathetic cardiac control and has been linked to PTSD symptomatology. It would appear that disorganized infants struggle to recover physiologically during the reunion phase. Secure infants, on the other hand, show high CAB scores, which suggests greater parasympathetic cardiac control, or cardiac recovery during reunion.

P2-G-192 Infants at 19 months selectively help those that accurately label objects

Rachel Horton[1], Elizabeth Enright[1], Jessica Sommerville[1]

[1]University of Washington

From a young age, infants are willing to help others (Warneken & Tomasello., 2009). But why do infants help, and what motivations are behind infants' helping behavior? Determining the ways in which infants are selective in their helping behavior may illuminate infants' motivations behind helping. Infants prefer interacting with people that are similar to themselves and that are members of their in-group (i.e., someone that shares their same preferences or speaks the same language as them) (Mahajan & Wynn, 2012; Kinzler, Dupoux & Spelke, 2007). In the second year of life infants may infer group membership based on a person's ability to correctly label known objects given that at this age they are learning words at an accelerated rate and know some labels quite well. It's unclear if infants would selectively help individuals they consider part of their in-group. To address this question, we investigated 19-month-old infants' rates of helping towards an individual that either correctly labeled objects or incorrectly labeled objects. In the

current study, 36 19-month-old infants watched an experimenter label 3 common objects, a toy car, a ball and a shoe. Infants were randomly assigned to either the correct or incorrect labeling condition. In the correct labeling condition, the experimenter labeled all the objects correctly (e.g, labeling the shoe a shoe). In the incorrect labeling condition, the actor labeled all the objects incorrectly (e.g., calling the shoe a ball). After the experimenter labeled each of objects 4 times the infant then watched the experimenter stack toys on a tall shelf. The experimenter accidently dropped a toy on the floor and asked the infant to help give her the toy because she was unable to reach it. Infants had up to 60 seconds to help give the toy to the experimenter. Infants were more likely to help the actor when she labeled objects correctly (65% of infants helped) than when she labeled objects incorrectly (25% of infants helped) (see Figure 1; $p < .02$). These findings demonstrate that infants are selectively helping based on characteristics of the recipient that may infer group membership, which may afford the infant future affiliative benefits. In ongoing work we are seeking to determine if these results truly reflect selective helping of in-group members or are better understood as a tendency to help competent or accurate labelers. In either case, these findings suggest that infants' motivation to help is not solely based on the needs of the recipient.

P2-G-193 Young Children's Overindulgence in Smart Devices and Associations with Maternal Factors in Supporting Their Playfulness

Yea-Ji Hong[1], Kangyi Lee[1]

[1]Seoul National University

As the use of digital media, including smart devices such as smart phones or tablets is increasing rapidly, the undeniable reality is that even younger children are gaining more access to smart devices, and becoming proficient smart devices users. Particularly, the prevalence of smart devices in young children's lives has changed their ways of interacting with others, and developing essential social-emotional skills. What do you think about the 'appropriate' roles of parenting for raising a child under the influence of digital media in this modern society? Infants and toddlers are more susceptible to its detrimental effects of media use, and thus, specific attention is given to what protective factors are to prevent young children from excessive use of smart devices. Among a variety of factors which have influence on human beings during one's entire life, a mother, in particular, has an effect on various parts of development of infants and toddlers. Few studies have examined newer smart devices and its relations to maternal factors, such as parenting efficacy, parenting attitudes, and perception about the effect of young children's smart devices

use on their development in a comprehensive framework. Maternal factors can be acted as protective factors of young children's overindulge in smart, which in turn, influence their playfulness. Deriving in part from the socio-emotional developmental perspective; therefore, the aim of this study considers infants and toddlers' playfulness under the influence of smart devices and associations with various maternal effects. In the present study, the sample included 278 Korean young children aged below 36 months enrolled in 18 childcare centers in Korea. Mothers' perception about the impact of smart devices on children (Kwon, 2005), mothers' parenting efficacy (Gross & Rocissano, 1998), mothers' negative parenting attitudes (Kim & Rohner, 2002), and infants and toddlers' overindulgence in smart devices (Lee, Jung, & Kim, 2015) were assessed by mothers. Main classroom teachers also completed young children's playfulness using a Korean version of Barnett(1990)'s children's playfulness scale by observing their play behaviors during free play time at the centers. The model was analyzed in a structural equation modeling framework to identify the structure and relations among variables. First of all, a confirmatory factor analysis was conducted to obtain comprehensive validity. The estimated model demonstrated a good fit of the data (÷2= 286.593 (df = 160, p <.001), CFI = .949, TLI = .939, SRMR = .049, RMSEA = .053, 90% confidence interval (CI) for RMSEA [.043, .063]). Next, structural equation modeling was performed to verify our hypotheses. Results are shown in Figure 1. The high levels of mothers parenting efficacy were significantly related to their negative parenting attitudes (â= -.34, p<.001), and then, mothers' negative parenting attitudes was also significantly associated with young children's levels of overindulgence in smart devices (â= .34, p<.01), which, in turn, finally resulted in their playfulness (â= -.30, p<.05). Infants and toddlers today have been immersed in a digital world. The results of this study have important implications for young children's media use and their playfulness, and thus, it suggests a new avenue of developmental research.

P2-G-194 Digital media use in Swedish families with a 9-month-old child

Mikael Heimann[1], Felix-Sebastian Koch[1], Ulrika Birberg Thornberg[1], Rachel Barr[2], Anett Sundqvist[1]

[1]Linköping University, [2]Georgetown University

The recent surge in availability of digital media has made media accessible even to very young children. However, we know very little of the effects of digital media on infant's social and cognitive development. In fact, there is a dearth of data on how families in Sweden and other countries view the use of digital media during the child's first year of

life. Here we present data from an ongoing longitudinal study of Swedish families that have answered a survey focusing on how media is used in the family. The project follows over 100 families starting when the child is nine months and ending at the child's second birthday. Currently, we have data from 69 families with a nine months old child. The specific measurement used is developed within an international collaboration with the focus on building a new comprehensive tool, the Comprehensive Assessment of Family Media Exposure (CAFÉ), which measures household media use through a web-based survey, time use diary, and passive sensing app installed on family mobile devices. More direct comparisons across countries will be possible to carry out in the future due to the fact that data collection with the CAFE assessment is ongoing in seven countries. So far sixty-nine Swedish families with mostly boys (65%) have completed the survey. Mean parental age is 31.7 (range 21-42). Swedish is the only language used in 78 % of the families. Twenty-two percent report that a second language is used alongside Swedish. All children are cared for at home (80% of the time by the mother) and the families report having computers (100%), smartphones (99%), TV (81%) and tablets (74%) at home. Two key questions focus on the child's experience with mobile devices and parental worries regarding their child's media use. Survey data indicates (see Table 1), that digital devices are mostly used for listening to music. That is the only category in which a majority (60%) of the families' report using mobile devices with their child. It is also noteworthy that 25 percent of the children already have used mobile devices for playing games at least once. Videochat is used 2 - 3 times per month or more in 74 percent of the families. A large majority of the parents (64%) worry that their child will be exposed to inadequate content by using digital media and almost as many believe that digital media creates dependence (Table 2). Thus, it is not surprising that a majority also report that they try to limit screen time or the content the child is allowed to watch. When it comes to the parents own media use forty-nine percent report using their cell phone when the child is playing and 31 % during the child's bedtime hour. The findings show both overlap and differences with the recent 2017 Commonsense media report which surveyed parents of American children. Usage of television was higher in the Commonsense media report and usage of videochat was much higher in Sweden. The amount of concern over media expressed by parents was similar in both countries.

P2-G-195 Differential selective attention to the mouth of a talking face in infants at-risk for ASD and typically developing infants

Masahiro Hata[1], Yoko Hakuno[1], Michiko Asano[1], Kazuhiro Abe[1], Yasuyo Minagawa[1]

[1]Keio University

Infant siblings of children with autism spectrum disorders (ASDs) and/or preterm infants are at increased risk for various developmental disabilities. While significance of the early intervention for the children with ASDs is obvious, little is known about the early behavioral marker that could identify the risk. To seek for a possible behavioral predictor for ASD, the present study focused on eye gaze pattern between infants at-risk and typically developing infants (TDI) during watching video clips of human face. TDIs are known to start to more focus on mouth movement than eyes around 8-10 month-old, which is thought to reflect audio-visual speech learning. Here we chiefly investigated whether similar developmental change in eye gaze is observed in infants at-risk. We also examined the eye gaze for facial expression without mouth movement. The present study assessed eight 6-month-old (female = 5, mean age (SE): 159 (5.4) days) and eight 9-month-old infants (female = 7, mean age (SE): 281.4 (6.6) days) as an at-risk for ASD group. TDI group included eight 6-month-old (female = 7, mean age (SE): 197.1 (4.6) days) and ten 9-month-old infants (female = 8, mean age (SE): 286.4 (2.4) days). One of the stimuli is a video of a woman who was talking to the infant (20 seconds), and the other is a silent video of another woman who was playing peek-a-boo with varying emotional expressions (5 seconds in each expression). Infant's eye movement was recorded using Tobii X120 Eye Tracker system (Tobii, Stockholm, Sweden). We created the three areas of interest (AOIs); around the eyes, mouth, and the entire face, and calculated the proportion-of-looking-time (total looking time at eyes or mouth / total looking time at the face) using an arcsine transformation. For each AOI (eyes and mouth), we performed an ANOVA with group (at-risk and TDI) and age (6- and 9- month-old) as factors. A significant interaction between group and age was observed for looking proportion of mouth ($F(1,30) = 6.103$, $p < .05$). The post hoc analysis showed a greater looking time proportion at mouth for at-risk infants ($p < .05$), and a higher proportion of mouth-looking for the TDI at 9-month-old relative to 6-month-old ($p < .001$). No significant effect of group and interaction was obtained for the eyes. As for the results of emotional face stimuli, we did not observe outstanding differences. However, our longitudinal data showed developmental changes of looking behavior for the at-risk group seem to follow the pattern of TDI. The TDI group showed a similar gaze pattern to previous studies. However, at-risk infants paid selective attention to mouth in the talking face even at their age of 6-month-old. This differential pattern of attention may relate to ASD's preference of moving object or salient physical movement from the early stage of development. We will also examine a correlation between these looking behaviors and infants' social and language ability at their age of 12 month-old and 18 month-old.

P2-G-196 Parent risk factors, physiological coregulation, and preschoolers' behavioral dysregulation

Frances Lobo[1], Catherine Hamby[1], Erika Lunkenheimer[1]

[1]Pennsylvania State University

Poor parental mental health and substance abuse are risk factors for behavioral problems in children. Researchers posit these risk factors influence child outcomes through parent-child relationship mechanisms. One possible mechanism is physiological coregulation. Physiological coregulation reflects the moment-to-moment attunement of parasympathetic processes in mother and child and is a correlate of adaptive behavior (Bornstein & Suess, 2000). Coregulation is a dynamic process that allows parent and child to jointly regulate the child's internal functions and promotes the child's internalization of regulatory skills (Harrist & Waugh, 2002). However, parental risk factors disrupt physiological coregulation (Lunkenheimer et al., 2017). The present study examined the role physiological coregulation played in moderating the association between maternal risk factors and child behavior problems. We hypothesized that poorer parent mental health and higher substance use would disrupt physiological coregulation thus increasing risk for behavior problems in children. Participants were mothers and children (N = 57) at risk for child maltreatment. At 30 months, mothers reported their psychopathology symptoms using the Brief Symptom Inventory (Derogatis & Fitzpatrick, 2004), their frequency of smoking, alcohol, and drug use with the Adult AOD Screening and Assessment Instrument (Winters & Zenilman, 1994), and their children's behavior problems using the Child Behavior Checklist (Achenbach & Rescorla, 2001). At 36 months, mother and child heart rate and respiration were measured during videotaped dyadic tasks (Lunkenheimer et al., 2017). Multilevel coupled autoregressive models were used to calculate coregulation parameters for each dyad by predicting mother respiratory sinus arrhythmia (RSA) over time from child RSA, and vice-versa. Path analytic models showed that an interaction between maternal psychopathology and mother-driven coregulation predicted children's internalizing ($b = -49.62$, $z = -2.05$, $p = .04$) and externalizing ($b = -85.63$, $z = -2.54$, $p = .01$) problems, above and beyond the main effect of maternal psychopathology. For participants with lower symptoms of psychopathology, there was a positive relation between coregulation and child dysregulation, but there was no association when psychopathology was high. There was also a significant interaction between parent substance use and child-driven coregulation ($b = 46.30$, $z = 2.02$, $p = .04$) in predicting children's externalizing problems, above and beyond the main effect of

substance use: coregulation and child dysregulation were positively related when mothers engaged in more frequent substance use. We found that physiological coregulation was related to child dysregulation when mothers had lower psychopathology symptoms and more frequent substance use. Greater parental psychopathology may interfere with the effects of parent-child coregulation on children's behavioral adjustment, whereas greater substance use may not. The findings are surprising given prior literature suggesting that coregulation supports better child self-regulation. However, other work has found physiological concordance in clinical samples with high risk (Suveg, Shaffer, & Davis, 2016), which may be reflected by the present high-risk sample. Future work could leverage advanced methods to address the complicated relations among familial risk, physiology, moment-to-moment coregulation processes, and child outcomes.

P2-G-197 Cultural differences in the development of face scanning

Jennifer Haensel[1], Mitsuhiko Ishikawa[2], Shoji Itakura[2], Tim Smith[1], Atsushi Senju[1]

[1]Birkbeck, University of London, [2]Kyoto University

Eye-tracking studies with adults have demonstrated significant differences in face scanning strategies between Western Caucasians (WC) and East Asians (EA; e.g. Blais et al., 2008), highlighting the role of the postnatal environment in shaping face perception processes. However, it remains unclear when and how these cultural differences in face scanning emerge. While limited evidence suggests that infants differentially scan own- and other-race faces by 10 months (Liu et al., 2011; Wheeler et al., 2011; Xiao et al., 2013), no study to date has directly compared two cultural infant groups to map out the developmental trajectory and examine possible underlying mechanisms that can explain how culture modulates face perception. The present study therefore used remote eye-tracking techniques to examine scanning behaviour in British and Japanese 10-month-olds and adults, who were presented with both static and dynamic faces. Dwell time and fixation analyses showed that, compared to Japanese participants, British adults looked significantly more at the mouth region of static, but not dynamic faces. In line with previous studies, Japanese adults also showed a tendency to look more at the bridge of the nose for both static and dynamic faces. In contrast, cultural differences in face scanning were less consistent for the 10-month-old infants. Both infant groups looked more at the eyes of static faces and the mouth region of dynamic faces, highlighting stimulus condition as a driving factor in face scanning. Participants were also presented with the gap-overlap paradigm and cognitive control task (Wass et al., 2011) in order to investigate the role of attentional control as a possible mechanistic factor in increasingly

culture-specific face scanning. As predicted, no cultural differences in disengagement latency (gap-overlap paradigm) or anticipatory looking (cognitive control task) were found for adults or infants. Future analysis will examine whether and how these cognitive performance measures relate to face scanning behaviour, and will also include 15-month-old British and Japanese infants. Overall, these findings indicate that while face scanning is modulated by stimulus characteristics in both adults and infants, culture only consistently drives scanning behaviour beyond the first year of life.

P2-G-198 Baby see, but baby do not do! A longitudinal study on newborns and infants' imitation and conspecific identification skills

Poliana Goncalves Barbosa[1], Elena Nicoladis[1]

[1]University of Alberta

Imitation abilities in infancy have long been proposed to be the building blocks of later social cognition skills (e.g., Gopnik & Meltzoff, 1994). Although Piaget (1953, 1962) argued that it was only in the coordination of secondary schemes that infants showed signs of true imitation, his approach was challenged by Meltzoff and Moore (1977), who argued that humans were capable of matching adults' facial gestures from birth. Meltzoff and Moore (1977, 1983, 1989, 1994) proposed a new theory based on their revolutionary discovery: the like me framework. The core of the like me framework is that infants are born with imitative skills, which allows them to match people's behaviours and to recognize that the adult modelling a certain behaviour is just like them. In the current study, I aimed to replicate Meltzoff and Moore's findings, as well as to test the like me equivalence framework by investigating if newborns are biased to specifically imitate humans (i.e., their conspecifics), or more broadly, face-like stimuli (e.g., an ape). Infants were longitudinally assessed (up to 7 days after birth, and at 1, 2, and 3 months of age). In each assessment, they were prompted with a moving pen, an ape robot protruding its tongue to the side, and an adult modelling lateral tongue protrusion. Infants' tongue movements were coded according to their direction (forward or lateral tongue protrusion). Surprisingly, I did not find any sign of imitation across conditions and time points (see Figures 1 and 2). I argue that I did not replicate Meltzoff and Moore's findings because human beings are not capable of imitation either at birth or in the first the 3 months of age. I suggest that the associative sequence model (Ray & Heyes, 2011) or Jones' (2015, 2016) revision of Piaget's (1953, 1962) theory might be a way to predict the emergence of imitation in infancy.

P2-G-199 Predictors of the Discrepancies Between Fathers? Real and Ideal Parenting Investments

Lindsey Gedaly[1], Geoffrey Brown[2]

[1]University of North Carolina at Greensboro, [2]University of Georgia

Parenting has long been considered a mother's job, but fathers are now more involved in childcare than ever before (Parker & Livingston, 2016). Research has shown that fathers play important roles in their children's development, with father involvement being associated with children's language, cognitive, and social-emotional development during infancy (Cabrera, Shannon, & Tamis-LeMonda, 2007), and social-emotional and academic functioning throughout childhood (Allen & Daly, 2007). Although many fathers may be happy with their parenting investments, others may wish that they could be more or less invested. How fathers prioritize the fathering role may help to explain why some fathers are more involved in caregiving. The present study examined the discrepancies between fathers' reported real and ideal investments in the parenting role, as well as the factors that account for these discrepancies. We hypothesize that mothers' and fathers' reports of maternal gatekeeping and coparenting quality at 13 months, as well as their depressive symptoms at 13 months, will be positively associated with fathers' reported role discrepancies at 3 years. Participants were 64 married couples with children aged 12 months at wave one, and three years at wave two. Fathers' parenting investments were measured using a penny-sort task, in which fathers were provided with 15 coins and instructed to divide them among 5 roles (Parent, Spouse, Worker, Social, and Other) according to how they make commitments to each role (perceived investment). They were then asked to sort the coins according to how they would ideally like to make commitments to each role (Ideal Investment). Analyses focused on the discrepancies between the perceived and ideal investment scores in the parenting role. Mothers reports of coparenting quality were measured using the Parenting Alliance Inventory (PAI; Abidin & Brunner, 1995; Konold & Abidin, 2001), and both paternal and maternal depression were measured using a 14-item modified version of the Beck Depression Inventory (BDI; Beck, et al., 1961). Findings indicate that a little over half of the fathers in the sample were satisfied with their investments, a little below one fourth felt under-invested, and another fourth felt over-invested (figure 1). Results from multiple regression analyses indicated that when mothers were more satisfied with their coparenting relationships, fathers were more likely to feel over-invested ($\beta = 0.31$, $p < .05$). Additionally, when fathers reported more depressive symptoms, they were more likely to feel over-invested ($\beta = 0.49$, $p < .05$),

but when mothers reported more depressive symptoms, fathers were more likely to feel under-invested ($\beta = -0.31$, $p < .05$). Neither fathers' reports of coparenting quality nor mothers' or fathers' reports of maternal gatekeeping were predictive of father role discrepancies. These findings suggest that the coparenting relationship and mothers' and fathers' depressive symptomatology play a role in predicting how satisfied fathers are with their parenting investments. As fathers who view parenting as more salient to their identities are more likely to be invested in parenting (Stryker & Serpe, 1994), programs aimed at increasing father involvement should focus on increasing the salience of the parenting role for fathers.

