

ABSTRACT BOOK
Day 3, Tuesday, July 3rd



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ICIS 2018 Abstract Book – Tuesday 3rd July

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Symposium abstracts: Tuesday, 3rd July

S8.2 Symposium: Action dynamics: A window into the developing mind

S8.2i The Development and Modulation of Mimicry in Infancy

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Mimicry, the tendency to spontaneously and unconsciously copy others' actions, plays an important role in communication and affiliation, yet little is known about its development. The dominant view on the neural basis of mimicry appeals to a coupling between perception and action. One theory suggests that these couplings are formed through associative learning during correlated sensorimotor experience. I will present work that provides support for this idea by showing that perceptual-motor couplings can be formed through observing one's own actions and imitative social partners, and that they play a role in supporting mimicry behaviour in infancy. Although mimicry is often thought to be an automatic consequence of these perceptual-motor couplings, recent studies with adults have demonstrated that mimicry is flexibly modulated by social signals, such as eye contact. Therefore, we also investigated whether mimicry is already modulated by social signals from early in life. 28 4-month-old infants (M = 120 days; range 104 - 142 days; 11 girls) were presented with videos of models performing facial actions (e.g. mouth opening, eyebrow raising) accompanied by direct or averted gaze, while we measured activation over the corresponding muscle regions using electromyography (EMG) to obtain an index of mimicry. We found that 4-month-olds only showed evidence of mimicry when they observed facial actions accompanied by direct gaze - a repeated measures analysis on Mimicry scores (i.e. activation over the corresponding muscle region minus activation over the non-corresponding muscle region) with Gaze direction (Direct vs. Averted) demonstrated a significant main effect of Gaze direction, $F(1, 27) = 7.997$, $p = .009$, $\eta^2_p = .229$. 27 of these infants also participated in a face-to-face interaction session with their mother from which the amount of maternal imitation was coded. We found that the mothers' tendency to copy their infants' facial actions during the face-to-face interaction session was related to the infants' facial mimicry behaviour during the EMG experiment, $r(25) = .395$, $p = .042$. Together these findings suggest that mimicry is supported by perceptual-motor couplings that are formed through correlated sensorimotor experience, and that one of the hallmarks of mimicry - that it is modulated by social signals - is apparent from at least 4-months of age.

S8.2ii Infants' visual experience with others' actions primes their motor representations

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The perception and representation of others' actions is crucial for understanding our social world. One prominent hypothesis suggests that actions are understood by observers mapping perceived actions to their own motor representations. If correct, then the development of action understanding should be linked to motor development. Critically, the early development of goal-directed reaching in infants affords a unique opportunity for studying the contributions of motor experience. Although infants begin to demonstrate goal-directed reaching between 4- and 5-months of age, they reach initially for objects with only their ipsilateral hand (i.e., hand on the same side of the body as object), and do not begin reaching with their contralateral hand (i.e., crossing the body midline) until approximately 7-months of age. If action understanding is related to motor experience, then the development of infants' motor simulation of ipsilateral reaches should emerge earlier than their motor simulation of contralateral reaches. During the past decade, we have studied this question by testing 9-month-old infants with a modified version of Piaget's A-not-B search task. Infants are tested in a version of the task in which they observe the experimenter reach during the A-trials and do not search themselves until the final B-trial. If infants map observed actions to their own motor representations, then they should demonstrate the search error for ipsilateral but not for contralateral reaches because the motor representation is less developed for the latter reach type. A series of experiments confirmed this prediction. Subsequent research revealed that infants' motor representations for contralateral reaching can be primed. Following a two minute familiarization phase during which an experimenter reaches repeatedly for objects with his contralateral hand, infants demonstrate the search error with the experimenter now reaching with his contralateral hand (Figure 1). In this previous research, ostensive cues (e.g., eye gaze, infant-directed speech, contingent responding) were used by the experimenter during the familiarization phase. The goal of the current research was to evaluate the necessity of these ostensive cues. Unlike the previous experiment, there were now two conditions in which the experimenter either used or did not use ostensive cues. Contrary to our expectations, infants in both conditions demonstrated the search error (67% vs. 75%). Moreover, there was no difference in their likelihood to look at the experimenter's face, toys, or actions during the familiarization phase as a function of condition. Converging evidence is provided by a second study in which 9-month-old infants were tested with

only the experimenter's hands-and-arms visible during testing, which is not sufficient to induce a search error, even if they had been primed with infant-directed speech (Figure 2). If, however, they were primed with the experimenter performing goal-directed reaches prior to testing, they committed the search error. These results are significant because they suggest that 9-month-old infants require minimal guidance to learn about goal-directed actions. We hypothesize that ostensive cues and social communication are unnecessary because actions are sufficiently salient to independently recruit infants' attention and elicit motor simulation. The implications for the development of joint attention will be discussed.

S8.2iii Supporting Infants' Tool Use by Constraining Their Initial Grasp of the Tool

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o use a tool effectively, a person must integrate knowledge about the tool and how to grasp it into their plan for acting on the tool (Creem & Proffitt, 2001). By studying the development of tool use during the first years of life, researchers can gain insight into infants' cognitive and motor abilities. Prior research on infants' tool use has investigated the development of spoon use (Connolly & Dalgleish, 1989), and has shown that it is characterized by considerable inflexibility (Barrett, Davis, & Needham, 2007; McCarty, Clifton, & Collard, 1999, 2001). In one task, 15-month-old infants were shown how to solve a novel task (lighting up a lightbox) by using a spoon in a novel way: holding the spoon's bowl and inserting its handle into a hole in the side of the lightbox. Despite the fact that the experimenter clearly demonstrated this solution two times immediately prior to giving the infants a chance to solve, the researchers found that 15-month-olds were highly resistant to grasping the spoon by the bowl and their failure rate was relatively high. However, the 24-month-old infants tested in the same procedure were highly successful. What accounted for this transition? To investigate the source of this failure to activate the lightbox using the spoon in this unconventional way, the current study was designed to test the possibility that infants' lack of flexibility was caused by their immature executive functioning. We reasoned that if infants were having difficulty solving the task because they could not inhibit the prepotent action of grasping the spoon's handle, perhaps they would succeed if we forced them to grasp the spoon's bowl. The study included forty-seven 14- to 18- month old infants (26 male, 21 female, average age 15 months, 8 days). Two different tools were used on different trials: one was a standard metal teaspoon, and the other was a novel tool that shared many

spoon-like properties but was not recognizable as a spoon (see Figure 1). Each tool was presented in a holder designed to force infants to grasp the round end (the entire tool was visible, but only the round end was accessible for grasping). In the other half of the trials, the tool was presented flat on the table. So, each infant was given four opportunities to solve the lightbox task with both the tool (spoon or novel tool) and presentation method (in holder or on table) counterbalanced among participants. The analyses revealed that the mode of tool presentation (whether in the holder or on the table) was a reliable predictor of ability to solve: $\beta = 0.67523$, $\chi^2(1) = 0.29520$, $p = 0.022$, CI [0.09664-1.25382], with infants succeeding in activating the lightbox with the spoon significantly more often when the spoon was presented in the holder (see Figure 2). Together, these findings lead us to conclude that the reason (or at least one reason) why the infants were failing to solve the lightbox task using the spoon was because they could not inhibit a conventional handle-grasp of the spoon. In contrast, the infants did not have difficulty grasping the round end of the novel tool. These results provide insight into how infants' prior experiences with certain kinds of tools can help--and hinder--their use of those tools. As infants' planning skills develop and their executive functioning is more mature, they can use tools more effectively to accomplish their goals.

S8.2iv Spatial Planning During Object Fitting

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Developmental assessments have often included shape fitting tasks as an index of normative adaptive behavior and problem solving (Gesell & Thompson, 1934; Bayley, 1969). In these assessments, children are typically given a summary score based on which shapes they fit into corresponding apertures. The process by which children accomplish shape fitting, however, has received little attention. Yet a focus on process can illuminate underlying developmental changes in the spatial planning abilities that give rise to advances in shape fitting. In this presentation, we look at the process of shape fitting by adapting motion capture technology for use with young children. We report two completed studies and one study currently in progress that examine how young children prospectively orient objects when attempting to align and fit them into an aperture. Across these studies, we systematically varied the spatial structure of the objects to be fitted. In Study 1, children between 16 and 33 months ($N=30$) wore reflective markers on their hands, enabling us to densely track their spatial adjustments

in three dimensions. Manual displacements of the handheld rod (Figure 1a) were separated into translations (changes in the lateral position of the object) and rotations (changes in the orientation of the object). Results revealed that prior to 24 months, children mainly used a two-step approach in which they initially translated the rod to the aperture and subsequently rotated the rod to match the aperture's orientation. In contrast, older children evidenced a more integrative strategy: they simultaneously coordinated translational and rotational displacements as they transported the rod to the aperture. Further, the oldest children evidenced such coordination soon after they picked up the rod, suggesting they had formulated an action plan at the outset of the task. Additionally, their translations became more efficient, covering a shorter distance. In Study 2, we added an orthogonal handle to the rod (Figure 2b) to understand how a more complex three-dimensional structure affected spatial coordination. A new sample of children (N= 35, 17-36 months) was tested. Children were asked to insert the distal segment (rod) of a handled object into an aperture as they held the object by its handle. Results indicated that the increased spatial demands associated with the handled rod interfered with children's ability to pre-align the rod. Children did not consistently pre-align the distal segment (rod) of the object relative to the aperture until approximately 30 months. Adding a handle to the rod thus delayed pre-alignment of the rod by about a half-year. In Study 3, we added either a handle parallel to the rod (Figure 1c) or another handle that was perpendicular to the rod (Figure 1d). We are currently collecting data with a new sample of children (18-48 months). Results will be considered in relation to how object structure influences the dynamics of spatial coordination by young children and more broadly, how a focus on process in addition to outcome can illuminate developmental changes in spatial thinking.

S8.3 Symposium: Building bridges from prenatal to postnatal: Using postnatal experimental approaches to understand prenatal perception

S8.3i Tracking fetal neurological development using noninvasive magnetoencephalography

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Fetal magnetoencephalography (fMEG) is a non-invasive method for investigating evoked brain responses and spontaneous brain activity generated by the fetus in utero. Fetal MEG is recorded using the SARA system installed at University of Arkansas for Medical Sciences (UAMS). The SARA system's array of 151 primary sensors is curved to fit the shape of the maternal abdomen. To track the neurological development of the fetus, we have performed serial studies (starting at 28 weeks of gestation) of the fetal auditory evoked response (AER), visual evoked response (VER), and spontaneous brain activity. The routine recording sessions range from 6 to 12 minutes in a continuous mode at a sampling rate of 312.5 Hz. The position and orientation of the mother's abdomen, relative to the sensor array, are determined using three localization coils placed at fiducial points on the mother's right and left sides, and spine at the level of the umbilicus. Fetal head position is defined using a portable ultrasound scanner when the patient sits in front of the array. The ultrasound examination to evaluate fetal head position is repeated at the end of the study. Fetal auditory as well as visual evoked fields have been successfully recorded in basic stimulus-response studies. The AER experimental protocols we have tested include the following parameters: Frequency-- 500 Hz to 1 kHz, Duration--100 ms to 1 s, Interstimulus Interval (ISI) --1 to 2 s, and Intensity (measured outside in the air)--100 to 120 dB. The general approach of most fetal AER studies is to search for an evoked component around 200 ms, which is interpreted as a delayed component corresponding to the adult N100. Various fetal MEG investigators have recorded peak AER amplitude ranging from approximately 30 to 175 fT and the latency of the primary response component from 125 to over 200 ms. VER studies were performed using 100- and 500-ms duration stimuli with an ISI of 2 seconds. Further, the paradigms investigating precursors for cognitive development, such as habituation and mismatch response have also been applied successfully with fMEG. Fetal MEG is a promising, and to date it is the only non-invasive approach for the prenatal assessment of precursors for cognitive development.

S8.3ii Using postnatal methodologies to index behavioural and physiological response to social stimuli in utero

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The question of whether human higher-level cognitive abilities are innate or learned through experience over time has been historically debated in all areas of developmental psychology. One area that has not escaped this debate has been the study of infant's ability to process the social world around them. Many assume that establishing evidence for these abilities in very young infants provides evidence of innate origin. For example, the discrimination of social, emotional information has been found from birth. Contagious crying, where an infant cries in response to the sound of another's cry has been considered a precursor to the development of empathy. Buhler & Hetzer (1928) first reported 84% of infants between 1- and 14- days old cried when exposed to another crying infant. Through four experiments, Simner (1971) aimed to investigate the reliability of contagious crying under controlled, experimental conditions. Infants who were exposed to the sound of a newborn cry cried significantly more than those who were presented with either a) silence, b) white noise, c) a computer-generated cry, or d) the cry of an older infant. Hoffman (1975) interpreted this seemingly peer-related response as potential evidence for an innate precursor to empathy in which empathic distress is experienced long before the understanding of other people. Innate interpretations such as these fail to account for experiences encountered during development prior to birth. Mampe et al. (2009) show that the newborn cry melody is already shaped by the native language indicating, processing during, and influence of, the auditory environment in utero. This opens up an important question as to which aspects of social stimuli the human fetus has the capacity to process and respond to prior to birth. This presentation will present data from a modified version of newborn contagious cry studies in a prenatal sample. Using 4D ultrasound, facial expression will be compared in response to a) newborn cry, b) 1-month-old laughter, and c) baseline silence. In addition, attentional allocation will be compared across conditions through the measurement of fetal heart rate (Clifton, 1974; Nelson et al., 1978). Preliminary results (N = 33, gestation 33-34 weeks GA) show the presence of mouth movements and appropriate facial expressions and variation in heart rate recordings. Though fetuses in the third trimester are likely to have been exposed to sibling cries, none will have yet heard their own cry. Thus, the response to emotional stimuli before birth will contribute to our understanding of well-documented capacities in neonatal infants earlier in development than has previously been indexed and prior to the acquisition of postnatal

experience. In addition, this adds to our methodological understanding of what sorts of stimuli and what sorts of behavioural responses can be investigated in a prenatal population.

S8.3iii Exploring the utility of light based visual stimuli and experimental paradigms in the third trimester fetus

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It has long been known that the late term human fetus has the capacity to process perceptual information (deCaspar & Spence, 1986). The advent of 4D ultrasound technology now allows for the detailed assessment of fetal behavior. The viability of performing an experimental paradigm with fetal participants, based on visual stimuli, has not until recently been examined. Newborn infants have shown a preference to engage with a top heavy, face-like stimulus when contrasted with all other forms of stimuli. We examined fetal head turns to visually presented upright and inverted face-like stimuli, comprising three dots. Here we show in a final sample of 39 fetuses that the fetus is more likely to engage with top-heavy configural stimuli when contrasted to bottom heavy visual stimuli (Reid et al., 2017). This result is similar to behavioural patterns seen in newborns (Simion et al., 2002). Our fetal experiment illustrates the validity of delivering visual stimuli via light to the human fetus. We also report a recent study exploring the processing of visual representations of number during the third trimester. Behavioural responses to stimuli were assessed in a final sample of 34 participants. Light presenting 2 or 3 dots (order counterbalanced) was positioned on the maternal abdomen for 45 seconds to the side of the fetus (Left, N = 16, Right, N = 18). Fetuses spent more time looking towards than away from the 2-dot set only, $z = 2.293$, $p = 0.022$. No significant difference was found in looking to versus away from 3 dots. This indicates a possible difference in processing of the two number sets. To our knowledge, this is the first study to investigate visual discrimination of number in a prenatal sample and provides the basis for a more thorough examination. This provides further evidence for the utility of examining prenatal behavioural response to visually-presented information. Additionally, this provides further evidence of the potential to address questions of prenatal visual discrimination by utilising techniques more closely resembling postnatal methodology than is currently the case in the prenatal field. References deCaspar, A.J. & Spence, M. (1986). Prenatal maternal speech influences newborns' perception of speech sounds. *Infant Behavior and Development*, 9, 133-150.

Reid, V., et al. (2017). The human fetus preferentially engages with face-like visual stimuli. *Current Biology*, 27(12),1825-1828. Simion, F., et al. (2002). Newborns' preference for up-down asymmetrical configurations. *Dev Sci*, 5(4), 427-434.

S8.4 Symposium: Infant directed speech: cross linguistic differences and its role in facilitating early language processing

S8.4i Neural Tracking of Infant Directed Speech by Seven-Month-Old Infants

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This study investigated preverbal infants' neural entrainment to natural speech, specifically comparing neural responses to infant- and adult-directed speech registers. Neural tracking of speech refers to the process by which cortical activity tracks the dynamic patterns in the speech input, both low-level spectrotemporal speech features as well as higher-level speech-specific information. Neural tracking in adults is associated with effective encoding of speech, but this has not been investigated in young infants. Infant-directed speech (IDS) refers to the speech register parents use when addressing their young infants. In comparison to adult-directed speech (ADS), it is characterised by a number of linguistic and acoustic qualities that have been proposed to assist infants' language learning. However, the mechanisms by which IDS might facilitate early language development remain unknown. Given the acoustic differences between IDS and ADS, and the fact that IDS recruits greater attention and neural arousal in young infants, it is possible that IDS and ADS afford different opportunities for neural encoding of incoming speech. Therefore, this study investigated the role of IDS in pre-verbal infants' neural encoding of speech by measuring the tracking of incoming speech by cortical activity. Recent research provides a framework for investigating neural tracking of continuous speech features using non-invasive EEG [Di Liberto, O'Sullivan, Lalor (2015) Low-frequency cortical entrainment to speech reflects phoneme-level processing. *Current Biology* 25(19): 2457-2465]. This approach is based on a ridge regression fit (Temporal Response Functions, TRFs) between the speech envelope and the EEG signal and allows prediction of the resulting EEG and the derivation of quantitative measures that have been linked to cortical entrainment. Seven-month-old infants' cortical responses were recorded via electroencephalography (EEG). During the task, infants listened to 8 minutes of naturally produced IDS recorded as a mother spoke to her own 7-month-old infant (in Australian English) and to 8 minutes of ADS recorded as the same mother spoke to an adult experimenter. We predicted higher synchronisation levels between neuronal activation patterns and the speech envelope for IDS compared to ADS, as reflected in better prediction of the unseen EEG signal for the low-frequency EEG-speech envelope correspondences recorded in IDS than in ADS.

Results showed that significant prediction correlations emerged in response to IDS, forming a cluster composed of 8 electrodes in the frontal area ($p = .023$), but this did not emerge in response to ADS. This indicates that the low-frequency cortical tracking of the speech envelope is stronger for IDS than for ADS. This finding suggests that IDS has a privileged status over ADS in facilitating successful neural encoding of incoming speech which may, in turn, augment infants' early speech processing and even later language development. These findings may assist us in shedding light on the early language processing deficits experienced by infant populations who are exposed to non-optimal IDS such as infants with hearing impairment and infants at-risk for cognitive disorders.

S8.4ii Segmenting words in IDS and ADS: Insights from computational models

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Infants must be able to extract the phonological forms of words (wordforms) from continuous streams of speech so as to match them with meanings [1]. A crucial question is to what extent segmenting wordforms is easier when the speech is addressed to children (Infant Directed Speech/IDS) than to adults (Adult Directed Speech/ADS) [2]. Modeling research may give insight into plausible segmentation mechanisms infants could use, by replicating endpoints and analyzing the impact of factors found to play a role in controlled settings. In this talk, we provide an overview of modeling work assessing potential learnability differences between IDS and ADS. The models used in previous studies are divided into two major classes, depending on the input received: symbolic or speech-based models. For example, in [3], the authors applied segmentation models on a transcribed Japanese corpus containing both IDS (mother playing with toys/reading book) and ADS (mother talking to experimenter). Orthographic transcriptions were mapped to phonological (symbolic) forms, word boundaries were removed to mimic running speech and four word segmentation algorithms were applied to recover the boundaries. Results showed that the IDS performance was slightly better than the ADS one. Since one may argue that these results, based on symbolic representations, cannot capture what very young infants do,

other studies looked at models taking in input raw speech [4]. In that study, American mothers were provided with objects/photos labeled with target-words they should describe to their children and to a confederate adult. A cognitively plausible word-discovery model was then applied to the speech recordings. Resulting scores were similar across registers, with some evaluation metrics showing an advantage for IDS, while others for ADS. In this study, we are improving over previous work in three key ways. First, we extend this approach to a new language (French). Second, we employ a unique database collected using a Language ENvironment Analysis (LENA) device [5]. Thus, for the first time, we analyze completely ecological IDS and ADS, as the latter are conversations between mothers and other adults overheard by children in their everyday life. Third, we aim to combine both symbolic and speech-based approaches, which we believe are complementary, on the same corpus. Symbolic models can control for register differences in acoustic implementation, whereas speech-based models may be more realistic with respect to the variability infants are exposed to. We have applied three symbolic segmentation algorithms, using either lexical or sub-lexical cues for segmentation, on the transcriptions of 4 from the 18 children in the corpus. The preliminary results show that IDS performs slightly worse than ADS (in a regression with $R^2=0.90$ the estimate for register is $\beta=-0.016$, $p=0.57$). By the time of the symposium, we will have completed the application of symbolic algorithms (including some with memory constraints [6]), as well as the forced alignment and the acoustic analyses necessary for the speech-based models. This innovative approach could shed unique light on potential word-segmentation differences between IDS and ADS.

S8.4iii What we can learn from fully annotated corpus of infant-directed speech in Japanese: Challenging the conventional methods of analyzing IDS properties

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Cumulative research on IDS has revealed that prosodic and segmental properties of IDS differs from those of ADS. Many of these properties have become widely accepted, often cited in introductory text books. Closer examinations of these findings have revealed, however, that some of the conventional methods of analyzing IDS properties have often failed to take the underlying assumptions of the measurement methods, and the results obtained with these methodologies had given rise to inaccurate and/or misleading conclusions. The present paper demonstrates this point with two well-known properties of IDS; slower speech rate, and exaggerated intonation, using a fully

annotated corpus of infant-directed speech in Japanese. Speech rate of IDS is often described as slower than ADS. Yet, the evidence for this came from simply comparing average syllable durations between IDS and ADS samples, ignoring the fact that utterances in IDS are shorter than ADS. When the fact was taken into account that syllables at phrase final position tend to be longer than those at non-boundaries, speech rates in IDS and ADS were equal [1]. Exaggerated intonation is another property of IDS that is widely known to occur cross-linguistically. Yet, a previous found that the exaggeration does not occur in Japanese IDS [2]. We found that this was because the previous study did not take into account that the system of intonation in Japanese differ from English, and when we took this into account, intonation of Japanese IDS was indeed exaggerated [3]. These studies highlights the often neglected fact that IDS features are specific to the languages in which they occur, and analyses of IDS without reference to the linguistic context in which they occur could result in misleading conclusions. References [1] Martin, A., Igarashi, Y., Jincho, N., & Mazuka, R. (2016). Utterances in infant-directed speech are shorter, not slower. *Cognition*, 156, 52-59. [2] Fernald, A., Taeschner, T., Dunn, J., Papousek, M., de Boysson-Bardies, B., & Fukui, I. (1989). A cross-language study of prosodic modifications in mothers' and fathers' speech to preverbal infants. *Journal of Child Language*, 16, 477-501. [3] Igarashi, Y., Nishikawa, K., Tanaka, K., & Mazuka, R. (2013). Phonological theory informs the analysis of intonational exaggeration in Japanese infant-directed speech. *The Journal of the Acoustical Society of America*, 134(2), 1283-1294.

S8.5 Symposium: Infants' and toddlers' evaluations of others' moral characters

S8.5i Sociomoral kinds?: Individuation by sociomoral behavior in 11-month-old infants.

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Infants in the first year of life are sensitive to the sociomoral behaviors of other agents. For instance, infants interpret an agent's actions towards another's goal as 'helpful' or 'unhelpful'. An important open question, however, is whether infants represent such sociomoral behaviors as fleeting actions that are subject to change from one moment to the next, or instead as stable traits that constitute an important part of an agent's individual identity. Do infants represent helpful and unhelpful actions as arising from different social kinds of agents? Infants' kind-based representations have been assessed in other contexts through so-called individuation studies, which examine the criteria that infants use to infer how many distinct objects exist in a scene. The current project uses this same strategy to determine whether infants possess kind categories for sociomoral behavior. Specifically, we tested whether infants use the types of sociomoral behavior they observe to individuate the number of agents that exist in an event. We tested sixteen 11-month-old infants and recorded their baseline looking times towards one or two puppets being revealed behind a screen. During test trials, infants then witnessed a sequence of events involving a puppet appearing twice from behind an opaque screen to perform different sociomoral actions towards another agent (e.g., helping then hindering its goal or vice versa). Crucially, both puppets were identical in their appearance and they were never seen on the stage at the same time. Once the sequence of helping and hindering actions was completed the screen dropped to reveal either one or two puppets on the stage and infants' looking times were measured. Results revealed a statistically significant interaction between baseline and test trials resulting from longer looking times toward two objects in the baseline trials, and longer looking times toward one object in the test trials (see Figure 1). These results suggest that infants individuated two agents behind the screen based upon the different sociomoral actions the puppets exhibited. A control experiment was run to determine whether infants' individuation judgments were based on viewing a puppet engaged in opposing sociomoral actions or simply because of the total number of action sequences involved in the event (regardless of their valence). We tested a separate group of 16 infants in the same task except that the identical-looking puppets appeared at two different times to engage in identical rather than different sociomoral behaviors (two

helping or hindering actions). Our results showed that the interaction between baseline and test trials was no longer significant (see Figure 2); In both trials infants looked longer toward two object outcomes (their baseline preference), suggesting that they fail to individuate two objects behind the screen if they perform two identical sociomoral actions. Overall, the results of this study indicate that 11-month old infants use information about moral disposition to individuate agents. We discuss how this result and on-going work is consistent with the possibility that infants represent moral dispositions as an intrinsic and identity-determining attribute of other agents.

S8.5ii The Role of Helpers' and Harmers' Mental States in Infants' Sociomoral Evaluations

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Research has demonstrated that infants in the first year prefer helpful agents who facilitate others' goals over harmful agents who prevent them (Hamlin & Wynn, 2011; Hamlin, Wynn, & Bloom, 2007). These findings are suggestive that infants evaluate helpers and harmers, but they do not speak to exactly what information infants use to generate sociomoral evaluations of a helper or harmer's character. Infants' evaluations could be based on mental states, associated outcomes, or both. This ambiguity could be elucidated by studying infants' evaluations of agents who help or harm without intending to. To this end, we studied: (i) infants' evaluations of agents who are coerced to help or harm; and (ii) agents who accidentally cause help or harm. In the first experiment, we examine the evaluation of coerced helping and harming by 13-month-olds in video stimuli adapted from the paradigm of Hamlin et al. (2007). If infants base their evaluations on helpers' and harmers' mental states, then they should differentiate between coercers and the agents (coercees) whom coercers force into helping or harming third-parties. Data collection is ongoing. Preliminary results are promising, and collection is well on track to being completed, reaching our preregistered sample size (n=64) by June 2018. In a complementary set of three experiments, we examined the evaluation of intentional and accidental acts of helping and harming by 10-month-olds in a puppet-show paradigm. We hypothesized that infants should prefer relatively more intentional helpers over less intentional helpers, but relatively less intentional harmers over more intentional harmers. Across the first two experiments (n=128), we found that infants incorporate and privilege intention to generate evaluations of true accidents, but not of negligent accidents. Specifically, infants preferred an agent who intentionally

helped a third-party over one who helped accidentally, and an agent who accidentally harmed a third-party over one who harmed intentionally, but only if accidental agents had not acquired knowledge of the third-parties' goals, and resulting outcomes were therefore truly accidental (i.e., not negligent). In a third experiment (n=64), we directly explored whether infants differentiate negligent from true accidents. We found that infants preferred truly accidental over negligently accidental harmers, but did not reliably distinguish negligently accidental from truly accidental helpers, consistent with research suggestive that people are especially sensitive to negligently accidental harm. The current experiments demonstrate that infants use mental states in their sociomoral evaluations. Infants did not base evaluations solely on outcome; they differentiated between coercers and coercees, and between truly accidental and intentional helpers and harmers. These results imply that infants use agents' intentions to generate sociomoral evaluations of agents involved in coerced action and true accidents. These findings enhance our understanding of exactly what information infants use in evaluating an agent's character.

S8.5iii How ingroup positivity and outgroup negativity differentially motivate social behavior in infancy

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Moral development is deeply intertwined with intergroup cognition. Infants use information about groups to evaluate people's moral status (Hamlin et al., 2013) and expect individuals to perform moral behaviors differentially based on group membership (Lieberman et al., 2017). These processes also influence infants' own preferences and behaviors; infants prefer ingroup members over outgroup members across a range of experimental paradigms (Kinzler et al., 2007). Yet, it remains unclear exactly what motivates this preference--do infants want to interact with ingroup members, or do they want to avoid outgroup members? Some work (Buttelmann & Bohm, 2014; Pun et al., 2017) suggests that ingroup positivity plays a stronger role than outgroup negativity in guiding infants' and children's preferences. Yet, this work may not fully account for the range of beliefs that guide infants' sociomoral behavior. It is possible that some expressions of ingroup positivity or outgroup negativity emerge before others; our experiments assess the relative emergence of preferences for ingroup over outgroup members (Study 1), spontaneous behavioral attitudes towards them (Study 1), and biases in resource distribution to them (Study 2). In Study 1, sixteen 18- to

24-month-old toddlers were introduced to two dolls; an ingroup member and an outgroup member. Groups were distinguished by clothing color, novel labels, and language spoken. Toddlers were then handed each doll individually for 30 seconds. Video-coding of toddlers' behavior indicated that 13 of 16 toddlers preferred the ingroup to the outgroup doll (binomial test, $p < .05$). However, toddlers did not display markedly positive or negative behaviors toward either doll (p s $> .22$), suggesting that although toddlers consistently preferred the ingroup member, they did not spontaneously act positively or negatively toward either individual. In Study 2, 18- to 24-month-old toddlers were introduced to an ingroup and an outgroup doll as in Study 1, then were asked to either give a treat to, or take a treat from, one of two bowls. For half the infants, one bowl belonged to the ingroup doll, and the other bowl was unclaimed. For the other half, one bowl belonged to the outgroup doll, and the other bowl was unclaimed. Ingroup positivity would be expressed by showing biased behavior towards the ingroup doll (taking the treat from the unclaimed bowl rather than the ingroup member, and giving a treat into the ingroup member rather than the unclaimed bowl); outgroup negativity, by showing biases against the outgroup doll (giving the treat to the unclaimed bowl rather than the outgroup member, and taking the treat from the outgroup member rather than the unclaimed bowl). Preliminary data (29 toddlers) demonstrate that infants show bias against the outgroup puppet for both giving and taking, whereas they show bias toward the ingroup doll for taking, but not for giving. Results will be discussed as showing whether infants reveal behavioral biases in resource allocation even though they don't reveal affective biases in spontaneous behaviors, and whether ingroup positivity is stronger or weaker than outgroup negativity.

S8.5iv 2-year-old toddlers make broad inferences about moral characters

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Recent findings indicate that toddlers hold moral expectations about how individuals will treat others, and attribute a deficient moral character to individuals who violate these expectations. With respect to fairness, for example, young children not only expect individuals to act fairly, but also prefer fair over unfair individuals and expect others to reward or praise fair but not unfair individuals. In our research, we asked how broad are the inferences toddlers draw about the moral characters of individuals who violate moral expectations. Specifically, after seeing an individual violate one moral expectation, would toddlers no longer expect the individual to adhere to a different moral

expectation? Such a result would suggest that toddlers draw a broad inference about the individual's character that extends to other moral contexts. We focused on two expectations, harm-avoidance and fairness, and asked whether 2-year-old toddlers who saw a protagonist harm one individual would no longer expect the protagonist to act fairly when dividing resources between two other individuals. We manipulated whether the protagonist perpetrated 1 vs. 3 harmful actions, and whether the target of these actions was an outgroup (Experiment 1) or an ingroup (Experiment 2) individual. In Experiment 1, toddlers in the 1-action condition watched events involving two groups of puppets, rabbits and dogs. In the labeling trial, A1-A3 (e.g., three rabbits) and B1 (e.g., a dog) labeled themselves (e.g., "I'm a rabbit!", "I'm a dog!"), to make group boundaries salient. In the harm trial, A2 and A3 were absent; while A1 watched, B1 completed a task (tower, puzzle, or picture), and then A1 destroyed it. In the test trials, B1 was absent, and A1 divided two toys equally (fair event) or unequally (unfair event) between A2 and A3. The 3-action condition was identical except that toddlers received three harm trials (tower, puzzle, and picture). Toddlers in the 1-action condition looked significantly longer at the unfair than at the fair event, whereas toddlers in the 3-action condition looked equally at the events. Thus, after seeing A1 harm B1 once, toddlers still expected A1 to act fairly toward A2 and A3; after seeing A1 harm B1 three times, however, toddlers no longer expected A1 to act fairly. Experiment 2 was identical except that B1 was replaced by A4, so that A1 now harmed an ingroup individual. Toddlers in both the 1-action and 3-action conditions looked equally at the fair and unfair events. Thus, after seeing A1 harm A4 either once or three times, toddlers no longer expected A1 to act fairly toward A2 and A3. Together, these results support two conclusions. First, 2-year-olds draw broad inferences about moral character: A protagonist who harms an outgroup member multiple times, or who harms an ingroup member either once or multiple times, is no longer expected to act fairly. Second, in line with prior results, toddlers do not view a protagonist's single harmful action as unacceptable when directed at an outgroup individual, and they therefore do not use this action to draw broad inferences about the protagonist's moral character.

S8.6 Symposium: The important role of maternal contingent responsiveness in infant social and communicative development

S8.6i The Relation between Early Contingency Detection and Joint Attention across the First Year: The Moderating Role of Mother-Infant Synchrony

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Contingency detection (Tarabulsky et al., 1996) and mother-infant interaction (Feldman, 2007; Beebe et al., 2012) both play fundamental roles in the development of social behavior. Recent findings suggest that heterogeneity in early contingency detection (i.e., associative learning) predicts quality of social behavior across infancy, including joint attention (Reeb-Sutherland et al., 2012). However, little is known about how the mother-infant interaction impacts the relation between early contingency and the development of social behavior. Therefore, in the current study, we examined whether synchrony in the mother-infant interaction as well as maternal report of stress in the mother-infant interaction moderated the relation between individual differences in early contingency detection and later joint attention. The sample consisted of 64 infants (52% males). At 1 month of age, contingency detection was assessed in sleeping infants using an eyeblink conditioning (EBC) paradigm (Reeb-Sutherland et al., 2012). At 5 months of age, mother-infant synchrony and maternal stress were assessed. Specifically, to assess synchrony, a 2-minute period of mother-infant social engagement was coded and a synchrony score was computed using the Infant and Caregiver Engagement Phases (ICEP; Weinberg & Tronick, 1999). Mothers' perceived stress related to the mother-infant interaction was measured via maternal report using the parent-child dysfunctional interaction subscale of the Parenting Stress Index - Short Form (PSI-SF; Abidin, 1990). At 12 months, responding to joint attention (RJA) and initiating joint attention (IJA) were assessed using the Early Social Communication Scale (ESCS; Mundy et al., 1996). A significant two-way interaction between EBC and synchrony was found for IJA ($\beta = 2.07$, $SE = 1.002$, $\Delta R^2 = .069$, $p < .05$, Figure 1). Similarly, a significant two-way interaction between EBC and maternal stress for IJA was found for the parent-child dysfunctional interaction subscale ($\beta = -.060$, $SE = .029$, $\Delta R^2 = .062$, $p < .05$, Figure 2). Follow-up analyses revealed a significant relation between EBC and IJA only when synchrony was high ($p < .05$) and maternal stress was low ($p < .05$). No significant interactions were found for RJA. The current results suggest that infants who display enhanced contingency detection early in life demonstrate significantly higher levels of initiating joint attention approximately one year later but only when they experienced higher levels of synchrony with their mother and when their mother reported lower levels of

stress related to the mother-infant interaction. These findings reveal a novel mechanism through which the interaction between fundamental contingency detection and the mother-infant relationship impact the quality of social behavior development. Furthermore, these findings suggest that infants who display low levels of early contingency detection may be at higher risk for later social problems particularly when they have mothers who have high stress and low synchrony and that this specific group should be targeted for interventions.

S8.6ii Dyadic Interaction Predicts Vocabulary at 12 & 18 Months: Roles of child vocalizations and conversational turns across infancy

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Caregiver-child interactions are characterized in part by dyadic synchrony: behavioral and affective matching and turn-taking (Feldman, 2007). Dyadic contingency promotes predictable caregiving and provides a foundation for attachment, intimacy, symbol use, empathy, and language development (Feldman, 2007; Harrist & Waugh, 2002). For example, conversational turn-taking (CTT) involves contingently responding to one another's vocalizations, providing opportunities for social responsiveness and caregiver shaping of infant vocalizations (Warlaumont, 2014; Goldstein & Schwade, 2008). Caregivers scaffold interactions with infants, and as age and social competence increase, infants play an increasingly greater role (Feldman, 2007). However, there have been few longitudinal investigations of developmental trajectories of infant-caregiver CTT (e.g., Abney et al., 2017). Thus, the nature of the infant's contribution to CTT, and relations between CTT and developmental outcomes (e.g., vocabulary size) remain unclear. We investigated the development of CTT longitudinally at 3, 6, 12, and 18 months ($n_s=58, 90, 77, 56$, respectively). At all ages, caregivers and infants participated in an 8-minute lab-based dyadic interaction. Recordings were analyzed using the Language Environment Analysis (LENA) system. We converted automated counts of conversational turns, child vocalizations, and adult words to per-minute rates. At 12 and 18 months, parents completed the MacArthur-Bates Communicative Development Inventories (MB-CDI). We focused on receptive vocabulary at 12 months and expressive vocabulary at 18 months. Conversational turns predicted vocabulary size. By 12 and 18 months (but not earlier) turns positively predict concurrent vocabulary size, $p_s<.04$ (Table 1). Further, child vocalizations (but not adult words) positively predict vocabulary size at each age, $p_s<.02$ (Table 1). Change across age was also evident. As expected, conversational turns

increased from 3-18 months (226.39% increase; Figure 1). This was due in part to the large increase in child vocalizations across 3 to 18 months (adult words remained stable). To characterize the roles of adult and child contributions to the development of CTT, we regressed turns on to child vocalizations and adult words at each age. Child and adult contributions to turns were both significant ($ps < .003$) and stable across age; however, child contributions were much larger than adult contributions to CTT at all ages. Findings suggest that parents are scaffolding CTT by responding vocally to the opportunities provided by child vocalizations, thereby transforming child vocalizations into conversational turns. Finally, we explored scaffolding of child vocalizations in more detail. Surprisingly, 3-month adult words predict both later child vocalizations and conversational turns, $ps < .03$ (Table 1). Both conversational turn-taking and frequency of child vocalizations predict vocabulary development and that turn-taking increases dramatically across 3-18 months. Results highlight how infants promote their own linguistic development within the context of parent language scaffolding. Greater adult language input in early development promotes more child vocalizations in later development. In turn, by producing more vocalizations, infants provide more opportunities for contingent responses from adults. Adults then transform child vocalizations into conversational turns by responding when children vocalize.

S8.6iii Predictive relations between maternal contingent responsiveness, infant neural responses and infant social behavior over the first year of life

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Behavioral research suggests that through exposure to repeated contingent caregiver responsiveness, infants are thought to develop an understanding of how the self and other can interact to share experience, laying a foundation for more complex social understanding. The current presentation will focus on the ways in which the early caregiving environment may shape the infant brain and associated development of social understanding and behavior over the first year of life. Particular emphasis will be given to the role of the contingent structure of caregiver behaviors as they arise within micro-analytically coded face-to-face mother-infant interactions - i.e. the extent to which maternal behaviors are temporally matched to, and contingent upon infants' changing cues and states. Data from a longitudinal study will be presented. Data analyses aimed to characterize (a) how infant brain development is influenced by experience of contingent maternal responsiveness over the first year of life; (b) whether differential

brain development is associated with individual differences in infants' emerging social capacities; and (c) whether dispositional infant temperamental reactivity might moderate these effects making some infants more susceptible to caregiving influences than others. Results provide support for the idea that contingent-maternal-responsiveness influences infant brain activity to in turn, support the development of infant social behavior. Moreover, results suggest that highly temperamentally reactive infants may be especially susceptible to these maternal influences. Future research directions will be discussed - including the utility of analyzing infants' real-time EEG responses during caregiver-infant interactions. In addition, clinical and policy-related implications will be emphasized regarding the importance of fostering face-to face interactions during the first year of life within both the home and the infant daycare setting.

S8.7 Symposium: Charting the emotional landscape of toddlers with autism spectrum disorder: a multi-method approach

S8.7i Diminished fear and heightened frustration in response to naturalistic challenges designed to elicit negative affect

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Introduction. Expression of emotion is a fundamental capacity present from birth and helps to ensure basic infant-environment interactions (Izard, 1978). Although both anger and fear are negative emotions, anger is expressed in response to goal blockage and results in approach behaviors such as protesting and struggling, while fear occurs in response to threat or uncertainty and is associated with withdrawal behaviors such as turning away and freezing. Positive affect is a relatively neglected dimension. Like anger, it is characterized by approach tendencies and manifests in laughter and increased activity level. Young children with ASD have been described to exhibit a restricted range of emotional expressions (DSM-V, 2013), or less positive and more negative affect than their peers (Garon et al., 2009; Jahromi et al., 2012; Macari et al., 2017; Snow et al., 1987; Yirmiya et al., 1989). However, little is known about emotional reactivity in toddlers with ASD in response to a range of standardized challenges. Hypotheses. To examine emotional reactivity in toddlers with ASD compared to their non-ASD peers in response to in-vivo behavioral probes, eliciting three emotions: joy and the conceptually distinct emotions of fear and anger. Study Population. 99 toddlers (M=21mo, range: 13-30mo): 43 with ASD and age-matched peers with developmental delays (DD; n=16) or with typical development (TD; n=40). Methods. Nine selected episodes from the Laboratory Temperament Assessment Battery (Lab-TAB; Goldsmith & Rothbart, 1999) were administered. Episodes were designed to elicit Fear, Joy, and Anger. Intensity of emotional response was coded offline by blinded coders and standardized composites were computed across facial, vocal, and musculoskeletal channels. Results. Between-group ANOVAs revealed no significant effect of diagnosis for intensity of joy, ($F(2,99)=.14$, $p=.87$) but significant group differences for intensity of fear ($F(2, 95)=6.44$, $p<.01$) and anger ($F(2,98)=3.54$, $p<.05$). Toddlers with ASD exhibited less intense fear than TD ($p=.002$; $d=.75$) and DD ($p=.011$, $d=.80$) controls and expressed significantly more intense anger than their DD peers ($p=.016$, $d=.73$), and marginally more intense anger than TD ($p=.064$, $d=.40$) controls. Within the ASD group, the ADOS-Toddler Social

Affect score was significantly negatively correlated with the intensity of joy ($r = -.33$, $p < .05$) but not with the negatively-valenced emotions. Results indicate that, compared to non-ASD peers, toddlers with ASD exhibited similar levels of positive affect in response to pleasurable stimuli. This finding is consistent with work showing that processes underlying the neural response to obtaining rewards (i.e., liking, or the hedonic aspect of the reward system) may be intact in ASD (Damiano et al., 2014). However, our results indicate that toddlers with ASD exhibited less intense fear responses to novel and potentially frightening stimuli and more intense angry affect in the context of goal blockage during the Lab-TAB's naturalistic and standardized emotion-elicitation probes. Consistent with studies of typically-developing infants (Planalp et al., 2017), our results suggest utility in isolating components of negative affectivity. The basic attentional and physiological processes underlying attenuated reactivity during frightening situations and accentuated reactivity during frustrating situations require further examination.

S8.7ii Diminished fear response in toddlers with ASD is associated with attenuated changes in physiological arousal

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Introduction. Compared to typically developing toddlers (TD) and controls with developmental delay (DD), toddlers with autism spectrum disorder (ASD) express less intense negative emotional behaviors in response to real-world fear-eliciting challenges (Macari et al., 2017; Abstract #1). It is not clear if this phenomenon is due to differences in behavioral display of emotions or in arousal levels in response to these events. Physiological arousal is thought to be altered in ASD; however, research findings have been inconsistent, likely due to differences in induction techniques, intensity and valence of emotional triggers, and measurement methods. **Hypotheses.** (1) To examine concurrently for the first time, physiological arousal (changes in skin conductance level, ΔSCL) and intensity and valence of behavioral affective responses to structured real-world challenges in toddlers with ASD. (2) To test whether ASD toddlers show greater ΔSCL in response to Anger- and Fear- but not Joy-eliciting probes as seen in typical

development (Kreibig et al., 2010). (3) To test whether the magnitude of Δ SCL is associated with intensity of emotions exhibited during Fear and Anger but not during Joy probes. Study Population. Participants included 26 toddlers with ASD (age: $M=23\text{mo}$, $SD=3$) and 24 age and age-matched TD controls (age: $M=22\text{mo}$, $SD=4$). Methods. Δ SCL was measured in response to multi-trial conditions eliciting Fear, Anger, or Joy, using an Affectiva Q-Sensor placed on the child's ankle. Δ SCL was calculated between the start and end of each trial, standardized and averaged within each condition. Intensity of emotional behavioral responses was coded offline. Results. At baseline, the ASD and TD groups showed comparable SCL scores ($p>.40$). A linear mixed model analysis of Δ SCL indicated no effect of diagnosis ($p=.74$), a significant effect of condition, ($p<.001$), and a diagnosis by condition interaction ($p=.012$). Δ SCL in the ASD group was comparable to the TD group in the Anger ($p=.58$) and Joy ($p=.17$) conditions, but was lower in the Fear condition ($p=.016$). In the two groups combined, Δ SCL was positively correlated with intensity of Anger ($r(36)=.30$, $p=.07$) and Fear ($r(35)=.45$, $p=.008$), but not with Joy ($p=.75$). Regression analysis of Δ SCL in the Fear condition revealed a significant contribution from parent-reported ECBQ Fear score ($p<.002$) and observed intensity of anger and fear (both $p<.002$, Adjusted $R^2=.42$), but not from autism severity, NVDQ, or VEQ. Physiological arousal increased in response to negatively- but not to positively-valenced challenges in both groups. The magnitude of changes in physiological response to Anger and Joy probes was comparable between ASD and TD toddlers. However, ASD toddlers showed an attenuated physiological response to Fear probes, mirroring the differences observed at the behavioral level (Abstr.#1). Changes in physiological arousal level were predicted uniquely by both parent-rated fearful temperament and intensity of behavioral fear responses, but not by severity of autism or levels of functioning. These findings show the usability of measuring physiological arousal when examining emotional response in toddlers with ASD and inform both clinical and theoretical approaches regarding response to threat in ASD.

S8.7iii Atypical approach-avoidance response to threat in toddlers with ASD

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Introduction. Difficulties in social communication and interaction are characteristics of individuals with autism spectrum disorder (ASD). Accordingly, research has primarily investigated the underlying mechanisms of perception and understanding of social signals in ASD. However, how young individuals with ASD emotionally experience their environment may critically impact their interaction with social partners. For example, children and adults with ASD show higher levels of anxiety. However, recent research revealed that compared to typically developing toddlers (TD) and controls with developmental delay (DD), toddlers with ASD express negative emotions less intensely (Macari et al. 2017, Abstract1 and show an attenuated physiological response (Boccanfuso et al. 2017, Abstract2 when presented with fear-eliciting probes. This study aims to expand this novel area of research by examining attentional vigilance and approach-avoidance behaviors towards real-world threatening stimuli in toddlers with ASD. Hypotheses. Toddlers with ASD do not process threatening stimuli typically, therefore show reduced attentional vigilance and more approach behaviors towards fear-eliciting probes compared to TD toddlers and toddlers with DD. Study population. 54 toddlers with ASD (age:M=22.59mo,SD=2.95; 7F), 21 toddlers with DD (age:M=21.42mo,SD=4.42;11F) and 56 TD controls (age:M=21.06mo,SD=3.77;26F) completed the study. Clinicians established diagnostic status using several assessment tools (Mullen, ADOS, and Vineland). Methods. Toddlers were confronted with real-world challenges based on the Laboratory Temperament Assessment Battery (Lab-TAB, Goldsmith & Rothbart, 1999). Among these were three fear-inducing episodes in which a 'threat' was presented to the child (crawling spider, roaring dinosaur and scary masks). Among several other variables, indices of attentional vigilance to threat (proportion of looking time to threat, to parent, or away) and approach-avoidance behaviors (proportion of body movements towards the threat, escape towards the parent or to other location) were coded offline by blinded coders and averaged across the three fear-inducing episodes. Results. A multivariate ANOVA revealed significant group differences regarding threat-related approach-avoidance behaviors ($F(2,128)=10.25, p<.001$). Toddlers with ASD spent more time approaching the threats during the fear-inducing challenges compared to TD toddlers ($p<.001, d=.62$) and toddlers with DD ($p=.010, d=.84$). However, despite spending less time looking at their parents ($F(2,128)=3.78, p=.025$) and more time looking away ($F(2,128)=2.13, p=.017$) compared to the TD toddlers ($ps<.011$), the group of toddlers with ASD spent a large and similar amount of time attending to the threat ($F(2,128)=1.16, p=.316$) compared to the two other groups of toddlers during the fearful episodes. These findings of increased approach behaviors in toddlers with ASD corroborate our results of attenuated physiological arousal and reduced intensity of facial, vocal, and bodily

expressions of fear towards threatening stimuli. Furthermore, toddlers with ASD paid as much attention to the threats as the TD toddlers, yet approached them more often than their TD and DD peers, thus they may have not perceived them to be as threatening. Investigating the emotional reactivity of young children with ASD across multiple response systems is key and can help better characterizing the early development of emotions of children with ASD.

S8.7iv Intensity of fearful affect during fear-inducing naturalistic probes is associated with attentional capture by threatening facial and vocal stimuli in toddlers with ASD and TD

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Background. Behavioral and neurophysiological evidence suggests that biologically-relevant stimuli such as facial expressions (Vuilleumier & Schwartz, 2001) and emotionally-valenced sounds (Ethofer et al., 2006) are prioritized in the attentional system as reflected by their enhanced capacity to capture attention. Rapid detection of emotional signals is thought to be affected in ASD, though evidence remains scant and conflicting, particularly in the early developmental stages. Here we examine for the first time, attention capture by threatening stimuli presented through visual (static faces) and auditory channels (nonsense phrases) in toddlers with ASD and typically-developing (TD) controls. We also examine, for the first time, direct links between attention capture by threat and intensity of fear response during real-world challenges. **Hypotheses.** Attentional capture by threatening stimuli in visual and auditory domains are associated with intensity of fear response during real-world challenges as well as with severity of autism symptoms and verbal and nonverbal developmental quotient in toddlers with ASD and TD controls. **Study Population.** Toddlers with ASD (n=29) and age-matched TD (n=29) toddlers (mean age=23 mo, SD=4). **Method.** Toddlers participated in an eye-tracking study investigating attentional capture by threatening stimuli. The toddlers completed a preferential looking paradigm in which their latency to orient to static angry faces (Face condition) and angry voices (Voice condition) were measured. Toddlers also completed a series of real-world behavioral fear-inducing probes adapted from the Laboratory Temperament Assessment Battery (LabTAB, Goldsmith et al., 1999). Ratings of peak intensity fear responses were coded offline by a blind rater.

Subsequently, we evaluated correlations between latency to orient to threat and intensity of fearful emotions during the challenges. Results. The groups did not differ in the latency to orient to angry faces ($p=.467$) or angry nonsense phrases ($p=.566$). In the combined groups, the latency to orient to the threatening targets was not associated with severity of autism symptoms, or with verbal or nonverbal DQ in either condition (all $p\text{-values}>.4$). However, there were significant correlations between the intensity of fearful behavioral responses during the Lab-TAB probes and latency to orient to angry voices ($r(54)=-.32$, $p=.020$) and faces ($r(26)=.45$, $p=.023$). This is the first study to report on associations between attention capture by threatening information conveyed through visual and auditory channels and intensity of negative affect in response to real-world fear-inducing challenges. Latency to orient to threat was not associated with severity of autism symptoms or levels of verbal or nonverbal functioning. However, children who responded with more intense fear tended to orient faster to angry voices and slower to angry faces. The mechanisms underlying this disparity are not known, but they may be related to differences in temporal structure of the stimuli or to differences in neural networks involved in processing emotional signals in visual and auditory modalities. Data collection for this project is ongoing and we plan to examine these questions in greater detail. These findings provide novel insights into threat processing and the complex associations between affective attention and emotional expression in very young children with and without ASD.