P2-G-200 Intervention and change in parental behaviour of 0-to 36-month-old infants Followed by child protection agencies: A meta-analysis

Audrey Gauthier-Légaré[1], Émilie Langlois[1], Kim Gagnon[2], Audrey Morissette[1], Jessica Pearson[3], George Tarabulsy[1]

[1]Université Laval, [2]Université de Sherbrooke, [3]McGill University

Parental maltreatment and negligence constitute a breakdown in the basic behaviors that are part of the parent-child relationship and have major effects on infant and child development in social, emotional and cognitive spheres (Bernard, Butzin-Dozier, Rittenhouse & Dozier, 2010; Spratt et al., 2012). Short of placement with foster parents, structured interventions intended for families appears to be the best option to ensure the appropriate care and development of children and many such strategies have been the object of evaluation as to how they influence child outcome. Results have been mixed and difficult to integrate, given the differences in measures and strategies that were used. The purpose of this meta-analysis is to examine the effectiveness of such programs, conducted within child protection agencies, with respect to infant and child outcome. Method. Pertinent studies were systematically collected using databases (MEDLINE, PSYCINFO) and reference lists from relevant papers on the subject. Studies published between 1970 and July 2016, involving 0 to 36-month-old infants and children, that included an intervention strategy, conducted within child protection services, and a measure of child outcome (attachment, parent-child interaction, cognitive development) were considered in this meta-analysis. Study selection procedures revealed that only 9 studies corresponded to the selection criteria. The following moderators were coded for and considered: Type of intervention strategy (targeting children; parents), outcome measure (cognitive development; attachment; behaviour problems) and whether intervention involved other settings, most notably, daycare settings. Results. Results show

a significant influence of intervention on child outcome, all types combined (d = .45, p < .00; Q = 66.26; k = 9). Moderation analyses reveal that among the 9 studies, type of intervention, involvement of other settings, and specific outcome that is considered, significantly moderated effect sizes. Studies that focused on child educational targets, rather than therapeutic or relational targets in intervention yielded lower effect sizes. Studies that focused on attachment, as opposed to those that addressed internalized and externalized behaviour problems, yielded greater effect sizes. Moreover, studies where intervention strategies were mainly delivered by child protection service professionals, in comparison to daycare workers, also revealed greater effects. No moderation was obtained for year of publication or child age. Discussion. This study focused on intervention strategies that were implemented within child protection settings, targeting 0 to 3-year-olds. The study also focuses on child outcome as a dependent variable, critical to our understanding of child protection efforts. As such, a first result concerns the low number of evaluation studies that were found. More research must be conducted in this area to more appropriately understand the effects of child protection services on child development. Second, the overall effect size that was found reveals that, within these 9 studies, structured intervention strategies provide moderate to high effects with regard to child development, and that effects are particularly high within studies that were characterized by meaningful moderating variables.

P2-G-201 Toddlers? Preferential Bias toward the Resource-Rich and An Intervention to Reduce it

Melody Buyukozer Dawkins[1], Renée Baillargeon[2]

[1]University of Illinois at Urbana-Champaign, [2]University of Illinois

In many countries around the world, there is a large gap between the rich and the poor. This pervasive tolerance for social and economic inequality is particularly puzzling in light of recent evidence that an equity-based sense of fairness emerges early in life. In resource-allocation tasks, for example, young children take individuals' prior resources into account: Although they divide resources equally among similarly advantaged individuals, they allocate more resources to disadvantaged than advantaged individuals. But if fairness is a universal component of human moral cognition, why are we content to live in unfair societies? To address this issue, researchers across the social sciences have explored numerous factors ranging from self-interest to system justification. Within developmental psychology, one factor that has recently received a great deal of attention is a preferential bias toward the resource-rich: children age 4 years and older have been

shown to prefer advantaged individuals over their disadvantaged counterparts. Here we asked two questions: Would 25-month-old toddlers already exhibit this preferential bias for the resource-rich, and if yes, were there interventions that might reduce it? In Experiment 1, toddlers first received three familiarization trials in which an experimenter (E) revealed the belongings of two dolls to demonstrate that one was resource-rich and the other was resource-poor. Next, in each of four test trials, the dolls expressed different preferences or opinions and then left; children then endorsed one of the dolls. Thus, (1) one doll preferred toy-A, one doll preferred toy-B, and children were asked which toy they preferred; (2) the dolls used different sides of a bell apparatus to ring a bell, and children then rang the bell using one of the sides; (3) when asked which of two toys was a "wug", one doll pointed to toy-C, one doll pointed to toy-D, and children were asked to give E the wug; and (4) when asked which of two toys rattled when shaken, one doll pointed to toy-E, one doll pointed to toy-F, and children had to find the rattle. Across trials, toddlers significantly endorsed the preferences and opinions of the resource-rich doll. Experiment 2 built on prior findings about interventions designed to reduce social biases and examined whether toddlers' preference for the resource-rich doll might be reduced by providing personal details about each doll outside of her resource-status. Our procedure was similar to that of Experiment 1 with one exception: Before the familiarization trials, toddlers were shown two separate story books that reported three items about each doll (e.g., one doll had a sister, liked coloring books, and enjoyed swinging on the swing at the park). After E read the stories, the same familiarization and test trials as in Experiment 1 took place. Across all four test trials, toddlers now endorsed either doll at chance-level. Together, our results indicate that a preferential bias toward the resource-rich is already in place by 25 months of age and that a simple intervention that provides additional personal information about the resource-rich and the resource-poor helps reduce this bias.

P2-G-202 Cosleeping and Attachment: Does Sleep Arrangement Matter

Kaitlin Fronberg[1], Douglas Teti[1]

[1]Pennsylvania State University

The choice of using solitary vs. cosleeping sleep arrangements in infancy has generated much debate. Advocates of cosleeping note that cosleeping safely practiced promotes breastfeeding and easier infant monitoring (Ball, 2003; McKenna et al., 2007). Others, however, note the links between cosleeping and reduced parent and infant sleep quality and increased parenting stress, particularly when cosleeping is prolonged (Teti et al.,

2016). Relatively few studies have attempted to link cosleeping with formative developmental milestones in infancy, such as attachment security. A recent study (Mileva-Seitz et al., 2016) reported links between solitary sleep and insecure attachment; however, this research only looked at sleep arrangements at 2 months and did not take into account that infant sleep arrangements are quite fluid across the first year (McCoy at al., 2004). The present study examined first-year sleep arrangement patterns in predicting infant attachment security at 12 months. In addressing this question, we note that attachment theory says little about linkages between infant sleep arrangements and attachment security and ties infant attachment straightforwardly to quality of parenting behavior. Thus, we hypothesized that any linkage between first-year sleep arrangement patterns and infant attachment would be accounted for by quality of parenting. One hundred sixty-seven primarily Caucasian families (83%) with healthy infants were home-visited when infants were 1, 3, 6, 9, 12 months. Parents reported on sleep arrangements at each age point and infants were broken into two main first-year sleep arrangement categories: Predominant cosleepers slept with their parents in the same room and/or same bed as parents for at least the first nine months. Predominant solitary sleepers slept in a room separate from parents before 6 months and remained in solitary sleep the rest of the year. Security of infant-mother attachment was assessed at 12 months with the Attachment Q-Set (Waters, 1995) by blind observers trained to high reliability. At each age point, mothers' parenting quality was assessed from videorecordings of bedtime parenting, using the Emotional Availability (EA) Scales (Biringen, 2000). Mothers' bedtime EA was highly stable across age (rs = .31 to .61, all ps < .05), and thus EA scores across the first year for each mother were combined. Analyses of variance revealed that infants in predominantly solitary sleep were more security attached to mothers than infants in predominantly cosleeping arrangements (M=.43 vs. .37, $p < .05$). However, EA among mothers in predominantly solitary sleeping arrangements was also significantly higher than among mothers in predominantly cosleeping arrangements (M = 5.41 vs. 3.26, $p < .001$). Subsequent analyses of covariance, controlling for maternal EA, revealed no differences between predominantly solitary and predominantly cosleeping infants in attachment security, and thus the association between first-year sleep arrangement patterns and insecure attachment was accounted for by quality of parenting. These findings nevertheless beg the question of why persistent cosleeping was associated with less sensitive parenting. We plan to address this issue in more depth come conference time, with analyses that compare well-adapted vs. poorly-adapted persistent cosleepers on various measures of parental and family well-being across the first year.

H: Emotional Development

P2-H-203 Infant Emotion Discrimination from Biological Motion

Marissa Ogren[1], Brianna Kaplan[2], Kerri Johnson[1], Scott Johnson[1]

[1]University of California, Los Angeles, [2]New York University

Emotion discrimination, the ability to differentiate one discrete emotional state from another, is critical for social development because it provides the foundation for recognizing and understanding emotions, vital skills for successful social interactions. Infants begin to distinguish between different emotions from a young age, and their ability to discriminate facial expressions of emotion and emotional tones of voice is well-established. However, less is known about infant emotion discrimination from body movements (Missana, Atkinson, & Grossman, 2015; Zieber, Kangas, Hock, & Bhatt, 2013). Here, we ask if infants discriminate between distinct emotions in point-light displays (PLDs) produced by affixing a small number of illuminated dots on the joints of a person walking in place on a treadmill. Emotions in PLDs were produced by asking walkers to imagine emotional scenarios to induce anger, happiness, sadness, or a neutral state prior to recording their gaits. In Study 1, 26 infants (Mage=14.7 months; SD=2.0) viewed 18 side-by-side pairs of 10s videos: angry/neutral, happy/neutral, and sad/neutral PLD walkers as the infants' eye movements were recorded. Motion parameters (extent and speeds of dot motions) of each PLD were also measured. Infants looked more at angry > neutral ($t(25)=3.167$, $p=.004$), happy > neutral ($t(25)=3.312$, $p=.003$), and neutral > sad ($t(25)=-4.132$, $p<.001$). In each pairing, infants looked more to the PLD with more total body movement. Therefore, we conducted Study 2, which presented a new group of 26 infants (Mage=15.0 months; SD=2.4) with inverted versions of the same pairings, as inversion disrupts adults' processing of social stimuli (faces and PLDs). Study 2 yielded similar findings to Study 1 (Angry > neutral: $t(25)=3.811$, $p=.001$, Happy > neutral: $t(25)=2.724$, $p=.012$, Neutral > sad: $t(25)=-2.238$, $p=.034$), indicating that the results of Study 1 could have been driven by low-level motion preference. Results from Study 1 and Study 2 are depicted in Figure 1. We are currently conducting Study 3, which directly pairs all three emotional stimuli (angry/happy, angry/sad, happy/sad) in both orientations. The angry and happy stimuli do not significantly differ in terms of total movement, but both have more movement than the sad stimuli. Data collected thus far (N=16, Mage=16.0 months; SD=2.2) show that in the upright orientation infants looked more at angry > sad ($t(15)=1.883$, $p=.079$), happy > sad ($t(15)=2.57$, $p=.021$), and about equally to angry and happy ($t(15)=0.153$, $p=.880$). Similarly, in the inverted orientation the infants looked more at angry > sad ($t(15)=2.666$, $p=.018$), happy > sad ($t(15)=2.183$, $p=.045$), and about equally to angry and happy ($t(15)=1.076$, $p=.299$). Results from Study 3 are depicted in

Figure 2. Overall, the results indicate that 15-month-old infants discriminate emotions in human walking motions based on total movement, but may not discriminate such emotions independently of this low-level motion preference. This suggests that discrimination of emotional body movements may develop later than discrimination of emotional faces or voices.

P2-H-204 Social Support Moderates the Relation between Childhood Trauma and Prenatal Depression in Teen Mothers

Amanda Nowak[1], Patty Kuo[1], Julia Braungart-Rieker[1]

[1]University of Notre Dame

Prenatal depression is a strong predictor of postpartum depression and subsequent negative parent and child outcomes (Edwards & Hans, 2016; Luoma et al., 2001; Robertson et al., 2004). Moreover, there is substantial research linking childhood trauma with later depression in adulthood (Mandelli et al., 2015). However, less is known about the relation between childhood trauma and prenatal depression. It is possible that positive factors in mothers' lives (e.g., social support) mitigate the deleterious effects of trauma history on depression. These moderating mechanisms may also vary as a function of mothers' risk status (i.e., teen mothers versus adult mothers). Given the predictive value of prenatal depression, it is important to understand the factors that influence and ameliorate depressive symptoms during pregnancy. The purpose of the current study was to determine whether maternal childhood trauma predicts prenatal depression and whether mothers' social support moderates this relation. We also explored whether these relations were different for teen and adult mothers. The sample followed 682 first-time mothers and their infants (50% male) from mothers' third trimester of pregnancy until their child was 36 months old (Borkowski et al., 2011). Teen mothers (TM) accounted for 58% of the total sample and adult mothers (AM) accounted for 42% of the total sample. Self-report data for maternal social support (MSSI; Pascoe & Earp, 1984) and prenatal depression (BDI-II; Beck, 1996) were collected during the third-trimester home visit. Mothers' self-reported childhood trauma (CTQ; Bernstein & Fink, 1998) was collected during the 6-month home visit. To test a model in which social support moderated the relation between childhood trauma and prenatal depression differently for TM and AM, we conducted a multigroup moderation analyses (Muthén & Muthén, 1998-2002). When regression paths for TM and AM were freely estimated, model fit was excellent, RMSEA = .00, CFI = 1.00, $\chi 2(3) = .0$, $p = 1.00$ (see Figure 1), and fit significantly better than the fully constrained model, $\chi 2diff(3) = 8.12$, $p < .05$. For both TM and AM, experiencing greater

childhood trauma significantly predicted higher levels of prenatal depression. Both social support and its interaction with childhood trauma was significant in predicting prenatal depression for TM (p's < .05), but neither was significant for AM (p's > .37). TM simple slopes (Preacher et al., 2006) revealed that at low levels (-1SD) of social support, childhood trauma was positively associated with prenatal depression, and the slope was significantly different from zero, t = 3.53, p < .05. In contrast, at high levels (+1SD) of social support, the slope was not significantly different from zero, p = .90 (see Figure 2). Although childhood trauma predicts prenatal depression for both low- and high-risk mothers, social support for at-risk mothers may be particularly salient for ameliorating depressive symptoms. These results have implications for preventative interventions for reducing rates of prenatal depression in young mothers.

P2-H-205 Examining Pathways Linking Maternal Depressive Symptoms to Maternal Sensitivity: Role of Maternal Causal Attributions

Pamela Norcross[1], Esther Leerkes[2]

[1]University of North Carolina at Greensboro, [2]The University of North Carolina at Greensboro

Maternal characteristics may contribute to individual differences in the quality of caregiving (Belsky, 1984). In particular, elevated maternal depressive symptoms are associated with less sensitive maternal behavior (Goodman et al., 2011), including less sensitive responding to infant distress signals (Leerkes, 2010). For intervention purposes, it is important to identify mechanisms that explain the association between depressive symptoms and compromised sensitivity to infant distress. Interpreting infant cues may be difficult for mothers with elevated depressive symptoms (Field, 2010). For example, depressed mothers are more likely to make negative attributions about infant behavior, which has been linked with negative parenting in prior research (Sellers et al., 2014). In this poster, we examine the extent to which links between elevated maternal depressive symptoms and maternal sensitivity to distress at 6 months is mediated by two types of causal attributions about infant crying: negative (e.g.,baby is difficult, manipulative), and situational/emotional (e.g.,baby is upset by the situation, no one is helping baby). Mothers (n= 191;50% African American and 50% European American) and their infants (50% female) participated. Mothers rated their own depressive symptoms on the Center for Epidemiological Studies-Depression scale during their third trimester, and when infants were 6 months old. These correlated significantly (r = .42, p < .001) and were averaged. Maternal sensitivity was rated during 3 distress-eliciting tasks (anger, fear, and arm-

restraint tasks) when infants were 6 months. Immediately following the distressing tasks, mothers viewed the recorded tasks, and rated the extent they agreed with causal attributions about why their infant was crying, yielding 2 attribution scores used in this study described above: negative (6 items, overall alpha = .830, and situational/emotional (3 items, overall alpha = .831). The hypotheses were tested in a path analysis using multiple regression, with results presented in Figure 1. Social economic status (SES) was considered as a covariate because it correlated positively with both maternal sensitivity ($r = .50$, $p < .001$) and maternal depression ($r = -.36$, $p < .001$). As predicted, there was an indirect effect of maternal depression on sensitivity through maternal negative causal attributions ($B = -.004$, CI (-0.04, -0.005), such that mothers with elevated depressive symptoms attributed infant crying to negative infant traits, which in turn placed mothers at higher risk for insensitive responses towards their crying infant. Maternal depressive symptoms were directly associated with lower maternal sensitivity ($B = -.34$, $p < .001$) over and above this indirect effect. In contrast, the path from maternal depressive symptoms to situational attributions was not significant ($B = .07$, $p = .33$), ruling out an indirect effect. However, the path from situational causal attributions to sensitivity was significant ($B = .20$, $p < .05$), indicating when mothers have a reasonably accurate, emotion focused understanding of why their infant is crying (i.e. upset by the situation), they are more likely to respond sensitively to their infants. The model accounted for 32.6% of the variability in maternal sensitivity to distress. Helping mothers with depressive symptoms take their infant's perspective, and make fewer negative attributions about infant crying, may be a useful intervention strategy.

P2-H-206 Predictors of Adaptive and Maladaptive Maternal Responses to Toddler Negativity

Adriana Molitor[1], Madison Holland[1], Allison McInnis[1], Sophia Woolery[1]

[1]University of San Diego

Experts agree that parenting practices can promote or undermine the development of coping skills as toddlers manage challenging situations. Researchers also agree that individual differences in parenting can derive from both child and parent characteristics. Nonetheless, predictors of parenting strategies remain unclear, particularly for positive parenting practices among non-risk samples. For example, research suggests that child negativity can evoke harsh control; however, it is unclear whether other aspects of toddler temperament influence other types of maternal responses especially those that are most adaptive during a challenging situation (e.g., problem-focused coping). The present study

explored influences on maternal responses to toddlers' negativity during hypothetically challenging situations. Specifically, we examined whether adaptive versus maladaptive parenting strategies (e.g., problem-focused coping vs. distress or wish-granting) were related to aspects of toddler temperament or maternal emotional-social competence. As part of a larger investigation, 94 mothers of toddlers (M= 31.7 mos.; 47f:47m) from a community sample completed self-report measures of: 1) toddler temperament (ECBQ); 2) maternal emotional-social skills (EQi-S); and 3) maternal use of various parental strategies during scenarios with their toddler (CTNES). We hypothesized that lower toddler negativity and higher maternal emotional-social competence would predict greater likelihood of adaptive responses such as problem-focused coping. Conversely, we predicted that higher toddler negativity and poorer maternal emotional-social skills would predict maladaptive maternal-reported strategies. Analyses confirmed an absence of gender differences in maternal reactions. Moreover, mothers' reported use of problem-focused strategies was unrelated to toddler negativity; instead it was predicted by toddler attentional focus and maternal emotional-social competence. Follow-up hierarchical regression indicated that mothers' emotional-social competence explained their reported use of problem-focused strategies while toddler attention became irrelevant. In terms of maladaptive practices, maternal wish-granting was wholly unrelated to toddler temperament and was tied only to poorer maternal emotional-social competence. On the other hand, higher toddler frustration predicted both maternal distress and punitive reactions. These reactions, respectively, also were linked to toddler inattention and impulsivity. Hierarchical regression indicated that the likelihood of distress responses was explained by poorer maternal emotional-social competence rather than toddler frustration or inattention. Nonetheless, maternal punitive responses remained explained by both toddler impulsivity and lower maternal emotional-social competence. Overall, maternal responses to toddlers during hypothetically challenging situations appeared less related to child dispositions than to mothers' emotional-social competence. Those with better emotional-social competence showed a greater likelihood of embracing problem-focused strategies. Those with poorer emotional-social skills reported tendencies toward ineffective or undesirable reactions (e.g., distress, wish-granting, punitive responses). Yet, maternal punitive tendencies during hypothetical scenarios also were linked to toddler impulsivity. Follow-up observations of maternal behavior during structured observations are planned.