S9.3 Symposium: Walk, talk, play: changes across the transition from crawling to walking in infancy

S9.3i Infants' use of posture during play and exploration: A longitudinal investigation

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Infants' postural options increase with locomotor progression, which broadens their interactions with and explorations of their surroundings. We aimed to examine how the progression from sitting to walking affects the range of interactions infants entertain with their surroundings during play. We observed 13 infants in biweekly laboratory free-play sessions, held from 6 to 17 months. The room contained toys, a couch, and infant-sized stairs. At 15-sec intervals, we video-coded infants' targets of interaction (e.g., objects, furniture), postures (e.g., sitting, standing), and categories of interactive behaviors with targets: passive involvement (e.g., hand on), fine motor manipulations (e.g., pressing button), or gross motor exploration (e.g., pushing cart). When infants transitioned between targets, we identified whether they changed or maintained their postures during those transitions. During the pre-locomotor period, infants primarily used sitting postures to engage in fine motor manipulations. When transitioning from one target to another, they did so while changing or maintaining posture equally. In the crawling period, infants' use of sitting postures for focused fine motor manipulations declined. Instead, they used sitting postures to engage in all three categories of interactive behaviors equally. They also began to use kneeling/squatting and standing postures for passive involvement with targets. During the walking period, infants mainly used sitting postures for passive involvement with targets. Now, kneeling/squatting postures were more likely used for fine motor manipulations, while standing postures continued to be used for passive involvement. During the walking and crawling periods, infants' transitions from one target to another usually also involved changing postures. As infants acquire mobility, their body becomes a tool for exploration allowing for a growing diversification of their behavior and interactions with the world.

S9.3ii Learning to talk while learning to walk: Measuring language during the transition to walking in infants at risk for ASD

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For neurotypical infants, learning to walk is accompanied by a shift in language development (e.g. Walle & Campos, 2014). This is likely because walking affords infants new and more autonomous ways of interacting with people and objects in their environment (e.g. Karasik, Adolph & Tamis-LeMonda, 2014; Clearfield, 2010). However, infants with Autism Spectrum Disorder (ASD) may experience this transition differently: there is substantial evidence that both motor and language development are disrupted in ASD (e.g. Garrido et al., 2017; Jones et al., 2014). The present study examined language growth during the transition to walking in the infant siblings of children with ASD. These infants have a heightened risk (HR) of developing ASD themselves, with a recurrence rate of 18.7% (Ozonoff et al., 2011). Participants were 91 HR infants and a comparison group of 25 infants with no family history of ASD (Low Risk; LR). Both groups were visited monthly at home as part of a larger study. This study focused on 7 visits, which began 4 months before walk onset, and concluded 3 months after walk onset. Walk onset was established through parent-report. To assess Receptive and Expressive Language a parent completed the MacArthur-Bates Communicative Development Inventory (Fenson, 1994) at each visit. At 36 months, 15 HR infants received an ASD diagnosis (HR-ASD), 26 HR infants had significant language delay (HR-LD), and 50 developed typically (No Diagnosis; HR-ND). Data were analyzed using two piecewise Hierarchical Linear Models--one assessed receptive and the other expressive language growth. These piecewise models allowed us to estimate linear growth in language over the entire trajectory (piece 1; all time points), as well as additional linear growth from the final crawling visit forward (piece 2). We controlled for differences in chronological age. Model estimates are depicted for receptive and expressive language in Figure 1 and 2 respectively. Results revealed that typically developing infants--both LR and HR-ND--showed significantly increased growth in both receptive and expressive language following walk onset. This replicates previous findings that walk onset marks an inflection point in typical language development. This pattern of results was also found for the HR-LD infants, although their increase was attenuated relative to LR infants. Only HR-ASD infants did not show increased language growth in either receptive or expressive language following walk onset. Typically, learning to walk orchestrates change in a host of seemingly unrelated domains--these changes assist language learning (e.g. Campos et al., 2000). However, present findings suggest this phenomenon unfolds differently in infants with ASD, who are already vulnerable to social and communication deficits. It is likely that walking affords all infants more autonomy to "forage" for social experiences--this autonomy may lead infants with ASD to different experiences.

S9.3iii Talking on the go: Vocalization in crawling and walking infants

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Locomotion and language are important achievements in infancy that alter ways infants engage with people and objects. After infants begin to crawl and walk, they can choose to be near or far away from caregivers, visit new and familiar places, and discover and retrieve objects in the course of their travels. After the onset of words, infants can express their intentions using socially shared conventions. Given the developmental timing of locomotion and language, researchers have begun to ask whether these skills are functionally related. Researchers have speculated that developmental shifts brought about by walking--travel greater distances, access and carry objects, and share objects in new ways--may be associated with the observed growth in language. But, it is still unclear when differences in language occur. When infants begin to walk, they often crawl; regardless of locomotor posture, infants move to get to people, places, and things. We asked about real-time differences in crawlers' and walkers' vocalizations: Do infants vocalize while stationary or while moving? Do walkers vocalize while moving in prone or upright postures? Do mothers tend to vocalize when infants are moving or stationary? Mothers of 50 11-month-old crawlers reported infants' receptive and productive vocabulary and gestures using the MCDI. At 13 months, MCDI measures were collected and mothers and their crawlers (n=26) and walkers (n=24) were video-recorded at home during everyday activities. We are transcribing mothers' and infants' utterances and coding whether infants were stationary or moving (prone or upright) while hearing and producing vocalizations. We hypothesize if crawlers vocalize while moving prone and walkers vocalize while moving upright, crawlers will vocalize more than walkers because dealing with concurrent task demands for inexperienced walkers might be a challenge. However, if crawlers and walkers vocalize while moving prone, then they should not differ on vocalizations, as opportunities for movement are similar. We expect mothers of walkers to vocalize more to their infants recognizing them as developmentally advanced. Alternatively, mothers may vocalize similarly to crawlers and walkers but increase vocalizations when infants are on the move. Infants showed gains in language from 11 to 13 months; we found no differences between crawlers and walkers at 13 months or at 11 months, when all infants were crawling. Preliminary analyses from 15 minutes of each infant's video (6 crawlers, 6 walkers) indicate no differences between crawlers and walkers on amount of vocalizations produced (M=110.0, 120.5, respectively) or mothers' vocalizations to crawlers and walkers (M=253.3, 242.67). Since infants and mothers vocalize at the same rates, we will classify

vocalizations based on infant posture and movement to address our research question. By using maternal report with transcription from video, we obtain contextualized assessment of mothers' and infants' vocalizations. Real-time changes in motor and language development may uncover the processes of change that may explain the possible catalytic effects of walking on language.

S9.3iv Crawling and Walking Infants' Home Language Environments: Relations with Concurrent Vocabulary Size

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A growing body of empirical research indicates that the transition from crawling to walking is associated with changes in infants' vocabulary sizes (e.g., Nelson et al., in press; Walle & Campos, 2014). Changes in infants' social and language environments corresponding with the onset of walking are one mechanism through which such changes in vocabulary size may be facilitated (see Karasik et al., 2013; Walle & Warlaumont, 2015). The present study used day-long audio recordings of same-aged crawling and walking infants to explore how parent-infant vocal interactions, specifically parent labeling and imitation of infant vocalizations, were associated with infant language outcomes.

Day-long audio recordings were collected using the LENA pro system (N=24, 12 walking infants). Infant age did not differ between crawling (M=12.55 months) and walking (M=12.69 months), infants, $p=.50$.

The parent activated the recording at the start of a typical day and each recording was at least 10 hours in total duration. LENA's Automatic Data Extractor was then used to identify the 3 most voluble infant (i.e., containing the highest number of infant vocalizations) and 3 most voluble interactive (i.e. containing the highest number of conversational turns between the infant and caregiver) 5-minute samples from each infant's recording. Trained researchers hand coded each segment for all infant and adult vocalizations. Each infant vocalization was coded as canonical (speech-like), non-canonical (non-speech-like), or reflexive (i.e. laugh or cry) (Burder et al., 2013). Adult vocalizations directed toward the infant were classified as the adult labeling a referent or imitating the infant's vocalization (i.e., exact repetition of an infant babble). Parents also completed the MacArthur-Bates Communicative Development Inventory (MCDI) (Fenson et al., 1994) to assess infant receptive and productive vocabulary size. Parents also reported the infant's locomotor status (i.e., crawling or walking).

Separate hierarchical multiple regressions examined the relations of each parent vocalization type, infants' walking status, and the

interaction term with infant receptive and productive vocabulary scores.

Analyses of parent labeling revealed an interaction with infant locomotor status predicting both infant receptive, $B=1.34$, $p=.057$, and productive, $B=1.30$, $p=.04$, vocabulary size. As shown in Figure 1, walking infants who received more labeling by the parent had larger vocabulary sizes, but no such effect was present for the crawling infants.

Analyses of parent imitation indicated a significant interaction with infant locomotor status in predicting infant receptive, $B=1.28$, $p=.048$, and productive, $B=1.39$, $p=.01$, vocabulary size. Examination of the interaction (see Figure 2) indicated that parent imitation of walking infants was associated with larger vocabulary size, but not such pattern was present for crawling infants.

This naturalistic study indicates that parents' responding to infant vocalizations is differentially associated with crawling and walking infants' language development. Further analysis of dyadic contingencies of parent responses to infants' canonical and noncanonical vocalizations are currently in progress. Potential social and biological mechanisms that may account for observed differences in crawling and walking infants will be discussed.

S9.4 Symposium: More than meets the eye: pupil dilations and spontaneous eye blinks offer new insights into infant cognition

S9.4i No one anticipated that! The advantage of pupil dilation over pro-active gaze in the study of infant social cognition

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Much research over the past two decades has focused on the ability of infants to infer others' goals in order to predict their actions. Some have proposed a "direct matching hypothesis", whereby action-understanding results from a mechanism that maps an observed action onto the infant's own motor representations, possibly involving mirror neurons (Iacoboni et al., 1999). Alternatively, a "learning hypothesis" suggests that the repeated observation of specific behavioural patterns allows infants to integrate standard behaviours into learned representations that, in turn, predict others' actions (Catmur, Walsh, & Heyes, 2009). We contrast these two hypotheses within the area of goal attribution (i.e., whether infants distinguish observed events caused by a deliberate agent from similar events that are not the outcome of agency). Forty-two 12-month-old infants (22 male, 20 female) were shown a video in which objects moved to a target (either a person's hand or a bucket). The objects either moved through self-propelled motion (SPM) or were carried by a human agent (HA). All infants were first familiarized with one of the four video conditions (target x motion), then tested using a 2 (motion) X 2 (target) factorial design. We recorded infant gaze to identify any proactive goal-directed eye movement (PGDEM). We also recorded pupil diameter as an additional dependent measure. Pupil dilation reflects cognitive arousal, and could thus index mismatches between infants' predicted goals and observed test events. Infants exhibited PGDEM in the HA but not in the SPM conditions. However, pupil dilatation was significantly higher for SPM than HA. This study suggests that novelty of self-propelled events could be sufficiently captivating to disrupt trajectory learning. That is, a parcimonious interpretation of our findings is that SPM disrupts PGDEM, rather than suggest (without evidence) that HA has a special status. Our work itself does not deny a role of a mirror neuron system (if any) in action understanding. Rather, it highlights a role for online learning that must be factored in when studying cognitive abilities in infants. Finally, we do not show effects related to the target of motion (hand or bucket). This may not disprove but certainly questions the "goal directedness" assumed to be

assessed in such tasks. Finally, pupillometry enables us to make nuanced interpretations that would elude studies based on gaze or looking times alone.

S9.4ii Pupil dilation as a window into arousal sharing

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In everyday life, we communicate our feelings in different ways - facial expressions, posture, vocal tone, and even pupil size. Pupil dilation is a signal of arousal or cognitive processing (Laeng, Sirois, & Gredebäck, 2012). Across a series of studies, we demonstrate that even young infants recognize and respond to the pupil dilation of others with pupil dilation of their own. This phenomenon is known as pupillary contagion and is likely to be an early form of arousal sharing that could contribute to later development of empathy. In our initial study, we showed that infants at 6 and 9 months of age dilated their pupils more to schematic images of eyes with larger vs. smaller pupils (Fawcett, Wesevich, & Gredebäck, 2016). No comparable effect was seen for images that used squares instead of circles, and thus did not resemble eyes. A later study built on these results by showing 4- and 6-month-old infants photographs of real eyes edited to have large, medium, or small pupils (Fawcett, Arslan, Falck-Ytter, Roeyers, & Gredebäck, 2017). Again, infants reacted with greater pupil dilation to the images with large pupils than either medium or small pupils, showing that the effect is present with more ecologically-valid stimuli as well. In the current study, we are presenting 6- and 10-month-olds with images of eyes that indicate an emotional expression, in addition to varying in pupil size. The emotions depicted are happy, sad, fearful, and angry. Examining pupillary contagion across emotion types and ages will give insight into whether and when in development infants take on others' arousal differentially based on displayed emotions, which could have implications for empathy. In the study, infants observe a total of 48 images, varying in emotion, pupil size, and model sex. Infants' pupil size during presentation of the image is calculated relative to a baseline fixation screen to give a pupil change value. This pupil size change is an indicator of arousal that results from viewing the image. Preliminary results suggest: 1) pupil dilation overall is greatest to the angry faces compared to fearful, sad, or happy and 2) unexpectedly, pupil dilation (change from baseline) is greatest to models with medium-sized pupils ($M = .12$) compared to either large ($M = .07$) or small ($M = .06$). Final data will be presented at the conference. Together, this new data will extend previous work, shedding new light

on pupillometry as a practical and valuable tool for examining emotion and arousal sharing early in life.

S9.4iii Spontaneous Eye Blinking: A Complementary Measure for Probing the Mechanisms of Cognitive Function

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Foundations. Spontaneous eye blinking rate (SEB) has been regarded as a putative index of central dopamine (DA) system activation for decades. Prior work includes pharmacological manipulation of DA, studies of human cognition, and clinical applications. Generally, elevation in the rate of SEB is believed to reflect greater DA activation, but both the rate and timing of blinks have been used to make inferences about behavior and underlying systems. Baseline SEB rate shows wide individual differences at all ages and the rate is sensitive to ongoing behavior. The temporal pattern of blinks has been used to infer dimensions of information processing such as sustained attention, stimulus salience and reward value. Recently, interest in SEB has increased dramatically yet developmental work lags behind. Our work. Work in our lab has focused on charting the developmental course of SEB from infancy to childhood, examining factors affecting SEB rate and timing, and exploring correlates of individual differences in SEB rate. We have studied the following factors in relation to SEB rate: visual attention, working memory, motor activity, temperament, positive affect, frontal EEG asymmetry, and the relative amplitude of steady state evoked potentials. Our work has shown utility in using blink rate (tonic and phasic indices), the timing of blinks (with respect to other events), and the variability in blink rate. The core part of the presentation for ICIS will be recent results from two collaborative studies that examine SEB rate concurrently with EEG measures. In one study, we observed that individual differences in SEB rate were linked to changes in frontal EEG asymmetry (Fig 1) during a cognitive task. The site and timing of the asymmetry suggest that the DA system modulates the task-related changes in asymmetry. Further, these results might reflect the early expression of the dorsal attention network and suggest that tonic DA differences influence that expression. In a second study, we observed a modulation of spatial attention that precedes blinks. By using steady state evoked potentials (SSVEP), we can identify fluctuations of spatial attention while gaze is directed toward a target (Fig 2). These two studies indicate the potential power of combining SEB measures with EEG to gain leverage on understanding mechanisms of cognitive function. Bridges.

Knowledge about the development, mechanisms and function(s) of SEB in infancy is limited, and so the potential for involvement by developmental scientists and those from other fields (and levels of analysis) is substantial. Work in our lab has shown some promise of SEB for revealing new information about cognition when using EEG. Investigators of cognitive function with interests in visual attention and working memory may also find SEB useful. Further, SEB rate could be relevant for those interested in motivation and temperament. Finally, because eye blinks are brief events that occur at low rates, those interested in modeling or in other mathematical approaches could make contributions by studying the temporal patterns of SEB. To the extent that SEB reflects features of central DA activation, it may provide insight into the development of DA-modulated systems.

S9.4iv Pupil Dilation, Eye-blink Rate, and the Value of Mother Establish the Origins of Reward Learning in Infancy

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The brain is adapted to learn from interactions with the environment that predict or enable the procurement of rewards (Schultz, 2010). For human infants, the mother is most often associated with primary biological rewards such as food and warmth, as well as the most likely provider of emotional and social rewards such as comfort and responsiveness. In this study we capitalize on the reward value of mother to establish the origins of reward learning mechanisms, using saccadic latency measures as well as physiological eye metrics of pupil dilation and eye-blink rate (EBR). Converging lines of research have demonstrated links between reward-related striatal dopamine activity and measurable changes in spontaneous EBR and pupil dilation (Eckstein et al., 2017). When a reward is repeatedly paired with a predictive cue, the dopamine response gradually decreases following the reward itself and increases in response to the reward-predicting cue (Schultz, Dayan, & Montague, 1997). Thus, the predictive cue acquires value in eliciting a dopaminergic response and the associated power to engage learning mechanisms. In an eye-tracking experiment, we presented 7-month-old infants with video stimuli that parametrically increased in social-emotional value (mother, female stranger, male stranger) or in visual attention/interest value (dynamic cartoon, slowed silent cartoon, static cartoon image). The video of the infant's mother elicited larger pupil dilations and more smiles, indicative of greater social-emotional value, as well as meaningful differences in EBR that positively correlated with time spent with mother.

Having established infants' baseline responses to the videos, we paired them with arbitrary shape cues in a cue-target associative learning task. On each trial, a shape cue was followed by its paired reward video in a fixed quadrant of the screen, allowing us to measure infants' latencies as they made saccades to the cued quadrants. We observed the strongest spatiotemporal learning (i.e., faster latency, $F(3,141)=7.07$, $p<0.001$, $\eta^2=0.131$) for the mother reward video, shown in Figure 1A. We also observed a larger increase in pupil dilation to the mother-predictive cue from pre-test to post-test ($M=0.11$ mm, $SD=0.46$; $F(3,90)=2.54$, $p=0.061$, $\eta^2=0.078$) indicating that the heightened pupillary response transferred from the mother reward video to the mother-predictive cue during learning, shown in Figure 1B. Finally, the extents of learning and transfer were predicted by individual differences in infants' baseline EBR to their mother's video, as shown in multiple regression models (Table 1). Taken together, these results provide the first evidence of a dopaminergic basis for reward learning in infancy. Furthermore, this study demonstrates how pupillary and blink responses can provide a window into learning mechanisms in infants, unlocking reward and reinforcement circuitry for exciting future investigations.

S9.5 Symposium: The future of infancy research: examining what infants' everyday experiences can tell us about development

S9.5i The Roles of Gesture and Statistical Cues on Word Learning in Shared Storybook Reading

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Children rapidly learn the word-object mappings even though they are facing the challenge of referential uncertainty (Quine, 1960). When parents read books to their infants, how do infants learn to associate the words with multiple objects on the page. Using data from parent-child book reading interactions, we analyzed moment-by-moment eye movement data to examine the role of gesture and statistical cues on word learning. Specifically, we investigated 1) whether parent's and child's gestures could direct the child's attention to the object named by the parent during naturalistic storybook reading; 2) given that parents repeatedly name objects, how statistical information across multiple instances could provide converging evidence of the correct word-object mapping? We predict that even though individual naming instances can be ambiguous, gestures and statistical cues can significantly reduce the degree of referential uncertainty in this context, offering a statistical solution to build correct word-object mappings. Method. Parents were instructed to read to their children (Mage=18.5m.o.) at a table using 5 wordless storybooks provided. Both participants wore head-mounted eye trackers, which allowed us to keep track of their moment-by-moment looking behavior in real time (Figure 1). In total, we collected 45 book reading sessions from 14 dyads. Results. For each naming instance, we measured how often infants look at the named object 3 seconds after the naming onset. There are two major findings based on 1930 naming instances across 45 sessions. First, social/gesture cues create better individual learning instances. As shown in Figure 2A, most of the individual naming instances are either highly informative (about 10% of cases), meaning that infants always look at the named object or highly misleading (above 50% of cases), meaning that infants do not look at the named object within a 3-second naming window. However, when naming is coupled with a gesture from either the parent ($\beta=.27$, $p<.001$) or the child ($\beta=.36$, $p<.001$), infants are more likely to direct their attention to the named object. Second, accumulated statistics reduce referential uncertainty. Because parents repeatedly name the same object within and across pages, we calculated accumulative looking time across all the naming instances of the same label and found that due to repeated naming, a large proportion of (over 20%) of misleading cases was no longer misleading (Figure 2B) and high informative and ambiguous cases also

increased dramatically. We then separated objects into infrequently named and frequently named objects and found that infrequently named items on average were named 1 or 2 times. As shown in the bimodal distribution in Figure 2C, naming instances were either highly informative or highly misleading. Frequently named items on average were named 5 to 6 times (Figure 2D). The flatter distribution showed that learners were more likely to spend some time looking at the target, which allowed them to use cross-situational statistics to aggregate information across multiple learning instances. Using data jointly created by parents and children in everyday book reading context, we demonstrated that both gesture cues and statistical information across multiple instances could dramatically reduce referential ambiguity and provide converging evidence of the correct word-object mappings.

S9.5ii Everyday cues to infant word learning in the home

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Infants' home environment is often depicted as this "messy," "chaotic" place, with countless people, objects, animals, places, and events all bid for infants' attention. In the lab, researchers control for distractions while studying infants' early language development. However, that doesn't offer much insight into how infants manage to learn new words in "messy" environments. Previous laboratory work has shown infants rely on various cues during interactions with caregivers (e.g., gesturing/touching objects) to make salient connections between words and referents--do interactions look similar in everyday environments? We investigated how cues in infants' home environment influence infants' early language experiences and whether infants' day-to-day environment and routines help scaffold their early word learning. We asked: (1) What visual and tactile cues accompany common nouns directed to infants in the home? 2) Do caregivers' use of common nouns vary in predictable ways across their everyday routines and locations? Participants were 40 healthy, first-born 13-month-old European-American infants and their English speaking mothers in NYC. Dyads were video-recorded in home during their naturalistic routines for 45 minutes. Videos were transcribed, revealing 65,655 total words (with over 1,800 unique words) directed to infants across the sample. In order to detail the multiple physical cues to infant word learning that accompany the words mothers' direct to their infants, we limited our scope common concrete nouns infants learn first using the MCDI. Our final list included 59 target nouns spoken by at least 25% of mothers. Using transcripts, we identified 3,219

naming events across participants: 6-second intervals when mothers used one of the target nouns. Naming events were coded for object presence, mothers and infants' visual (social and object gaze) and tactile cues (gestures and touching object), routine type (mealtime, grooming, toy-play, literacy, and unstructured play), and location (room and place within the room; e.g. living room, couch). Analyses revealed in-home interactions between infants and mothers were rich with visual and tactile cues. Mothers named objects 1) that were physically present, 2) using simultaneous visual and tactile cues, 3) while infants also used visual and tactile cues. Although mothers looked at infants during most naming events, bouts of joint engagement were relatively low. Deeper investigation into contextual cues revealed that routine and location systematically organized mothers' language. For example, mothers frequently used animal names (e.g., dog) when infants engaged in literacy and toy-play, but almost never while infants engaged in other routines, such as mealtime and grooming. Similar patterns emerged in our analysis of location. Food naming events occurred while infants were in the kitchen (especially at the table), and were infrequent in the bedroom, living-room, and bathroom. Together, data reveals that infants' everyday life and home environments are not so "messy." Infants' day-to-day experiences and interactions are replete with regularities that shape infant-directed speech; providing infants systematic and structural cues to word meaning, scaffolding language development.

S9.5iii What you get is what you give: The effects of peer speech on language outcomes of infants

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A rich body of literature has examined the relation between the linguistic input infants receive and their subsequent language development. Such studies have revealed that the quantity of speech, grammatical complexity, and variability of the vocabulary used in caregivers' speech were associated with infants' language gains. Similar results have been found within the context of the classroom. However, little is known about the role peers play in the development of language in the first five years of life despite the import of peer interactions in fostering social and cognitive development. This is in part because our current understanding of early classroom social interaction relies primarily on teachers' observations and experts' manual coding of interactions, which provide

insightful snapshots of classroom dynamics but are limited in the scope of information acquired simultaneously. Here, we employed objective, continuous measurements of infants' location and vocalizations in an early intervention classroom to examine the influence of peer interactions on infants' language use.

Data were collected weekly over ten consecutive weeks in an inclusive intervention classroom of seven Deaf/Hard-of-Hearing infants with cochlear implants and three typically hearing peers (Mage=36.8 months, SD=3.3 months). Continuous, objective measurements of infants' location and orientation were collected using the Ubisense system. The classroom was outfitted with four sensors that tracked active tags worn by infants using radio-frequency identification. Periods of social contact were defined as instances where infants were within 1.5m of each other, a distance at which co-location between infants occurs more than would be expected by chance, and were also oriented toward one another within 45°. Infants also wore LENA audio recorders, allowing for automated analysis of day-long vocal recordings. Synchronized LENA and Ubisense measurements indicated when infants were in social contact and vocalizing.

Linear mixed-effects models were employed to predict infants' language use from the proximal input of their peers. Each infant had variable levels of social contact with their peers in the course of an observation and during those periods of social contact their peers vocalized at different rates. Infants' total vocalization levels during each observation were positively predicted by their peers' input during social contacts in the previous week, $b=0.90$, $se=0.31$, $t=2.89$, $X^2(1)=8.30$, $p<0.01$. Specifically, infants who received the most input in a given week generally vocalized more, regardless of their social partner, during the subsequent week. Additionally, the amount of input infants received from each of their social partners positively predicted the amount of vocalizations they produced when interacting with those same peers the following week, $b=0.36$, $se=0.11$, $t=3.30$, $X^2(1)=10.77$, $p<0.01$. Interestingly, after controlling for peer input, there were no main effects of hearing status on language use--suggesting that peer interaction is crucial for this at-risk population.

By capitalizing on automated, objective measurement techniques, this investigation allowed us to examine, in heretofore inaccessible ways, the mechanisms by which peer language input promotes infants' language development. These findings highlight the crucial role of peer interactions in infants' language production and development.

S9.6 Symposium: Advancing the science of infant cry research: which caregivers are at risk for problems in parenting?