P2-H-207 The Effects of Neighborhood Risk and Surgent Temperament on Internalizing Behaviors Across Early Childhood

Meghan McDoniel[1], Kristin Buss[1], Dawn Witherspoon[1], Ginger Moore[1], Cathi Propper[2]

[1]Pennsylvania State University, [2]University of North Carolina, at Chapel Hill

Child characteristics, (e.g., temperament; Buss,2011; Putnam & Stifter,2008) and environmental characteristics, (e.g., neighborhood disorder; Bush et al.,2010) have, independently, been associated with high levels of internalizing behaviors. Few studies have looked at how child and environmental characteristics differentially affect developing internalizing behaviors across early childhood. In preliminary work, we found child temperament moderated the effect of neighborhood risk on internalizing behaviors at 5-years; the relation between high neighborhood risk and internalizing behaviors was found for low fear children, suggesting fearless children are more prone to the impact of neighborhood risks (McDoniel,2017). To better understand the effect of neighborhood risk and fearlessness on developing internalizing behaviors, the current study examined trajectories of internalizing behaviors from toddlerhood through early childhood and how trajectories differed as a function of fearless temperament (e.g., surgency) and neighborhood risk. Data for the current study were collected from 206 racially/economically diverse families from the southeastern US who participated in a longitudinal study of child health and development from infancy to childhood. Complete data were available for 152 children (80 females;38 families below federal poverty threshold;77 African American, 71 Caucasian, 4 Biracial). When infants were 6-months, mothers reported perceived neighborhood quality, safety, and disorder using Neighborhood Perception and Neighborhood Descriptions scales (Coulton, Korbin, & Su,1996). High neighborhood risk was defined as low quality, low safety, and high disorder. At 36-months, mothers completed the Child Behavior Questionnaire (CBQ) to measure surgent temperament. At 24-,30-,36-, and 60-months, mothers completed the Child Behavior Checklist (CBCL) to measure internalizing behaviors. Latent growth analyses of CBCL internalizing scales revealed optimal fit statistics for a linear model across the four ages (Figure 1; RMSEA=0.07; CLI=0.94; TFI=0.92; SRMS=0.10). The model included neighborhood risk and the CBQ surgency scale as predictors and race/ethnicity, gender, and SES as covariates (Table 1). Neighborhood risk had a significant positive effect on the intercept at 24-months but no effect on the slope (Figure 1). Thus, high perceived neighborhood risk at 6-months was related to greater internalizing behaviors at 24-months, but did not affect change in behaviors across childhood. Surgency had a significant effect on the intercept at 24-months and on the slope; high surgency was related to fewer internalizing behaviors at 24-months but significant increases in internalizing behaviors across childhood (Figure 1). Results suggest internalizing may develop adaptively to the environment. For children in risky neighborhoods, internalizing

behaviors developed early and remained steady across early childhood. Future work could determine if internalizing in risky neighborhoods remains adaptive or becomes problematic later in childhood. We also found surgent children started out low in internalizing but significantly increased across time. It may be that surgency is a marker for differential sensitivity to environments. Alternatively, parents may socialize surgent children differently, especially in high risk neighborhoods. Future work could determine environmental moderators or mediators of increasing internalizing behaviors for surgent children.

P2-H-208 Family Structure and Child Outcomes: Mediation by Parenting and Moderation by Race and Maternal Social Support

Lindsay Taraban[1], Daniel Shaw[1], Thomas Dishion[2], Melvin Wilson[3]

[1]University of Pittsburgh, [2]Arizona State University, [3]University of Virginia

American families have become increasingly diverse and fluid, with only a quarter of children now being raised by their married, biological parents (Fields et al., 2001). Prior research has indicated that overall children experience more optimal emotional, behavioral, and academic development when raised by married parents compared to single mothers or mothers with unstable romantic partners (Murry et al., 2001; Stephens 2006). Parenting has been theorized as one potential mechanism for this association, but little empirical research has tested this claim (Dunifon et al., 2002). Further, although father presence in early childhood has been shown to have a positive effect on development (Lewis & Lamb, 2003), it is unclear whether this remains the case when fathers are in and out of the home throughout early childhood. Finally, family structure should be considered in a broader ecological context, taking into account factors like family background and social support networks, which may provide buffers against stressors such as single parenthood (Armstrong et al., 2005). Using data from a diverse, longitudinal sample of low-income families (N = 628; Early Steps Multisite Study; Dishion et al., 2008), the present study tested whether different types of family structure from ages 2 to 4 were associated with child emotional and behavioral outcomes, and whether positive parenting mediated this association. Mothers were grouped into three categories: stably single (from child age two until age four), stably partnered (i.e. had the same live-in partner from child ages two to four), and unstably partnered (i.e. had at least one live-in partnership transition between child ages two to four). Further, based on cultural differences between African American and white families (i.e., presence of kinship networks, single motherhood more prevalent), we tested whether such associations differed as a function of race. Finally,

based on evidence that mothers' satisfaction with social support is associated with both parenting and child outcomes (McEachern et al., 2013), we plan to test the moderating role of maternal social support satisfaction on associations between structure and parenting and between parenting and child outcomes. Measures for this study were taken from home assessments at child ages 2, 3, and 4, and came from previously established and validated observational and report measures (Table 1). Initial analyses using multiple regression revealed that overall, stably partnered mothers displayed higher levels of positive parenting compared to stably singly mothers, accounting for income and parent education level. Future analyses will explore potential differences in this association as a function of race. For both races, children of single mothers had lower levels of behavior problems at age 4 compared to children of mothers who experienced at least one partnership transition, but this association was not mediated by positive parenting. Future analyses will test whether high levels of maternal social support satisfaction moderate the strength of these associations. Overall, initial results highlight the importance of considering not only family structure, but also context and process in understanding links with child behavioral outcomes in infancy and early childhood.

P2-H-209 Maternal Nurturing experiences affects the perception and recognition of adult- but not infant- facial expressions

Michiko Matsunaga[1], Yuari Tanaka[1], Masako Myowa-Yamakoshi[1]

[1]Kyoto University

Perceiving and recognizing the facial expressions are crucial for parenting. Recent studies have shown that mothers' physiological state differs from non-mothers, mother's ability to perceive and recognize facial expression could be influenced by structural and functional changes of their brain and drastic hormonal fluctuation which continue from pregnancy to after giving birth. The present study investigated whether and how maternal nurturing experience influences the perception and recognition of both infant and adult facial expressions. We also consider the relationship with trait anxiety as an individual personal factor. The sensitivity to emotion signals were assessed by comparing the performance of primiparous mothers (n = 25) whose infant were 7- to 10-months old and non-mothers (n = 28) on an emotional face perception task. We used unknown infant and adult stimuli (i.e., neutral, happy, sad) which were changed gradually differing emotional intensity in 10 stages from neutral to 100% intense emotional expressions. Participants asked to detect (1) whether they perceive the emotional signal or not, and (2) The emotion category they perceived from stimuli (happy or sad). we defined sensitivity and accuracy

of emotional signals as follows. Sensitivity; as an index of perception of emotional signals, which means the thresholds of detecting facial emotional signals from. Accuracy; as an index of recognition of emotional signals, which means the accuracy of identifying a category of emotional signals. Trait anxiety was measured with the Japanese version of the State-Trait Anxiety Inventory (STAI). We found that there is no nurturing experience effect on perceptual sensitivity of both infant and adult emotional facial expressions ($F(1,51) = .11$, $p = .74$, $\eta^2 = .00$) by conducting three-way ANOVA. However, mothers had an enhanced accuracy for facial expressions, but only for adults ($G^2(1) = 4.03$, $p < .05$) and not for infants ($G^2(1) = .42$, $p > .05$) by conducting multinomial processing model analysis. Moreover, we also found that there were negative relationships between anxiety and perceptual sensitivity to infant sad and adult happy emotions only in mothers (for infant sad, $R^2 = .11$, $\Delta F(1,49) = 5.48$, $p < .01$; for adult happy, $R^2 = .13$, $\Delta F(1,49) = 7.57$, $p < .00$) by conducting hierarchical multiple regression analysis. As trait anxiety increased so did mother's sensitivity to perceive facial expressions both for infants and adults. In conclusion, these findings suggest that nurturing experience enhance mother's ability to recognize adults' emotional cues. There is a possibility that their amount of experience might be not enough to show a nurturing effect in determine 'unknown' infant faces. Besides, although excessive anxiety and sensitivity to emotional signals may also cause severe stress, an optimal level of maternal trait anxiety (i.e., not clinical level of higher anxiety) may enhance sensitivity for both infant and adult emotional signals.

P2-H-210 You're not my mom! Investigating how face familiarity impacts neural response to emotion in 3.5-month-old infants

Alexandra Marquis[1], Xiaomei Zhou[1], Shira Segal[1], Alysha Bernstein[1], Keisha Gobin[1], Margaret Moulson[1]

[1]Ryerson University

Being able to recognize faces and understand different emotions is critical to infants' social interaction. Newborns can discriminate between familiar and unfamiliar faces (Bushnell, 2001); by 3 months of age, infants can differentiate between emotional expressions (e.g., happy and fearful; Quinn et al., 2011). Despite extensive research into the development of identity and emotion recognition, few studies investigate their interaction. A few studies have found that infants recognize emotion more readily when expressed by caregivers (e.g., mom; Walker-Andrews et al., 2011). No one has yet investigated the neural underpinnings of this phenomenon. In the current study, we aim to understand the neural mechanisms underlying how infants process information

regarding face familiarity, emotion, and their interaction. Forty 3.5-month-old infants were presented with familiar (mom) and unfamiliar (female stranger) faces expressing happy and fearful expressions. While viewing faces one at a time, infants' brain activity was recorded using high-density EEG. Preliminary analyses (n=14) focus on the Nc, a negative-going component occurring ~350-600ms post-stimulus presentation over frontocentral leads, reflecting allocation of attention to a stimulus (Courchesne et al., 1981). Mean amplitude was extracted between 378-600ms over left (13, 19, 20, 24), midline (5, 6, 11, 12), and right hemisphere (4, 112, 118, 124). Consistent with past work, we hypothesized that the Nc would be larger to fearful than happy faces, and to mom's than stranger's face. We made no strong predictions regarding the interaction of familiarity and emotion; however, behavioural work showing better recognition of emotion expressed by mom suggests that the differential response to happy and fearful faces may be larger when the emotions are expressed by mom than stranger. Three analyses were conducted on our preliminary data, examining: 1) main effect of face familiarity; 2) main effect of emotion; and 3) their interaction. First, we found no main effect or interactions involving face familiarity on Nc amplitude. Second, we found no main effect of emotion, but a significant interaction between emotion and hemisphere ($F(2, 26) = 4.95$, $p = .029$). Follow-up tests suggest the response to happy faces was larger than the response to fearful faces over left hemisphere, whereas the reverse was true over right hemisphere, although no differences reached significance likely due to small sample size. Third, we found no significant interaction between familiarity and emotion. However, an examination of the means revealed an interesting pattern that may emerge when more infants are included in the analysis: when responding to mom's face, infants showed a larger Nc in response to happy (M=-6.63μV) than fearful (M=-3.24μV) faces. Conversely, when responding to stranger's face, infants showed a larger Nc in response to fearful (M = -10.04μV) than happy (M = -6.23μV) faces (Figure 1). Although firm conclusions cannot yet be drawn, our preliminary results suggest that face familiarity influences the neural processing of emotion in young infants. Given recent theoretical perspectives (Young & Burton, 2017) suggesting qualitatively different processing of familiar and unfamiliar faces, findings from the current study are timely and important in understanding the early development of such abilities

P2-H-211 Approach/Avoidance Responses to Novelty in Infancy as an Early Predictor for Behavioral Inhibition

Emma Margolis[1], Apongnwu Fopenawoh[1], Leslie Schneider[1], Ellen Leibenluft[2], Daniel Pine[2], Nathan Fox[1], Courtney Filippi[3]

[1]University of Maryland, [2]National Institute of Mental Health, [3]University of Chicago

Behavioral inhibition (BI) is a temperament defined by the tendency to withdraw from novel situations. While BI emerges around age 2, the precursor to BI, negative reactivity, emerges as early as 4 months of age (Fox et al, 2014). Negative reactive infants show high levels of motor activity and negative affect and have been shown to longitudinally exhibit more fearful and inhibited behavior (e.g., Kagan et al, 1988; Fox et al, 2015). The current study aims to understand two types of motor behavior exhibited by infants during 4-month reactivity assessments: approach and avoidant behavior. We hypothesize that infants showing high negative affect at 4 months will exhibit high levels of concurrent avoidant behavior. We further hypothesize that negative reactive infants that show high avoidance will be the most likely to exhibit behavioral inhibition in the preschool years. 291 4-month-old infants came into the lab for a reactivity assessment. During the reactivity assessment, experimenters presented mobiles with 1, 3, or 6 toys to the infant one at the time (for a total of 18 trials) and video recorded the infant's response. Coders identified: total motor activity, and affect (positive vs. negative vocalizations) and approach and avoidant behavior. Approach behavior was operationalized as instances when the infant reached out toward the mobile while looking at it. Avoidance was operationalized as turning away from the mobile. To evaluate relative differences across the approach/avoidance spectrum we computed differences scores (approach minus avoidance). Positive differences scores indicate a tendency towards approach behavior, negative scores indicate a tendency toward avoidant behavior and scores near 0 indicate equal amounts of approach and avoidant behavior. Preliminary results demonstrate that, as a group, negative reactive infants exhibited relatively more avoidance than positive reactive infants ($p<.032$; See Figure 1). This pattern was specific to the comparison between positive and negative reactive infants--overall, there was no association between negative affect and tendency to exhibit avoidance ($p>.192$). Next, we evaluated whether approach/avoidance tendency moderated the relation between affective reactivity and BI. Preliminary results indicated that approach/avoidance tendency moderated the relation between affect and BI ($R2change=.0375$, $F(1,231)=9.0232$, $p<.003$)--such that among positive reactive infants there was no association between approach/avoidance tendency and BI. However, among negative reactive infants there was a positive association between approach/avoidance scores and BI; indicating that those negative reactive infants who show the relatively more approach behavior during the reactivity assessment showed the highest BI scores as toddlers. Negative reactive infants that showed a tendency toward avoidance showed lower rates of BI (See Figure 2). Surprisingly, these data demonstrate that the negative reactive infants who reach toward the novel stimuli showed higher BI at age 2. To better understand this pattern, we are currently examining

how approach & avoidant behavior unfold over time (using latent growth curve analyses) and coding infant attention. Infant attention could tell us whether our operationalization of approach/avoidance is detecting differences in ability to disengage from the novel stimulus. These findings provide novel insight into the behavioral precursors of BI.

P2-H-212 Attention Bias in Context: Profiles of Family Emotional Climate Contribute to Infant Temperament and Attention to Threat

Leigha MacNeill[1], Jessica Burris[2], Kelley Gunther[1], Koraly Pérez-Edgar[1], Kristin Buss[1], Vanessa LoBue[2]

[1]Pennsylvania State University, [2]Rutgers University

Early occurring individual differences in attention may play a role in shaping developmental trajectories across childhood. Preferential attention to emotion appears very early in life. Children use attention to selectively process the environment and regulate their emotions, especially in situations that evoke negative affect (Pérez-Edgar & Hastings, in press). Individual differences in infants' developing attention patterns may be in part due to proximal environmental influences, such as early experiences in the family (Pollak, 2003). Parental anxiety (Morales et al., 2017), psychosocial stress (McLoyd, 1998), and attention allocation to emotions (Pollak, 2003) may serve as a model of emotional responding for children, particularly for young infants as they rely on their parents for learning how to navigate their social world. Infant temperament is also likely to predict children's attention allocation to emotions, as young children's negative affectivity has been positively associated with greater attention bias to threat (Cole, Zapp, Fettig, & Pérez-Edgar, 2016). Little research, however, has tested how these components of the family's emotional climate operate together to contribute to children's developing attention via infant temperament. Constructing profiles of family emotional climates using multiple indicators of parental modeling can provide a more nuanced representation of how early experiences in the family influence infants' developing attention allocation to emotions. Participants to date were 34 infants and their parents who are part of an ongoing longitudinal study on the development of attention processes. Infants (68% boys) were evaluated at age 4 months (Mage=4.49 months, SDage=.60 months). Parents completed the State-Trait Anxiety Inventory (STAI; Spielberger, 1983) to measure trait anxiety and the Confusion, Hubbub, and Order Scale (CHAOS; Matheny et al., 1995) to measure psychosocial stress. To measure infants' temperamental negative affect, parents completed the Infant Behavior Questionnaire--Revised (Gartstein & Rothbart, 2003). Parents also completed the eye-tracking version of the dot-probe task (MacLeod,

Matthews, & Tata, 1986). We assessed attention allocation to threatening faces via net dwell time. Infants will complete the eye-tracking version of the baby dot-probe at their 8-month assessment to measure attention allocation to threat. A latent family emotional climate score was created by standardizing measures of parent anxiety, psychosocial stress, and attention allocation to threat. Correlations are presented in Figure 1. A preliminary regression analysis revealed that the family climate latent score positively predicted infant negative affect (β=.271, t=2.36, p=.03). This suggests that greater combined environmental risk is linked to higher temperamental negative affect in infants. As the sample size increases, forthcoming analyses will include a latent profile analysis to construct family emotional climate profiles. Further, a moderation model will be tested to examine whether infants' negative affect at 4 months moderates the association between family emotional climate profile probabilities at 4 months and infant attention allocation to threat at 8 months of age. We hypothesize that a higher probability of belonging to a riskier family climate at 4 months will be linked to greater threat attentional allocation at 8 months for infants with heightened levels of negative affect.

P2-H-213 Exploration of Quadratic Relationships Between Prenatal Maternal Chronic Cortisol and Infant Negative Emotionality

Nora Erickson[1], Maria Gartstein[1], Sydney Iverson[2], Eric Desmarais[1]

[1]Washington State University, [2]University of Arizona

The current pilot study investigated non-linear relationships between prenatal maternal hair cortisol levels and early indicators of infant negative emotionality. Chronic cortisol concentration was explored as a biomarker of fetal exposure, given that maternal HPA-axis functioning plays an important role in the programming of infant temperament. Results indicated higher maternal cortisol levels in pregnancy were associated with greater infant reactivity. Study participants included a subset of pregnant women (n = 25) in their third trimester who were enrolled in a larger study examining interrelationships between prenatal anxiety and early indicators of infant negative emotionality. At baseline, participants completed an online questionnaire assessing demographic information, subjective stress, and indicators of depression and anxiety. To measure chronic cortisol levels, a hair sample was collected from the posterior vertex of the scalp when participants were approximately 36-weeks-gestation (SD = 1.15). A 3 cm portion proximal to the scalp was analyzed for each participant using the ELISA (enzyme-linked immunosorbent assay) procedure, with cortisol concentrations reported in pg/mg (Russell et al., 2014; Mean = 7.90, SD = 7.21). At Time 2, participants were contacted again at approximately 9 weeks

postpartum (SD = 1.15) and completed follow-up online questionnaires measuring birth outcomes, postpartum mental health, and infant temperament (assessed via the Infant Behavior Questionnaire-Revised, Short Form; IBQ-R; Gartstein & Rothbart, 2003; Putnam et al., 2014). Both factor-level and fine-grained indicators of infant negative emotionality were examined, including infant sadness, fear, distress to limitations, and falling reactivity. Given the exploratory nature of the study and small sample size, results were interpreted as significant at a p-value .10. Because multicollinearity was indicated, a composite variable ("prenatal distress") was created by combining scores for maternal self-reported depression (Edinburgh Postnatal Depression Scale; Cox et al., 1987), state anxiety (State Trait Anxiety Inventory; Spielberger et al., 1989), and perceived stress (Perceived Stress Scale; Cohen et al., 1983). Research questions related to longitudinal associations between prenatal maternal chronic cortisol and infant negative emotionality indicators were examined using linear regression analysis. Prenatal distress was entered first in all regression models. In Step 2, a nonlinear contribution of cortisol (i.e., quadratic cortisol term) was examined, controlling for the linear relationship (i.e., average cortisol concentration), given prior research indicating curvilinear links between stress exposure and a variety health-related outcomes (see e.g., Bush et al., 2011). Results were notable for a significant quadratic effect of prenatal chronic cortisol on the over-arching factor of infant negative emotionality, as well as the fine-grained measures of infant falling reactivity and distress to limitations. No significant effects were noted for infant sadness or fear (see Table 1). As depicted in Figure 1, the observed pattern of results indicated that lower maternal cortisol concentrations were associated with lower negative emotionality and distress to limitations, as well as higher falling reactivity. Overall, these preliminary results were consistent with expectations, yet warrant replication.

P2-H-214 Infant Frontal EEG Asymmetry Moderates the Association between Early Maternal Intrusiveness and 36-Month Anxiety and Depression

Ran Liu[1], Martha Ann Bell[1]

[1]Virginia Tech

Frontal EEG asymmetry (FA) represents the asymmetrical frontal brain activity of the two hemispheres, and has been widely related to approach-withdrawal motivation (Harmon-Jones & Gable, 2016) and psychopathology (Gatzke-Kopp et al., 2014). The power of FA to directly predict psychopathology is modest, however, and may be better understood as a moderator of the effect of the environment on developmental outcomes (Peltola et al., 2014). For example, for children (ages 6-13) at high familial-risk for depression, greater

right FA exacerbates the effects of stressful life events on internalizing (Lopez-Duran et al., 2012). To the best of our knowledge, no one has examined the moderating effect of FA between maternal negative behaviors and child internalizing behaviors across early development. The goal of our study was to examine how FA at 10 months moderated the association between maternal intrusiveness at 10 months and anxiety/depression at 36 months. Participants included 202 infants (104 boys, 98 girls) and their mothers. Baseline EEG at 10 months was recorded as the infant sat on mother's lap observing an experimenter manipulate an infant toy with bouncing balls. EEG power was computed for the 6-9 Hz infant alpha frequency band, which has been associated with patterns of emotion reactivity and emotion regulation during infancy (Bell & Fox, 1994). EEG power was expressed as mean square microvolts and the data were transformed using the natural log (ln) to normalize the distribution. We focused on FA at medial frontal (F3/F4), which is correlated with emotion, psychopathology, and approach-withdrawal motivation (Reznik & Allen, 2017). FA values were computed by subtracting left EEG power from right EEG power (F4-F3). Because power in the 6-9 Hz band is inversely related to cortical activation (Fox, 1994), a negative asymmetry score reflects greater right frontal activation (associated with withdrawal) and a positive asymmetry score reflects greater left frontal activation (associated with approach; Smith & Bell, 2010). Maternal behavior was recorded during a 2-minute free play task, during which mothers were told to play with their infants as they would at home. Maternal intrusive behaviors (e.g., intrusive physical manipulations) were coded off-line on a 4-pointed Likert-scale (i.e., 1 none to 4 high). The ICC reliability was .95. Anxious and depressed outcome at 36 months was measured by Child Behavioral Checklist (CBCL 1½-5 anxious/depressed; Achenbach & Rescorla, 2000). Regression analysis indicated that maternal intrusiveness at 10 months positively predicted anxiety/depression at 36 months. This association was moderated by FA at 10 months (Table 1). We used one standard deviation plus (i.e., left FA) and minus (i.e., right FA) the mean of moderator to plot the variables and test the statistical significance for each simple slope. The association between maternal intrusiveness and anxiety/depression was significant only when infants showed relatively higher right but not left FA (Figure 1). These data highlight that left FA, considered an approach-directed motivation (Harmon-Jones & Gable, 2016), mitigates the adverse effects of maternal negative behaviors on the development of anxiety and depression in early childhood.

P2-H-215 Using Child Behavior Checklist Detecting and Assessing Preschool Children with Autism Spectrum Disorder.

Yu-Han Lin[1], Chin-chin Wu[1]

[1]Kaohsiung Medical University

Background and Objectives: Children with autism spectrum disorder (ASD) usually accompanied emotional and behavioral problems. Children with emotional and behavioral problems could result in more impairments on their social and communication, thus make stress on their caregivers. Children Behavior Checklist 1.5-5 (CBCL/1.5-5) is a tool for evaluating emotional and behavioral problems of preschool children and is used to screen ASD children. However, there is no research in Taiwan. In this study, the CBCL/1.5-5 is used to detect and assess preschool children with ASD. Methods: 328 children under 48 months old, including 130 children with ASD, 135 children with developmental delay (DD), and 63 children with typical development (TD). The CBCL/1.5-5 was completed by the caregivers for measuring emotional and behavioral problems of all children. Results: ASD group is higher than DD group and TD group on internalizing problems of broadband scales, withdrawn subscale of syndrome scales, and pervasive developmental problems subscales of DSM-direct scale. In addition, ASD group is higher than TD group on both externalizing and total problems of main scales, and emotionally reactive of syndrome scales. All of withdrawn, pervasive developmental problems and internalizing problems are better index for distinguishing children with ASD from children with DD. Using signal detection theory, cut-off scores of each subscales are as below: T-score of 65 in the withdrawn subscale, the sensitivity and specificity were 69% and 68%, respectively; T-score of 69 in the pervasive developmental problems subscale, the sensitivity and specificity were 70% and 64%, respectively; T-score of 62 in the internalizing problems subscale as the cut-off, the specificity were 63% and 60%, respectively. All of withdrawn, pervasive developmental problems, attention problems, internalizing problems and total problems are better index for distinguishing children with ASD from children with TD. Using signal detection theory, cut-off scores of each subscales are as below: T-score of 59 in the withdrawn subscale, the sensitivity and specificity were 87% and 75%, respectively; T-score of 64 in the pervasive developmental problems subscale, the sensitivity and specificity were 82% and 81%, respectively; T-score of 56 in the attention problems subscale, the sensitivity and specificity were 73% and 64%, respectively; T-score of 59 in the internalizing problems subscale, the sensitivity and specificity were 75% and 72%, respectively; T-score of 58 in the total problems subscale, the sensitivity and specificity were 79% and 68%, respectively. The results revealed that using the withdrawn and pervasive developmental problems subscale as a screening index for detecting children with ASD, it showed accepted validity. Conclusions: Used the CBCL/1.5-5 as a screening tool for children with ASD, the withdrawn and pervasive developmental problems subscale have moderate validity, suggest the two subscales can be screening tool in the clinical setting.

P2-H-216 Depressed Mothers' Positive Affect with their Partners and their Infants: Evidence for Compensatory Effects on Parenting

Rachel Level[1], Micah Mammen[1], Ginger Moore[1]

[1]Pennsylvania State University

Background: Mothers with depression report more marital conflict, express more negative affect toward partners, and are less positive with infants than other mothers. Examining time-lagged effects, Kouros et al. (2014) found that mothers may "compensate" following unsatisfying marital interactions by investing more positively in parenting. The current study examined time-lagged effects in postpartum mothers observed negative and positive affect during marital discussions and subsequent mother-infant interaction. Compensation theory predicts depressed mothers would be more negative and less positive during discussions with their partners than other mothers but rebound to be more positive with infants during a subsequent mother-infant interaction. Methods: Mothers (N = 46) were observed interacting with their partners and with their 7-month-old infants. Mothers were 20-42 years old (M = 31.00, SD = 5.12) and predominantly Caucasian, married, and middle-class SES. Maternal depressive symptoms were assessed using the BDI-II. First, couples discussed a topic of current conflict for 10 minutes (divided for analysis into two 5-min episodes) followed by a 5-min discussion of positive experiences. Second, mothers participated in a Face-to-Face Still Face (FFSF) with their infants composed of 2-min normal play, still-face, and reunion episodes. Mothers' positive and negative facial and verbal expressions were microcoded at 1-s intervals and aggregated as percentages of time separately by interactive episode (Conflict1, Conflict2, PosExp; NormalPlay, Reunion). Complete data were available for 36 mothers; data were missing due to technical problems or infants unable to complete the FFSF. Results: Repeated measures GLM analysis of positive affect found a significant episode by BDI interaction, $F(4, 31) = 3.02$, $p < .05$. Higher levels of depressive symptoms were related to a greater decrease in positive affect between Conflict1 and Conflict2, $F(1, 34) = 4.34$, $p < .05$, and a greater increase between the PosExp discussion with partners and the FFSF with infants, $F(1, 34) = 8.32$, $p < .01$. To illustrate, mothers were categorized as depressed (n = 6) or non-depressed (n = 30) based on recommended BDI cutoff of 16 (Fig 1). Depressed mothers were sometimes less positive and more negative when interacting with partners and trended toward being more positive with infants than non-depressed mothers (Table 1). Analysis of negative affect found that all mothers showed decreased negative affect between Conflict2 and PosExp, $F(1, 34) = 21.30$, $p < .001$, and between PosExp discussion

and the FFSF, $F(1, 34) = 18.40$, $p < .001$. Discussion: As expected, maternal depression was associated with a decrease in positive affect and more negative affect when interacting with partners. Although all mothers were more positive with their infants than during discussions with partners, depression was related to a greater increase in positive affect with infants following more negative interactions with partners. Findings support compensatory theory and suggest that depressed mothers may try to attenuate negative affect related to marital relationships by enhancing positive interactions with their infants. Given that very high levels of positive affect during mother-infant interaction may be related to lower mother-infant synchrony (Moore et al., 2016), results will be discussed in terms of potential impact on infant social-emotional development.

P2-H-217 Mothers' Self-Reported Emotion Regulation Predicts Infant Outcomes

Esther Leerkes[1], Jinni Su[2]

[1]The University of North Carolina at Greensboro, [2]Virginia Commonwealth University

Parental emotion, and the ability to regulate emotions appropriately, is believed to be an important contributor to optimal parenting and subsequent child adjustment (Dix, 1991). Our own recently published work has demonstrated that mothers' physiological dysregulation while caregiving at 6 months, characterized by skin conductance level (SCL) augmentation and low respiratory sinus arrhythmia (RSA) withdrawal relative to baseline, was directly associated with infants' subsequent attachment disorganization and elevated behavior problems. However, measuring physiological indices of arousal and regulation may not be feasible in large scale research or clinical interventions given the cost. Hence, we sought to determine if: (1) self-reported and physiological indices of emotion regulation correlate; and (2) if self-reported emotion regulation predicts infant attachment disorganization and behavior problems independent of maternal physiology and important covariates (adult attachment coherence and a broad measure of maternal emotional risk). Participants were 259 mothers (50% African American, 50% European American) and their infants (52% female). Mothers' completed the Difficulties with Emotion Regulation Questionnaire (DERS: Gratz & Roemer, 2004) prenatally and at 6 months postpartum. Maternal sensitivity was observed during a series of distress-eliciting tasks at 6 months and 1 year. At 6 months, mothers' SCL and RSA were assessed during a resting baseline and during the distress-eliciting interactive tasks. Infant attachment disorganization was assessed via the Strange Situation at age 1, and mothers reported on child behavior problems on the BITSEA at age 2. Covariates included (1) the 9 point coherence rating derived from the Adult Attachment Interview which was administered to

mothers during the 3rd trimester and (2) a composite of mothers' self-reported prenatal depressive symptoms, neuroticism, agreeableness (reversed), trait positive emotions (reversed), trait negative emotions, and emotion regulation difficulties. The results indicate that mothers who reported more emotion regulation difficulties at 6 months demonstrated lower RSA withdrawal during the interactive tasks at 6 months ($r = -.17$, $p < .05$). Additionally, mothers who demonstrated dysregulated arousal (high SCL augmentation/low RSA withdrawal) during the interactive tasks reported higher emotion regulation difficulties ($M= 1.95$, $SD = .75$) than mothers who demonstrated well-regulated arousal (high SCL augmentation/low RSA withdrawal) ($M= 1.42$, $SD = .25$), $t (45) = 3.28$, $p < .01$. In addition, mothers' self-reported emotion regulation difficulties predicted greater likelihood of being classified as disorganized (see Figure 1) and higher behavior problems (see Figure 2). Moreover, these effects were independent of the prior reported effects of maternal physiological dysregulation while caregiving and other covariates. The previously reported interaction between maternal RSA withdrawal and SCL augmentation remained significant as well. These effects were direct and not mediated by maternal sensitivity. The results suggest that mothers' self-reports of emotion regulation difficulties on the DERS demonstrate convergent validity with physiological dysregulation while caregiving and predictive validity to infant outcomes over and above a host of covariates. As such, it may be a useful tool in future research and intervention efforts focused on parenting and child ad

P2-H-218 Evidence for Dysregulation in Infants of Depressed and Anxious Parents on a Variety of Emotional Tasks

Jessica Burris[1], Denise Oleas[1], Zachary Walden[1], Emily Kim[1], Kristin Buss[2], Koraly Pérez-Edgar[2], Vanessa LoBue[1]

[1]Rutgers University, [2]Pennsylvania State University

Infants of anxious and depressed parents are at risk for developing a number of emotional problems over the course of development. As a result, researchers have taken a vested interest in studying early emotional reactivity in these infants to best identify early markers of future maladaptive behavior. Here we examined differences in 4- to 24-month-olds' (N=123, M=14.14 mos) emotional responding to salient social and nonsocial encounters associated with mothers' self-reported levels of anxiety and depression. Infants participated in the Lab-TAB behavioral battery (Goldsmith & Rothbart, 1999), which assesses individual differences in infants' emotional responding across a number of tasks. Many of the tasks included in the Lab-TAB aim to elicit specific emotional responses. For

example, in one task designed to elicit fear, a mechanical spider toy unexpectedly approaches the infant. In another task designed to elicit anger, infants are presented with an interesting toy (i.e. "bumble pig") that is subsequently placed in a sealed container, preventing the infant from interacting with it for a short period of time. Infants' emotional responses are assessed via measures of facial and vocal affect (both presence and intensity), bodily changes, and other behaviors (e.g., attempts to escape). Here we asked specifically if there is a relation between maternal anxiety levels and whether infants show the expected or normative emotional responses to these tasks. Interestingly, we found that parents of infants who did not show anger in response to the container task had significantly higher depressive symptoms as measured by the Beck Depression Inventory ($F(1, 121)=6.93$, $p=.01$), and significantly higher anxiety levels as measured by both the Beck Anxiety Inventory ($F(1, 121)=6.72$, $p=.01$), and the State-Trait Anxiety Inventory ($F(1, 121)=4.14$, $p=.04$), when compared to infants who showed the expected pattern of emotional responses. A similar pattern was found for a subset of older infants who also participated in the spider task: Infants who did not exhibit facial fear during the spider task had parents with significantly greater depressive symptoms as measured by the BDI ($F(2, 44)=3.18$, $p=.04$). Importantly, there were no significant relations between parental anxiety/depression and infants' emotional responses that were not specifically predicted for these tasks (i.e. joy in response to the spider's approach). These findings have implications for infants' dysregulated behavior (e.g. Buss, 2011) during emotionally evoking situations and their parents' clinical profiles. Data analysis is still ongoing and we aim to extend these results to other tasks in the Lab-TAB battery to investigate whether the links between dysregulated emotional responses and parental anxiety/depression is only evident for tasks designed to elicit negative affect in nonsocial situations, or whether they also extend to tasks that elicit positive affect or involve social interactions with a stranger or the infants' mother.

P2-H-219 Associations of Regulatory Aspects of Parental Functioning, Parenting and the Home Environment with Child Attachment Behaviors

Jessica Williams[1], Holly Brophy-Herb[1], Neda Senehi[1], Danielle Dalimonte-Merckling[1], Hailey Choi[1], Casey Campbell[1], Mara Stein[1]

[1]Michigan State University

Toddlers' attachment behaviors are influenced by parenting and the family climate. We posit that regulatory aspects of parental functioning, including aspects of parenting, and of the home environment play a role in children's organized attachment behaviors. For

example, poor parental regulation and harsher parenting are often related (Crandall, Deater-Deckard & Riley, 2015) and are counter to the climate needed to foster attachment. Similarly, regulatory aspects of the family climate are associated with children's sense of themselves and the familial affective climate (Fiese, 2006) and may relate to attachment behaviors. Little research has used a regulatory framework to examine parental and family characteristics as related to attachment. Thus, this study examined associations between maternal regulatory behaviors, responses to toddlers' emotions, regulatory aspects of the family environment and toddlers' attachment behaviors. Data from 108 mothers (mixed income; 24% of parents had a high school education or less; 76% college or beyond) and toddlers (Mage = 26.24 months, SD = 6.81; 54 girls) were collected in a lab setting via a larger study. Mothers' regulatory behaviors were assessed as parenting distress (Parenting Stress Index-distress subscale; Abidin, 1990) and impulse control (Difficulties in Emotion Regulation Scale; Gratz & Roemer, 2004). Parenting included punitive responses to toddlers' expressions of emotions (Coping with My Toddlers' Negative Emotions Scale; Spinrad et al., 2004). Aspects of the familial regulatory environment included the presence of consistent family routines in the home Family Routines Questionnaire; Fiese & Kline, 1993) and the family's emotional climate (Family Assessment Device- affective responsiveness; Epstein, Baldwin, & Bishop, 1983). Toddlers' attachment behaviors were assessed with the Devereux Early Childhood Assessment (Powell, Mackrain, & LeBuffe, 2007). Hierarchical linear regression analyses revealed that 23% of the variance in attachment behaviors was explained via associations with the maternal and familial regulatory climate, R^2 = .23, F(7, 107) = 5.67, p = .000. Maternal impulsivity was negatively associated with toddlers' attachment behaviors, β = -.22, p = .031. Family routines, β = .19, p = .03, and family affective responsiveness, β = .31, p = .001, were positively associated with attachment. Neither child age, parental education level, maternal distress or punitive reactions to toddlers' emotions, were related to attachment behaviors. Associations between family routines and affect, both aspects of the family regulatory climate, and attachment behaviors underscore the need for a broad familial framework in considering attachment. The family environment plays a key role in children's meaning-making processes (Fiese, 2006). Such processes, including the establishment of routines that carry emotional significance and shared family warmth, likely promote secure internal working models. Maternal impulsivity models dysregulatory behavior for the child and reflects low emotional availability. We anticipated that punitive responses to children's emotions, characterizing dysregulation when toddlers are most in need of support, would relate to less optimal attachment. Low variance in harsher responses may have limited analyses. In summary, results indicate the regulatory aspects

of the parental and home environment, all of which are modifiable, relate to toddlers' attachment behaviors

P2-H-220 Environmental and individual risk factors for co-occurring disorders in clinic-referred preschoolers

Valerie Langlois[1], Aliya Mubarak[1], Allaire Marie-Eve[2], Chantal Cyr[1]

[1]Université du Québec à Montréal, [2]Université du Québec à Montréa

Environmental and individual risk factors for co-occurring disorders in clinic-referred preschoolers Langlois, V., Mubarak, A., Allaire, M., & Cyr, C. A large number of studies on child psychopathology have shown that it is common to have two or more mental health disorders (e.g. Kim & al., 2003). Comorbidity can be predictive of multiple dysfunctions in infancy, as well as an important risk factor for later maladjustment (Newman & al., 1998). Co-occurring diagnosis can be seen as a distinct syndrome, and can result from exposition to shared risk factors (Caron & Rutter, 1991). Numerous studies have shown that factors from the family environment, such maternal insensitivity, are good predictors of child behavior problems (NICHD, 2004; Moss, Cyr & al., 2004). Furthermore, individual risk factors such as difficult temperament traits, can also lead to the development of emotional or behavioral difficulties (Hubin-Gayte, 2006). According to a cumulative risk model, constitutional traits may increase the risk of negative mental health outcomes when combined to damaging environmental conditions, such as maternal insensitivity and psychosocial distress (Hooper & al., 1998). However, to date, very few studies have examined the cumulative effect of the immediate family environment and individual risk factors on co-occurring disorders in young children (e.g. Appleyard, Egeland, Dulmen & Alan Sroufe, 2005). To better understand the mechanisms involved in the co-occurrence of disorders, the current study examined whether the additive roles of maternal insensitivity (as an environmental risk factors) X impulsive temperament trait (as an individual risk factor) are associated to the presence of co-occurring disorders in clinic-referred preschoolers. The sample is composed of 59 children (72% boys; average age of 3 years old) and their mothers, recruited from CHU Sainte-Justine, a child psychiatric hospital clinic in Canada. All instruments have been highly validated. Mothers completed the Temperament Assessment Battery for Children-Revised (TAB; Martin & Bridger, 1999) yielding scores of impulsivity. Child diagnoses and co-occurrence of disorders were assessed by well-trained child psychiatrists using the Axe I of the DSM-IV (APA, 1994). Maternal sensitivity was assessed by an independent observer using The Parent-Child Interaction Scale for Preschoolers (Moss et al., 2005). Results of a logistic regression on

co-occurrence showed a non-significant main effect of temperament (b= 0.384, p=.328), but a marginal main effect of maternal sensitivity (b= -0.801, p=.057) and a significant interaction effect of Child impulsivity X Maternal sensitivity (b= 1.303, p=.026). Post-hoc analyses on the interaction effect revealed that children low in impulsivity and exposed to a high level of maternal sensitivity were significantly less at risk to present co-occurring disorders (b= -2.11, p=.007), while those high on impulsivity, whether their mothers were less or more sensitive, were more likely to present co-occurring disorders (b=-0.786, p=.059. and b=-0.536, p=.418). The discussion will focus on the role of parent-child interactions for low impulsive children as a protective factor against severity of clinical disorders during infancy.