S9.6i The Combined Effects of Prenatal Exposure to Maternal Stress Physiology and Acute Stress on Newborn Neurobehavior

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Maternal exposure to stress during pregnancy has a variety of deleterious impacts on offspring biological and behavioral regulation (for reviews see Schetter, 2011, Entringer, Buss, & Wadhwa, 2015; Monk, Spicer, & Champagne, 2012). However, there is little research examining how prenatal stress affects newborn neurobehavior. Prenatal programming models suggest that early life stress exposure may direct stress response systems toward behavioral strategies that are adaptive (Boyce & Ellis, 2005). We tested this model by examining how prenatal exposure to maternal autonomic reactivity was related to newborn neurobehavioral reactivity in the context of maternal exposure to acute stress. Because research indicates that maternal exposure to an infant cry stimulus elicits a strong stress response, the present study utilizes an infant cry to assess maternal autonomic responses prenatally (Riem et al., 2012; Soltis, 2004). We hypothesized that mothers with higher levels of prenatal stress and RSA reactivity to the infant cry would have infants with more arousal at birth, poorer attention, and more hypertonicity. The sample was comprised of 72 mother-infant dyads. Mothers were 70% Caucasian and 30% minority. Maternal mean age was 27.8 years. Infants were 55% male and 45% female. Mothers were invited to the lab during the third trimester of pregnancy and physiological, questionnaire, and interview data were collected. Mothers were continuously monitored via electrocardiogram (ECG) while watching a 1 minute baseline seascape video as a task matched control. Next, mothers watched a 1 minute video of an infant cry stimulus. Respiratory sinus arrhythmia (RSA) was calculated using Mindware Technologies, LTD software and RSA withdrawal scores were created by subtracting mean RSA during the cry stimulus from mean RSA during the baseline condition. Mothers completed the UCLA Life Stress Interview (LSI; Hammen et al., 1985;1987). Acute stress was calculated by summing the number of discrete acute stressful events mothers reported during pregnancy. After delivery, the NICU Neurobehavioral Network Scale (NNS), a standardized comprehensive evaluation of the neurobehavioral performance of newborns was administered to newborns 24 hours after birth (Lester & Tronick, 2002). An exploratory factor analysis was performed on the NNS subscales, and 3 primary factors emerged: 1. Attention (high attention and low

lethargy), 2. Arousal (low self-regulation and high levels of arousal), 3. Hypertonicity (high hypertonicity, low hypotonicity) (see Table 1.). There were no significant main effects of maternal HR or RSA reactivity in response to the cry stimulus on the NNNS factor scores. A significant interaction between prenatal acute stress exposure and maternal RSA withdrawal during exposure to the cry stimulus predicted newborn arousal (see Figure 1). There were no significant differences in newborn arousal for low physiologically reactive mothers, regardless of their acute stress exposure. However, mothers who experienced higher levels of acute stress during pregnancy and exhibited higher RSA reactivity to the cry stimulus gave birth to newborns who displayed higher levels of self-regulation and lower levels of arousal at birth. These counterintuitive findings will be explained in the context of prenatal programming theory.

S9.6ii Partner Presence Buffers Fathers' (not Mothers') Autonomic Physiological Response to Infant Distress

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Research indicates that infant distress elicits heightened autonomic physiological responding in adults and that such responding holds significance for caregiving behavior and infant attachment (Moore et al., 2009; Groh et al., 2017). However, the majority of research has examined mothers' physiological responding. The current study applied a broader family systems approach to examining parents' responding to infant distress. Specifically, we examined mothers' and fathers' respiration sinus arrhythmia (RSA) when listening to an infant distress vocalization (i.e., crying) because prior evidence indicates that infant distress elicits RSA withdrawal--reflective of physiological self-regulation (Porges, 2007)--in women (Moore et al., 2009). Moreover, we examined whether partner presence played a role in buffering parents' autonomic responding to infant distress. Finally, we examined the role of mothers' attachment in moderating the extent to which partner presence buffered parents' RSA withdrawal. The sample comprised 129 mother-father dyads of 6-month-old infants. Mothers and fathers were invited to the lab and physiological sensors measuring heart rate and respiration were applied. Next, parents completed a 4-min resting baseline and listened to an audio recording of an infant crying for 2 min while being physiologically monitored. Approximately half of the sample completed this procedure separately, and the other half completed this procedure together while holding hands. RSA withdrawal scores were created by subtracting RSA during the crying condition from RSA at rest. After

completing this procedure, mothers' completed the Attachment Script Assessment (Waters & Rodrigues-Doolabh, 2004). Partner presence significantly predicted fathers', but not mothers', RSA withdrawal when listening to infant crying. Specifically, fathers' exhibited less RSA withdrawal when listening to infant crying with their partner present ($M = 0.04$; $SD = 0.73$) than when alone ($M = 0.21$; $SD = 0.65$), suggesting that fathers rely less on internal resources to cope with infant distress when their partner is present. Moreover, mothers' attachment security interacted with partner presence in predicting fathers' RSA withdrawal to infant crying. Fathers' exhibited significantly less RSA withdrawal when their partner was present, especially if their partner exhibited higher levels of attachment security, suggesting that when mothers have attachment representations that facilitate their ability to serve as a secure base, fathers are especially likely to rely less on internal resources for coping with infant distress.

S9.6iii Prenatal Physiological Response to Infant Cues Differentially Predict Attachment Classification: The Moderating Role of Prenatal Stress

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Introduction. Infants emit positive and negative emotional signals to communicate basic needs for survival, comfort, and play. Regardless of their intended message, infants' emotional bids can elicit a wide range of caregiving responses ranging from anger, a desire to soothe, or a need to withdraw. Variations in caregiver response have been linked to a range of psychosocial factors, most notably, depression. However, caregiver stress is likely to be just as potent a factor in shaping how a parent does or does not respond to their infants' cues. Toward the goal of identifying caregivers at risk of misinterpreting and/or responding insensitively to infants' emotional bids, researchers have turned to the prenatal period to understand whether prenatal response patterns to infants' emotional cues are related to postnatal child outcomes. In a sample of 105 low-SES, primiparous women, this study examines whether prenatal physiological responses to an infant's distressed and non-distressed cues are differentially related to the quality of the infant-mother relationship 18 months later. Given that maternal stress levels might exacerbate (or mitigate) these associations, we examine whether perceived prenatal life stress moderates these links. Method. Our sample is 72% European American, 28% minority. The mean age of the women is 21.6 years ($SD = 3.9$) and the average level of education is 10.2 years ($SD = 1.9$). The mean household income was \$9,634 per year, just below the US Census Bureau's poverty line. Over 93% of our sample

scored above the cutpoint of 11 on the Screening Scale for Problems in Parenting SSPP, which has been shown to coincide with increased risk for abusive parenting. Women's prenatal physiological reactions (heart rate and RSA change) were obtained while they watched video clips of infant non-distress and distress signals. In addition, women completed a battery of questionnaires prenatally, including measures of recent life events (Recent Life Events) and anticipated parenting stress (Becoming A Parent, Ideas About Becoming a Mother). Infant attachment classification was determined with the Strange Situation Procedure when infants were 18 months. Results. We use Hierarchical Linear Modeling (HLM) to test models linking continuously measured prenatal physiological reactivity to infant emotional cues with infant attachment status at 18 months postpartum. Perhaps most interesting in our results thus far is a pattern linking what we call expectant women's "activated avoidance" in response to infant distress (increased HR and increased RSA), and little physiological response to infant's non-distress with infant avoidance at 18-months. This contrasts significantly with women of eventually secure infants who show clear evidence of physiological approach (i.e., increased HR, decreased RSA) to both infant's distressed and non-distressed emotional bids (Figure 1). Additional results will test the moderating role of women's reported prenatal stress. Preliminary results reveal interesting dichotomies in women of avoidant babies where they report high levels of prenatal life event stress, but low anticipated parenting stress; in the face of objective, stressful events, for some expectant women, minimization of stress may be a coping mechanism that predisposes them and their offspring to relational difficulties.

S9.7 Symposium: Infant cued interventions: steps towards integrating neuroscience and individualized care

S9.7i Improved Short Term Outcomes of Preterm Infants Exposed to Parental Responsive Paced Feeding

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Background The transitioning of preterm infants to oral feeding (OF) may take days to weeks and depends on infant maturity and caregivers abilities to support it. Early feeding experiences among preterm infant may adversely affect feeding behavior during childhood. **Aim** To study the effect of individualize responsive feeding (IRF) on outcomes of infants born preterm. **Methods** Randomized controlled trial that included healthy infants born at <32 weeks of gestational age (GA). Parents randomized to the intervention group were introduced to responsive based interaction, holding and pacing during OF. Additionally, medical orders of this group allowed 2-4 hours intervals between feeds as well as a flexible volume of 90 - 180 ml/kg/day (equal to 15-30 ml/kg/meal). Intervention started upon arrival to 34 weeks GA. The controls were traditionally fed (TF) in a predetermined timing and volume. A third historic group (hTF) was added due to contamination of the study as time elapsed. **Results** Included in the study were 104 infants (IRF-32, TF-35, hTF-37). Maternal, and infant's characteristics were comparable among the groups. The IRF reached full oral feeding (FOF) a week earlier ($34.4 \pm .41$, vs. $35.4 \pm .97$ and $35.4 \pm .79$ $p = .00$) gained significantly more weight during the 2nd week of the intervention (34.3 ± 12.6 vs. 25.7 ± 10.6 and 31.0 ± 9.6 gr $p = 0.006$, Figure) and was discharged home significantly earlier ($36.4 \pm .6$ vs. $36.86 \pm .9$ and 37.3 ± 1.3 $p = .001$) compared to the TF and hTF respectively. An ANOVA analysis showed that prematurity measures and the intervention type predicted the age at discharge, so that younger GA ($F=4.170$, $p<0.044$), lower BW ($F=5.951$, $p<0.001$) and infants' morbidities ($F=4.677$, $p<0.011$) were associated with longer hospitalization. Undergoing intervention was associated with earlier discharge ($F=5.888$, $p<0.0001$). Regression model of the above variables was also highly significant in predicting age at FOF accounting for 38.3% of the variance while 19.1% of it accounted to the intervention type. Given the expected relationship between age at FOF and age at discharge home, we explored the factors predicting age at discharge using a comparable model. The full model demonstrated that GA, CRIB and twinhood were no longer significant, while the effects of BW and the intervention type were preserved and accounted for 22.8% of the variance explained: BW accounted for 8.3% of the variance

($R^2=8.3\%$, significant F changes $p=.003$) and the intervention type accounted for additional 14.5 % of the variance explained ($R^2=14.5\%$, significant F changes $p=.000$). Demographic measures (first child, maternal education, and parental income) were all found to be non-significant. The study's closure date was determined due to increasing parental request to switch to IRF and nursing refusal to continue to TF infants. Conclusion Parental guided IRF as conducted in the present study is safe and associated short term advantages. Moreover our finding suggests that the intervention is possibly effective in a wide array of populations.

S9.7ii Early Development of Very Young Premature Infants: Effects of Feeding Method and Neurological Vulnerability

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Introduction premature infants are often challenged by immaturity, brainstem related dysfunctions and volume-driven fixed-scheduled care. Recent public-policy advocates infant-guided preterm care, including more individualized tailored infant-cued feeding intervention protocols. We examined the relationship between 3 levels of ITI implementation as a function of neurological status (2 levels, brainstem evoked response dysfunction vs typical functions) on outcome at the neonatal intensive care unit (NICU). The hypothesis tested was that Responsive Feeding Interaction (RFI) will more positively affect medical and developmental outcomes. Methods 104 low-risk premature infants participate in this study. Infants included in the study were born earlier than 32 weeks gestational age. A historic traditionally fed control group (hTF, N=37) was recruited prior to the shift in the new feeding protocol. The infants were fed a predetermined amount every three hours, by bottle or by gavage, until the amount was consumed. An arbitrary date was selected for the shift in the feeding protocol and 67 infants were recruited and randomly divided into two experimental groups. In the Responsive Feeding Interaction group (RFI, N=32), feeding intervals and volume intakes were determined pending upon by parent or caretaker identifying infant hunger and satiety cues. RFI parents received training before and during transition to oral feeding. The additional research group was a traditionally fed group, yet since this group was recruited parallel to the RFI group, it was influenced by the shift in the feeding protocol and therefore is viewed as an intermediate level group (TF, N=35). Auditory brainstem evoked responses (ABR, N=40; ABR typical function - 19, ABR dysfunction - 21) were

measured by a trained audiologist. Results ANOVA analyses comparing the effect of the ITI on outcome indicate difference between the research groups at establishment of full oral feeding ($F= 18.25$, $p=.001$). Post hoc Scheffé test indicate that the duration of the transition from enteral tube to full oral feeding was shorter in the RFI group. A mediator model revealed that the significant total effect of feeding method on age at discharge such that the age at discharge was earlier in the RFI group ($-.52$, $p<.001$, 95% CI -0.77 to -0.28) was partly mediated by percentage of feedings attended by parents (indirect effect = 0.19 , 95% CI $-.37$ to -0.05). An interaction was found between feeding method and neurological status ($F=4.35$, $p\leq.05$) such that infants with brainstem dysfunction benefitted more from RFI regarding weight gain during the 2nd transition week, relative to non-compromised infants. Furthermore, the sum of medical events during the intervention period was significantly lower in the typical ABR function group compared to the ABR dysfunction group ($F=6.1$, $p<.05$). Discussion These results point to the positive effect of ITI on NICU outcome of premature infants. Intervention gains seem to be mediated by parental presence and moderated by infant's integrity of ABR, suggesting involvement of brainstem related pathways in the susceptibility and/or in feeding intervention efficacy in preterm neonates. Furthermore, these results validate the usage of neonatal ABR as a measurement of brainstem function.

S9.7iii Gaze contingent infant tailored social development study with infants at risk for socio-communication disorders

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Social and attention regulation as well as brainstem functionality are known to be impaired in children with Autism Spectrum Disorder (ASD). However, the understanding of these traits at infancy is sparse and diagnosis of the disorder at infancy is not yet possible. Siblings of diagnosed children and infants born preterm are at high risk to be diagnosed with ASD. The current work was developed under the assumption that ASD associated traits could be observed among infants at such high risk by exhibiting compromised auditory brainstem evoked responses (ABR), deficits in visual attention and a reduced social preference, all indicative of brainstem abnormalities. We explored the notion that infant-tailored and controlled tasks (ITCT) using gaze-contingent paradigms with high temporal and spatial resolution could potentially detect very fine gaze differences. The gaze contingent paradigm enables an infant-cued intervention, in

which initiation and cessation of stimulation and the choice of stimulus type are determined by the infant, thereby expressing the infant's preferences, while avoiding hyper-arousal by social content and stress. Importantly, the relations between a compromised ABR and gaze behavior were explored. The study cohort (N=114) were classified into 3 groups: the first comprising of infants at high risk to develop ASD on a genetic risk factor (having an older sibling with diagnosed ASD; N=18), the second comprising of infants at high risk given a prematurity risk factor (N=61), and the third, was a yoked control group of newborns born at term with no first or second degree relative with ASD (N=35). The participants born preterm underwent an ABR recording, administered soon after birth. At 9 months, all infants underwent ITCT including 1. Tasks probing for direct/indirect gaze and meaningful/non-meaningful speech preference. 2. Tasks containing non-social stimuli with varying arousing levels and complexity. 3. Behavior observations and parental report questionnaires for detecting emotional-socio-communicative deficits. Results showed group differences in all three hypothesized domains. Reduced preference for social stimuli was noted among high risk infants compared to controls ($F=4.66$, $p=.014$, $\eta^2=0.096$, Figure 1); Further, differences in visual attention were found between the three groups in the presence of non-social yet salient stimuli ($F=11.306$, $p<0.001$, $\eta^2=0.203$), as well as pupil dilation differences ($F=3.33$, $p=0.013$, $\eta^2=0.098$). Finally, differences in disengagement latencies were found between high and low risk groups for early brain-stem dysfunction ($F=5.328$, $p=0.002$, $\eta^2=0.176$). The study's main contribution was by suggesting the presence of traits that are characteristic of ASD among infants at risk to develop the disorder and its broader phenotype already at 9-months of age. These traits involve differential developmental functioning, which are widely distributed, such as early brainstem functionality, attention regulation and social motivation. These notions suggest possible avenues for future research among infants at risk for ASD, directing the literature toward early markers of gaze behavior and pupil dilation in the presence of social and non-social stimuli. Current findings suggest that these symptoms are general characteristics of at-risk infants, while future replication and longitudinal follow-up studies may focus on finer features of these traits as possible markers for ASD development.

S10.2 Symposium: Effort and persistence across early development

S10.2i Predictors of Persistence During Infancy

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From early childhood through adulthood, research consistently finds that individuals who persistently work to overcome challenges tend to be more successful than individuals who exhibit less stamina and determination (Duckworth et al. 2007). Despite the importance of persistence later in life, very little is known about the developmental origins of persistence. In the current study, we investigated how infants' persistence is shaped by early socialization practices. Specifically, we asked whether infants' persistence while attempting to solve impossible tasks is related to the ways their parents talk about persistence during problem-solving challenges. Infants, aged 6 to 18 months, were tested in a two-part within-subjects study. In the first phase (Experimental Phase) the infant sat at a table across from an experimenter who attempted to solve a task (e.g. pull a rope to get an out-of-reach toy; Fig 1A). Depending on the condition, the experimenter easily solved the task, struggled before solving the task, or struggled but did not solve the task. Infants were then given the opportunity to solve that same task, which was always impossible to solve (i.e. it was glued to the table). We repeated this procedure three times, such that infants had the three opportunities to view the experimenter solve the task and solve it on their own. We coded how long infants persisted in solving the task (seconds spent producing behaviors that could potentially solve the task), the number of distinct strategies used to solve the task, and their facial expressions while persisting (i.e. positive vs. negative affect). In the second phase of the study (Free Play) the experimenter gave the parent a toy that was slightly too advanced for their infant to solve independently (e.g., shape sorter with knobs; Fig 1B). The experimenter left the room after instructing the parent to "play with this toy just like you would at home, until your child is done playing. It is typically for older children, so see what you can do to help him/her figure it out." We coded the type of language parents used and analyzed whether it was related to infants' persistence during the Experimental Phase of the study. We transcribed parental talk into utterances, and coded each utterance along three dimensions: (1) Praise Type, (2) Persistence Focused, and (3) Self-Reflective (examples in Fig 2). Infants with parents who primarily use process-centered praise persisted for marginally longer ($M = 91.36s$, $SE = 30.79s$) than infants with who primarily use generic praise ($M = 43.35$, $SE = 5.27$; $W = 47$, $p = .08$; Fig 2A). Although parents did use person-centered praise (e.g. "you're so strong!"), there were no parents who used this as their primary form of praise. Infants with parents who explicitly talked

about the act of persisting during the free play persisted for significantly longer during the experiment ($M = 54.76$, $SE = 6.58$) than infants with parents who did not explicitly talk about persistence ($M = 21.89$, $SE = 1.95$; $W = 14$, $p = .007$; Fig 2B). Although not statistically significant, infants with parents who used self-reflective language persisted for slightly longer ($M = 61.59$, $SE = 47.69$) than infants with parents who did not use self-reflective language ($M = 49.75$, $SE = 6.02$; $W = 32$, $p = .42$; Fig 2C). In sum, findings suggest that the type of language parents use when helping their infants solve a difficult problem is related to their persistence.

S10.2ii Practice what you preach: Children integrate adults' outcomes, actions, and testimony to decide how hard to try

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Children's persistence in the face of challenges is key to academic success. Yet, we know very little about how parents and educators can help foster persistent behavior in children. Here, we looked at how preschool age children integrate observations of adult actions and outcomes with adult testimony to decide how hard to try on a novel task. We looked at an uninstructed condition and three kinds of instructions meant to reflect common messages children hear about persistence: honest expectations ("this task might be hard"), pep talks ("you can do it!"), and moral exhortations ("it's important to try"). Children heard each message at baseline or after seeing an adult demonstrate either high or low effort and either succeed or fail at a task. In total there were 20 conditions across four experiments ($n = 520$). Children consistently attended to the outcome of adult actions: across all experiments, children tried harder after seeing the adult succeed than fail. When the adult failed to reach their goal, adults' effort had no impact on children's persistence. However, when the adult succeeded, children paid attention to how hard she tried: In three of the four experiments, children tried harder in the high effort success conditions than the low effort success conditions. The one exception was when children were warned that the task might be hard (the honest expectations experiment): in this case children persisted equally in both success conditions. Finally children persisted longest in the pep talk and moral exhortation high effort success conditions: that is, children tried the hardest when the adult practiced what she preached, and it paid off. Taken together, this work suggests that children integrate evidence about outcomes, actions, and testimony in calibrating their own effort on novel tasks, and that adults can help foster children's persistence by modeling

persistence in their own successful goal-directed actions and by explicitly testifying to the value of effort and encouraging children to try.

S10.2iii Preschoolers' inferences about task difficulty and effective allocation of effort

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The ability to reason about task difficulty is critical for many real-world decisions, such as whether to pursue a goal or how to divide labor across tasks. Because young children routinely face novel tasks, the ability to reason about difficulty is critical for making effective decisions to explore, learn, and cooperate. While previous work suggests that an adult-like concept of difficulty develops late (Nicholls & Miller, 1983), recent work shows an early-emerging sensitivity to the cost of goal-directed actions (Liu et al., 2017; Jara-Ettinger et al., 2015). Here we ask whether young children can infer the relative difficulty of simple, novel tasks in a concrete, physical domain, even from simple static photos of their initial and final states (e.g., building block structures, Exp.1) and how such inferences support effective decisions (Exp.2). In Exp. 1, adults (N=45) and preschool-aged children (N=52-61, Age: 3.0 - 5.6) saw a pair of "initial state" photos (each showing an agent with scattered wooden blocks) and a pair of "final state" photos (each showing the agent with the finished block structure), and judged which was easier (harder) to make. Across 8 trials, we varied the relative difficulty of these tasks by presenting two structures that differed in the expected number of actions for completing the structures (number of blocks, stability of structures, number of agents involved) or the process of the required actions given identical structures (distribution of block types, length of process). Adults' judgments were near ceiling on all trials (all p's < 0.001 binomial). However, children's accuracy showed both remarkable success and striking failure: Accuracy was high on trials that differed in the expected number of actions (all p's < 0.001 binomial; not different from adults on 4 trials) but at chance when it was necessary to reason about the process of actions (see Figure). We replicated these results in two separate groups of children (N=70). These results suggest that by preschool age, children can infer the relative difficulty of novel tasks based on an intuitive understanding of physics and goal-directed actions, but the ability to consider more nuanced aspects of agents' actions may continue to develop. In Exp. 2 we asked whether inferences about task difficulty can support effective allocation of effort across tasks. Children (N=218, age: 3.0-5.9) were introduced to an agent who had to help one

of two agents who were building towers that varied in the expected number of required actions (Collaborative Decision condition), or an agent who had to build one of the two towers for the same outcome (Individual Decision condition). Children chose the harder tower in the Collaborative condition ($p < 0.001$, binomial) and the easier tower in the Individual condition ($p = 0.004$ binomial; condition difference: $p < 0.001$, Fisher's Exact), but only if they could tell which tower was harder than the other. Adults ($N = 102$, age: 19-68) made similar judgements (Collaborative Decision: $p < 0.001$, binomial; Individual Decision: $p < 0.001$, binomial; $p < 0.001$, Fisher's Exact). These results suggest that even though the ability to infer the difficulty of novel tasks continues to develop during preschool years, it is already powerful enough to support further decisions about which goal to pursue or whom to help.

S10.2iv Infants use risk and effort to infer what agents value

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Every day, we interpret the actions of other people in terms of hidden variables, like desire, belief, and cost. Where does this ability come from? Despite infants' limited experience, their interpretations of other people's actions are guided by assumptions about agents' physical properties (Saxe et al., 2006), intentions and goals (Woodward, 1998), mental states (Luo & Baillargeon, 2007), causal powers (Muentener & Carey, 2010), and dispositions to act efficiently (Gergely & Csibra, 2003; Liu & Spelke, 2017). This wealth of findings does not reveal, however, (a) whether infants reason about variables like cost and reward productively, within a single coherent system, and (b) whether these variables refer to perceptual or abstract content. We tackled these questions by asking whether infants use the cost that an agent expends to attain a goal state to infer the value of that goal state for the agent: whether infants infer rewards from costs. Specifically, we tested whether infants solve this problem by inverting a mental model of action planning, trading off the costs of acting against the rewards actions bring. Across three experiments, $N = 80$ ten-month-old infants first saw an agent act towards two target goals under conditions of varying cost (Fig 1A-B, 1D). Specifically, the agent took a small but not a medium cost for one goal, and took a medium but not a high cost for another goal. Then, infants watched the agent choose in alternation the higher or the lower value target when both were present at equal cost (Fig 1C, 1E). If infants infer the reward of the targets to the agent from the cost undertaken to reach them, and then they should be more surprised when the agent chooses the lower value

target, looking longer at the test trials displaying that action. Across all experiments, infants looked longer at the lower value action ($M=26.99s$, $SD=14.13$) than the higher value action ($M=21.64s$, $SD=13.94$), 95% CI [0.139, 0.415], $B=0.277$, $SE=0.070$, $\beta=0.424$, $t(80)=3.975$, $p<.001$, one-tailed, mixed effects model with random intercepts for participant and experiment. These expectations held regardless of whether infants saw an agent cleared higher barriers (Exp. 1, Fig 1A), climbed steeper ramps (Exp. 2, Fig 1B) or jumped wider gaps (Exp. 3, Fig 1D) for one target over the other, suggesting that an abstract variable--such as "force," "work," or "effort"--supported infants' inferences. We also modeled infants' expectations as Bayesian inferences over utility-theoretic calculations, with either integrated vs separated, and abstract vs cue-based, understandings of cost and reward, and found that only the model that represented these variables as abstract, integrated representations accounted for our findings. We end by discussing newer work showing that older infants ($N=32$ thirteen-month-olds) use other abstract variables, like the risk of a given action (Fig 1E), to make similar inferences. Before human infants learn to walk, leap and climb, they leverage mental models of agents and actions--forward models of how agents plan, and inverse models for working backwards from agents' actions to the causes inside their minds.