P2-H-221 Emotional Responses and Executive Functioning Predict Women?s Causal Attributions about Infant Crying

Lauren Bailes[1], Mairin Augustine[2], Margaret Swingler[2], Esther Leerkes[3]

[1]University of North Carolina at Greensboro, [2]University of North Carolina at Chapel Hill, [3]The University of North Carolina at Greensboro

Difficulty regulating emotions in response to infant crying has been highlighted as a potential risk factor for harsh or less-sensitive parenting (Leerkes et al., 2011). However, poorer executive function (EF) skills may also undermine sensitive parenting in response to challenging child behavior by increasing the tendency to form unrealistic or negative cognitions about the child and the situation (Deater-Deckard, Wang, Chen, & Bell, 2012). This study examined EF as a moderator of the association between two measures of emotional response (global emotion regulation, ER; cry-specific arousal) and causal attributions about infant crying. It was hypothesized that each emotion measure would predict less-positive causal attributions in participants with poorer EF skills. Participants (87 nulliparous college-aged females, 47.9% White) completed the Behavior Rating Inventory of Executive Function (Gioia et al., 2000), which yielded Behavioral Regulation and Metacognition scales, and the Difficulty with Emotion Regulation Scale (Gratz & Roemer, 2004). Higher scores indicated higher difficulty for each. During a laboratory visit, participants rated their level of arousal after a silent condition and infant cry exposure condition; change in arousal between the crying and silent condition was used as a measure of emotional arousal when exposed to crying. Additionally, participants were shown videos of infants crying in response to fear- and anger-inducing stimuli, and completed questionnaires assessing minimizing (baby was hungry), negative (baby was manipulative), and situational/emotional (baby was upset by the situation) causal

attributions about the infants' crying (Leerkes & Siepak, 2006). Multiple regression models were run to examine interactions between emotional responses (global ER difficulties and cry-specific arousal) and EF difficulties to predict causal cry attributions. Race, socioeconomic status, sleep deprivation, and participant age were included as covariates. Preliminary results revealed significant interactions between EF and emotional responses predicting attributions about the fear clips. Specifically, greater global ER difficulties related to more minimizing attributions for participants higher (B = 0.53, p = .03), but not lower (B = -.26, p = .23), in metacognitive EF difficulties (Figure 1). Additionally, cry-specific arousal related to more situational/emotional attributions for participants lower (B = .07, p = .04), but not higher (B = -.05, p = .11), in behavioral control EF difficulties (Figure 2). Lastly, across emotion responses, more behavioral control EF problems tended to relate to more negative attributions. Data for approximately 20 more participants is anticipated and models will be reanalyzed with the full sample. Taken together, the current results suggest that young women are most likely to make maladaptive causal attributions about crying when they have difficulties with both EF and ER. However, better EF skills can buffer the negative impact of greater emotional arousal in response to infant crying, thus increasing the likelihood of adaptive attributions about crying. Additionally, these patterns appear to be more tied to responses to infant fear relative to anger. These results have potential implications for parenting and warrant replication in parent participants.

P2-H-222 Father's Mental Health Predicts Rating of Child's Externalizing Behavior, Internalizing Behavior and Dysregulation in Toddlers

Lara Kyriakou[1], Andrew Ribner[1], Clancy Blair[1]

[1]New York University

ICIS Poster: Father's Mental Health Predicts Ratings of Child's Externalizing Behavior, Internalizing Behavior and Dysregulation in Toddlers. L. Kyriakou, A. Ribner, C. Blair, The New FAMS Investigators. There is a growing body of research that shows that fathers, like mothers, are at increased risk for depression in the post-partum periods (Goodman, 2004). Depressed fathers in the postnatal period are more likely to have children with behavioral problems (Ramchandani et al., 2008). Despite the findings, the effects of paternal mental health disorders on children's development are under-studied (Kane & Garber, 2004) and may be overlooked for the impact they have on the early development of their child (Cabrera, Tamis-LeMonda, Bradley, Hofferth, & Lamb, 2000; Lamb & Lewis, 2004). It is unclear the mechanisms by which these associations exist, however Ramachandani et al., 2008, suggest that perhaps behavior problems in children with depressed fathers may be

mediated in part through environmental factors. In the present investigation, we explore the role of father's mental health in the perception of their child's temperament and behavior. To do this, we leverage a longitudinal prospective study of N = 388 cohabitating first-time parents across the US, the UK, and the Netherlands. Participants were recruited prenatally from hospitals, prenatal classes, and an OB/GYN practice, and data collection took place prenatally when moms were in their third trimester, and when children were 4-, 14-, and 24-months of age. Fathers completed online questionnaires about their own mental health and their perceptions of their children's development at each time point. A factor score of parent mental health was developed for fathers' mental health using scores on the Center for Epidemiological Studies-Depression (Radloff, 1977), the State-Trait Anxiety Inventory (Spielberger et al., 1983), and the General Health Questionnaire (Goldberg et al., 1997), ($\chi 2(21) = 58.05$, $p < .001$; RMSEA = .061[.043,.080] $p = .155$, CFI = .980). Both fathers and mothers completed the Early Childhood Behavior Questionnaire (Putnam, et al., 2006) when children were 14 months. Correlational analyses reveal that higher levels of father's mental health symptoms was associated with perceptions of children's externalizing behaviors, internalizing behaviors, and dysregulation (r's = .20 - .28, p's < .001). In contrast, father's mental health was unrelated to mothers' ratings of child externalizing and dysregulation (p's > .2), though fathers' mental health remained related to mothers' rating of internalizing behaviors ($r = .10$, $p = .04$). This discrepancy suggests there may be a unique role for fathers' mental health in their personal perception of their children's behavioral regulation. References: Cabrera, N.J., Tamis-LeMonda, C.S., Bradley, R.H., Hofferth, S., & Lamb, M.E. (2000). Fatherhood in the twenty-first century. Child Development, 71, 127-136. Dix, T. & Meunier, L. N. (2009). Depressive Symptoms and parenting competence: An analysis of 13 regulatory processes. Developmental Review, 29 (1), 45-58. Goldberg, D. P., Gater, R., Sartorius, N., Ustun, T. B., Piccinelli, M., Gureje, O., & Rutter, C. (1997). The validity of two versions of the GHQ in the WHO study of mental illness in general health care. Psychological Medicine, 27(1), 191. Goodman JH. Paternal postpartum depression, its relationship to maternal postpartum depression, and implications for family health

P2-H-223 Postpartum Depression and Violations of Parental Childcare Expectations in Coparenting Across the Transition to Parenthood

Regina Kuersten-Hogan[1], Allison Shea[1], Jacleen Charbonneau[1], Maria Kalpidou[1]

[1]Assumption College

Several prenatal and postpartum risk factors have been identified that predict unsupportive coparenting during the transition to parenthood. For example, maternal depression during pregnancy negatively impacts the coparenting relationship (Feinberg, 2003). Violations in mothers' prenatal childcare expectations (Van Egeren, 2004) and discrepancies between mothers' expected and actual postpartum childcare have also been associated with less supportive postpartum coparenting (Khazan et al., 2008). However, it is unclear whether parental postpartum depression (PPD) contributes to violations of prenatal childcare expectations. In addition, little is known about the role of fathers' PPD and childcare expectations in the emerging coparenting relationship. The present study aimed to explore whether parental PPD and childcare expectations during pregnancy predict coparenting dynamics observed at 3 months postpartum. A nonclinical sample of 26 couples was assessed during pregnancy and at 3 months postpartum. Parents' depression was measured using the CES-D (Radloff, 1977) at both assessment points. Parents' expected (pregnancy) or actual (3 months) and preferred childcare division was assessed using the "Who Does What" questionnaire (Cowan & Cowan, 1988). Composite scores measured parents' violated prenatal and postnatal childcare preferences and interparental discrepancies between expected and actual childcare division at 3 months. Prenatal coparenting was observed while couples played with a doll representing their baby (PLTP, Carneiro et al., 2006). Postnatal coparenting was observed during mother-father-baby interactions (LTP, Fivaz-Depeursinge et al., 1999). Interactions were coded for competition, cooperation, verbal sparring, parental warmth and investment, and coparental warmth. Findings indicated that maternal PPD was more predictive of coparenting dynamics than was paternal PPD. Mothers with greater prenatal PPD experienced less harmonious coparenting (greater competition and verbal sparring, lower coparental and maternal warmth) observed at 3 months. Greater interparental differences in expected childcare division during pregnancy and greater violations of mothers' prenatal and 3-months childcare expectations were also associated with less harmonious coparenting observed at 3 months. However, parental prenatal PPD and childcare expectations were also interrelated: Greater prenatal parental PPD was associated with mothers' and fathers' perceptions of greater violations of prenatal childcare preferences at 3 months. Fathers' prenatal PPD was also associated with greater discrepancies between actual and preferred childcare duties reported by both parents at 3 months, while mothers' prenatal PPD was associated with greater interparental differences in 3-month-childcare. In contrast, parents' PPD at 3 months showed no significant associations with their childcare expectations. Partial correlations indicated that violations in childcare expectations continued to predict 3-month-coparenting dynamics even after controlling for prenatal parental PPD (see Table 1). In conclusion, prenatal PPD

and violations of parental childcare expectations represent risk factors for postpartum coparenting. Larger discrepancies between parents' expected and actual postpartum childcare division set the stage for less harmonious coparenting, a finding not explained by parents' PPD. Future research should replicate these findings with clinical families.

P2-H-224 Mother-Toddler Cortisol Synchrony Longitudinally Moderates Risk for Child Internalizing Symptoms

Anne Kalomiris[1], Elizabeth Kiel[2]

[1]Miami University of Ohio, [2]Miami University

Cortisol synchrony, or the mutual regulation of cortisol levels within mother-toddler dyads, provides a foundation for the development of toddler physiological regulation (Feldman, 2012). It is crucial to understand how cortisol synchrony serves as a context for the emergence of anxiety spectrum problems in children. Early risk factors for the development of internalizing symptoms include the toddler having inhibited temperament (Rubin et al., 2002), a mother with anxiety symptoms (Fisak et al., 2012), and receiving protective parenting behaviors (Chorpita & Barlow, 1998). Variability remains in these empirically-established links, however, leading to increased interest in determining contexts that influence their stability. This investigation will longitudinally identify how mother-toddler cortisol synchrony moderates the relation between early risk factors and future internalizing symptoms. Cortisol data was collected from two independent samples of mother-toddler dyads. In the first sample, 70 mothers and their 2-year-old toddlers participated in a laboratory visit to assess both toddler inhibited temperament and toddler and mother total cortisol concentration (Pruessner et al., 2003) in response to novelty. Synchrony was calculated by regressing total concentration for toddlers on the total concentration for maternal cortisol variables, respectively. Unstandardized residuals from each of these regression equations yielded continuous measures of synchrony. Results revealed that higher cortisol synchrony reduced the concurrent association between maternal worry (Penn State Worry Questionnaire, Meyer et al., 1990) and toddler internalizing symptoms (Figure 1; b=-0.01, SE=0.00, t=-2.14, p=.033; Infant-Toddler Social Emotional Assessment [ITSEA], Carter et al., 2003) and inhibited temperament and internalizing symptoms (b=-0.01, SE=0.00, t=-3.19, p=.001; ITSEA, Carter et al., 2003). Higher cortisol synchrony also marginally reduced the risk that inhibited toddlers would develop internalizing symptoms one year later (Figure 1; b=-0.00, SE=0.00, t=-1.72, p=.086). Data collection for the second sample of mother-toddler dyads is ongoing. Currently, 57 dyads have participated in an annual laboratory visit at toddler ages 1, 2,

and 3. Cortisol data in response to novelty episodes was collected from mothers and toddlers at the 1- and 2-year old visit and was processed in an identical manner to the first sample. Cortisol synchrony remained fairly stable across these assessments (r=.56, p=.013). Cortisol synchrony moderated the relation between maternal report of protective behavior at toddler age 1 (Child Rearing Practices Report, Dekovic et al., 1991) and observed anxiety risk one year later (A path; b=-0.03, SE=0.01, t=-2.50, p=.025; Buss & Goldsmith, 2000), such that only at low levels of synchrony did this relation remain (b=1.14, SE=0.50, t=2.27, p=.036). Further, while controlling for protection and this interaction, age 2 anxiety risk related to maternal report of anxiety at age 3 (B path; b=0.37, SE=0.15, t=2.44, p=.027; ITSEA, Carter et al., 2003). Anxiety risk marginally and indirectly linked early protection to future anxiety at age 3 only for those dyads low in cortisol synchrony (IE=0.523, 90% CI [0.027,1.705]). This indirect effect will be reexamined with a larger sample. This suggests the importance of considering how mutual regulation of physiology in mother-toddler dyads buffers against risk for anxiety development.

P2-H-225 Maternal Childhood Trauma and Stress During Pregnancy

Parisa Kaliush[1], Sarah Terrell[2], Brendan Ostlund[1], Mindy Brown[1], Elisabeth Conradt[1], Sheila Crowell[2]

[1]University of Utah, [2]The University of Utah

Background: Pregnant women who have experienced childhood trauma are at heightened risk for continued victimization, lifestyle risk behaviors, more frequent hospitalizations, and preterm birth, which is the leading cause of infant mortality (Wosu, Gelaye, & Williams, 2015). Despite clear and consistent links between childhood trauma and stress during pregnancy, there is little research on mechanisms underlying this association, which hinders comprehensive prenatal care. It is possible that psychophysiological stress reactivity is a mechanism underlying the association between childhood trauma and pregnancy stress, and that these associations vary across levels of emotion dysregulation; however, no research to date has explored these relations. Thus, we propose a moderated mediation model (Figure 1) in which psychophysiological stress reactivity (specifically, respiratory sinus arrhythmia [RSA]) mediates the relation between childhood trauma and pregnancy stress, and emotion dysregulation moderates these associations. We predict that women who report more severe childhood trauma will exhibit greater RSA reactivity in response to an infant cry paradigm and endorse greater pregnancy stress, and these effects will be amplified by greater levels of emotion dysregulation. Method: Participants (n = 85) include English- and Spanish-speaking pregnant women in the western United

States drawn from an NIH-funded study examining intergenerational transmission of emotion dysregulation. Participants are screened and enrolled to over-represent women who score high on emotion dysregulation relative to the typical distribution of scores on the Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004). In addition to completing the DERS, participants complete the Childhood Trauma Questionnaire (CTQ; Bernstein et al., 1994) and UCLA Life Stress Interview (LSI; Hammen et al., 1987). In the lab, participants watch a four-minute video, including a one-minute neutral beach scene (i.e., baseline) and one-minute female infant crying (i.e., cry). RSA reactivity is assessed via BioLab 3.1.2 software, and calculated by subtracting average baseline from average cry RSA values. Results: Preliminary regression analyses revealed a significant main effect of CTQ on LSI scores ($B = .01$, $\beta = .27$, $p < 0.01$), as well as a significant main effect of DERS on LSI scores ($B = .01$, $\beta = .36$, $p < 0.001$; see Table 1), indicating that reports of more severe childhood trauma and greater emotion dysregulation uniquely predict greater stress during pregnancy. We did not find a significant interaction effect between CTQ and DERS on LSI scores. Discussion: Participant recruitment continues, and psychophysiological data as well as the remainder of self-report and interview data is forthcoming. Preliminary findings indicate significant relations between childhood trauma, emotion dysregulation, and stress during pregnancy. Based on previous literature, we anticipate RSA reactivity to the infant cry paradigm will mediate these meaningful relations. Findings will be discussed in terms of a lifespan developmental view of emotion dysregulation as well as implications for the intergenerational transmission of risk and resilience. It is imperative that we study mechanisms underlying pregnancy stress and identify patterns of negative coping before birth in order to inform interventions for vulnerable mothers.

P2-H-226 Young Children's Regulatory Strategies: Associations with Maternal Strategies and Children's Temperament

Caroline Mueller[1], Kelsey van Boxel[1], Melinda Nguyen[1], Hailey Grant[1], Linsay Edwards[1], Anne Hungerford[1]

[1]University of North Carolina Wilmington

Research indicates associations between maternal behavior and young children's anger expression and regulatory strategies, including children's use of distraction. Distraction is associated with less anger (Calkins & Johnson, 1998) and more adaptive behavior (Steelandt, Thierry, Broihanne, & Dufour, 2012) in anger-eliciting contexts. In general, maternal intrusiveness is associated with greater child anger and lower use of distraction;

maternal sensitivity and "gentle" control are associated with lower anger and greater use of distraction (Calkins & Johnson, 1998; Calkins, Smith, Gill, & Johnson, 1998; Feldman, Dollberg, & Nadam, 2011). Most research focuses on "global" maternal behaviors (e.g., sensitivity, control). However, specific strategies that mothers use in anger-eliciting contexts (e.g., distraction) also are likely to have relevance for children's acquisition of effective regulatory strategies (Putnam, Spritz, & Stifter, 2002; Stansbury & Sigman, 2000). It was hypothesized that mothers' and children's parallel strategies in an anger-eliciting context would be positively correlated. Associations between mothers' and children's regulatory behaviors also were expected to be stronger for children higher in temperamental anger proneness than for less anger-prone children, consistent with some past research (Kochanska & Kim, 2013; Razza, Martin, & Brooks-Gunn, 2012). Eighty-one mother-child dyads participated in laboratory assessments when children were 24 and 36 months old. Mothers reported on children's temperamental anger proneness at 24 months via the Toddler Behavior Assessment Questionnaire (TBAQ; Goldsmith, 1996). Mothers' and children's regulatory behaviors were coded at 36 months during an anger-eliciting "locked box" task (PS LAB-TAB; Goldsmith, Reilly, Lemery, Longley, & Prescott, 1993). Strategies were coded in 10-s intervals and included distraction (e.g., mothers making suggestions for other activities; children directing their attention away from the locked box) and object focus (e.g., mothers encouraging children to try to unlock the box; children looking at or manipulating the locked box). Independent teams of coders recorded mothers' and children's strategies. As hypothesized, mothers' and children's use of distraction was positively correlated, $r\ (78) = .62$, $p < .001$, as was mothers' and children's use of object focus, $r\ (78) = .31$, $p = .006$. Hierarchical regression analyses were conducted to examine independent and interactive effects of temperamental anger proneness and maternal regulatory strategies in predicting children's regulatory strategies. The model predicting children's object focus from mothers' use of object focus, children's temperamental anger proneness, and their interaction was not significant, $F\ (4, 71) = 1.42$, $p = .24$ (see Table 1). However, the model predicting children's use of distraction from mothers' use of distraction, children's temperamental anger proneness, and their interaction was significant, $F\ (4, 71) = 8.58$, $p < .001$ (see Table 2). Consistent with preliminary analyses, children whose mothers used distraction were more likely to use distraction themselves. Temperamental anger proneness did not moderate the association between mothers' and children's use of distraction. Implications and limitations of the current study, including the inability to determine the direction of association between mothers' and children's use of strategies, will be discussed.

P2-H-227 Effect of Sadness and Effortful Control on Mastery Motivation in Toddlers

Su-Ying Huang[1], Hsin-Ju Wu[2], Da-Fang Lo[2]

[1]National Chung-Cheng University, [2]Fu Jen Catholic University

Mastery motivation is a goal-directed process that impels children to master skills. Examining the effect of emotionality and self-regulation on motivation will be great of importance in understanding the phenomenology of motivation (Pekrun, 2009; Morgan et al., 2012) and formulating intervention strategies. Sadness expression increases before 18 months old (Axia & Bonichini, 1998) and is related to behavioral demilitarization and goal-regulatory processes (Carver & Scheier, 2011). Effortful control is a broad self-regulatory dimension and provides children with the flexibility to regulate attention, inhibit the immediate influence of dominant response, and activate behaviors to attain goals (Gartstein & Rothbart, 2003; Rothbart & Hwang, 2005). This study adopted the psychobiological approach of temperament by Rothbart et al. (e. g., Rothbart & Derryberry, 1981) to investigate the relationships of sadness and effortful control with both the instrumental and expressive aspects of toddler's mastery motivation. Whether the effect of effortful control on mastery motivation depend on the level of sadness also examined. Sixty-eight Chinese mothers (education level range 12 year to 18 year, mean = 16.12) and their children (age range = 1.75 year to 3.83 year, mean age = 2.89 year), 44 boys and 23 girls participated this study. Mother rated their children's instrumental aspects of mastery motivation including object-cognitive persistence, gross motor persistence, social persistence with adults, social persistence with children (add up to the indicator of total persistence) and expressive aspects of mastery pleasure, negative reactions to challenge using the Dimensional Motivation Questionnaire (DMQ 18; Morgan et al., 2015). Children's sadness and effortful control also rated by their mothers using Early Children Behavior Questionnaire-Short Form (ECBQ-SF; Putnam et al., 2006). Three hierarchical regression analyses were conducted to examine the effect of disposition sadness and effortful control on three indicators of mastery motivation (i.e. total persistence, mastery pleasure, negative reactions to challenge) after controlling for maternal education level and children's gender. Effortful control made a unique contribution to total persistence ($\beta = .36$, $p < .05$). Sadness had no significantly direct effect on any indicator of mastery motivation, however, there was an interaction effect between sadness and effortful control on total persistence, negative reactions to challenge ($\beta = -.31, -.26$, $p < .05, .055$). The interaction effect as depicted in Figure1 showed that a low level of sadness together with effortful control ameliorated total persistence ($\beta = .36$, $p < .05$); Effortful control buffer the effect of high levels of sadness on negative reactions to challenge(Figure 2). Children with higher effortful control had

high persistence while mastery skills and sadness moderated the effect of effortful control on mastery motivation. Nurturing toddler's ability of self-regulation and providing intervention to relieve the occurrence of sadness will be enhancing children's motivation.

P2-H-228 Prenatal Interparental Conflict as a Predictor of Infant Emotion Regulation at 5 Months

Ana Hernandez[1], Jennifer Ablow[1], Sienna Howells[1], Jeffrey Measelle[1]

[1]University of Oregon

Authors: Ana C. Hernandez, Jennifer C. Ablow, Sienna Howells, & Jeffrey Measelle Affiliation: University of Oregon Title: Prenatal Interparental Conflict as a Predictor of Infant Emotion Regulation at 5 Months Introduction: The development of emotion regulation during early childhood has received a considerable amount of attention, especially within infant-caregiver contexts. A newer and much more limited line of research has shifted the focus to the relationship dynamic of multiple caregivers and how this might impact a child's developing emotion-regulatory capacities. Emotional Security Theory suggests that children's adjustment depends on feeling safe and secure in the context of both the parent-child relationship and the interparental relationship. Albeit prior research has linked interparental conflict and children's emotion dysregulation, most of this research has been conducted during the postpartum period after children are born. Largely unexplored is the effect that interparental conflict might exert prenatally despite ample evidence that maternal stress is intimately linked to fetal central nervous system development. This study aimed to address this gap by examining the associations between interparental conflict during the prenatal period, including more extreme forms of conflict and domestic violence, and infants' emotion regulation at 5 months postpartum. Method: A sample of 105 low-SES infant-mother dyads was followed prospectively across the pre- to postnatal transition, as part of a longitudinal project in a mid-sized city in the Pacific Northwest. Mothers came into the laboratory during their third trimester of pregnancy to complete multiple questionnaires, including the Conflicts Tactics Scale 2 (CTS-2), a measure of how much partners engage in psychological and physical conflict, and the Dyadic Adjustment Scale (DAS), a measure of relationship quality. At 5-months postpartum, mothers and infants came into the laboratory to participate in the Still-Face Paradigm (SFP) while being continuously monitored behaviorally and psychophysiologically. For the present analysis, infant respiratory sinus arrhythmia (RSA), an index of parasympathetic regulation of the heart, was quantified during a baseline/resting state, during the 'still-face' phase of the SFP, and during the

reunion phase. At 5 months, mothers again completed the same battery of questionnaires. Results & Discussion: We used multivariate regression models to test the hypothesis that interparental conflict during the prenatal period would have independent associations with infant physiology, while controlling for postnatal conflict. Contrary to prediction, prenatal interparental conflict was not predictive of infant RSA during the 'still-face' or reunion phases at 5 months, although postnatal conflict showed a borderline trend with infant physiology during reunion (ß = -.27, p= .07); specifically, greater postnatal conflict was moderately associated with lower RSA, or greater distress, during reunion. In contrast, greater prenatal parental conflict was associated with significantly higher infant baseline RSA at 5 months (see Figure 1; ß = .35, p = .04). This result suggests that exposure to extremes of interparental conflict prenatally may already be conditioning what will be significantly higher resting state RSA postnatally. We and others have shown that high infant RSA at rest is synonymous with constant physiological attempts to regulate chronic arousal.

P2-H-229 Association between psychosocial stress and faecal microbiota in pregnant women

Christine Hechler[1], Klaudyna Borewicz[2], Roseriet Beijers[1], Edoardo Saccenti[3], Marianne Riksen-Walraven[1], Hauke Smidt[2], Carolina de Weerth[1]

[1]Radboud University, [2]Laboratory of Microbiology, Wageningen University & Research, [3]Laboratory of Systems and Synthetic Biology, Wageningen University & Research

Background: Recent research indicates that maternal psychosocial stress during pregnancy, i.e. general and pregnancy-related anxiety and stress, adversely affects infant birth outcomes and child emotional and behavioral development. While the mechanisms underlying this relation are only partly understood, one of these might be that maternal prenatal psychosocial stress affects child development and health via the mother's, and in turn the child's, intestinal microbiota. Previous research has indeed found links between maternal pregnancy stress and the child's intestinal microbiota (Zijlmans et al., 2015). The goal of the present study is therefore to investigate the remaining part of this potential mechanism, namely the relation between psychosocial stress and faecal microbiota in pregnant mothers. To our knowledge, this is the first study to look at the association between maternal psychosocial stress and microbiota in pregnancy. Methods: During the third trimester of pregnancy (35 weeks gestation), 73 mothers filled in questionnaires on general and pregnancy-specific stress and anxiety. The also provided a stool sample from where microbial DNA was extracted. Results: A significant association was found between

maternal general anxiety and microbial composition. Mothers with high general anxiety had, amongst others, higher relative abundance of Faecalibacterium than mothers with low general anxiety. In contrast, mothers with low general anxiety had, amongst others, higher levels of Lactobacillus and Ruminococcus than mothers with high general anxiety. We also found differences between mothers with high and low anxiety in the relative abundance of bacteria that have previously been associated with physical conditions. In contrast, we did not find any associations between the other psychosocial stress variables and relative abundance of specific microbial groups. Conclusions: The current study shows significant associations between maternal general anxiety during pregnancy and microbial composition. This is an important first step to further investigate associations between maternal prenatal psychosocial stress and maternal and infant intestinal microbiota as a mechanism underlying effects on (later) child outcomes. Moreover, the results provide new leads for future research on potential prenatal intervention strategies using beneficial microbes.

P2-H-230 Maternal Responsivity to 3-Month Old Infant Affect Transitions Predicts Later Infant Negative Affect

Meeka Halperin[1], Kaya de Barbaro[2], Sherryl Goodman[1]

[1]Emory University, [2]The University of Texas at Austin

Sensitive parenting - appropriate and timely responding to infants' cues - is associated with infants' optimal development of physiological, cognitive, social, and behavioral self-regulatory skills (Tronick & Cohn, 1989). Depression interferes with mothers' sensitive responsiveness (Lovejoy, et al., 2000), and sensitivity may mediate the relationship between maternal depression and infants' later development (Milgrom, Westley, & Gemmill, 2004). Maternal depression is also associated with infants exhibiting more negative affect (Aktar et al., 2017). Infants' greater negative affect has been concurrently and prospectively related to decreased ability to self-regulate (Egmose, Cordes, Smith-Nielsen, Vaever, & Koppe, 2017), which is associated with greater risk for social and academic difficulties, and the development of psychopathology (Calkins & Hill, 2007; Zeman, Cassano, Perry-Parrish, & Stegall, 2006). Thus, among infants of depressed mothers, it is important to understand potential contribution of mothers' patterns of contingent responses to infants' cues to infants' expression of negative affect over time. We aimed to elucidate the potential role of contingent discordant maternal affective responses to their infants' affective shifts and hypothesized that 1) a greater rate at which mothers contingently respond with more negative affect when infants transition to more

positive affect, and 2) a greater rate at which mothers contingently respond with more positive affect when infants transition to more negative affect, would predict infants' greater expressed negative affect at 6- and 12-months of age. Mothers (n = 167) with depression histories and their infants were video recorded during 5-minute face-to-face play interactions at laboratory visits when infants were 3-, 6-, and 12-months old. N = 13 infants were excluded for extreme negativity (>84% or 2SD over mean % time in negative affect) and n = 1 for sleeping throughout the segment. We coded mothers' and infants' affect valence and intensity frame-by-frame using Mangold INTERACT, with a high degree of inter-rater reliability (Dawson et al., 1999). We identified all instances in which infants 1) shifted to more positive affect, then calculated the proportion of those shifts in which the mother subsequently responded within 3 seconds with more negative affect; and 2) shifted to more negative affect, then calculated the proportion of those shifts in which the mother subsequently responded within 3 seconds with more positive affect. The median rate at which mothers contingently shifted to more positive affect within 3 seconds of any infant affect shift was 12%, and 13% for more maternal negative affect. As hypothesized, greater rate of mothers' contingent discordant responses to infants' shifts to more positive affect at 3-months (i.e. mothers' shift to more negative affect) predicted a higher proportion of infant negative affect at 6-months, $n = 129$, $r = .19$, $p < .05$, but not at 12-months. A greater rate at which mothers contingently responded with more positive affect to their infants' shifts to more negative did not significantly predict infant negative affect at 6- or 12-months of age. These outcomes suggest that the role of mothers' discordant contingent responses to infants' cues in predicting infants' later negative affect expression may be specific to mothers' negative affect responsivity to infants' positive affect shifts at 3-months of age.

P2-H-231 Maternal Stress and Infant Sleep at 3 Months

Melissa Grimes[1], Marie Camerota[1], Cathi Propper[2]

[1]University of North Carolina at Chapel Hill, [2]University of North Carolina, at Chapel Hill

Objectives Prior literature has provided evidence of the links between caregiver well-being and child sleep. However, most of this work examines factors of psychopathology such as depression and anxiety as proxies for parental well-being (e.g., Armitage et al., 2009; Teti & Crosby, 2012). Perceived stress is an important normative component of well-being, as it is a measure of how well one adapts to the stressors in their particular environment (Cohen, Kamarck, & Mermelstein, 1983). During infancy, children rely on their caregivers to structure their sleep environments and nighttime routines (Sadeh, Tikotzky, & Scher,

2010). It is therefore imperative to understand the normative processes that affect how caregivers can influence their children's sleep. The current study examines the association between maternal perceived stress and infant sleep at 3 months of age. Methods The current study utilizes data from the Neonatal and Pediatric Sleep (NAPS) Study, a prospective and longitudinal study of 102 African-American infants and their caregivers. Maternal perceived stress was measured via self-report on the Perceived Stress Scale-10, which contains 10 questions assessing the extent to which an individual is stressed regarding situations that have occurred in the past month (Cohen et al., 1983). A sample item is "In the last month, how often have you felt that you were unable to control the important things in your life?" Infant sleep was measured via actigraphy throughout the nighttime period for 7 nights. For our analyses, we examined the average nighttime sleep duration and the average longest sleep period at 3 months of age. Results Preliminary analyses reveal that perceived stress was associated with objective infant sleep duration (β = .27, p =.03) and longest sleep period (β = .24, p =.04) when the infant was 3 months of age. Greater maternal stress was linked to higher quality sleep, even when controlling for child gender, family socioeconomic risk, and maternal employment status. Conclusion Contrary to our hypotheses, we found that mothers who report higher levels of everyday stress have children who are attaining higher quality sleep at 3 months of age. Therefore, we will next examine specific maternal behaviors that may be driving this association, including increased maternal anxiety and more structured bedtime routines.

P2-H-232 Relations among parental emotion modeling, cultural orientations, and child adjustment in toddlerhood

Jessica Grady[1], Delaney Callan[1]

[1]University of the Pacific

Parental values and beliefs, including culture-specific values and beliefs (Halberstadt & Lozada, 2011), influence how parents teach about emotions and how this teaching affects child adjustment (Denham et al., 2014). We examined relations among parents' modeling of emotions, cultural orientation, and child social and emotional adjustment in a diverse sample of parents of children between the ages of 20 and 36 months. Relations between individualism and collectivism and emotions have been studied in preschoolers, however less is known about how these cultural orientations may be associated with how toddlers develop emotionally (Halberstadt & Lozada, 2011) or how parents approach the task of teaching toddlers about emotions. Data collection is ongoing. Preliminary data are available from 41 parents (N=40 mothers, 1 father; Mage=31.24 years, SD=4.58) of

children (N=22 boys) between the ages of 20 and 36 months (Mage=24.74 months, SD=3.24). Seven parents identified as Asian American, 1 as Black or African American, 19 as White or European American, 12 as Hispanic or Latino, and 2 as two or more races. Parents' reported their emotion modeling using the Self-Expressiveness in the Family Questionnaire (Halberstat, Cassidy, Stifter, Parke, & Fox, 1995). Two subscales were derived: positive expressivity and negative expressivity. Cultural orientation was assessed with the Cultural Orientation Scale (Triandis & Gelfand, 1998). Following Triandis and Gelfand (1998), we created scores for vertical and horizontal collectivism and individualism. Child social and emotional adjustment was measured using the Brief Infant Toddler Social and Emotional Assessment (Briggs-Gowan, Carter, Irwin, Wachtel, & Cicchetti, 2004), from which we derived scores for three domains of adjustment: internalizing, externalizing, and competence. All scales showed appropriate reliability (α>.75). Correlations among variables are reported in Table 1. Direct associations were found between parental positive expressivity and parent-rated child internalizing, externalizing, and competence (see Table 1). Parents higher in positive expressivity reported their children as less internalizing and externalizing and more competent socially and emotionally. Results also indicated that parents who expressed more positive emotions reported stronger values of horizontal and vertical individualism and horizontal collectivism. Next we tested for mediation, based on the following criteria (Holmbeck, 1997): a) parental expressivity (predictor) was associated with parental cultural beliefs (mediator), b) parental expressivity (predictor) was associated with child adjustment, and c) parental cultural beliefs (mediator) were associated with child adjustment. Mediation was tested using multiple regression analyses (see Table 2). Results indicated that the association between parental positive expressivity and child externalizing behavior was mediated by parental horizontal individualism, and the association between parental positive expressivity and child competence was mediated by parental vertical individualism. Combined, these findings indicate that parents who value horizontal and vertical individualism and horizontal collectivism tend to be more affectively positive in their interpersonal interactions with their toddlers. Affective positivity also bodes well for children's positive adjustment through parental valuing of vertical and horizontal individualism.

P2-H-233 The development of spontaneous facial responses to others? emotions in infancy. An EMG study

Elena Geangu[1], Jakob Kaiser[2], Maria Magdalena Crespo-Llado[3], Chiara Turati[4]

[1]University of York, [2]Ludwig-Maximilians University Munich (LMU), [3]Lancaster University, [4]University of Milano-Bicocca

Viewing facial expressions often evokes facial responses in the observer. These spontaneous facial reactions (SFRs) are believed to play an important role for social interactions. However, their developmental trajectory and the underlying neurocognitive mechanisms are still little understood. In the current study, 4- and 7-month old infants were presented with facial expressions of happiness, anger, and fear. Electromyography (EMG) was used to measure activation in muscles relevant for forming these expressions: zygomaticus major (smiling), corrugator supercilii (frowning), and frontalis (forehead raising). The results indicated no selective activation of the facial muscles for the expressions in 4-month-old infants. For 7-month-old infants, evidence for selective facial reactions was found especially for happy faces (leading to increased zygomaticus major activation) and fearful faces (leading to increased frontalis activation), while angry faces did not show a clear differential response. This suggests that emotional SFRs may be the result of complex neurocognitive mechanisms which lead to partial mimicry but are also likely to be influenced by evaluative processes. Such mechanisms seem to undergo important developments at least until the second half of the first year of life.

P2-H-234 Mother-infant physiological synchrony during strange situation: Pronounced differences between disorganized and secure dyads

Pooyesh Ganji[1], Jeffrey Measelle[1], Jennifer Ablow[1]

[1]University of Oregon

Mother-infant physiological synchrony during strange situation: Pronounced differences between disorganized and secure dyads Pooyesh Ganji, Jeffrey Measelle & Jennifer Ablow Background: In first months of life, caregivers and infants co-create experiences of regulation. Attunement, a relational approach that emphasizes bidirectional influences between a mother and infant, shapes an infant's regulatory capacity at behavioral and physiological levels through repeated, daily interactions across early life. Contemporary biosocial models propose that the attachment relationship may well be the principal context in which biobehavioral development occurs and regulatory capacities take shape. Research has also shown that, in the context of early primary relationships, the emotional wellbeing of the caregiver plays a pivotal role in the structuring and consolidation of an infant's emotion regulatory processes. Mothers who respond sensitively and contingently to their infants foster optimal regulatory abilities as the child matures, while mother-infant

interactions that are disrupted due to maternal internalizing symptoms can lead to less optimal regulatory patterns. Polyvagal theory provides a neurovisceral model that links attachment and arousal modulation, as indexed by respiratory sinus arrhythmia (RSA). RSA reflects the action of the parasympathetic nervous system (PNS) on the heart via the 10th cranial (vagus) nerve. Few studies have examined links between attachment and changes in RSA during each of the discrete phases of the Strange Situation Procedures (SSP). This study aimed to examine mother-infant physiological attunement in the context of the SSP to clarify attachment-related patterns of physiological responding and to examine whether maternal symptoms of trauma moderate infant's RSA and mother-infant physiological attunement. Method: 105 low-SES infant-mother dyads were followed prospectively across the pre- to postnatal transition. At the time of enrollment, primiparous women were living below the US federal poverty level. Data for the present investigation was collected at 18-month post-partum, when dyads participated in a number of challenge tasks, including the SSP. Maternal and infant physiology was monitored continuously throughout the SSP, yielding measures of heart rate and interbeat interval, which enabled us to estimate respiratory sinus arrhythmia (RSA) for both infants and mothers using CardioEdit software (2007). Mothers also completed the CES-D and Trauma Symptom Checklist-40. Results: Coding of the SSP sessions with our sample yielded the following attachment classifications: Insecure-avoidant (7.8%); Secure (65.6%); Insecure-Resistant (6.3%); and Disorganized (20.3%). Although the number of secure infants is consistent with reported norms, our higher-than usual number of disorganized infants likely reflects the high-risk nature of our sample, including the high percentage of mothers with histories of clinically significant depression (over 85%) and trauma (69%). HLM analyses are under way to characterize infant's physiology during the various phases of the SSP and to test patterns of infant-mother physiological attunement during the separation and reunion phases. Initial analyses of our RSA results suggest that disorganized infants show little RSA regulation (i.e., recovery) during reunion, whereas their mothers evidence a pronounced increase in RSA without a corresponding (and predicted) decrease in heart rate

P2-H-235 Understanding Emotional Connection In Infant-Mother Dyads

Cynthia Frosch[1], Marcus Fagan[1], Mark Lopez[1], Wendy Middlemiss[1], Mei Chang[1], Amie Hane[2], Martha Welch[3]

[1]University of North Texas, [2]Williams College, [3]Columbia University

Introduction: Emotional Connection (EC) is a dyadic level construct that has been linked to positive maternal and child outcomes (Hane et al., 2015; Welch et al., 2015; 2016). Emotional connection reflects the extent to which a parent and child are mutually responsive, expressive, and engaged with each other. This research investigated a new, brief measure of EC, the Welch Emotional Connection Screen (WECS) for understanding socioemotional development across the first three years of life. Two primary research questions were investigated: 1) How does observed mother-infant EC at six months relate to mothers' reports of preschooler's (age 3) behavior problems? 2) How does EC at six months relate to later mother-preschooler attachment? Hypotheses: Drawing from the extant literature on co-regulation during infancy (e.g., Doiron & Easterbrooks, 2012), and consistent with Welch et al. (2016), we predicted: 1) assessment of EC at six months during face-to-face play would better predict child behavioral outcomes at age 3 years than assessment of EC during toy-based play; and 2) ratings of EC at age six months would be unrelated to later parent-preschooler attachment. Study Population/Method: A sample of 40 6-month-old full term infants and their middle class parents participated. Families were videotaped in their homes. Mothers played independently with their infants in two contexts: face-to-face play and toy-based play. Videotaped interactions were subsequently coded using a 3-point scale for four items on the WECS (Welch et al., 2016). When children were age 3 years, mothers completed the Child Behavior Checklist (Achenbach 1988; 1992) and the Attachment Q-Set (Waters, 1987). Results: Assessment of emotional connection during face-to-face play (vs. toy-based play) when infants were six months of age predicted child behavioral outcomes at age 3 years. More specifically, EC during face-to-face play at six months was significantly related to mothers' reports of child behavior problems at age 3. In dyads rated "Not Connected" on the WECS at six months, children were reported to experience more externalizing behavior problems as preschoolers ($t(38) = 3.03$, $p < .01$). Similarly, when dyads were rated as "Not Connected" at six months, mothers reported more overall child behavior problems on the CBCL ($t(38) = 3.13$, $p < .01$) at 3 years. In contrast, assessment of EC at six months during toy-based play was not associated with subsequent reports of children's behavior problems. In addition, results indicated that six month ratings of EC as assessed in both the toy-based ($t(35) = -1.95$, $p = .85$) and face-to-face play ($t(35) = -.31$, $p = .77$) paradigms were unrelated to mothers' reports of their preschoolers' attachment as assessed by the AQS. Conclusion: The WECS holds promise as a valid and reliable predictive screening tool for young children at risk for adverse behavioral outcomes. Moreover, these findings suggest the importance of interaction context (face-to-face vs. toy-based play) when assessing EC and highlight the distinctness of early EC from later mother-preschooler attachment security. Implications of EC in terms of family dynamics are discussed from the perspective

of both calming cycle theory (Welch et al. 2016) and family systems theory (e.g., Cox & Paley, 2003).