S10.3 Symposium: It takes two to regulate: the interplay between parents and infants in the development of regulatory capacities

S10.3i Infants' Moderate Arousal and Maternal Sensitivity Predict Self-regulation in Early Childhood

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From an optimal arousal perspective, moderate levels of arousal are associated with well-developed self-regulation, and both extreme ends to diminished self-regulation (Blair & Ursache, 2011). This might be especially true within the context of sensitive parenting, as various theorists have emphasized that the development of self-regulation builds upon early experiences within the proximal environment (e.g., Kopp, 1989; Sroufe, 2000). The aim of this study was to examine prospective links between infant arousal and parenting at 6 months, and child self-regulation at 18 months and 4.5 years. We hypothesized that the prospective relation between arousal and self-regulation had an inverted u-shape. Moreover, we expected this association to be stronger in the context of high maternal sensitivity. A total of 149 children (69 girls and 80 boys) were included in this study. At 6 months, parents reported on their infants' arousal using a diary. The percentage spend crying, and the percentage spend fussing were distilled. Maternal sensitivity was coded during a three minute novel toy task. At 18 months and 4.5 years, self-regulation was assessed with various tasks. Multiple regression analyses indicated infant arousal and maternal sensitivity predicted a significant proportion of variance in self-regulation at 4.5 years, but not at 18 months. Within the context of high maternal sensitivity, fussiness showed an inverted u-shaped relation with self-regulation at 4.5 years. When maternal sensitivity was low, there was no association between fussiness and self-regulation. For crying, there was an initial negative association with self-regulation at the lower end of the distribution of crying. This association decayed, and became non-significant at higher levels of crying. When maternal sensitivity was low, there was no association. The results indicate that, in the context of high maternal sensitivity, moderate levels of fussiness and low levels of crying relate to improved self-regulation.

S10.3ii Typologies of Dyadic Infant-Mother Emotion Regulation: Implications for Infant Self-Regulatory Development

Penina Backer¹, Cynthia Stifter¹

Dyadic emotion regulation refers to the joint modulation of affective rhythms as two interactive partners dynamically adapt to each other's cues across time (Feldman, 2012). Research demonstrates that infant-mother dyadic emotion regulation exerts long-term effects on children's social-emotional development, promoting secure attachment, self-regulation, empathy, and prosociality (Beebe, Jaffe, Markese, et al., 2010; Feldman, 2007). Although dyadic regulation of distress is considered particularly important in promoting positive outcomes (Gianino & Tronick, 1988), this construct has typically been studied in low-stress contexts. Therefore, the current investigation aimed to identify patterns of dyadic emotion regulation following a highly distressing immunization procedure, as well as to explore implications for subsequent self-regulatory development. Participants were part of a larger longitudinal study (N = 150) examining emotional development over the first decade of life and were predominantly White and middle class. When infants were 2 months old, 141 dyads (75 female infants) participated in an immunization procedure. Dyads were video-recorded as the infant received vaccinations during a routine medical visit, and infant crying and maternal soothing behaviors were subsequently coded (Jahromi, Putnam, Stifter, 2004). At 6 months, 133 dyads (66 female infants) participated in a laboratory visit that included the Lab-Tab gentle arm restraint procedure (Goldsmith & Rothbart, 1999). Both infant crying and regulatory behaviors were coded. Dyadic regulation after the 2-month immunization procedure was statistically constructed using Hidden Markov Modeling (HMM; Stifter & Rovine, 2015). This technique identified a set of latent states defined by the likelihood that a particular level of infant distress would co-occur with specific soothing behaviors. The HMM also generated transition probabilities, which gave the likelihood dyads would move between states, as well as posterior state trajectories for each dyad, which represented movement through states across time. Cluster analysis of posterior state trajectories yielded 4 groups of dyads, which were interpreted as representing distinct typologies of dyadic distress regulation (see figure 1). Well-regulated dyads successfully attained and maintained a low-distress and/or calm state via maternal holding, rocking, and vocalizing. In contrast, poorly regulated dyads failed to attain and maintain a low-distress or calm despite maternal soothing. Disorganized dyads were characterized by intense infant distressed accompanied by a lack of maternal soothing, and "food to soothe" dyads were defined by the use of oral soothing strategies. Linear regressions predicting 6-month infant self-regulation based on 2-month cluster membership revealed significant effects for attention orienting ($F(3, 113) = 3.135$) and dysregulation (avoidant behavior, tension release, $F(3, 113) = 2.796$). Contrasts indicated that dyads characterized by "food to soothe" produced infants who

engaged in significantly more attention orienting behaviors than well- and poorly regulated dyads; poorly regulated dyads produced infants who engaged in significantly more dysregulatory behavior than all others. Results thus demonstrate the importance of early dyadic distress regulation in facilitating infant's self-regulation of distress.

S10.3iii Comparing Mechanisms Relating Parenting, Stress and Child Regulation in High- and Low-Risk Populations

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Disruptions in infant emotion regulation, (ER) are predictive of later developmental delays, behavior problems, and strain on the parent-child relationship (Degangi, 2000). Studies demonstrate strong ties between ER and parenting behaviors (Haley & Stansbury, 2003) and parenting stress (Feldman et al., 2004). These relations may differ, however, depending on the risk-status of mothers, whereby children of less-prepared mothers (i.e., teen and high-risk adult mothers) may be more affected by maladaptive parenting behaviors than children of low-risk mothers. Given that early child ER has broad implications for later child outcomes, our goal is to elucidate mechanisms through which positive parenting, parenting stress, and ER vary across differing levels of maternal risk. We hypothesized that pathways relating parenting to child ER would differ between three groups of first-time mothers (teen mothers, and high and low risk adult mothers). Namely, we expected that teen and high risk mothers would have children more impacted by parenting stress and positive parenting practices than low risk mothers. We followed 682 first-time mothers and their infants (50% male) from pregnancy through 36-months postpartum. Teen mothers (TM), low-educated, high-risk adult mothers (< 2 years of post-secondary education; HRM), and high-educated, low-risk adult mothers (≥ 2 years of post-secondary education; LRM) accounted for 58.1%, 24.8%, and 17.22% of the total sample, respectively. Positive parenting and ER (collected at 4, 8, 18, and 30 months) were measured during a 30-minute home observation where mothers performed a daily task with their infant nearby. Positive parenting was measured from observations assessing mothers' positive affect, warmth, and responsivity (IT-HOME; Caldwell & Bradley, 2001; Landry et al., 1997). ER was measured from observational ratings of children's frustration tolerance, negative affect, composure, ability to sustain attention, and adaptability to change (Landry et al., 1997). Lastly, parenting stress (collected at 6, 12, and 24 months) included mothers' self-reported total stress (PSI - SF; Abidin, 1995). Multi-group longitudinal pathway analyses

(Muthén & Muthén, 1998-2002) indicated differences in how parenting impacted ER across the three groups of mothers (TM, HRM, LRM). Fit indices suggested good model fit based on CFI (.90), RMSEA (.06), and Chi-square (χ^2 (105) = 188.09, $p > .10$).

Significant pathways for each mother group are in Figure 1. In general, only TM and HRMs' parenting behaviors impacted 30-month child ER, where the single association between parenting behaviors and infant ER for LRM was found in early infancy.

Parenting stress was only predictive of ER for TM. Parenting stress was predictive of both early and later positive parenting for TM and HRM, but only predictive of positive parenting in infancy for LRM. Results highlight the importance of positive parenting and limited stress in higher-risk families. Mother's risk status, in particular their educational attainment, may impact the ways in which they parent their children, and in turn child ER development.

S10.4 Symposium: Enhancing the interpretation of infant gaze behavior using modeling approaches

S10.4i Computational exploration of hierarchical gaze structures from infant habituation paradigms

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Habituation paradigms are used extensively in infant studies, and when paired with controlled, experimental manipulations, can be a useful technique for indirectly measuring infant looking preferences before they can explicitly verbalize and respond. It is common practice to allow infants to reach a predetermined threshold of non-experimental gaze fixations before signaling the end of a trial, i.e., an accumulation of "look-away" time based on real-time eye gaze monitoring. After habituation, any changes in looking duration when given a novel stimulus can be interpreted as sensitivity to the specific manipulation eliciting the change in behavior. However, much of the data collected to assess habituation before a testing phase often goes unused despite its richness in providing further indication of the processes and factors leading up to habituation. As part of this symposium, we propose a computational approach toward analysis of infant habituation data by utilizing the full tracking sequence, trial-by-trial. Specifically, we outline details for modeling the decay rates of infant looking behavior, treating short bursts of fixations and extinctions as a hierarchical structure. Local fixations and subsequent gaze switches to new regions are spatiotemporally interdependent, with sequences of fixations often leading to short extinction periods. Gaze path sequences are built-up hierarchically until enough visual information is accumulated, thus reaching the global habituation threshold. Repeated trials of the same type provide another layer in this hierarchy. We explore alternative approaches for modeling distributions of looking time decay rates themselves, employing methodologies from other disciplines such as survival analysis, diffusion processes, or exponential functions. Furthermore, we address methods for classifying the hierarchical tree structures estimated during the habituation process, and use these structures for making comparisons among groups demonstrating familiarity/novelty preferences during testing, and how these structures can be mapped back to specific individual traits. One area where analyzing looking patterns as hierarchical structures becomes especially important is with tasks that embed spatiotemporal dependencies into their design, such as in infant versions of visual finite state grammar tasks. When infants are expected to learn that distinct shapes have a specific sequential pattern with constraints on which shapes are allowed to be seen before or after others, repeated exposure to

several grammatical sequences elicits emergent looking behavior as information about the grammatical rules accumulates over time. These looking patterns are informative for understanding the rule-learning processes just as during the testing of novel grammatical sequences. Computational analysis of local-level gaze behavior can provide insight into how spatiotemporal correlations in moment-to-moment visual exploration are coupled to specific sets of visual features. The current approach takes steps towards uncovering the underlying mechanisms by accounting for the emergence of hierarchical structures of looking behavior over time. Additionally, the number of trials required to reach habituation threshold can be optimized via real-time analysis of decay rates among individual infants of various ages, resulting in an increase in data collection efficiency and quality during looking preference testing phases.

S10.4ii Infant free-viewing: the role of object knowledge

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What factors drive infants' gaze behavior over complex real-world scenes? In adults, the traditional view holds that low-level perceptual salience (contrast, color and orientation of pixels) plays a major role in where we look. Recently, more and more researchers studying scene perception agree that it is actually higher order top-down information, such as meaningful objects, that determines where we look. For young infants, perceptual salience is likely to have a larger influence than knowledge of objects, as many objects that appear in real-world scenes are unknown. However, as infants get older and their object knowledge increases, the influence of objects on gaze behavior is likely to increase as well. In this study, we examined if and how object knowledge is related to infants' gaze behavior. Forty infants (6 - 12-month-olds) freely viewed 29 scenes for 8 seconds. The scenes were selected from the OSIE (Object and Semantic Images and Eye-tracking) dataset in which objects are tagged. Parents were asked to what extent they thought their infant knew the objects displayed in the scenes on a scale from 'never seen' to 'can name the object'. We used GLMMs (Generalized Linear Mixed Models) to model gaze behavior as a function of object knowledge and age, while controlling for the influence of the central bias, perceptual salience and the size of objects. Four different models were fitted to assess the role of (1) fixation locations, (2) fixation durations, (3) the number of fixations on objects, and (4) the order in which objects were fixated. Although, we expected that known objects would be more frequently fixated than unknown objects, this was not the case after controlling for the

influence of centrality, saliency and size. However, the results did show a developmental pattern in the role of semantic knowledge for the models of number and order of fixations. As expected (and preregistered in the Open Science Framework) older infants looked more often and earlier at familiar objects, than younger infants. In contrast, younger infants looked more often and earlier at salient objects, compared to older infants. These results provide evidence for a development between 6 and 12 months from salience-based to knowledge-based exploration behavior during free viewing. These results can be understood in terms of the two ongoing processes during a fixation; extracting information at the current location and selecting a new location. The developmental pattern that we found here seems to apply to the process of selecting fixation locations. Older infants selected familiar objects earlier and more often than younger infants. Whereas younger infants selected perceptually salient objects earlier and more often. Using a state-of-art modeling approach allowed us to study the interaction between infants' individual characteristics and scene properties, while controlling for global viewing biases during free-scene viewing.

S10.4iii Age-dependent saccadic models

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Saliency models aim to predict where we look at within a visual scene. They are based on low-level visual features including color, intensity, and orientation. They process these visual features to generate a 2D saliency map, indicating the most salient part of the image. In contrast with saliency models, saccadic models intend to predict the sequence of eye fixations, i.e. the way observers deploy their gaze while viewing a stimulus on screen. Rather than computing a unique saliency map, saccadic models compute plausible visual scanpaths, i.e. the actual sequence of fixations and saccades unfolding across time. By the term plausible, we mean that the predicted scanpaths should be as similar as possible to human scanpaths. They should exhibit similar characteristics, such as the same distributions of saccade amplitudes and saccade orientations. Saccadic models offer many advantages over saliency models. The most important one is the ability to tailor the saccadic model to a particular context, such as a particular type of scene, a particular population or to a particular task at hand. This modelling framework not only relies on the image salience (i.e. properties of the stimulus) but most importantly on our ability to model viewing biases and systematic

gaze patterns of observers. In this presentation, we introduce an age-dependent saccadic model able to reproduce the gaze behavior of a certain target age group. The main components of saccadic model are first presented [Le Meur & Liu, 2015; Le Meur & Coutrot, 2016]. We then train our model with eye-tracking data recorded in five age groups: 2 y.o., 4-6 y.o., 6-8 y.o., 8-10 y.o. and adults [Helo et al., 2014]. We show that the joint distribution of saccade amplitude and orientation is a visual signature specific to each age group, and can be used to generate age-dependent scanpaths.

S10.4iv Using computational modelling to reveal the components of fixational control in infant dynamic scene viewing

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Computational modeling of eye movement control has been integral in advancing our understanding of adult active vision during saccadic tasks, reading, and more recently scene perception. Such models allow hypotheses about the underlying stages of saccadic control and the interacting automatic and direct/top-down processes to be tested and the parameters of each component of the model estimated. The application of computational modeling to infant eye movement data has the potential to be highly informative especially because these processes are thought to mature over the first two years of life and the only way to traditionally reveal individual differences in these processes in adult psychophysics is to use thousands of trials which is unfeasible for infants. The goal of this project was to demonstrate that the CRISP theoretical framework and computational model of fixation durations (FDs) could be used to adequately model infant data with minimum modification and reveal developmentally informative individual differences in eye movement control. The CRISP model was used to investigate the underlying mechanisms modulating FDs in 6-month-olds by applying the model to empirical eye-movement data gathered from groups of infants and adults during free-viewing of naturalistic and semi-naturalistic videos. Participants also performed a gap-overlap task to measure their disengagement abilities. Results confirmed the CRISP model's applicability to infant data. Specifically, model simulations support the view that infant saccade programming is completed in two stages: an initial labile stage, followed by a non-labile stage. Moreover, results from the empirical data and simulation studies highlighted the influence of the material viewed on the FD distributions in infants and adults with saccade timing parameters varying between naturalistic and semi-naturalistic video types. In order to demonstrate how CRISP could

be used to reveal interesting developmental differences, infants were grouped depending on whether they had a large or small disengagement effect during the Gap-Overlap task. Model fits revealed that infants with large disengagement effects had large parameter estimates in all stages of the model including labile and non-labile saccade programming and slower information processing suggesting a less mature eye movement control system. The present work suggests that infant FDs reflect on-line perceptual and cognitive activity in a similar way to adults, but that the individual developmental state of the oculomotor system affects this relationship at 6 months. Furthermore, computational modeling filled the gaps of psychophysical studies and allowed the effects of these two factors on FDs to be simulated in infant data providing greater insights into the development of oculomotor and attentional control than can be gained from behavioral results alone.

S10.5 Symposium: Sensitivity to lexical tones in tone and non-tone language learners: evidence from discrimination, word learning and word recognition

S10.5i The developmental trajectory of linguistic and musical pitch perception among non-tone language learning monolingual, bilingual and tone-language learning bilingual infants ---- evidence from EEG

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Behavioural studies have observed differences in linguistic pitch perception across tone- and non-tone-language learning infants. The former keep their sensitivity to linguistic pitch during the perceptual attunement in the first year after birth, whereas the latter lose such sensitivity, although they remain sensitive to non-linguistic pitch information (Mattock & Burnham, 2006). Tone-language learning infants' musical pitch perception remains unclear. As tone-language children and adults show more fine-grained musical pitch processing than their non-tone-language peers (Creel, Weng, Fu, Heyman & Lee, 2018), this study explores whether the same effect may occur in infancy. Additionally, the influence of bilingualism on infant linguistic and musical pitch processing is also examined on a neural level. The research questions are: How do infants' linguistic experiences alter their pitch perception along the developmental trajectory? To what extent do language and music share (or not share) processing components? One-hundred and twenty infants aged 5-6 and 11-12 months participated in the study. Infants were further grouped into three language conditions: monolingual Australian English, bilingual Australian English with a non-tone language, and bilingual Australian English with a tone language. The non-dominant language was at least 20% of total language exposure among the bilinguals. Participants underwent passive oddball paradigms comprising one linguistic pitch contrast (contracted Mandarin tone, Liu & Kager, 2014) and one musical pitch contrast (violin tone, Liu & Kager, 2017) assessed via electroencephalography. Distinct neural processing patterns were observed across infants from different language backgrounds. Specifically, monolingual Australian infants exhibited decreased mismatch responses (MMR) to linguistic but not musical pitch. Bilingual Australian-non-tone-language learning infants had similar patterns except that their musical pitch perception became more mature with time, showing mismatch negativity (MMN) responses. Preliminary results with bilingual Australian-tone-language learning infants revealed the most interesting patterns, with limited music but robust linguistic pitch sensitivity at 5-6 months, and MMRs for both language and music processing at 11-12 months. Infant pitch process may be subject to

language-specific (exposure to a tone language) and language-general (bilingualism) factors. Similar to the findings among bilingual adults (Krizman, Marian, Shook, Skoe, & Kraus, 2012), bilingual exposure may impact cross-domain auditory processing in infancy.

S10.5ii Thai infants' sensitivity to lexical tone and stress in early speech perception

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Newborns are sensitive to the rhythmic and prosodic patterns of their native language, which is attributed to their prenatal exposure to these cues from the environment. This early sensitivity allows infants to successfully differentiate samples of familiar and unfamiliar languages that belong to different rhythmical classes (e.g., English and Japanese). During the first year of life, infants' speech perception is further attuned to their native language. Four-month-olds are able to differentiate languages based on their stress patterns, and by nine months of age, infants recognise the phonotactic patterns and the phonetic categories used in their native language. For instance, Burnham and colleagues (1997) assessed English-learning six-to-nine-month-old infants' ability to differentiate English and Thai words. English and Thai are both stress-timed languages, but unlike English, in Thai, the weak-strong stress pattern is predominant and lexical tone is phonemic. This study demonstrated that infants showed a preference to listening to English over Thai words only when presented with bi-syllabic and not mono-syllabic words. Therefore, infants only successfully identified their native language by relying on stress cues, but they showed no discrimination when only phonetic information was available in the task. The present study assessed this ability in infants acquiring Thai. Given that Thai is a lexical tone language, it was predicted that this language-specific phonetic information would assist infants in native language perception even in the absence of stress cues. Following Burnham et al., Thai infants between six and ten months of age (N = 32) completed a preferential listening paradigm. Infants were randomly assigned to the one-syllable or two-syllables condition. In the two-syllables condition, English and Thai words differed both in their stress patterns (strong-weak vs. weak-strong) and in the presence of lexical tone. In the one-syllable condition, however, words differed based on the presence or absence of lexical tone, but no information about their stress patterns was available. All stimuli consisted of low-frequency words unfamiliar to young infants and were recorded by a

bilingual Thai-English speaker in adult-directed speech. During a familiarisation phase, infants were presented with English words when they oriented to one side of the experimental set up, and with Thai words when they oriented to the other side. During the test phase, infants' looking time to each side was recorded across six trials as a measure of their preference to the word lists in each language. Infants showed a significant preference to Thai in both the one-syllable and two-syllable conditions. Therefore, while infants acquiring English in Burnham et al.'s study and infants acquiring Thai in this study were sensitive to the predominant stress patterns of their native language, Thai infants' early sensitivity to lexical tone allowed them to discriminate native words even in the absence of additional prosodic cues.

S10.5iii The contrastive use of lexical tones: The choice of tones matters

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Recently, a number of papers have demonstrated that infants start off flexible in their willingness to treat pitch contours as relevant to word meaning, and narrow this interpretation as they gain experience with a native language that does not use pitch to differentiate word meaning (e.g., Hay et al., 2015; Singh et al., 2014). However, much of this work has focused on rising vs falling lexical tones. In our subsequent work, using the modified Switch Paradigm, we find that patterns of early flexibility do not hold for all lexical tones. Specifically, 14-month-olds appear to treat lexical tones contrastively only if one of the labels has a rising pitch contour, but fail at all other lexical tones contrasts. Here, we seek to extend our understanding of role of pitch contours in infants' early lexical representation by replicating Singh et al (2014) with 18-month-olds using different pitch contours. Infants were taught two novel object labels (/di/ and /ku/) with distinct pitch contours (e.g., /di/ rising and /ku/ dipping). Infants were then tested on a correct pronunciation trial (e.g., /di/ with a rising pitch) and on a mispronounced test trial (e.g., dipping /di/). If infants have integrated the pitch contour information into their lexical representations, they should look at the target object when it is labeled correctly, but not when they hear a pitch mispronunciation. We find that while infants maintain some sensitivity to pitch characteristics at 18 months, the rising vs falling distinction may be especially salient for English-learning infants; indeed, we did not fully replicate Singh et al.'s (2014) findings with different pitch contours. This research suggests that infants' native-language experience may impact the mapping of pitch contours to meaning differentially for different tone contrasts. Our results indicate that

caution should be taken when making generalizations about tone learning, especially when studies use a limited number of contrasts.

S10.5iv Sensitivity to tones, vowels, and consonants in monolingual and bilingual learners of Mandarin.

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Although tone language learners represent the linguistic majority, much less is known about how tones are integrated into lexical representations in comparison to more typically studied vowels and consonants. In a series of studies, sensitivity to tones versus vowels and consonants are compared in a word recognition paradigm across age groups. In the current paper, tone learners were compared on their abilities to detect vowel, consonant and tone mispronunciations of familiar words. In order to chart the developmental trajectory of spoken word recognition abilities, children were tested at 2 years of age (Experiment 1; N = 46), 3 years of age (Experiment 2; N = 24), 4-5 years of age (Experiment 3; N = 25) and 6 years of age (Experiment 4; N = 20). In each task, Mandarin learning children heard auditory labels in the presence of visually presented targets and distractors. Labels were either correctly pronounced or mispronounced due to a vowel, tone or consonant substitution. Upon hearing each label, proportion of total looking to target (PTL) was logged compared to chance (.5). In Experiments 1, 2 and 3, results revealed that toddlers and pre-schoolers mapped correct pronunciations onto visual targets, but did not map vowel, consonant or tone mispronunciations onto the target object. A comparison of the strength of sensitivity to vowel, consonant and tone mispronunciations revealed unequal levels of sensitivity to each type of mispronunciation as well as developmental change in mispronunciation sensitivity across age groups. In particular, mispronunciation effects were particularly strong for tones in infancy (2 years of age) but sensitivity to tone mispronunciations declined with age, while sensitivity to vowel and consonant mispronunciations was weaker than sensitivity to tones in infancy. However, vowel and consonant mispronunciation sensitivity increased with age. Specifically, between infancy and early childhood, children progressed from a sharp sensitivity to tones in infancy to treating tone akin to correct pronunciations at age 6. This loss of sensitivity was not observed for vowels or consonants. A second study was aimed at comparing tone, vowel and consonant sensitivity in monolingual and bilingual learners of a tone language in a mispronunciation paradigm. Results suggested that in infancy, monolingual Mandarin

learners and bilingual English-Mandarin learners demonstrated similar sensitivities towards tone when time-aggregated measures (i.e. PTL) were taken. However, when time course measures were extracted, monolingual Mandarin learners demonstrated a faster response time to tone mispronunciations compared to bilingual English-Mandarin learners. Mandarin monolingual learners also demonstrated faster responses to vowel mispronunciations relative to consonant mispronunciations, whereas bilingual English-Mandarin learners were similarly sensitive to vowel and consonant mispronunciations. Taken together, these results point to a dissociation between sensitivity to suprasegments (tone) and segments (vowels and consonants) during infancy and early childhood both in terms of sensitivity thresholds for segmental versus suprasegmental contrasts and in terms of developmental change over time. Findings are discussed in terms of their implications on theories of phonological representation in infancy and early childhood.

S10.6 Symposium: Preferring one among others: on the construction of social selectivity in infancy

S10.6i The role of social status in social selectivity: infants are sensitive to social status when predicting others' social relationships

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Humans are born in social groups organized hierarchically with two well-known roles: leaders and followers. Leaders are defined as individuals who have a significant influence on others' actions (followers). We have addressed the early representation of leader-follower relationships in infants. First, 12-, 15-, and 18-month-olds were familiarized with animations depicting two agents (the followers) selectively imitating the intransitive actions of another agent (the leader). During test, the infants observed either a follower failing to follow the leader's path (incongruent outcome), or the leader failing to follow a follower's path (neutral outcome). The participants looked significantly longer at the incongruent than at the neutral outcome from 15 months of age. These results demonstrate infants' capacity to represent a leader-follower relation as asymmetric and stable across time. Next, we explored infants' intuitions about who would be selected as a leader between two agents with different power (amount of control over limited resource). Eighteen-month-old infants were familiarized with one agent (the observer) watching two other agents successfully picking up a ball one after the other. However, when both agents tried to pick up the ball at the same time, the same agent always prevailed (the winner). Critically, we manipulated how the winner prevailed, through communication or using force. During test, the observer followed one of the agents - either the "winner" (congruent output) or "loser" (incongruent output). Participants looked significantly longer at the incongruent outcome than at the congruent one only when the force was not used by the winner. These results evidence infants' capacity to link social power with leadership considering the way the agent succeeded in conflict situations. Altogether, our results demonstrate infants' sensitivity to agents' different social status and how this leads to asymmetrical relationships.