P2-H-236 Maternal Anxiety and Depression Prospectively Predict Physiological Regulation of Social Fear in Infants

Anna Zhou[1], Alicia Vallorani[1], Jennifer Phillips[1], Koraly Pérez-Edgar[1], Vanessa LoBue[2], Kristin Buss[1]

[1]Pennsylvania State University, [2]Rutgers University

Early atypical social fear is suggested to be a precursor to developing social anxiety (Brooker, Kiel & Buss, 2016). Research suggests that maternal internalizing symptoms influence infant social fear. Maternal depression predicts steeper increases in fearfulness during infancy (Gartstein et al., 2010). Maternal anxiety predicts trajectories of social fear in infants and toddlers (Murray et al., 2008; Brooker et al., 2013). Research has also shown that infants' behavioral displays of stranger fear can be influenced by mothers' anxious behaviors (de Rosnay et al., 2006). Stable, high levels of stranger fear over time is associated with poorer respiratory sinus arrhythmia (RSA) suppression at 6 months, suggesting that infant RSA associated with social fear can act as a biomarker for later socioemotional problems (Brooker et al., 2013). However, it is unclear how maternal internalizing symptoms influence the physiological regulation of social fear in infants. Research has demonstrated that chronic maternal depression is related to higher RSA reactivity in children (Ashman et al., 2008), but to our knowledge no study has examined the effects of maternal internalizing symptoms on RSA suppression during a social fear task in infants. The present study is part of an ongoing larger longitudinal project where infants participate at 4, 8, 12, 18 and 24 months of age. Parents self-report their internalizing symptoms when infants are 4 months using the Beck Anxiety Inventory and Beck Depression Inventory (Steer & Beck, 1997; Beck, Steer & Brown, 1996). When infants are 8 months, we collect ECG during a 4-minute baseline and a 90-second stranger task as part of the Lab-TAB protocol (Goldsmith et al., 1994). To date we have both 4- and 8-month data on 17 infants. Mean reactivity from baseline to the stranger task suggests RSA augmentation (M = 0.28, SD = 0.81). In a regression model controlling for maternal depression, maternal anxiety at 4 months significantly predicted increases in RSA from baseline to the stranger task at 8 months (ß=0.16, t(15)=3.43, p=0.004), indicating poorer RSA suppression of stranger fear. However, when controlling for maternal anxiety, maternal depression at 4 months significantly predicted decrease in RSA from baseline to the stranger task at 8 months (ß=-0.25, t(15)=-4.18, p=0.001), indicating better RSA

suppression. These findings suggest that maternal anxiety and depression prospectively influence physiological regulation of social fear. In particular, it is interesting that maternal depression predicted RSA suppression whereas anxiety predicted augmentation during a stranger task. This raises the question of what adaptive patterns of RSA look like for 8-month-olds given that stranger fear is often considered as adaptive for infants (Bretherton & Ainsworth, 1974). As the average pattern was augmentation, it may be the expected pattern at this age to recruit parasympathetic resources during social tasks. Fearful behavior during social fear tasks and longitudinal socioemotional outcomes can help us better understand the links between maternal internalizing symptoms and infant social fear. These results highlight the importance of considering early maternal factors and how they may influence physiological regulation of stranger fear during infancy and subsequent trajectories of social fear.

P2-H-237 Measuring Early Childhood Development in Brazil: Evidence from the Caregiver-Reported Early Development Index

Elisa Rachel Pisani Altafim[1], Dana McCoy[2], Alexandra Brentani[1], Günther Fink[3]

[1]University of São Paulo, [2]Harvard University, [3]University of Basel

Investments in early childhood development (ECD) services are particularly necessary in low-income and middle-income countries, where the proportion of children younger than 5 years old who are not reaching their developmental potential remains high (Black et al., 2017). The Caregiver Reported Early Development Index (CREDI) is a population-level measure of ECD for children from birth to age three designed to provide conceptually rich, developmentally informed, population-level data on global progress in alleviating ECD-related inequities (McCoy et al., 2017). The present study aims to analyze the internal consistency and discriminant validity of CREDI short form within 1265 children in Brazil under age 3. The study includes two samples: a sample from São Paulo, southeast Brazil (N = 678) and an online sample with participants from different parts of Brazil (N = 587). The CREDI exclusively relies on caregiver reports and the short form includes 20 yes/no items specific to each six-month age band (0-5mo, 6-11mo, 12-17mo, 18-23mo, 24-29mo, & 30-35mo) to assess the overall development of children from 0 to 35 months across motor, language, cognition, socioemotional and mental health domains. The CREDI is scored continuously using age-standardized scoring procedures that are based on children's raw percent "yes" (pass) responses within each age group. The results of Cronbach's alpha suggested adequate internal consistency/inter-item reliability ($\alpha > .80$) for the CREDI within each of the six age groups, 0-5 months (online, $\alpha = 0.91$, N = 17), 6-

11 months (online, α = 0.86, N = 47), 12-17 months (online, α = 0.83, N = 37), 18-23 months (online, α = 0.87, N = 5), 24-29 months (online, α = 0.89, N = 38; in-person, α = 0.83, N = 100), 30-35 months (online, α = 0.87, N = 49; in-person, α = 0.82, N = 492). The results of tests of discriminant validity of CREDI scores based on child and family characteristics are presented in Table 1. Regarding the in-person sample, the multivariate analyses showed that a significant proportion of the variance in CREDI scores could be explained by the included predictor variables (R2 = 0.12, p < 0.0001). Specifically, children who were female, had caregivers with higher education, came from households that were high in socioeconomic status (based on an asset quintile), and came from high-stimulation households showed higher CREDI scores. Similarly, in the online sample, the multivariate analyses showed that a significant proportion of the variance in CREDI scores could be explained by the included predictor variables (R2 = 0.09, p < 0.0001). Children who were female and came from high-stimulation households showed higher CREDI scores. The CREDI was able to discriminate between children's skills based on gender, caregiver education, socioeconomic status and adult stimulation. The results of the present study provide preliminary evidence of the CREDI short-form's validity, as a measure of early childhood development within Brazil. The CREDI could therefore be an option for monitoring child development, as well as evaluating intervention programs to support child development at a population level.

P2-H-238 Mother and Infant Negative Affect Predict Infant Physiological Regulation During a Frustrating Task

Jennifer Phillips[1], Alicia Vallorani[1], Anna Zhou[1], Koraly Pérez-Edgar[1], Vanessa LoBue[2], Kristen Buss[1]

[1]Pennsylvania State University, [2]Rutgers University

Emotion regulation is the capacity to adapt to fluctuations in our evoked emotions (Cole et al., 2004). Inability to regulate negative emotions, such as frustration, is linked to negative socio-emotional outcomes (Calkins & Keane, 2004), highlighting the importance of developing regulatory skills from an early age. Both maternal and infant factors may contribute to emotion regulation development (Crokenberg et al., 2004). Research suggests that maternal internalizing, related to negative affect, may relate to poorer regulation strategies in infants (Granat et al., 2017; Prenoveau, 2017). Additionally, when infants display high levels of negative affect during a frustrating task, they exhibit poorer regulatory strategies (Ekas et al., 2011; Stifter & Braungart, 1995). One way of assessing regulation during frustration is through respiratory sinus arrhythmia (RSA), a physiological

measure which may better capture individual differences in regulation than behavioral measures during infancy (Calkins et al., 2002, 2009). Easily frustrated infants show more difficulty in suppressing RSA during tasks, suggesting poorer regulation (Calkins et al., 2002). Past research has also suggested that maternal affect can impact an infant's regulatory capacity (Baker & McGarth, 2011). In light of these resultsis and other studies that have demonstrated the importance of infant affect on infant regulation, the present study investigated how both early maternal and infant negative affect may individually impact physiological markers of regulation in later infancy (i.e. RSA). later infant regulation.RSA. Mothers and infants were recruited as part of a larger ongoing longitudinal project. To date, 16 Mother-Infant pairs have completed the first two waves of the study at 4 and 8 months. At the 4-month visit, mothers self-reported their negative affect using the PANAS (Watson et al., 1988) and reported infant negative affect via the IBQ-R (Gartstein & Rothbart, 2003). At the 8-month visit, infants provided ECG data during a 4-minute baseline and a 90-second arm restraint task as part of the Lab-TAB (Goldsmith et al., 1994). Mean reactivity from baseline to arm restraint suggested RSA suppression ($M = -0.13$, $SD = 0.71$). Regression analysis revealed a main effect of maternal negative affect ($t = 2.53$, $p = 0.03$), such that greater maternal negative affect at 4-months predicted poorer infant RSA suppression at 8-months. Conversely, a trending main effect of infant negative affect ($t = -2.02$, $p = 0.06$) indicated that greater infant negative affect at 4-months predicted better infant RSA suppression at 8-months. Results suggest that both early maternal and infant factors may contribute to later regulatory capacity, but perhaps in different ways. Early in life, infants rely on their mothers for emotion regulation (Cole et al., 2004). Mothers exhibiting higher negative affect may be less able to provide regulatory support to their infants, which may lead infants to experience reduced regulatory capacity later in life. The fact that infant negative affect was related to better regulation during the frustration task is surprising as previous research has indicated greater negative affect is related to poorer physiological regulation during frustration (Calkins et al., 2009). This unexpected finding suggests the importance that future analyses consider how maternal and infant negative affect may interact to predict infant regulation.

I: Translational Science

P2-I-239 An examination of classic infant speech perception tasks and their practical applications beyond the lab

Giovanna Morini[1], Hannah Puttre[1], Emily Fritzson[1], Roberta Golinkoff[1], Thierry Morlet[2], Derek Houston[3]

[1]University of Delaware, [2]Nemours Alfred I. duPont Hospital for Children, [3]Ohio State University

Methods like the Preferential Looking Paradigm (Golinkoff et al., 2013) are used to examine how infants process speech and begin to develop linguistic skills. They are ideal because they do not demand overt responses from preverbal children, and instead measure behavioral responses (e.g., eye-gaze) that are present from an early age. Using these measures, labs across the world have studied various language-related skills. But what if these tools could be taken outside of the lab to actually make a difference in children's lives? For example, what if these measures could be used with clinical groups, such as infants who are deaf or hard-of-hearing (DHH) to better understand how the degree of hearing loss relates to speech processing skills and vocabulary outcomes? This information could inform interventions and influence children's linguistic and academic outcomes. One major limitation, however, is that prior work using these paradigms has focused on evaluating group effects and not individual differences. A need remains to explore how reliable these measures are for examining language-related skills in individual children - this is a fundamental step for translating methodologies for use with largely heterogeneous populations (e.g., DHH infants, who differ with respect to etiology and degree of hearing loss, as well as their underlying cognitive and linguistic capabilities). This project examines the reliability of three tasks: (i) preference for speech, (ii) vowel discrimination, and (iii) word recognition. Infants complete each task at 6, 9, and 12 months. A vocabulary measure is obtained at each visit and at 15 months using the MCDI. Twenty-seven infants are currently enrolled. Initial group analyzes suggest that infants show a preference for listening to speech compared to white noise, consistently at 6, 9, and 12 months (Figure 1). Second, infants successfully differentiate between /a/ and /i/ across visits (i.e., they show longer listening times in trials where there were alternating vowels "a-i-a-i", compared to non-alternation "a-a-a-a" - Figure 2). Preliminary analyses of test-retest reliability for the speech preference and vowel discrimination tasks show a lack of stability. Correlations for the preference for speech vs. non-speech at 6 compared to 9 months, and at 9 compared to 12 months showed no significant relationship (r= -.135 and r= -.121 respectively). Only test-retest reliability at 6 compared to 12 months was slightly better (r= .530). Correlations for vowel discrimination across all three visits were also weak (visit 1 to 2: r= -.135, visit 2 to 3: r= -0.121, visit 1 to 3: r= -.319). Note that not all participants have completed all visits, and missing data could be contributing to these findings. However, these preliminary results corroborate recently reported findings (Cristia et al., 2016) showing poor test-retest reliability in measures of infant speech perception. We will discuss the implications of these findings for efforts to develop clinically useful tools of assessing infant speech perception and describe possible

modifications that may improve test-retest reliability. Analyses of the word recognition task and additional individual analyses examining reliability and correlations with vocabulary outcomes will be available by the time of the conference.

P2-I-240 The Effect of Fetal Cocaine Exposure on Adolescent Risky Sexual Behavior

Inna Miroshnichenko[1], Nicholas Minar[2], Michael Lewis[3]

[1]Rutgers University, [2]Institute for the Study of Child Development, Rutgers RWJMS, [3]Institute for the Study of Child Development, Rutgers Robert Wood Johnson Medical School

Fetal cocaine exposure (FCE) poses a significant detrimental effect on early infancy by increasing the risk of shortened gestation and low birth weight (Gouin et al., 2011) as well as an early onset of the childhood/preadolescent period, which is linked to impairments in sustained attention and response inhibition (Ackerman et al., 2010; Bendersky & Lewis,1998). Currently there is limited data describing the effect of FCE and its subsequent impact on adolescent sexual behavior, but findings suggest that FCE increases the possibility of risky sexual behavior in adolescence (De Genna et al., 2014; Lambert et al., 2013; Min et al., 2015, 2016). Adolescents engaged in risky sexual behavior, such as: having their first sexual intercourse before age 15, acquiring a higher number of sexual partners, practicing unprotected sex, and sexual intercourse under the influence of substances have higher rates of STIs and unwanted pregnancy (SAMHSA, 2016, Cavazos-Rehg PA et al., 2011). The objectives of the current study were to: (1) examine the effect of FCE on risky sexual behavior in comparison to unexposed peers; (2) explore how the pattern of sexual behavior in our sample of adolescents from Southern New Jersey/Northern Pennsylvania compared to national survey data. Children (N = 329, 41% with PCE exposure) participated in a longitudinal study that followed them from birth to 17 years of age. Fetal substance exposure was assessed using a semi-structured interview administered to the mother within 2 weeks of their child's birth. Radioimmunoassay of newborn's meconium testing for benzoylecgonine (cocaine metabolite) following gas chromatography confirmed FCE. The pattern of sexual behavior during adolescence was assessed using the Youth Risk Behavior Survey (MMRW, 2004) and compared to national/regional data (CDC report, 2011; NJSHS, 2011). Our results indicated that infants exposed to cocaine have higher rate of sexual activity prior to the age 13 (28.3% vs 23.3%) compared to their unexposed peers. However, there were no significant differences between the exposed and unexposed groups regarding whether they were involved in a sexual relationship by age 17 (85.3% vs 88.4%). Additionally, differences between exposed and unexposed groups were observed

with regard to their number of sexual partners during adolescence, with the exposed adolescents having less promiscuity compared to non-exposed group. Lastly, our cohort sampled from the Southern New Jersey/Northern Pennsylvania region exhibited higher rates of risky sexual behavior compared to national/state data. Our study does not fully support the hypothesis that Fetal Cocaine Exposure would increase prevalence of risky sexual behavior during the late adolescent period. While infants exposed to cocaine subsequently went on to have earlier sexual experiences during puberty than their unexposed peers, they also tended to be less promiscuous, as measured by fewer sexual partners. Previous research has demonstrated that FCE alters the timing of pubertal development (Bennett et al., 2015), but our results suggest a less direct effect on risky sexual behavior during puberty. Our results highlight the importance of coexisting sociodemographic and environmental factors on the outcomes of adolescent sexual behavior, but suggest that further research is warranted.

P2-I-241 Developmental changes of social functioning and participation of young children with and without physical disabilities

Lin-Ju Kang[1], Ai-Wen Hwang[1]

[1]Chang Gung University

Background: Social function and social participation is vital for development of young children transitioning from infancy to preschool years. Social function refers to the ability and skills to interact and communicate with others. Social participation involves forming social relationships through engaging in daily activities. Young children with childhood-onset physical disabilities (PD) are at risk for experiencing limitations in social functions and social participation. Research is limited in describing developmental changes of social function and social participation of young children with and without PD. Objective: To track and compare social function, diversity and intensity of social participation across 3 consecutive time points for children 1-3 years of age with PD and typically developing (TD) peers in Taiwan. Method: The preliminary study included a convenience sample of 33 children with PD (mean age=2.8y, 19 boys) and 46 TD children (mean age=2.9y, 28 boys) as part of a larger follow-up study in Taiwan. Social function was measured by the 'Social function' domain of Chinese version of the Pediatric Evaluation of Disability Inventory (PEDI-C). Diversity and frequency of social participation was measured by the Chinese version of the Assessment of Preschool Children's Participation (APCP-C). The parents were interviewed three times, with a one-year interval, for two years. A two-way repeated measure ANOVA (2 groups x 3 times) was used to test for group differences.

Significance level was set at $p<0.05$. Results: For social function, both the children with and without PD showed increased the PEDI-C social function scores with age ($p <0.001$), while PD children had significantly lower scores than TD children ($p <0.001$) [Figure 1]. For social participation, significant interactions were found for the APCP-C diversity and frequency scores. Diversity scores of the PD children did not differ across 3 time points but the TD children increased significantly across 3 time points ($p <0.001$) [Figure 2]. Frequency scores of the PD and TD children did not differ across 3 time points ($p >0.05$). However, the data plots for intensity scores showed a decreasing trend for the PD children and an increasing trend for the TD children. Conclusion: Although social function skills of young children in this study speared to improve over time, the developmental patterns of social participation were distinct for children with and without PD. The TD children have been shown to engage in a greater variety of social activities when they grow, but not the PD children. The results have implications for providing young children, particularly those with disabilities, with supports and activity opportunities that facilitate social participation. Families and professionals are encouraged to work as partners to create a rich social and learning environment for young children.

P2-I-242 Sleep disordered breathing is associated with increased developmental delay and behavioral difficulties in Williams syndrome

Caroline Greiner de Magalhaes[1], Angela Becerra[1], Carolyn Mervis[1]

[1]University of Louisville

Introduction: Typically developing (TD) 2-year-olds who have sleep disordered breathing (SDB) are at greater risk for behavioral problems (Tamana et al., 2017). Although not much is known if TD 2-year-olds with SDB also are at greater risk for cognitive or language delay, TD 5 - 10-year-olds with SDB do have lower cognitive/language abilities than children who do not have SDB, and these difficulties are mediated by behavioral problems (Smith et al., 2017). Very little is known about the effects of SDB on children with developmental disabilities (DD). The aim of this study was to investigate the relations of SDB to cognition, language, and behavior in 2-year-olds with Williams syndrome (WS). Methods: Participants were 80 2-year-olds (M=2.33 years, SD=0.31, range=2.00-2.98; 32 girls, 48 boys) with genetically-confirmed classic-length WS deletions. Parents completed the Pediatric Sleep Questionnaire (PSQ; Chervin et al., 2000), which includes a 22-item SDB scale. A child is considered to have SDB if the parent responds "yes" to at least 7 of 21 items (given the participants' age, the nocturnal enuresis item was excluded). Parents also completed the Child Behavior Checklist 1.5-5 (CBCL; Achenbach & Rescorla, 2000),

which includes scales measuring a range of behavior problem types. Children completed the Mullen Scales of Early Learning (MSEL; Mullen, 1995) to assess cognitive and language abilities. Four scales are included: Visual Reception (measuring nonverbal reasoning), Fine Motor, Receptive Language, and Expressive Language. For both the CBCL and the MSEL, mean T-score for each scale for the general population is 50 (SD=10). Results: Parents indicated that children slept an average of 10.40 hours per night (SD=1.05, range: 7.25-13.33). This did not differ from the mean reported by Bell and Zimmerman (2010) for TD toddlers (p=.97). Parents reported that 56.3% of children had difficulty falling asleep, 17.7% had difficult bedtime routines, 13.8% took sleep medication, 12.5% woke up more than twice per night, 26.3% had restless sleep, and 25% had difficulty falling back asleep if they woke up at night. Eleven of the 80 children (13.8%) met the criterion for SDB. The children with SDB performed significantly worse ($p<.01$) than the children without SBD on the MSEL Visual Reception and Receptive Language (table 1). Similar results were found on several of the CBCL individual scales, and all three CBCL higher-order factor scales (table 2). Discussion: Similarly to TD 2-year-olds with SDB, 2-year-olds with WS who had SDB also had significantly greater behavior problems than 2-year-olds with WS who did not have SDB. In addition, the WS SDB group had significantly weaker nonverbal reasoning and receptive language abilities than the WS group without SDB. Although mean nighttime sleep for 2-year-olds with WS did not differ significantly from that for same-aged TD peers, parents of most participants reported significant difficulties with sleep or bedtime routine. Longitudinal studies of SDB and its relation to behavior problems and intellectual abilities in children with WS are needed. This study highlights the importance of early screening for SDB among children with DD. Theoretical and practical implications will be discussed.

P2-I-243 The factor structure and predictive utility of the IBQ-R in infants at high risk for developing autism

Angela Fenoglio[1], Sooyeon Sung[1], Jason Wolff[2], Kelly Botteron[3], Stephen Dager[4], Annette Estes[4], Heather Hazlett[5], Sarah Paterson[6], Robert Schultz[7], Lonnie Zwaigenbaum[8], Joseph Piven[9], Jed Elison[2]

[1]University of Minnesota, [2]University of Minnesota Twin Cities, [3]Washington University in St. Louis, [4]University of Washington, [5]University of North Carolina, [6]Temple University, [7]University of Pennsylvania, [8]University of Alberta, [9]University of North Ca

Background: A growing body of evidence suggests that the behaviors associated with autism emerge during the second half of the first year of life, including atypical

temperamental profiles (Garon 2009; Clifford 2013). One widely-used measure, the Infant Behavior Questionnaire-Revised (IBQ-R), was devised using normative data and posited a 3-factor structure (Gartstein 2003). Subsequent studies suggest that this structure varies by sample characteristics such as cultural context (Gartstein 2005) or sociodemographic status (Bosquet Enlow 2016). Infant sibling studies have found that ASD is associated with a temperamental profile characterized by lower positive affect, higher negative affect, and lower effortful control (e.g. Paterson, under review), and that high risk (HR) infants (with an older sibling with ASD) and low-risk (LR) control infants (without a family history of ASD) show group differences in temperament traits as well as the structure of higher-order temperament factors (Garon 2016). Objectives: In Study 1, we assessed the factor structure of the IBQ-R at 6 and 12 months in a sample enriched for autism risk. In Study 2, we investigated the extent to which these early temperament factors predict dimensional developmental outcomes, and then characterized differences in temperamental profiles by risk and diagnostic status. Method: In Study 1 we investigated the factor structure of the IBQ-R in HR and LR groups (total n = 624) by comparing the fit of 3 models: two from the literature and one created via exploratory factor analysis (EFA). In Study 2, data from 497 infants (a subset of 624 with diagnostic outcomes) were used to construct a structural equation model (SEM) utilizing the best fitting factor structure from Study 1 for 6 and 12-month temperament data and a 24-month developmental outcome variable derived from measures of cognitive and adaptive functioning. Group differences were examined across diagnostic outcome groups using the new factor structure from Study 1. Results: Factor analyses suggest that a modified three-factor model from our EFA provides the best fit for this sample enriched for autism risk. SEM indicates that higher scores on Duration of Orienting at 12-months predicted lower scores on the developmental outcome at 24-months for the HR group ($\boldsymbol{\beta}$ = -.21, $p < .001$). Also, the HR-ASD group showed lower Positive Affectivity than both the HR-neg and LR groups at 6 and 12-months of age. Conclusions: The traditional 3-factor model of the IBQ-R may not be ideal for samples enriched for autism risk, and HR and LR groups show different patterns of associations between temperament factors and developmental outcome. While the association between higher 12-month orienting and lower 24-month developmental outcomes in the HR group may seem contrary to prior findings showing an association between lower Effortful Control and ASD, the best-fitting model excluded all regulatory subscales except duration of orienting. The items making up this subscale seem to reflect sustained attention. Absent the association between positive affect and orienting seen in the LR group, the development of HR infants may not be served positively by sustaining attention on objects in the environment.

P2-I-244 Maternal Postnatal Psychosocial Distress and Its Association With Cortisol Levels and Immunological Composition in Breast Milk

Marina Aparicio[1], Christine Hechler[2], Roseriet Beijers[2], Juan Miguel Rodriguez[1], Leonides Fernandez[1], Carolina de Weerth[2]

[1]Complutense University of Madrid, [2]Radboud University

The beneficial influences of breastfeeding on infant health are widely recognized. A wealth of bioactive factors in breast milk seems responsible for these beneficial effects. These factors include oligosaccharides, bacteria and immune components. Some studies indicate that maternal postnatal stress is related to alterations in immunological components of human milk. However, studies investigating the relationship between maternal postnatal psychosocial distress using in-depth profiling techniques assessing a broad panel of immune factors are scarce. Furthermore, limited information is available on the levels of increase/decline of immune components and cortisol during the first months postpartum in relation to maternal mood. This study investigated the association between maternal postnatal psychosocial distress (e.g. anxiety, depression and stress), cortisol and immunological components in breast milk, including immunity factors (IL1β, IL6, IL12, IFNγ, TNFα, IL2, IL4, IL10, IL13, IL17), chemokines (L8, Groα, MCP1, MIP1β), growth factors (IL5, IL7, GCSF, GMCSF, TGFβ2) and immunoglobulins (IgA, total IgG, IgM) across the first three months postpartum. Milk samples from 59 healthy mothers after full term pregnancies were collected at three time points during the first 3 months post-delivery. Maternal postnatal psychosocial distress was measured using self-reported questionnaires. BM immune compounds were quantified by magnetic beads-based multiplex immunoassays. Cortisol levels were quantified by liquid chromatography-tandem mass spectrometry. Multivariate analyses were performed to assess the association between maternal postnatal psychosocial distress and milk immune and cortisol levels. All the assayed immunological factors could be detected in all milk samples over the first 3 months postpartum, with the exception of GMCSF. IL6 and IL7 were increasingly detected over time (p=0.037 and 0.004, resp.). The concentration of immunological factors significantly decreased during the first 3 months postpartum for IgA (p =0.003), IgG (p =<0.001), IgM (p =<0.001), TGF2 (p =0.029), GRO (p =0.001) and EGF (p =<0.001). Cortisol was detected in almost all of the samples and its concentration significantly increased over time (p =0.003). Significant differences were observed in milk immune factors and cortisol between mothers with high psychosocial distress compared to mothers with low psychosocial distress. Mothers with high psychosocial distress had significantly higher concentrations of IL6 at week 2 (p=0.05), cortisol at week 2 (p=0.029) and DTWUFI at week 12 (p=0.05), and lower levels of IL5 at week 12 (p=0.023) compared

to mothers with low psychosocial distress. The development over time of immunological components in milk also differed between groups. In mothers with high psychosocial stress, IgG, IgM, MIP-1β and GRO-α significantly decreased during the first months (p=0.031, p=<0.00, p=0.002, p=0.002, resp.). In milk of mothers with low psychosocial distress, IgM, IgA, MIP-1β significantly decreased over time (p=0.001, p=0.008 and p=0.012, resp.). Breast milk of mothers is characterized by changes in abundance of immunoprotective compounds and cortisol during the first 3 months postpartum. The kinetics of increase/decline were different between mothers with high and low self-reported psychosocial distress for IgA, IgG, GRO-α and cortisol. The relevance of these changes for infant health requires future research.

P2-I-245 Paid Maternal Leave is Associated with Better Language Outcomes during Toddlerhood

Karina Kozak[1], Cynthia Rodriguez[2], William Fifer[2], Amy Elliott[3], Natalie Brito[1]

[1]New York University, [2]Columbia University Medical Center, [3]Sanford Health

Background: Past studies have reported negative effects of mothers returning to work shortly after giving birth for both early cognitive skills and externalizing behaviors, with effects persisting even after controlling for quality of child care, home environment, and maternal sensitivity (Berger, Hill, & Waldfogel, 2005; Han, Waldfogel, & Brooks-Gunn, 2001). Other studies conducted internationally have found no effects of maternal leave on cognitive or educational outcomes (Baker & Milligan, 2011; Dustman & Schonberg, 2012; Rasmussen, 2010). Mothers that take time off from work after giving birth presumably have more time to talk to their newborns; this increase in the number of early interactions is hypothesized to be associated with better language outcomes. Whether or not this time off is paid can influence the amount of stress the mother experiences during that time, as foregoing income can be stressful. This added stress may affect interaction quality between the mother and child. The current study examined associations between paid and unpaid maternal leave and developmental outcomes during toddlerhood. Methods: Three hundred twenty-eight infants (161 males) between the ages of 24- and 36-months were contacted by phone and a demographic survey, assessing socioeconomic status and maternity leave, as well as two standardized child development measures (BITSEA: Brief Infant Toddler Social Emotional Assessment & PARCA: Parent Report of Children's Abilities) were verbally administered. The BITSEA is a 42-item parent report comprised of a problem score and a competency score. The PARCA is also a short parental report assessing the child's non-verbal cognitive and linguistic skills. Results:

Controlling for family income, maternal education, and age of infant, toddlers who had mothers who took paid time off after birth had significantly higher language composite scores on the PARCA assessment, F(1, 310) = 12.9, p = .002, than toddlers whose mothers took unpaid time off. The language composite score is comprised of a vocabulary assessment and sentence complexity score, both of which were also significant (p = .001 & p = .039, respectively). When adding maternity leave to the model, neither family income nor maternal education significantly predicted language scores (p = .36 & p = .92, respectively). Additionally, there was no difference between mothers who took paid leave for 1-6 weeks vs. 7 or more weeks (p = .99). No significant associations were found for maternity leave (paid or unpaid) and non-verbal cognitive or social-emotional scores. Conclusion: Independent of socioeconomic status, children whose mothers had paid time off after birth later had higher language scores than children whose mothers took unpaid time off. This study represents a first step at examining the efficacy of paid family leave; future studies will need to examine the role of maternal stress and parent-child interactions in relation to these results.

P2-I-246 Early developmental pathways to childhood symptoms of ADHD, anxiety, and autism spectrum disorder (ASD)

Rachael Bedford[1], Elizabeth Shephard[2], Bosiljka Milosavljevic[3], Teodora Gliga[3], Emily Jones[3], Andrew Pickles[2], Mark Johnson[3], Tony Charman[2]

[1]King's College London, [2]Institute of Psychology, Psychiatry and Neuroscience, [3]Birkbeck, University of London

Background: Children with autism spectrum disorder (ASD) often have co-occurring symptoms of attention-deficit/hyperactivity disorder (ADHD) and/or anxiety. It is not clear whether these disorders arise from shared or distinct developmental pathways. We explored this question by testing the specificity of early-life (infant and toddler) predictors of mid-childhood ADHD and anxiety symptoms compared to ASD symptoms. Methods: Infants (n = 104) at high and low familial risk for ASD took part in research assessments at 7, 14, 24, and 38 months and 7 years of age. Symptoms of ASD, ADHD, and anxiety were measured by parent report at age 7. Activity levels and inhibitory control, also measured by parent report, in infancy and toddlerhood were used as early-life predictors of ADHD symptoms. Fearfulness and shyness measured in infancy and toddlerhood were used as early-life predictors of anxiety symptoms. Path analysis models tested associations between early-life predictors and mid-childhood ADHD and anxiety symptoms compared to mid-childhood ASD symptoms, as well as the influence of

controlling for ASD symptoms on those associations. Results: Increased activity levels and poor inhibitory control were predictive of ADHD symptoms (activity: ADHD hyperactivity $\beta = 0.72$, $p < 0.001$, ADHD inattention $\beta = 0.44$, $p = 0.006$; inhibitory control: ADHD hyperactivity $\beta = -0.35$, $p = 0.001$, ADHD inattention $\beta = -0.33$, $p = 0.002$; see Figures 1&2) but not ASD or anxiety; these associations were unchanged when controlling for ASD symptoms. Increased fearfulness was associated with anxiety symptoms ($\beta = 0.32$, $p = 0.03$; see Figure 1), and shyness predicted ASD symptoms ($\beta = 0.29$, $p = 0.007$; see Figure 2). The association between fearfulness and anxiety became marginal when controlling for ASD symptoms. Conclusions: The specificity of early-life predictors to ADHD symptoms indicates that early developmental pathways to ADHD can be distinct from ASD. The overlap of early-life predictors of anxiety and ASD, and the modification of associations between predictors and anxiety by ASD symptoms, suggests that these disorders might share common early developmental pathways.

P2-I-248 Is There Empirical Evidence that Earlier is Better for Intervention with Children with Autism Spectrum Disorders?

Tamique Ridgard[1], Sofia Pham[1], Patricia Towle[1], Patricia Patrick[1]

[1]Westchester Institute for Human Development

OBJECTIVE. The objective of this literature review was to examine the evidence for earlier vs. later intervention for young children with ASD (with early intervention (EI) defined as occurring during the birth-to-three period). Although researchers and clinicians agree that the earlier children start an intervention program, the better (Wallace & Rogers, 2010; Zwaigenbaum et al., 2015)--this belief tied to the mounting evidence for efficacy of early intervention for ASD (Reichow et al., 2014; Estes et al., 2015)--it is not clear what direct evidence exists for this assertion (Vivanti, 2014). Based on a preliminary perusal, there is not a focused literature on age of starting EI as an isolated variable; however, there is a growing set of studies wherein age is one of several predictors explored, and emphasized more or less. Certain predictors in infancy have come to be known as important influences on later functioning levels in ASD. These include early cognitive/adaptive/language level, social-communication skills, and to a lesser extent, autism severity (Howlin et al., 2009; Makrygianna et al., 2010; Zachor & Itzchak, 2010). METHOD. Studies were identified that included age of starting intervention as a predictor of later capability levels of children diagnosed early with ASD From 1995 onward. Criteria for inclusion were: published in a peer-reviewed journal, available in English, included age of starting early intervention as one focus of inquiry, included children under three years of age, more than 20 participants

or greater than 10 in each group compared in intervention studies. A final, important inclusion criterion was that the research design partialed out the effects of other known predictors, specifically early IQ or DQ, while examining the age of starting intervention variable. If the study was comparing a younger and older group, they had to describe and then control for baseline differences between them. The studies were then characterized in terms of overall research design, participant characteristics, follow-up period, predictor variables, risk for bias, and data analytic methods. Results across studies were synthesized and outcomes interpreted with a focus on the role played by age of entering early intervention. RESULTS. Eight studies were reviewed in depth, three of which focused on the infancy period. In general, age of starting intervention did contribute unique variance (although small in magnitude) and conferred an advantage. Important findings were the presence of interaction effects showing that better progress depended on age and several other factors working together, and that children tended to make the most progress early on in their intervention, whether it was 18-24 months, 24-36, months, or even later in the beginning of the preschool period. CONCLUSIONS. The relationship between age of starting intervention and later level of functioning needs to be viewed within a context of developmental potential of the child and the type and intensity of intervention. With these considerations, there is now a beginning body of evidence that starting before age three and optimally by age two or younger will make a difference in eventual functioning in children with ASD.

J: 40th Anniversary

P2-J-249 Nutrition and Anemia in Lao Children: Determining Contextual Influences

Nathaniel Sichter[1], Dorianne Wright[1], Jeffrey Measelle[1]

[1]University of Oregon

Background: Adequate nutrition during the first 1,000 days of life (from conception until a child's second birthday) has a profound impact on a child's ability to grow, learn, and thrive. However, a multitude of factors impact the ability for young children in Laos - the poorest of the Southeast Asian countries - to receive adequate nutrition. For example, limited access to diverse foods, lack of health care, and unsanitary conditions are just some of the factors that may contribute to under-nutrition in young infants and children. Anemia - a condition marked by reduced hemoglobin concentration - is one of the most widespread consequences of under-nutrition affecting young children in Laos. Anemia can be caused by poor diet and exacerbated by infectious diseases, such as malaria or diarrhea, and social factors, such as socioeconomic status or cultural practices. Although

the prevalence of childhood anemia is alarmingly high in Laos, anemia remains understudied within the first 1,000 days of life. The goal of the present study was to examine the link between Lao children's nutritional profile and clinical levels of anemia in children under two years, and to determine whether contextual factors such as SES, ethnicity, cleanliness of the home, and health status of the child moderate this association. We hypothesized that malnourished infants would show clinically significant anemia. However, we also predicted that an association between infant malnutrition and anemia would be strongest among the poorest and most ethnically marginalized families among whom custom and poor access limit the consumption of nutrient-rich foods. Additionally, we predicted that infants in less sanitary households would be both more anemic and have a greater incidence of infectious diseases given weakened immunities. Method: Data were collected in 2014 as part of Friends Without a Border (FWAB)'s Baseline Medical Study in Laos, which used the WHO's two-stage cluster design. Data were collected from 968 children under five years of age in 90 villages across three districts of the Luang Prabang Province. An adapted version of UNICEF's Multiple Indicator Cluster Survey (MICS v.4) was used to measure a wide range of health indicators, including infant health status and, importantly, families' nutritional practices, composition of food basket, and issues of food security. In addition, a battery of anthropometric and biological indicators was collected, including the use of a point-of-care hemoglobin tester (HemoCue Hb 201). Results: Preliminary analyses suggest that large portions of children in the sampled districts were undernourished. Specifically, we are finding a high prevalence of stunting (low height-for-age), wasting (low-weight-for-height), and underweight children (low weight-for-age) (see Figure 1). We have also found high rates of childhood anemia (see Figure 2). Analyses are underway to explore the association between families' nutritional profile and infant anemia, as well as to test potential moderators.

P2-J-250 Trends across 40 years in the ICIS flagship journal(s): A computational analysis

Gwen Gustafson[1], James Green[1], Anna Green[2]

[1]University of Connecticut, [2]Harvard Medical School

The International Congress of Infant Studies debuted in 1978 along with a flagship journal, Infant Behavior and Development. The journal endures but was replaced as the flagship by a new journal, Infancy, in 2000. The articles in the flagship journal(s) are a trove of information regarding trends in author demography and research topics. We have undertaken a quantitative analysis of the content of all articles from 1978 to the present.

In this historic anniversary year, such an analysis will complement remembrances and qualitative analysis and, perhaps, help to inform the future. Text files are being created for every article across the 40 years; the present abstract is based on the 10 years completed thus far (1978, 1983, 1988, 1993, 1998, 2003, 2008, 2013, 2016, and 2017). The text files were processed using Python 2.7 to create two spreadsheets. One sheet included information pulled directly from predefined fields in the text files (e.g., title of the publication, year, author affiliations). The second spreadsheet contained words from all the titles, abstracts, and keywords. Words that occurred only once were eliminated, and common words were excluded using the Python Natural Language Toolkit v2.0.4 (http://www.nltk.org) corpus of stopwords. The words were then sorted alphabetically and examined for high frequencies and thematic clusters. For example, a content area called "neuroscience" was created from the following words: brain, cardiac, cortex, cortical, cortisol, electrophysiological, EEG, EMG, eye-tracking, heartrate, neural, neurobehavioral, neurodevelopmental, neurological, and vagal. 16 such content areas were created, and each text file was reanalyzed with Python to determine whether it contained any of the words from each of the content areas. First analyses document that fully half of the first authors now hail from countries other than the United States (Figure 1) and that the number of different countries represented has grown across the years. (The 1978 volume listed but a single paper from outside the USA!) Converging results suggest that infancy research is becoming more and more collaborative: significant increases (by ANOVA) across the years in mean number of authors per article; mean number of affiliations per article; mean number of different countries per article; and (for articles that list any US states) mean number of different states per article. A finding to provoke discussion is the steady increase in the number of first authors who are women (Figure 1B). Content analyses (Figure 2) suggest strong upward trends in percent of articles that use terms related to language/communication, attention, and learning. Neuroscience may also be on the rise. On the other hand, the proportion of studies that mention risk appears to turn downward, as does the proportion for perception. Note (Figure 2, inset) that while mothers are often mentioned, the proportion of text files that make explicit mention of fathers has remained stubbornly low, on par with mention of nonhuman organisms. When all 40 years are ready for analysis, we will be able to make full use of computational scanning, inferential statistics, and sophisticated graphics to add detail, nuance, and depth to the presentation.

P2-J-251 In Fantz' research: The pioneering work of Dr. Robert L. Fantz in developing the study of infancy

Nicole Sugden[1], Becky Choma[2]

[1]University of British Columbia, [2]Ryerson University

Dr. Robert Lowell Fantz, PhD., PhB., (see Figure 1) was foundational in establishing the study of visual perceptual development in infancy. From his beginnings as a comparative psychologist and biologist, his interest in the role of nature and nurture in early perceptual development lead him to apply strategies from research with chickens to primates and then to human infants. By developing the infant preferential looking paradigm and infant visual habituation paradigm, he opened new avenues for research into what infants perceive, discriminate, and remember. Infant looking tasks allowed infants the opportunity to exhibit what they could do, if simply asked the right questions. By using these methods, Fantz established norms of infant visual acuity, perception, and memory. Despite leaving a heavy research-footprint, there is little known about Fantz. We explore what influenced this pioneering researcher and his seminal work; we trace his research path from his undergraduate studies at the University of Chicago to his dissertation on form perception in chicks, to his comparative primate work, and finally to his infant research during his 34 years at Case Western Reserve University. As Fantz sought to understand the role of nature and nurture, we seek to understand Fantz.