S10.6ii The role of information seeking in social selectivity: infants' social preferences are driven by an expectation of information

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Before 12 months of age, infants already show behavioural preferences for others who evidence cues to same-group membership such as race or native language (Bar-Haim et al., 2006; Kinzler et al., 2007). While infants' selectivity for social partners is well documented, its function remains unclear. We propose that infants' preferences for same-group social partners may be driven by infants' motivation to learn, and are modulated by the perceived potential of a social partner to provide information. To investigate this hypothesis, we measured EEG theta activity, a neural rhythm shown to predict the degree of learning in infants and adults (Bergus et al., 2014; Guderian et al., 2009), and to index an active and selective preparation for encoding information in adults (Gruber et al., 2013). The first studies (Bergus et al., 2016), established that infants exhibit an increase in theta activation when they can expect to receive information. Crucially, infants have been shown to expect information from native but not from foreign speakers, providing the first direct evidence that infants treat native speakers as superior sources of information and selectively prepare to learn from them. These studies suggest infants' in-group preferences might not be driven by affiliative motives or in-group loyalty (Baillargeon et al., 2015), but rather by potential learning opportunities offered by different individuals. Given that information provided in one's own language allows for better learning, it follows that infants' motivation to learn would result in behavioural preferences (as expressed in heightened attention, willingness to interact, etc.) favouring members of their own group. Consequently, if infants indeed primarily focus on potential information gain, then it should be possible to manipulate these biases by manipulating the information provision from social partners. In a series of three follow-up studies, using the same measure of anticipatory theta oscillations, we investigate 11-month-old infants' expectation of information when faced with: a native vs. a foreign speaker, both offering non-verbal information (Exp1); an ignorant native vs. a knowledgeable foreign speaker (Exp2); and two foreign speakers, ignorant vs. knowledgeable (Exp3). In addition, Exp2 and 3 include also a behavioural measure of infants' preference, in which each of the two speakers simultaneously offers infants one of two identical objects (replicating Kinzler et al., 2007), to further explore how infants' expectation of information affects their behavioural expressions of social preferences. Neural and behavioural results converge in support of the hypothesis that once a so-called 'out-group' social partner has been shown to be informative, infants are willing to both learn as well as interact with them to the same extent as with 'in-group' members. In sum, changing infants' expectation of information provision from different social partners seems to eliminate the previously

found preferences for native over foreign speakers (Kinzler et al., 2007), challenging the very concept of in-group biases in infancy.

S10.6iii The role of similarity in social selectivity: infants use similarity to make inferences about social relationships and social structure

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Similarity influences myriad social relationships. From group membership to friendship, to marriage, to mere proximity, people who are similar to one another tend to be closer than people who are dissimilar. Here, we present research indicating that infants understand the importance of homophily in determining social structure. Specifically, we show that infants (ages 9-months to 16-months) expect people who share important similarities to be more likely to affiliate than people who are dissimilar, and that infants (ages 11-months to 15-months) expect people from the same social group to share traits. Across all of the studies we use a violation-of-expectation looking-time method: infants tend to look longer at events that are inconsistent with their expectations, so we measured their attention as evidence of their inferences. In Studies 1-3 we find that infants expect people who are similar to one another to affiliate. Infants were randomly assigned to see two people be similar to each other or dissimilar to one another (Study 1: Food Preferences, Study 2: Language, Study 3: Ritualistic Actions). Then, in test trials the two people alternated between acting like they were friends (by smiling and waving at each other) and like they were not friends (by turning away from one another). When the actors had been similar, infants looked longer when they acted like they were not friends, whereas when the actors had been dissimilar infants looked longer when they acted like they were friends (see Figures 1 & 2). Thus, infants expected actors who were similar to be more likely to be friends than actors who were dissimilar. In Study 4, we focused on inductive inferences based on group membership. Infants were randomly assigned to see two actors from the same linguistic social group (two English-speakers, or two Spanish-speakers) or from different social groups (one English-speaker and one Spanish-speaker). Afterwards, infants watched one of these actors like one of two foods. In test trials, the second actor disagreed with the first by disliking the same food, or provided instead disliked the previously uneaten food. Infants in the same language conditions looked longer when the second actor disagreed ($M=6.3s$) than when disliked the novel food ($M=4.2s$, $p<.01$), suggesting they found disagreement surprising. However, infants in the different languages condition looked longer when the second

actor ate the new food ($M=6.2s$) than when she disagreed ($M=4.2s$; $p<.01$), suggesting they do not always find disagreement surprising, but rather that they expect people from the same group (but not all people) to agree. Overall, these results suggest that infants use similarity to make important social predictions. They infer that people who are similar will interact positive and will share traits. Future research should focus on which types of similarity might be most relevant to infant social cognition, and whether similarity plays a role in how infants think about other types of social relationships (e.g., dominance and kinship).

S10.6iv The role of rationality in social selectivity: infants' preferences are guided by the perceived rationality in agents' behaviours

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From early on infants navigate the social world selectively, preferring some individuals to others. Some of the cues that predict infants' social preferences have been defined, such as familiarity with the language/accent an individual speaks (Kinzler et al., 2007; Begus et al., 2016) or reliability of the social partner when providing information (Tummeltshammer et al., 2014). Nevertheless, the underlying mechanisms guiding early life social selectivity are still a subject of debate. Here we highlight the importance of successfully interpreting others' intentional actions to interact and learn from them, which have been proposed to be based on the principle of rationality (Gergely & Csibra, 2003). From early infancy, humans implicitly assume agents to perform the most efficient means action to obtain a desired reward by minimizing the costs they expect to incur (Jara-Ettinger et al., 2016; Liu & Spelke, 2017).
 In a set of two studies, we used a violation of expectation paradigm to investigate whether the assumption of efficiency guides 15-months-old infants' expectations about others' social preferences. In the first study, we familiarized 24 participants with two animated geometric figures that performed the same goal-directed action, while a third agent observed them ("observer"). After familiarization, the efficiency of the agents' actions was manipulated. In the final test, the "observer" approached the efficient agent ("expected condition") and the inefficient one ("unexpected condition") and we measured infants' total looking time to the screen in each condition. Infants looked significantly longer to the "unexpected condition" over the "expected condition" ($p < 0.001$). Study 2, as a control of Study 1, confirmed that infants' preferences were guided by the rationality of the agents' movements and not by the novelty of the rational agent's actions during the test

phase.
 These results suggest that the principle of rationality has an important role in early life social selectivity, as a basis to interpret others' behaviours. This proposal sheds light on the mechanisms that might underlie previous findings in infants' social selectivity, such as the preference for accurate or reliable partners as individuals who behave rationally (Tummeltshammer et al., 2014; Zmyj et al., 2010). We are currently investigating infants' sensitivity to cultural goals, as a way of explaining actions that might seem apparently inefficient. Humans are constantly exposed to cultural behaviours or rituals that might involve inefficient actions to obtain a simple reach-object goal, but that are rational beyond a certain cultural goal.

S10.7 Symposium: From research to practice: bridging the gap through communication and partnerships

S10.7i Connecting, Communicating, and Collaborating with Educators and Industry

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Researchers in cognitive development are gaining increasingly robust understandings of the developmental trajectories that describe learning in various domains, and discovering more about how social and cultural practices contribute to learning. These new understandings complement, extend and, sometimes, challenge existing ways of thinking about children's learning. At the same time as researchers are making new discoveries, informal learning institutions (e.g., museums, zoos), private sector industries (toys, television, app developers), and schools are creating environments and products intended to support children's learning. Typically, pursuits in cognitive development research unfold independently from the design, development and implementation of learning opportunities for children. This disadvantages children and families because it limits the extent to which the development of experiences and products are firmly grounded in contemporary empirical understandings of children's learning. To best support children's learning, researchers must take initiative in making their work accessible to multiple audiences. It is also critical that those developing learning experiences for children actively seek out and use knowledge derived from research. In this talk, I share lessons learned from engaging with nonacademic professionals to help inform the development of evidence-based learning experiences for children. I discuss the benefits and challenges of creating and sustaining such partnerships, examine how such partnerships inform the development of learning experiences for children, and consider how interacting with informal educators and industry partners can contribute to academic research agendas by bringing to light new questions about how children learn as they engage in everyday routines. Specifically, I will discuss four settings within which participants work to connect academic research with the professional activities of nonacademic audiences. 1) An NSF-funded project in which academic researchers have been collaborating with informal educators to support educator professional development, activity development, and scholarly research. 2) A consulting project with a large toy company wherein a team of academic researchers helped to establish age appropriate learning targets, evaluate competitor products, and generate ideas for new toys. 3) A "content and curriculum" advisory board to a children's television company in which academic scholars use their expertise to critique program concepts, identify

potential opportunities to infuse programs with curricular goals and suggest pedagogical approaches informed by the science of learning. 4) The Goddard School (a nationwide system of over 400 centers) Educational Advisory Board's efforts to communicate theoretical, empirical and experienced-based insight to inform educational philosophy, programs and implementation. General discussion will focus on how reliance on a transmission model of communication often fails to take into account diverse forms of knowledge and expertise and, thus, may leave little space for a dynamic exchange of ideas and approaches. In considering how each of the partnerships described contribute to my research agenda, I hope to facilitate conversation about how partnerships can be seen not solely as "outreach" but also as endeavors that can push the field in new directions.

S10.7ii Empowering Parents Through Everyday Brain Building Moments

Marissa Kaiser¹

¹Bezos Family Foundation

Science tells us that children develop the foundation for lifelong learning in early childhood. There is no time in life when the brain develops more rapidly than during the first five years. By building children's brains from birth, caregivers are shaping the foundation for future learning. Every time caregivers connect with children, it's not just children's eyes that light up - it's their brains too. In these moments, we can't see it happening, but the caregiver is shaping a growing mind. Strong adult-child relationships are critical to helping young brains grow. Even kids who cannot yet talk are looking, listening, and relating to the adults in their lives every hour of every day. This presentation will focus on how leaders in neuroscience, psychology, behavioral economics, parenting, and early childhood development can use the latest scientific research to empower parents and caregivers to discover new ways to spark brain building moments throughout a child's first five years of life. Discussion will include strategies for how to meet families in the places they live, work, and play as well as methods for engaging parents and caregivers. We will cover one strategy in particular, that of turning shared everyday moments between adult caregivers and children into brain building moments. Whether it's meal time, bath time, or anytime in between, there are always ways to nurture our children's growing minds.

S10.7iii Partnerships in Outreach and Education

Sarah Lytle¹

¹University of Washington

Although the science of child development is critical to the work of early learning providers, most professionals who work with young children have little exposure to the basic science of child development. Some of the biggest challenges the early learning community faces are a lack of access to science and a lack of connectivity between basic research and their day-to-day work. This presentation describes one programmatic effort to reduce barriers to science by providing free online resources and local events. By forming partnerships with local, national, and international organizations, research can be contextualized for specific audiences and paired with real-world applications for daily interactions with children. In this presentation, we will discuss how our team partners with organizations to disseminate scientific research findings in relevant and actionable ways to early learning practitioners. We will also discuss strategies for translating science accurately, pathways for building authentic relationships, and the importance of a bidirectional feedback loop to generate the most useful information for the early learning profession. As an example of one effort to make the science of child development as widely available as possible, we have begun to use technology to disseminate our discoveries to educators through a free online toolkit for professional development. At the core of the toolkit are a series of training modules. Each module is a short, 20- to 25-minute deep dive into a specific area of child development. They are written in easy-to-understand language, include a multitude of visuals to explain scientific concepts, and are accompanied by discussion guides and handouts. Some modules are also available in Spanish, Vietnamese, and Somali. The toolkit was designed for and in conjunction with the early learning community. All content undergoes a rigorous testing process that relies on partnerships with community-based organizations. These partners help to refine and contextualize scientific information in a way that connects it to the everyday decisions that practitioners make. Partners also facilitate uptake and dissemination of these resources. To date, these efforts have allowed us to share the latest science of child development with more than 200,000 early learning professionals.

Flash talk abstracts: Tuesday 3rd July

S8.8 Flash talk session 9: Babies in their natural habitat - The role of ecological validity in studies of learning

S8.8i Building Bridges across Agencies to Identify Communication Needs of Infants Born in Poverty

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The Shenandoah Valley is largely agricultural, spanning 4000 square miles, 6 small cities, 8 counties and .5 million residents. The Valley was settled by Protestant Germans, mostly Mennonite and Brethren seeking religious freedom in 1717. Welcoming soil and climate led to economic independence and beaconed migrant workers from outside regions and countries for almost three centuries (Mitchell, 1977). Forty years ago, Virginia's General Assembly recognized a need to pass the Agricultural and Forestal Districts Act to protect agricultural and forestal ecologies (Valley Conservation Council [VCC], retrieved 11/21/17). Today's Farm Bureau reported that the 1977 Act slowed annual loss of farm land, but a strong sense of urgency exists today about the declining agricultural economy in the Great Valley. Declining agriculture correlates negatively with a growing "extreme" poverty previously unknown in the Valley. The "meth epidemic has spread like a cancer into the Shenandoah Valley... prescription drug abuse, especially opioids...is rapidly growing and spreading" (Wallmeyer, 2016). The Department of Education (2016-17) reported a 10% growth across recent decades in students eligible for free and reduced meals, up to 49% in 2016-17. Wallmeyer described Virginia's "extreme rural poverty" as "hiding in the rich state." In this proposed Flash Talk, we will present this brief history of emerging poverty and the multi-agency initiative begun to document the need for communication support to Valley mothers and Infants Born into Poverty (IBiP). The dire language acquisition prognosis for IBiP has been well documented nationally (e.g., Hart & Risely, 2003; McGillon et al., 2017; Rowe & Goldin-Meadows, 2009; Suskind, 2015). We began collaborating in 2015 with a large hospital's mother-infant agencies; Hand-in-Hand for new mothers 18 and younger and Healthy Families for mothers 19 and older identify and support women with histories of addiction, crime, abuse, and (at risk for becoming) high school dropouts. To date, 18 (9 each) low- and mid-SES families offered financial incentives from these two agencies have participated in a weekend's use of LENA. We have supplemented LENA counts with detailed transcription of selected portions of the recordings to reveal that the low SES mothers speak significantly less to their 8-month-

old infants, using significantly fewer utterances, word repetitions and isolated words. We project the word gap between the low and mid-SES groups to be over 20 million words by the time the infants reach 4 years old. We have reported these data to Hand-in-Hand and Healthy Families, expanded outreach to the University's Institute for Innovation in Health and Human Services, Communication Disorders Applied Lab, and to local school board, Rotarian, library and local pediatrician personnel. We have received three small grants to collect more evidence and involve more faculty, students, university and local agencies to reach mothers and IBiP from homes where Spanish is used. This flash talk addresses the nature of the Valley's rural history, ecology, economy and our efforts to build bridges across Valley agencies to reduce the effects of poverty on language learning for infants and their families in the ever-changing Shenandoah Valley.

S8.8ii Solving Referential Ambiguity Is Easy

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¹Indiana University, ²University of Chicago

Learning first words should be a computationally difficult because infants must match heard names to seen things in a cluttered world. This uncertainty has defined the major theoretical problem and focus of research. Here we propose and provide evidence for the idea that the construal of the uncertainty problem may be fundamentally wrong. The natural training data for learning new words are generated in time by the behaviors of the mature social partner who provides the name and by the learner who is not just an observer but is actively engaged in the ongoing events. These interactions create a formal dynamic system in which the objects being handled, named, or attended to at any one moment in time depend on the objects being handled, named, or attended to at the previous moment in time. These kinds of behavioral systems create skewed frequency distributions in which a very few instances are very frequent, forming a very small set for learning. The results show that when parents and infants are put in a room to play for 10 minutes with a random set of 33 toys dumped in a pile on the floor, the parent repeatedly handles and repeatedly names a very small set (1 to 3 toys) as the infant repeatedly handles and repeatedly attends to the same small set of objects. The scenes are highly cluttered - with most of the 33 toys in the infant's view most of the time and the infant handles and looks at most of the toys at least once. But over the full 10 minutes of play, there is a highly focused training set for learning and considerably reduced uncertainty. Because it is a random set of toys (and because different dyads favor different toys), the reduced uncertainty is created by the dyad. The infants in this study were 12 month olds

(N= 16) and wore a head camera to record the first person view during play. Naming events were identified (N=580). From the infant head cameras (and supporting scene cameras), objects in infants' hands, in parent hands, and in the head camera image were coded for all naming events and also for non-naming events by sampling frames at 0.2Hz (1 frame every 5 sec, 2,008 frames total). The frequencies of objects were measured, and combined across infants using rank order of frequency, from the most frequent to least frequent object. Figure 1 shows the frequency distribution of object naming events and object handling events and the selectivity of the few objects of focus within the dyad. Figure 2 shows a Markov Chain Model of infants' object handling, the infants' high probability to handle the most frequent objects and lowest probabilities to transition to and from the least frequent objects. Dyad interest in a few objects is extended in time creating a selective set for learning. The relevant time scale for learning is not the naming event but the larger continuous context in which naming and object attention emerge.

S8.8iii Infants do not re-live the same hour all day long

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¹University of Oregon

Recent studies provide estimates of everyday experience, like infants see faces for one-fifth of their first year (Jayaraman et al., 2015), see a single object for 80 cumulated hours per two months (Clerkin et al., 2017), and take 14,000 steps per day (Adolph et al., 2012). Each of these estimates is computed by observing a rate at one timescale and then multiplying by a relevant number of waking hours. This linear extrapolation assumes that infants re-live the observed timescale uniformly, but we know that they do not. This fact has deep implications for estimating natural experience as well as understanding how it matters for learning. We illustrate two lessons and an emerging priority based on the everyday language and music of infancy. 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). LENA automatically modeled sound sources and word quantities. Trained coders identified music bouts (uninterrupted live and/or recorded singing, instrument playing, and vocally produced pitched, rhythmic patterns), each bout's tune, and each vocal bout's voice identity. Lesson 1: The content and timing of natural input is non-uniform. Infants encountered a mix of music content (Median=55 unique tunes), but a small set of items repeated over the course of the day (Fig. 1). Each infant's top 3 most frequent tunes accounted for a quarter of their tune tokens (Median=.25). Infants encountered the same voice in nearly half of the daily vocal music tokens

(Median=.46). Further, bouts were neither periodic nor random but rather bursty in time (Median B=.27; Goh & Barabási, 2008). Daily words and their sources were similarly distributed. Lesson 2: Linear extrapolations from short samples vary widely. How many words do infants hear each day? If extrapolating from one observed hour, the answer depends on which hour (Fig. 2; see also Tamis-LeMonda et al., 2017). This was also true for daily music. Estimates of cumulated experience constrain theories of how repetition matters for learning and also guide program evaluation (e.g., do parents talk more to their children after an intervention?), so we must grapple with the sample-dependent nature of these estimates. Emerging priority: Content that is naturally distributed over long time periods cannot be modeled within shorter time periods. Distributions arising from lots of repetition plus a very long tail of variability, or temporal dynamics with long pauses between content, are most apparent over extended timescales of experience. Compressing the temporal extent fundamentally alters the spacing and dynamics that real learners face. Similarly, the learning challenges posed by massive variability (and potential solutions offered by repetition) are artificially minimized by the limited number of tokens in the short learning schedules of traditional infant studies. Measuring subsets of natural experience is problematic because we do not yet understand the shape of longer timescale distributions; manipulating distributions in short experiments may yield limited insight as we precisely examine memory and generalization puzzles that real learners never actually solve. Instead, full day natural data suggest that the next steps in a research program designed to test hypotheses about how everyday input matters for learning should measure and manipulate experienced distributions at their naturally extended timescale.

S8.8iv Social Entry into Third Party Interactions in Preschool Classroom Settings

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Researchers concerned with the social and cognitive development of young children have highlighted the importance of children's social entry skills (Downer & Pianta, 2006). The ability to gain successful entry into peer interactions can impact children's acceptance and access into future peer interactions (e.g., Timler, Olswang, & Coggins, 2005). Although there has been much research on older preschool and school-aged children's social entry behaviors, it remains unclear how younger toddlers use social entry behaviors with their peers. The current study examined the social entry attempts and subsequent peer responses of 31 children (M= 30 months) in two mixed-age toddler classrooms in a

preschool center. Children and teachers were videorecorded during 30-minute unstructured play periods for a total of 2 hours and 45 minutes for each classroom. Children's social entry behaviors and peer responses were identified and classified when a child tried to enter into the third-party interaction. The coding system was adapted from Puttallaz and Wasserman (1989). Children used a total of 1,889 social entry strategies within 642 social entry attempts. Children used a variety of strategies to enter into these interactions, including object use, looking, and most commonly, proximity with looking (42%). There were also developmental differences in strategy type. Bringing an object to the third-party interaction was the most common strategy (39%) with the younger 15-through 18-month-old children; use of this strategy decreased with age. In contrast, children's preference to touch the object with which the third-party was interacting increased with age. Approximately 50% of the entry attempts involved two social entry strategies, and 20% involved three strategies. Within the first three social entry attempts, children who used three co-occurring strategies were positively responded to by their third-party members at a rate of 60%. In comparison, children who used only one social entry strategy in the first three attempts displayed a 29% positive response from the third-party. This difference was significant (Fisher's Exact, $p < .0001$) Finally, teacher presence was recorded during children's third-party entry attempts. Teachers were involved 92% of the time with children ages 15-23-months, 84% with 27-31-month-olds, 56% with 32-36-month-olds, and 62% with 41-47-month-olds. Further, teachers' presence related to the success of peer acceptance. The number of social entry attempts with teachers present were more likely to be successful (Fisher's Exact, $p < .0003$) . In sum, the current study contributes to our understanding of toddlers' social engagement strategies in early childhood classroom settings. Specifically, this data reveals that young preschoolers use a variety of social entry behaviors in order to enter into peers' third-party interactions. Further, teachers' presence relates to children's success at peer entry. Findings from this study highlight the use of non-verbal social entry behaviors as well as the teacher's influence in the formation of toddler's social entry skills.

S8.8v Developmental Changes in Visual Scene Statistics

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¹Indiana University

The visual system is tuned by inputs such that sensitivities and biases at all levels in the system reflect the statistical regularities in the world. However, the visual worlds of infants are very different from those of adults and may present different statistical regularities.

Little is known about the low-level statistics of available visual input as infants interact with the world in rapidly changing ways. Recent studies of the contents of infant-perspective scenes (sampled from a corpus of over 5 million head camera images) indicate that these contents change dramatically over the first year of life. Ceilings, wall edges, and high-contrast patterns characterize younger babies (below 3 months), while more crowded images characterize older babies. As a first step to analyzing the visual properties of these scenes, naïve human coders were asked to categorize images from a corpus of infant perspective scenes into the two categories. The corpus contained egocentric scenes collected by younger 4- to 13- week-old infants, and from older 28- to 34-week-old and from 48- to 51-week-old infants. Results indicate that young babies look at "emptier" scenes 12% more often than older babies. Initial analyses of the visual properties of these "emptier" scenes including spatial frequency and the number of segments--fit the idea that the inputs to the visual system, reflecting visual biases in the infants, change with development. The full analyses will include spatial frequency, orientation, contrast, and clutter measures across 1,821,021 frames.

S8.8vi Gaze-following in the Laboratory Does Not Generalize to Naturalistic Settings

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This talk will summarize analyses of data sets (including new analyses) showing that laboratory settings systematically over-estimate infants' tendency to follow an adult's gaze. Reasons for this contextual difference are not well understood, but the limited literature offers tantalizing clues. These clues might not only reveal why gaze-following differs across contexts, but might also suggest general ways in which properties of infants' environment affect their social attention and responses to social cues. One line of evidence follows a paradigm (Butterworth & Jarrett, 1991) in which infants sit facing an adult in an impoverished laboratory, and the adult turns to gaze at one of several static targets. This elicits gaze-following from infants 9 months or older (Deák, Pick & Flom, 2000), but if the laboratory setting is cluttered with potentially distracting objects, gaze-following (but not point-following) disappears, even in infants as old as 21 month (Deák, Walden, Kaiser, & Lewis, 2008). What does this mean? Possible answers are suggested by micro-behavioral studies of naturalistic infant-parent interactions. Infants in naturalistic settings attend little to adult faces (Deák, Krasno, Triesch, Lewis, & Sepeda, 2014; Frank, Vul, & Johnson, 2009; Yoshida & Smith, 2008; Yu & Smith, 2013). However, inattentiveness

likely cannot fully explain the near-absence of naturalistic gaze-following: Deák et al (2008), for example, ensured that infants looked toward parents' heads during gaze cues, and Deák, Krasno, Jasso, and Triesch (2017) conditionalized analyses on infant attentiveness, yet found virtually no instances of gaze-following without other cues (e.g., pointing). New analyses probe whether in the naturalistic interactions adult gaze-shifts affect infants' attention more subtly. Gaze-cues tended to follow other behavioral cues - object handling and/or verbal exhortations (Figure 1) - and therefore might have encouraged infants to "complete" attention-following. However additional analyses of infant following latencies, contingent on parents' cue combinations (from Deák et al., 2017) support the possibility that infant and parent gaze shifts merely become more synchronized with age. The discussion will consider (1) lessons for studies of infant social responses in laboratory vs. naturalistic contexts; and (2) given these findings, how might infants still use adult gaze cues in everyday settings.

S8.8vii Using Dual Head-Mounted Eye Tracking to Index Social Responsiveness in Naturalistic Parent-Child Interaction

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Screen-based eye-tracking studies have demonstrated atypical and diminished social attention in autism spectrum disorders (ASD) (Chita-Tegmark, 2016). It is currently unclear whether and how attentional abnormalities in children with ASD may occur during face-to-face interaction with a parent in an unconstrained environment. Recent technological developments have allowed us to track freely-moving children during social interactions (Smith, Yu, Yoshida, & Fausey, 2015) and to quantify the previously inaccessible nuanced social behavior of children and their parents. Here, we extend this paradigm to ask new questions about atypical development - specifically, whether, how, and when children with ASD coordinate their attention with social partners in free-flowing play. The current study aims to determine whether young children with ASD (24-36 months old) modulate their attention as a function of their parent's attention compared to age-matched typically developing (TD) children while engaging in naturalistic toy play by using head-mounted eye-tracking. Child-caregiver dyads played with 24 novel toys in a toy room space while wearing head-mounted eye-trackers. Figure 1 demonstrates the experimental set-up. Following eye-tracker set-up, each dyad was given the toys to freely play with, and encouraged to play as they would at home. Data has so far been collected from 4 ASD

child-caregiver dyads and 8 TD dyads, with additional data being collected and coded. We explored social responsiveness by measuring how socially modulated a child's attention is. Based on a study by Yu and Smith (2016), we sought to determine if bouts of sustained attention are extended when children are joined in looking at that object by a parent (i.e. moments of shared or joint attention) in this highly unconstrained scenario. TD children displayed longer bouts of sustained attention when engaged in joint attention with their parent than when attending to a toy alone, with an average difference of 1.24 seconds ($SD \pm 0.33s$). A similar effect was present but attenuated in our preliminary findings of children with ASD, with this group demonstrating an average difference of 0.73 seconds (0.98s). While the difference between two groups are not presently statistically significant, the sample size is small (data collection and coding is ongoing) and there are large individual differences: some participants with ASD show nearly no boost in attention when jointly engaging with a toy, and others show typical levels. We intend to examine the relationship between individual differences in social attentional responsiveness and clinical and behavioral measures (i.e., autism severity; receptive and expressive language abilities). In the current study, by leveraging a dual head-mounted eye-tracking paradigm, we demonstrate the feasibility of studying dyadic parent-child interaction with young children with ASD while they engage in free play with toys. Our preliminary results show present but attenuated social responsiveness in children with ASD. This large variability in social responsiveness may be linked to clinical outcomes to provide novel insight into how social responsivity relates to language abilities and symptom profile, and may provide individualized targets for future intervention. Additional data will be collected to further explore social responsiveness and modulation in ASD.

S9.8 Flash talk session 10: Babies and screens

S9.8i Does maternal technological distraction during infant feeding lower the quality of mother-infant interaction?

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Given the ever-increasing accessibility of handheld technologies (Pew Research Center, 2014), combined with the large number of daily feedings required by young infants (Fomon, 1993), it is possible that many caregivers regularly attend to technological distractors (e.g., television [TV], smart phones) to cope with the large volume of time they must dedicate to breast- and/or bottle-feeding. Indeed, our previous research illustrates 83% of mothers report using a technological distractor during one or more feeding/day (Golen & Ventura 2015a) and, on average, mothers report engaging in some sort of technological distractor during ~26% of daily feedings (Ventura & Teitelbaum 2017). In an observational study, we also found that mothers who were distracted during bottle-feeding exhibited significantly lower sensitivity to their infants' cues compared to mothers who were not distracted (Golen & Ventura 2015b). Although there is much interest in the potential effect of parent technological distraction on the quality of parent-child interactions, few studies have used experimental methods to examine causal associations between parent technological distraction and the quality of parent-child interactions. To this end, the objective of the present research was to experimentally test the impact of maternal technological distraction on the quality of feeding interactions during early infancy. A convenience sample of breastfeeding mothers with infants <6 months (n=25) were recruited through community advertisements. Dyads participated in a within-subject, experimental study, wherein mother-infant dyads visited our laboratory two times for feeding observations. Mothers were video-recorded while feeding their infants under two counterbalanced conditions: during the no distraction condition, mothers fed their infants while listening to classical music played at ambient levels and during the technological distraction condition, mothers fed their infants while watching a TV show on an iPad. Videos were later coded by two coders trained in the Nursing Child Assessment Feeding Scale (Sumner & Spitz, 1994), which contains 76 observable behaviors that are organized into four subscales that describe the mother's responsibility in the interaction (Sensitivity to Cues, Response to Distress, Social-Emotional Growth Fostering, and Cognitive Growth Fostering) and two subscales that describe the child's responsibilities (Clarity of Cues and Responsiveness to Caregiver). Mothers also reported

their typical level of technological distraction during infant feeding and all analyses were controlled for infant age and typical level of distraction. Infants were 19.3 ± 6.4 weeks of age, 76% of mothers were primiparous, and 80% of dyads were non-Hispanic White. During the technological distraction condition, mothers trended toward exhibiting lower sensitivity to infant cues ($F[1,20]=3.35$, $p=.08$) and engaged their infants in significantly less cognitive growth fostering ($F[1,20]=5.29$, $p=.03$) compared to during the no distraction condition. Mothers exhibited similar levels of responsiveness to infant distress cues ($p=.74$) and socioemotional growth fostering ($p=.58$), and infants exhibited similar levels of clarity of cues ($p=.33$) and responsiveness to their mothers ($p=.18$) during both conditions. In conclusion, this study is among the first to experimentally examine whether maternal technological distraction during feeding interactions impacts feeding outcomes. Findings illustr

S9.8ii Toddlers' Difficult Temperament and its Relation to Overindulgence in Smart Devices: Social-emotional Development as Moderator

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The interactive mobile smart media devices such as smartphones and tablets have been revolutionized young children's access to and experience of media. In this media-saturated environment, even young children are relatively competent users of user-friendly touchscreen based smart devices already at a young age. The rapid adoption of smart devices for toddlers is more directly related to family dynamics and child health and development (Kabali et al., 2015). As every parent is highly aware of the impact of this portable and instantly accessible source of smart devices, both negative concerns and potential outcomes for young children have received great attention. Therefore, parents may choose smart devices either to set limits around by control or to use as calming tools for them. In other words, parents of young children are more likely to have the power to make decision regarding media use. There are, on the other hand, elements of an individual child, like his or her patterns of social behavior, that likely affect why parents chose to use media the way that they do. Just as different parenting techniques are more or less effective for different children, given their various traits and temperament, it is suggested that parents' motives for media use for their young children likely vary as well based on a child's individual differences. Given that parents likely make decisions about young children's media use within the context of the parent-child relational dynamic; however, research is lagging behind to consider the nature of the child and how that may

influence that parent's decision-making process of its adoption. Also, in particular, the active use of smart devices for young children can be determined by their own temperament, and by the social-emotional development of toddlers. Therefore, the purpose of this research is to address the moderating effect of young children's social-emotional development in relation between toddlers' difficult temperament and their overindulgence on smart devices. The sample consisted of 215 Korean young children aged in between 24 to 36 months enrolled in 18 childcare centers in Korea. Toddlers' difficult temperament (Abidin, 1995) and their overindulgence in smart devices (Lee, Jung, & Kim, 2015) were assessed by mothers. Mothers reported that they allow their young children to use smart devices. Main classroom teachers also completed young children's social-emotional behavior inventory with 5 subscales including basic emotions and social behavior, self-concept, cognitive self-regulation, emotional self-regulation and social relationship with others (Kim, 2010). Hierarchical regression analyses were performed to examine the relations among variables. Children's month, sex, first time of using smart devices, and daily duration of smart devices use of toddlers were considered as covariates. Interaction effects were detected as illustrated in Figure 1 & 2. Toddlers' difficult temperament was significantly associated with their overindulgence in smart devices, and the associations were moderated by their basic emotions and social behavior, and social relationship with others, respectively. Such findings suggest that toddlers' social-emotional functioning is one of the key factors that may predict young children's media use, and more implications will be discussed.

S9.8iii What attracts the gaze of 18- and 24-month-olds during screen viewing?

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Conceptual representations of everyday scenes guide our visual attention. Allocation of attention and gaze are influenced by an interaction between bottom-up (i.e. perceptual features) and top-down (i.e. cognitive control) mechanisms (Itti & Koch, 2000; Parkhurst, Law, & Niebur, 2002). For instance, objects that are either visually salient or inconsistent with the scene context attract our attention. Language processing has also been shown to guide visual attention in adult participants (Andersson, Ferreira, & Henderson, 2011; Clarke, Coco, & Keller, 2013; Coco, Malcolm, & Keller, 2014). While these mechanisms have been extensively studied in adults, less has been investigated in developing populations. Currently, it is known that eye movement control develops during early childhood (e.g., Helo, Pannasch, Sirri, & Rämä, 2014; Helo, Rämä, Pannasch, & Meary,

2016; Luna, Velanova, & Geier, 2008). For instance, gaze allocation is less influenced by saliency in older than in younger children. However, little is known about the interaction between bottom-up and top-down mechanisms in young children. In the current presentation, we will show the results of two studies that investigated the influence of perceptual features, semantic inconsistencies and linguistic properties on attention allocation in 18- and 24-month-olds during a free exploration of visual scenes. We included vocabulary skills as a factor since around 18 months of age there is an extensive improvement in vocabulary skills - so-called vocabulary spurt (Ganger & Brent, 2004; Nazzi & Bertoncini, 2003). In Study I, we measured eye movements in children of 24-months and in adults while they explored visual scenes, which contained either an inconsistent (e.g., soap on a breakfast table) or consistent (e.g., soap in a bathroom) object either in a high-saliency or low-saliency condition. In Study II, we tested 18-month-olds using the same paradigm. Results of the Study I showed that saliency and object-label familiarity had a stronger effect on gaze allocation in 24-month-olds than in adults. Interestingly, 24-month-old children - in contrast to adults - presented a semantic consistency effect only when objects were highly salient. Whereas inconsistent objects attracted the gaze of 24-month-olds regardless of their vocabulary skills, gaze allocation to consistent objects increased with better vocabulary skills. Results of Study 2 showed that the gaze of 18-month-olds' was strongly guided by object saliency and object-label familiarity but not by semantic consistency. Unlike in 24-month-olds, language skills did not affect gaze allocation in 18-month-olds. Our findings suggest that 18-month-old children are attracted mostly by perceptual features and object-label familiarity, suggesting that bottom-up guidance is dominant over top-down processing. It is possible that at this age, children have not yet acquired enough semantic scene knowledge to guide their visual attention and gaze allocation. Later, at the age of 24-months, an ability to detect semantic inconsistencies emerges, but it is still strongly affected by perceptual features. Vocabulary skills affect visual attention only at 24-month-olds. It is plausible that, after the vocabulary spurt, development of top-down control of visual attention is linked with language skills. These findings further suggest that the top-down control of visual attention increases with age during early childhood.

S9.8iv Beyond babies and screens: Parental phone use and parenting behaviour

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Developmental studies of screen use often focus on the direct effects of screen use on infants and children. Our study focused instead on indirect effects of screen use by parents on infants and children. We examined whether parental phone use influences parenting during infancy in the context of infant feeding. Phone use was evaluated using a newly developed measure, the Distraction During Feeding Questionnaire. Parenting beliefs and behaviours were measured with the Baby Care Questionnaire (Winstanley & Gattis, 2013) and the Infant Feeding Styles Questionnaire (Thompson, Mendez, Borja, Adair, Zimmer, & Bentley, 2009). In Study 1, four parents of infants under 24 months participated in cognitive interviews to evaluate the three measures of parenting beliefs and behaviour. In Study 2, 309 parents of infants under 24 months completed the measures online. Responses to the Distraction During Feeding Questionnaire indicated that phone use was the most common form of distraction during feeding. Nearly all parents (95.5%) reported having their mobile phone on their person at least some of the time while feeding their infant. Similarly, nearly all parents (95%) reported checking their phone during infant feeding. Infant feeding was related to parental phone use. Phone use was positively related to indulgent feeding ($r(174)=0.238$, $p<0.001$), laissez-faire feeding ($r(174)=0.237$, $p<0.001$) and pressuring feeding ($r(174)=0.237$, $p=0.002$). Parents who reported more phone use during feeding also reported more indulgent feeding behaviours, more laissez-faire feeding behaviours, and more pressuring feeding behaviours. Research on screen use should look beyond the direct effects of screen use on infants to examine the indirect effects of screens on babies. Our study provides initial evidence that parental screen use influences parenting behaviours in meaningful ways. Further studies are needed to inform our understanding of indirect influences of screens on babies. Because parents completed all measures concurrently, we cannot infer causal direction from these data. Longitudinal studies are needed to evaluate the potential causal effects of indirect screen use on parenting behaviours and on infant outcomes.

S9.8v Heightened visual pop-out in toddlers with high daily touchscreen use.

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Individual differences in attention control early in development have been proposed to contribute to the development of executive function, which is linked to lifetime behavioural and educational attainment. The recent increase in touchscreen use (i.e. mobile phones and tablets) in toddlers (Bedford et al., 2016) has led to parental concerns about how the highly salient and contingent screens may be influencing the development

of attention control, potentially increasing exogenous control by salient events (i.e. pop-out) and impairing endogenous control (i.e. voluntary attention shifts). The aim of the current study was to investigate whether touchscreen use by toddlers was associated with differences in exogenous and endogenous control of visual attention using a gaze-contingent visual search task. The current study was part of the lab-sample from the Toddler Attentional Behaviours and LEarning with Touchscreens project (TABLET; Bedford et al., 2016; Cheung et al., 2017). Forty-eight 17-month-old babies were grouped based on their reported daily touchscreen use (High users: >15 minutes per day, and Low users: <15 minutes per day). Participants were presented with a gaze-contingent visual search task (adapted from Kaldy et al., 2011). A search array was presented until children fixated the target (a red apple), triggering a visual reward. The array could be a single feature array - blue apples with a red target (indexing exogenous control), or a conjunctive search array - a mix of blue and red full apples and cropped apples (indexing endogenous serial attentional search). Across 26 trials (8 single trials with set sizes 5 or 9, and 18 conjunctive trials with set sizes 5, 9 or 13) the time participants took to fixate the target (Search Reaction Time, SRT) was analysed for each type of search and set size. Of those participants who attended the lab visit a subset were excluded due to fussiness or experimental error. An $2 \times 2 \times 2$ ANOVA of usage (Low and High) by type of search (Single and Conjunctive) by set size (5 and 9) showed a significant interaction effect of usage by type of search on SRT - $F(1,36)=4.746$, $p=0.036$. This effect was followed up by a usage by set size ANOVA in each search type, revealing a faster SRT in single search in the group of toddlers reported as having high touchscreen use - $F(1,36)=9.006$, $p=0.005$, suggesting greater exogenous attention control, i.e. visual pop-out. No effects of usage were found in conjunctive search, but a set size effect was present - $F(2,68)=3.422$, $p=0.038$, confirming that both groups were similarly susceptible to set size effects in conjunctive trials (but not single trials) and able to perform endogenous serial search. Findings from the current study show that toddlers with high touchscreen use were quicker in finding a salient target when presented with a pop-out search array but their endogenous control of attention was preserved. What is not known is whether these findings are specific to screen-based tasks - with which the high-users have greater experience - or extend to real-world attention control. The implications of this finding for real-world behaviours and the on-going development of executive function will be investigated in future work.

S9.8vi Exploring the Transfer Deficit through Novel Noun Generalization

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Children's ability to generalize objects and concepts across various situations is essential to promoting language comprehension. In order to understand if children fully comprehend a label for an object, they need to recognize the object across various settings. One critical characteristic for generalization is object shape. Little work, however, has examined if children are able to use the same characteristics (e.g. shape) to learn object labels from technological devices (e.g. tablets and smartphones). Previous work has shown children are unable to transfer information, in general, from 2D images to 3D objects, known as the Transfer Deficit (Barnett & Ceci, 2002). Using a Novel Noun Generalization (NNG) task with tablets, smartphones and real life objects, children ages 18-36 months were asked to generalize a label from an exemplar to another item that matched the exemplar in either shape or material. Critically, children were placed in four conditions that were either consistent on technology modality or mixed/differed on the modality: mixed 2D to 3D, consistent 2D to 2D, consistent 3D to 3D, and mixed 3D to 2D. It was hypothesized that overall children would show a shape bias in all conditions. However, it was also hypothesized that children would select the correct shape match more often in the consistent conditions than in the mixed conditions. The results are consistent with our hypothesis and the previous literature; children selected the shape-matching objects more often than the material-matching objects in the 3D consistent condition, 63% of the time. Results show that children fail to generalize shape when exemplar and test objects were presented on a screen (2D). Specifically, children showed a Transfer Deficit, demonstrating poorer performance when generalizing from 2D to 3D and selecting the shape-matching item only 52% of the time. As children's age increased, correct choice selection for conditions involving 2D modalities marginally decreased. Moreover, children's attention to shape decreased the most in the 2D to 3D condition. Implications show that the process for learning novel words may be disrupted when smartphones and tablets are used. Children are not able to generalize objects from a 2D screen as well as they can with 3D objects.

S9.8vii Exposure to Screen-Based Media in Infancy Negatively Affects Executive Functioning in Toddlerhood: A Propensity Score Study

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The American Academy of Pediatrics (AAP) discourages parents of children under the age of 18 months from exposing their children to screen time of any kind (AAP, 2016). However, the prevalence of screens is nearly universal in much of the developed world: nearly 97% of households in the US report having at least one television (Nielson, 2017), and 95% of household with children between the ages of 0 and 8 have at least one smartphone (Common Sense Media, 2017). As well, despite AAP recommendations, the average child under age 2 is exposed to over 40 minutes of screen time per day, and parents report over 70% of children under 2 have watched television-based media, and nearly 50% have used smartphone-based media. This may have large implications for children's development, as prior studies have suggested exposure to screen-based media in infancy is negatively associated with cognitive development (Christakis, 2009). Here, we seek to investigate causal relations between electronic screen-based media use in infancy with the development of children's self-regulatory skills, specifically executive function (EF). Participants (N=272) are children of first-time parents in a larger prospective longitudinal study in the UK (N=150), the Netherlands (N=55), and the US (N=67) who have complete data on all measures. When children were 4 months of age, 65 parents reported their child did not interact with any electronic screen-based media (e.g., television, tablets, computers), whereas 207 parents reported their child did interact with screen-based media on a regular basis. At 14 months, children completed a series of three executive function assessments that measured inhibition, shifting, and working memory. Factor scores were obtained for accuracy on shifting and working memory tasks, and inhibition was latency to touch an attractive toy in seconds. Using a propensity score approach with genetic matching, children who did and did not watch screen-based media were matched on a host of child and parent characteristics, including parent age, education, income, mental health, country, self-efficacy, and satisfaction with life and their relationship with their partner, as well as child gender. There was adequate overlap in propensity scores between children who were and were not exposed to screen-based media (Figure 1). Results of regression analyses on each of the three executive function measures using propensity scores as weights are shown in Table 1. Participants who watched screen-based media at 4 months had worse inhibition and shifting abilities at 14 months ($\beta = -.17$, $p = .011$; $\beta = -.22$, $p = .033$, respectively), but there was no association between exposure to screen-based media and working memory. While this study does not investigate whether there is a relation between the amount or content of screen-based media with which infants interact, it provides suggestive evidence that regularly using electronic screen-based media may be detrimental for the development of executive function and self-regulatory skills broadly. However, is unlikely that occasional short-term exposure to screens impacts child development, and the associations found

here likely reflect an accrual of time spent exposed to screen-based media. Implications for child rearing, policy, and practice will be discussed.

S10.8 Flash talk session 11: ICIS 2028: Imagineering the next 10 years of infancy research

S10.8i Development of Brain Functional Connectivity and Its Relation to Infant Sustained Attention in the First Year of Life

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Introduction: Infant sustained attention is a type of endogenous attention that is characterized by a deceleration in heart rate (HR) and represents the arousal state of infants (Colombo, 2001; Richards, 1989). The study of brain functional connectivity is crucial to understanding the neural mechanisms underlying the improved behavioral performance (Mallin & Richards, 2012) and amplified ERP responses (Xie & Richards, 2016a, b) observed during infant sustained attention. Previous investigations on the development of functional brain connectivity during infancy are primarily confined to the use of functional and structural MRI techniques. The current study examined the relation between infant sustained attention and brain functional connectivity and their development during infancy with high-density EEG recordings. Method: Fifty-nine infants were tested at six (N = 15), eight (N = 14), ten (N = 17), and twelve (N = 13) months. Infant sustained attention was defined by measuring infant heart rate changes during infants' looking. Functional connectivity was estimated with the weighted phase lag index (WPLI) between electrodes on the scalp and between reconstructed cortical source activities in brain regions for infant theta (2 - 6 Hz), alpha (6 - 9 Hz), and beta (9 - 13 Hz) frequency bands. Age-appropriate average MRI templates (Richards et al., 2015) were used to create head and brain models for cortical source reconstruction. Graph theory measures (e.g., path length and clustering coefficient) were used to capture the changes in the overall architecture of brain networks. Figure 1 demonstrates the pipeline for source-space functional connectivity analysis. Results: It was found that infant sustained attention was accompanied by attenuated functional connectivity in the dorsal attention and default mode networks in the alpha band. Figure 2 depicts the connectivity within these two networks and how it was different between sustained attention and inattention. Graph theory analyses showed that there was an increase in path length and a decrease in clustering coefficient during infant sustained attention compared to inattention. The functional connectivity within brain networks and the graph theory measures of path length and clustering coefficient were found to increase with age. The characteristic of

small-worldness was found for infants at 6 and 8 months in the alpha and beta bands. Discussion: These findings suggest that infant sustained attention is accompanied by distinct patterns of brain functional connectivity. The attenuated within network connectivity in the alpha band for the dorsal attention and default mode networks might suggest the release of inhibition for these attention networks, which in turn influences infants' behavioral and physiological activities. The current findings also provide convergent evidence for the rapid development of functional connectivity in brain networks during infancy. The methods used in the current study suggest that cortical source analysis with EEG data can be used with infant participants to study the functional connectivity in brain networks.

S10.8ii How Insights from Behavioral Economics Can Support Re-Design and Enhance Impact of Infant Targeted Interventions

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Parent support programs promote positive parenting and early social-emotional and cognitive development (Layzer, Goodson, Bernstein, & Price, 2001; Lundahl, Risser & Lovejoy, 2006). Improving low and inconsistent engagement in such programs--including take-up, receptiveness to materials, and follow through--remains a challenge (Baker, Arnold, & Meagher, 2011). Most parenting interventions presume that parents understand the program's value and are ready and equipped to acquire targeted parenting behaviors and skills. Yet parenting an infant, especially for the first time, is complex and time-consuming and made further difficult under conditions of poverty (Mullainathan & Shafir, 2013). Consumed by economic instability and constant worry to meet their family's basic needs, low income parents juggle available financial and mental resources to be attentive to parenting support and related early interventions. Behavioral economics (BE), which integrates concepts from social psychology and conventional economics, offers insights about the ways drained or depleted mental resources, and the context of poverty, may interfere with parent intentions. We will present BE approaches--drawing on concepts of default choices, eliminating hassles, and positive affirmation--applied to a newborn home visiting program for low-income parents in New York City. In our randomized controlled study we automatically enroll new mothers in a text-based messaging program promoting early language interactions as compared to conventional approaches of advertising and self-enrollment. Mothers can opt-out from receiving text messages by texting "STOP". BE research suggests that individuals tend to opt for the default when

faced with multiple choices across life decisions including retirement savings and organ donations (Chapman, Li, Colby, & Yoon, 2011; Beshears, Choi, Laibson, & Madrian, 2009; Johnson & Goldstein, 2003). As of October 31, 2017, only 3 percent ($n = 9$) of a total of 329 new mothers opted out of text messaging services. Insights from behavioral economics also show that people are more likely to utilize programs and services when steps are streamlined and information is pre-populated (Bettinger, Long, Oreopoulos, & Sanbonmatsu, 2012). When babies reach 5 months of age, we send mothers a gift package with a personalized pre-populated New York Public Library (NYPL) card application. We further direct parents' attention to the literacy resources geographically available to them by accompanying the library application form with a visual map of local library branches and the schedule of story hours. Finally, we capitalize on affirmation of identity which has been shown to influence academic performance and social service utilization (Cohen & Sherman, 2014, Hall, Zhao & Shafir, 2014). We invoke positive affirmations of maternal identity through a script and video received at a second home visit, accompanied by a series of text messages (e.g. "You are doing so much to help your infant grow healthy and well. Give yourself a pat on the back!") hypothesized to overcome potential feelings of stigma, judgement, and threat to maternal self-concept. In this talk, we will introduce the principles of BE in the context of parenting, receipt of early development information, and more targeted interventions as a nascent yet highly promising direction for science and practice.

S10.8iii Studying social interactions in infants at-risk for autism using fNIRS - An ecologically valid neuroimaging approach

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Brain activation studies are often conducted in unnatural environments (with loud noise, bright lights, and large equipment). We predict that in the future neuroimaging will be possible in natural home environments during naturalistic play between infants and their caregivers using non-invasive, portable devices. In a preliminary study, we used an infant-friendly optical neuroimaging tool called functional near-infrared spectroscopy (fNIRS) that is relatively robust against motion artifacts. Behavioral signs of Autism Spectrum Disorder (ASD) are typically observable by the second year of life and a reliable diagnosis of ASD is possible by 2 to 3 years of age (Zwaigenbaum et al., 2015). Studying the development of infants with familial risk for ASD allowed us to investigate the early signs

of ASD risk within the first year. Brain abnormalities such as hyper-connectivity within the first year may precede the overt signs of ASD that emerge later in life. Specifically, we examined functional activation and connectivity during social interactions in 9 high-risk (HR; older sibling with ASD) and 6 low-risk (LR; no family history of ASD) infants from 6 to 9 months of age. We obtained two 30-second baseline periods and a 5-minute social interaction period (see Figure 1 for experimental conditions). HR infants showed reduced right-hemispheric activation compared to LR infants. HR infants also had greater functional connectivity than LR infants during the baseline period and showed a drop in connectivity during the social interaction period (Figure 2, * indicates a statistically significant difference after comparing the social period to the pre or post-social periods within each group). Our findings are consistent with previous work suggesting early differences in brain development associated with familial risk for ASD and highlight the promise of fNIRS in evaluating potential markers of ASD risk during naturalistic social situations during infancy. fNIRS systems are becoming increasingly portable and cost effective, making these systems useful for clinical contexts. A combination of behavioral and biomedical testing has the potential to enhance the reliability of early detection of ASD by combining behavioral markers as well as cortical activation/connectivity related neurobiomarkers. fNIRS-related variables could also serve as objective predictive or outcome measures in clinical trials of caregiver-mediated early interventions. Finally, our study finding that the observed hyper-connectivity "normalized" (similar levels to LR infants) during the social interactive periods of play provides additional support to the utility of early interventions that enhance positive parent-infant interactions to promote optimal development in HR infants (Green et al., 2015; 2017).

S10.8iv Improving Scientific Practice: The Advantages of Bayesian Sequential Testing in Infant Research

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Infant research is often time consuming and intensive, recruitment of participants is hard and expensive, while the quality of the data is low compared to adult data, and data loss is abundant. To illustrate the latter, 30% of loss of participant data is frequently reported. Infant research, in short, is not easy (Oakes, 2017, Infancy). Optimizing sampling plans such that neither too many nor too few participants are tested is hence of great importance to the field of infant research. The use of Bayesian sequential statistics enables

such optimization precisely (Wagenmakers et al, 2016, Cur Dir in Psych Science). The use of such sequential statistics has two major advantages. First, evidential strength can be expressed as being in favour of the null hypothesis or in favour of the alternative. Second, sequential testing allows different sampling schemes and optional stopping criteria when the evidence is strong enough. Third, evidence from different experiments can be combined easily into a single analysis to arrive at stronger conclusions. We illustrate the Bayesian sequential testing approach in replication research and in habituation research. In particular, we use a series of replications of Marcus et al. (1999, Science) testing rule-learning in infants. The figure illustrates the change of the Bayes Factor, that is the strength of the evidence, as more data is added from individual infants. This indicates that there is evidence in favour the null hypothesis in this experiment. This illustrates one of the major advantages of using Bayesian sequential testing over null-hypothesis significance testing: the possibility to differentiate between evidence for a true null effect versus lack of evidence to discriminate between the null hypothesis and the alternative hypothesis. Such reasoning can be very helpful in interpreting interaction effects with age, as is common in developmental research. Adopting Bayesian methods holds a great promise for improving the impact of infant research by providing stronger conclusions while minimising the number of required participants and trials.

S10.8v Accessing the dynamics of real-time interaction: A new lens into development

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From wearable cameras and step trackers to smart homes and smart thread, sensors to capture daily activity are literally being woven into the fabrics of our daily lives. The widespread adoption and presence of these sensors, paired with the coming of age of powerful algorithms to automatically extract meaningful activities from sensor datastreams, allows a novel opportunity to capture the dynamics of day-to-day activity, exposures, and interactions in unprecedented detail. I predict that the ubiquity of this technology will be a boon for developmentalists, who have long sought after daily interactions as the "proximal mechanisms of development" (Granic & Patterson, 2006). In particular, it is widely accepted that development emerges from the accumulation of hundreds of thousands of daily interactions, and that the dynamics of daily interactions shape longitudinal trajectories across domains (Thelen & Smith, 1994), from motor and language development to socio-emotional development and psychopathology

(Clearfield, 2011; Field, 1994; Goldstein & Schwade, 2008). These interactions are complex and are notoriously difficult to study (Baumeister, Vohs, & Funder, 2007). Behavior unfolds across many modalities or dimensions: e.g. physiology, gaze, embodied activity, affect. And interactions are organized across many timescales: from seconds (a contingent gaze shift) to minutes and hours (a play episode) to months and years (development of secure attachment) (de Barbaro, Johnson, Forster, & Deak, 2013). By providing unprecedented access to the complex structure of daily interactions, rapidly maturing technologies for sensing and activity recognition will be the basis of a new era of developmental science. Motion data, autonomic activity, and "snippets" of audio and visual recordings can be conveniently logged by wireless sensors (Lazer et al., 2009). Machine learning algorithms can process these signals into meaningful markers of individual and social activity, from affect and tone (Kim & Clements, 2015), to markers of depression (Alghowinem et al., 2013) and risky drinking behaviors (Bae et al., 2017). Theoretically-motivated aspects of interaction can be combined with subjective diaries, cognitive assessments, or even geo-located resources to characterize the structure of daily experiences and exposures. Captured over longitudinal time, such data provides a radical new opportunity to study processes by which individual differences emerge and stabilize. This flash talk will introduce attendees to the motivations, possibilities (current and future) and challenges of applying these tools to provide a new lens into development. By way of illustration, I will draw upon my ongoing efforts in an NIMH-sponsored project (1K01MH111957-01A1) to develop and leverage a mobile-sensor suite to capture theoretically-motivated markers of continuous mother and infant ambulatory activity, the goal of which is to address the transmission of risks for depression from mothers to infants. In addition, the goal will be to supplement this talk with an in-press methods paper that can be shared with audience members that will detail resources and best practices to facilitate the next generation of developmental scientists to contribute to this emerging area.

S10.8vi Shaping an online lab: Investigating infants' shape detection on the Lookit platform

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With a push for larger, more diverse data sets and a need for findings that replicate across a variety of contexts, infancy researchers are facing an immense challenge: How do we follow the best practices in psychological science with limited access to infant populations? We propose that the next 10 years of infancy research may benefit from an

online data collection platform that records video of infants' behaviors using the cameras installed in most home computers and portable laptops, allowing families to participate in studies wherever they be. Here we describe a study on the online developmental lab Lookit (Scott, Chu, & Schulz, 2017; Scott & Schulz, 2017). This is the first Lookit study directed by investigators outside of those who created it, and it aims to replicate Experiments 1 and 2 of Dillon, Izard, and Spelke (in review; $N=16$ in each experiment). Using a change-detection paradigm, Dillon et al. found that 6.5-7.5-month-old infants are sensitive to global shape changes in triangles over changes in triangles' position, scale, orientation, and sense. The Lookit study uses the identical procedures of Experiment 2 in that study (Fig. 1). Following a preregistered design and analysis plan, infants' looking time will be analyzed for the detection of global shape changes, as in Dillon et al., after 48 useable participants are collected (expected completion: April, 2018). Eventually Lookit will be promoted extensively to parents. However, the methods of recruitment for this study are limited to pre-existing lab participant databases and word-of-mouth. Sixty-one unique visitors to the site has yielded 27 infants completing the study. Twenty-three were in the target age range and born full-term. Five were excluded for technical failure (e.g., missing videos), one was excluded because the eyes were not visible, and one was excluded for fussiness. Sixteen usable participants ($M_{age} = 7.02mo$; 7 females) remained. While the current exclusion rate for technical failure is higher for the Lookit study (which relies on numerous technologies not involved in lab studies) than for the lab-based study (where an average of 0.13 technical failures occurred over the eight $N=16$ experiments in Dillon et al.), exclusion for fussiness is lower (lab average = 1.63 infants). Across four 60s, fixed-duration trials, infants looked significantly longer at the stimuli in the Lookit study ($M = 134.30s$) compared to Experiment 2 in the lab study ($M = 97.12s$; $P = .003$). A mixed-model linear regression found that, as expected, infants in the Lookit study looked equally to the left and right sides of the screen ($P = .558$) and looked less across the study's four trials (negative linear trend: $P = .031$). As in the lab-study, the total looking of four random infants was recoded by a second researcher, and the reliability between the two coders was high (Lookit: $r = .96$; lab average: $r = .98$). While lab-based studies allow for presentations that Lookit cannot achieve (e.g., large screens, navigable environments, and in-person interactions), Lookit allows researchers to study of infants' behavior, perception, and learning in the environments in which these activities normally take place. In the next 10 years of infancy research, online child labs like Lookit will eventually allow the testing of larger sample sizes, more diverse populations, and more measures on each child, ultimately increasing the robustness and generalizability of psychological findings with infants.

S10.8vii Neural coupling between infants and adults underlies naturalistic communication

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Efficient communication, which is critical for human survival, requires a dynamic exchange of information between multiple people. Early language acquisition provides an important model for understanding how information is transferred, but developmental methods and theories are constrained by the inherent challenges of working with immature learners. In the coming decade, research on infant learning will see increased integration of neural and behavioral approaches, which will uncover how humans learn and communicate in natural contexts. Recent fMRI work in adults has begun to do so by measuring coupling (inter-subject temporal correlation, or ISC) between the neural responses of a speaker telling a real-life story and listeners later hearing the story (Stephens, Silbert, & Hasson, 2010). Simultaneous measurement of infants and other people is required if we want to understand how the brain incorporates live behavioral feedback, but scanning awake infants is extremely difficult. To address this methodological challenge, we have recently developed a state-of-the-art fNIRS (functional near-infrared spectroscopy) system, which provides a non-invasive measure of changes in blood oxygenation due to neural activity. Most critically, fNIRS is minimally sensitive to motion artifacts and allows both infants and adults to interact freely while wearing comfortable caps. We assessed neural coupling between infants (9-15 months) and an adult experimenter during naturalistic communication (Fig.1). We simultaneously measured brain activity in the adult and the child (covering 57 measurement locations across the cortex). Specifically, we compared the strength of ISC in mPFC, parietal, and temporal areas (involved in prediction, language processing, and understanding others' perspectives) across two 5-minute conditions. In the "together" condition, the adult experimenter engaged directly with the child (playing, singing, and reading a story; Fig.1A). In the control condition ("apart"), the experimenter turned away from the child and told a story to an adult, while the child interacted quietly with his/her parent. We predicted that coupling would be stronger between the child and adult when they were actively communicating with each other than when they were communicating with others. Indeed, we found that mPFC and parietal areas were much more reliably coupled in the "together" than the "apart" condition. In addition, when we assessed the temporal precision of this coupling by shifting the signals relative to each other in time, we found that ISC in the mPFC was significantly stronger in the "together" than the "apart" condition not only when the signals were aligned, but also when the baby's signal was shifted one second earlier than the adult's (Fig.1B), suggesting that the

infant may be actively driving these interactions. Correlations between neural coupling and various behavioral measures of communicative success from the videos (mutual gaze, infant smiling/laughing, acoustic features of IDS) offer additional insights into the features driving this coupling. This study represents a crucial first step toward understanding how young children's brains begin to extract the most important structure from adults' input during natural play. This dual-brain approach to infant research could eventually lead to novel biomarkers for communication disorders, including autism, where neural coupling with adults may not be intact relative to typical learners.

Poster Session 3, Tuesday 3rd July

A: Motor and Sensorimotor Processes

P3-A-1 Reaching skills of infants born very preterm predict neurodevelopment at 2½ years

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Introduction: Infant reaching ability constitutes an important part of neurodevelopmental progress beyond motor function. Reaching for moving objects relies not only on motor function but on cognitive functions such as prediction and estimation. We have previously shown that very preterm infants are equally successful as full-term infants in catching a moving object at 8 months but their reaching strategies are less efficient. The aim of the present study was to investigate if reaching strategies at 8 months are associated with gestational age (GA) and neurodevelopment at 3 years corrected age in very preterm infants (GA<32 weeks). Methods: Thirty-six very preterm infants, 13 extremely preterm (GA<28 w) and 23 very preterm (GA 28-31 w), underwent a reaching task at 8 months corrected age. A camera system captured the movements of the hands and the object, and parameters reflecting movement planning and visuomotor control (aiming, movement speed, number of movement units used to plan and execute the reach, as well as shortest possible path of the hand relative the actual path taken by the hand towards the object) were calculated. Success and strategy parameters (how often the infant tried to reach, if it used both hands in coordination and how often it was successful) was noted. At 2½ years corrected age, cognition and language skills were tested with the Bayley Scales of Infant and Toddler Development (BSID III). Results: The table shows a summary of the results. For both groups there were associations between reaching for moving objects and cognitive and language skills at 2½ years. The more cognitively dependent parameters were in focus for the extremely preterm children, indicating relevance of basic problems on how motion information is used in action planning. For the very preterm children, bimanual strategies and success were of greater importance. Velocity during the reach and number of hits were not associated with outcome. Table: Correlations between reaching parameters at 8 months corrected age and BSID III subscale scores at 2½ years of corrected age in 26 children born extremely preterm and very preterm, respectively. Pearson (P) correlations and Spearman (S) correlations were used according to data characteristics. ** p<.01, * p<.05, ? p<.06 Discussion: Early reaching skills are associated

with later neurodevelopment in preterm children, but the associations differ between extremely preterm infants and very preterm infants. This information can offer additional insights to functional developmental trajectories and future intervention programs.

P3-A-2 Secondary Object Clearance in Reaching at 9 Months

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When reaching to pick up an object, adults have a propensity to circumnavigate other objects in the same vicinity, even when the secondary objects are not directly in the way of the planned reach. In lesion studies of adults, some neurological patients with sensorimotor compromise do not show the same circumnavigation. These observations of patients coincide with studies revealing a functionally segregated visual cortex: a ventrally situated stream that encodes object features in support of recognition, and a dorsally situated stream that encodes the spatial position of objects and guides action in relation to them. Because patients with damage to the dorsal stream vision-for-action pathway often do not accommodate secondary objects when reaching for others, the automated avoidance seen in healthy subjects appears to be supported by the dorsal stream. Research on infants and young children suggests that dorsal stream function may have a more protracted developmental time course than functions associated with other visual system structures. With the present work, we sought to further investigate the development of vision for action using reach navigation as an index of dorsal stream function. Thirty 9-month-old infants participated in a reach-to-grasp task involving multiple objects. Infants were outfitted with motion-analysis sensors on their wrists and presented with a visually salient target object when either no other objects were present within reach, or when a smaller, less salient object was placed in the workspace at one of four positions around the target object (left/right x nearer/farther, see Figure 1). None of the four positions of the second object blocked infants' direct reach toward the target. Reach movements were recorded, and measures of straightness and time between reach onset and contact with target were calculated. Reaches were then compared between target-only and target-with-other conditions. Target-only reaches were straighter than when a second object was present in the manual workspace, and target-only reaches also took less time to complete (see Figure 2). These findings indicate that by 9 months of age, infants' non-target accommodation in reach-to-grasp movements have begun to resemble those of adults when multiple objects are present in the workspace. To the extent that the behavioral propensity to accommodate extra objects in the workspace is

guided by dorsal stream activity, the development of such function appears to be underway in the ninth month of life.

P3-A-3 The development of joint visual attention skills in typically developing infants and infants with locomotor delay

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Several studies have shown that locomotor experiences facilitate the development of joint attention skills in typically developing infants (e.g. Campos, Kermoian, Witherington, Chen, & Dong, 1997), suggesting implications for infants with locomotor-delay. Until now, only few studies have addressed the development of joint attention skills in infants with locomotor-delay due to spina bifida uncovering deficits in joint attention skills in those infants (e.g. Campos, Anderson, & Telzrow, 2009). Notably, infants with spina bifida did not only suffer from motor impairments, they also showed deficits in other domains (e.g. Lomax-Bream et al., 2007). Hence, it is still open, whether locomotor delayed infants have deficits in joint visual attention skills or not. Therefore, we investigated joint visual attention skills of infants, who suffer from locomotor impairment without any other deficits. Our sample consisted of 11 infants with locomotor delay due to congenital idiopathic clubfoot (e.g. Garcia et al., 2011) and 14 typically developing infants. All infants were tested longitudinally at the ages of 6, 9 and 12 months. Additionally, we tested all infants 1 to 2 weeks and 5 to 6 weeks after their onset of crawling. According to Campos and colleagues (1997, 2009), each time we used a following of point and gaze gesture task: Target stimuli were 8 stuffed animals which were attached to a curtain on the left and right side, 45 and 90 degrees above and below the infants' eye level. The experimenter directed infants' attention and pointed/gazed simultaneously with an across-the-body gesture to each of the targets for three seconds two times (Figure 1). For all trials, we analyzed infants' shift of gaze direction during the first three seconds after the experimenter's calling and calculated the percentage of trials during which the infants looked at the correct direction where the targets were placed. Our results confirmed an obvious delayed onset of locomotion in infants with congenital idiopathic clubfoot, $t(17) = 4.18$; $p = .001$; however, our results did not indicate poorer joint attention performances in those infants, $F(1, 26) = 0.22$, $p = .64$ (Figure 2). Moreover, the onset of crawling had no significant impact on infants' performance in general, $F(1, 13) = 0.008$, $p = .928$. Only at the age of 9 months, the crawling control infants achieved significantly higher performances than the non-crawling clubfoot infants, $t(15) = -2.81$, $p = .013$, and clearly

higher performances than the non-crawling control infants ($t(11) = -2.31, p = .042$). Taken together, our findings imply a more complex interrelation between the development of joint attention skills and locomotor experiences than expected so far. Locomotor delayed infants due to congenital idiopathic clubfoot did not show poorer joint visual attention skills in general. Yet, locomotor experiences facilitated the development of joint attention skills in typically developing infants at the age of 9 months. Hence, further research is needed to gain a deeper understanding of the development of joint attention skills in typically as well as in locomotor delayed infants.

P3-A-4 Observing third-party ostracism enhances facial mimicry in 30-month-olds

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Mimicry, the tendency to spontaneously and unconsciously copy others' actions, plays an important role in social interactions. It influences liking and rapport between strangers, enhances the smoothness of social interactions, and increases helpfulness. Although mimicry is often thought to be a pre-potent, automatic response tendency, recent studies with adults have demonstrated that mimicry is flexibly modulated by social signals and social motivation. For example, it has been shown that priming participants with other-related antisocial stimuli (Wang & Hamilton, 2013) or giving them the goal to affiliate leads to increased mimicry behaviour (Lakin & Chartrand, 2003). Despite the important social functions that mimicry is thought to serve in adulthood, little is known about its development. For example, although recent studies have shown evidence for mimicry in infants and toddlers (e.g. Geangu et al., 2016; Isomura et al., 2016), it is unknown when mimicry starts to be influenced by social motivations. Here we investigated whether toddlers will use mimicry as a tool to enhance affiliation after observing third party ostracism. Thirty-four 30-month-olds were either presented with videos in which one shape was ostracised by a group of other shapes ($N=20$), or with control videos that did not show any ostracism ($N=14$) (Over & Carpenter, 2009). Before and after this, they observed videos of models performing facial actions (e.g. eyebrow raising, mouth opening) while we measured activation over the toddlers' corresponding facial muscles using electromyography (EMG) to obtain an index of facial mimicry. From this we calculated a mimicry score per trial by subtracting EMG activity over the non-corresponding muscle region from EMG activity over the corresponding muscle region (e.g. on an eyebrow trial we subtracted activity over the masseter region from activity over

the frontalis region, so that a more positive score indicates more mimicry). We also coded the videos for the percentage of trials in which the toddlers demonstrated overt, i.e. visible, mimicry of the facial actions. Given that mimicry may need to be perceptible to exert an influence on one's social partner, we predicted that overt mimicry may be more strongly influenced by toddlers' motivation to enhance affiliation than covert mimicry. However, analyses of covariance (ANCOVA) with the covert and overt mimicry scores at post-test as dependent variables, and pre-test as covariate showed very similar results for the two measures of mimicry, suggesting that overt and covert mimicry are supported by similar mechanisms. Overall, toddlers in the Ostracism condition showed a greater tendency to overtly and covertly mimic the facial actions at post-test when controlling for pre-test than toddlers in the Control condition. Nevertheless, the effect of condition (Ostracism vs. Control) only approached significance for the covert mimicry scores, $F(1,24) = 3.929$, $p = .059$, $\eta^2 = .141$. Toddlers in the Control group showed less covert mimicry at post-test than the toddlers in the Ostracism condition when controlling for mimicry at pre-test. These findings suggest that from at least 30-months of age facial mimicry behaviour can be influenced by affiliative goals.

P3-A-5 Joint attention decreases over the first year as infants incorporate objects into play: A recurrence-based analysis

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Micro-analyses of joint object play reveal that infants spend the majority of shared interactions looking at objects manipulated by their caregivers (Deak, Krasno, et al. 2014; Yoshida & Smith, 2008). In this report we use a specific non-linear time series technique called Cross-Recurrence Quantification Analysis (CRQA) to show that mother and infants' looking and touching behaviors become less coupled between four and nine months, spanning emergence of independent object manipulation (at approximately six months of age; Lockman & McHale, 1989). Thus, while parents' manual activity matters for joint attention, the significance and function of parents' manual actions changes over the course of the first year. We examined the multimodal dynamics of mother and infant joint-object play in longitudinal free play sessions at four, six, and nine months ($N=44$). For all interactions a set of three objects was always available to both mother and infant. Using multiple synchronized cameras, we annotated all changes in mother and infants' gaze and manual contact with the objects, at frame-by-frame resolution (10fps). Our previous

analyses of this dataset revealed that between six and nine months, infants spend more time looking to objects manipulated by parents while holding others (de Barbaro et al, 2016, Child Development). However, our previous analyses did not examine how mother and infant's ongoing looking and touching activities unfold during episodes of joint play. In this report, we use Chromatic-CRQ (Cox, Van der Steen, De Jonge-Hoekstra, Guevara & Van Dijk, 2016) to examine the coordination of joint activity during play episodes. We created Chromatic Cross-Recurrence Plots (CRPs) by calculating different types of recurrences of object contact between mother and infant for each of the three objects (red, green and blue). Each partner's contact with each toy ranged from 0 to 2 (no contact, looking or touching, looking and touching) at a resolution of 10 fps (Figure 1). Qualitative assessments of our CRPs suggest that that coordinated mother-infant object engagement is highest at 4 months and declines from four to nine months. However, although object play at four months is characterized by joint focus to single objects, at nine months joint object engagement has a more complex structure. Specifically, mother and infant begin to jointly coordinate activity between sets of objects, such that periods of mutual engagement with single objects are interspersed with joint play involving objects introduced by the mother and those introduced by the infant. Joint play thus becomes more complex as the dyad dynamically shifts focus in coordination, allowing more elaborate and complementary play routines such as imitation or games. Our poster will present CRPs as well as quantitative CRQA measures that can be used systematically assess the validity of our initial observations. For example, we will quantify the average and longest intervals of joint object contact to a single object by quantifying the line structures in RPs which are uninterrupted by lines of other colors (i.e. objects), and compare those to line structures representing maintained joint contact with shifting between (two) objects. This will capture the dynamics of joint shifting of focus of play between two objects. The results exemplify a new method for quantifying complex patterns of joint attention between parents and infants.

P3-A-6 Newborn Neurobehavior and Motor Development for Infants Diagnosed with Neonatal Abstinence Syndrome

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Over the last decade, use of opioids has increased substantially (Guy et al., 2017). Use of opioids during pregnancy can lead neonates to withdraw after delivery, [i.e., Neonatal Abstinence Syndrome (NAS)]. About half of newborns exposed prenatally will develop

NAS (Jansson & Velez, 2012). NAS is associated with health outcomes such as low birth weight and feeding difficulties and it can affect the movement system of infants, particularly hyperactive startle reflex, tremors, and increased muscle tone. The objectives of the current study were to describe associations among newborn infants' motor abilities and examine the nature of motor functioning in a retrospective sample of NAS neonates. The data presented in this abstract represent the first snapshot of neonates from a larger chart review of approximately 20,000 participants. Participants were 150 neonates diagnosed with NAS. Of the 150 charts reviewed, 104 infants were full-term, with no major medical concerns other than NAS, and were referred to physical therapy (PT) in the Neonatal Intensive Care Unit (NICU) between 2012-2016. Data was collected from delivery and medical charts and included background, medical, and developmental evaluations. The demographic and substance use characteristics of mothers in the current sample are described in Table 1. Examination of the frequency data from infants' PT examinations indicated several trends. The neurological portion of PT evaluation noted that 46.2% of newborns had arm and 50% had leg recoils were difficult to extend, and snapped back forcefully and 79% had popliteal angles that were less than 90 degrees. Together, these observations indicate that NAS infants are demonstrating behaviors indicative of atypical motor development. Additionally, there were twice as many state changes reported during evaluation (223) than before (106) or after (109) the evaluation. This finding has potential implications as caregivers may benefit from extra education about proper handling of newborns during these multiple state changes. Bivariate correlations indicated several associations worth mentioning. For instance, more disorganized state cues were positively correlated with poor feeding, stress cues, decreased postural control, and jerky/jittery motor quality (see Table 2). Additionally, self-regulation cues were positively related to smooth/sluggish quality of movement and negatively related to jerky/jittery quality of movement, stress/stability cues and disorganized avoidance cues. Interestingly, random/uncoordinated movements were associated with a shorter hospital stay. Finally, stress/stability cues and disorganized/irritable arousal cues were associated with a longer hospital stay and self-regulation cues were associated with a shorter hospital stay. This abstract serves as an initial glimpse into the first subsample of participants from a larger chart-review. Observation of disorganized arousal cues related to infants' feeding behaviors and poor feeding behaviors may impact later interactions with caregivers. Perhaps interventions aimed at reducing these types of arousal cues may result in better feeding behaviors and better infant-caregivers bonding and attachment. While many of the motor abnormalities detected in the first few weeks will improve and perhaps completely resolve over time, it is possible these delays in motor development are correlated with later socio-emotional or cognitive development.

P3-A-7 Tactile reaching: Linking action and multisensory information

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Tactile localization of targets on the body has been studied little despite its adaptive nature. This skill underlies behaviors such as feeding, grooming, and pointing to sources of discomfort. It involves multisensory integration, requiring coordination between touch, proprioception and sometimes, vision. Here we examined the origins of tactile localization by investigating how infants begin to localize targets on the body and the motor strategies by which they do so. Infants (N=78, age=7-21 months) were prompted to reach to vibrating targets placed at five arm/hand locations (elbow, crook of elbow, forearm, palm, top of hand), one by one. To localize these targets, infants had to reach with one arm to the other. We examined developmental changes in the bimanual strategies that infants used to localize the body targets. Results indicated that on most trials (178/234 successful reaches) the target arm moved toward the reaching arm to assist reaching (inter-rater reliability computed on ~20% of participants, Cohen's $k=0.95$). No effects associated with the left/right placement of the buzzer on the body were found. Generalized estimating equations (GEE) tested the effects of age, target location, and the Age x Location interaction on whether the target arm moved to assist reaching (yes/no). Likelihood of moving the target arm to the reaching arm varied by target location (Wald $\chi^2(4) = 10.15$, $p < .05$) with the average likelihood of moving the palm=95%, elbow=79%, top of hand=73%, crook of elbow=71%, and forearm=70%. Although there were differences as a function of location in terms of whether infants moved the target arm to the reaching arm, on most trials, infants evidenced such movement regardless of location. To explore developmental differences in localization strategies, we next addressed how infants moved the target arm. Movement was coded in terms of rotations, translations or combined rotations-translations (Cohen's $k=0.87$). Coordination strategy was analyzed using GEE to test the effects of age, target location, and an Age x Location interaction on whether the target arm performed one type of movement (rotation or translation) or two (combined rotation-translation). For elbow trials, infants became more likely to use two versus one motion types with age, while for the palm they became more likely with age to use one instead of two, as indicated by a significant Age x Location interaction (Wald $\chi^2(4) = 17.29$, $p < .01$). Results suggest that between the first and second years, infants are becoming more sensitive to how localization strategies can exploit the limbs'

biomechanical properties. When reaching to the elbow, combined rotations and translations increased with age, enabling infants to access the target more easily. For the palm, translations only increased with age, suggesting that infants became more efficient in accessing this target. Taken together, the results provide new information about how tactile localization develops and how functional capacities and biomechanical properties interact. Results will be considered in relation to other aspects of self-knowledge (e.g., mirror self-recognition) that also develop during this period.

P3-A-8 The progression of hand preference from unimanual to RDBM skills across infancy

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Background and Aims: Cascading theory posits that the development of hand preference is influenced by experiential factors and that hand preference for one manual skill can cascade into the next skill via practice of using the preferred hand (Michel, 1983). Previous research indicated that hand preference for acquiring objects is related to hand preference for unimanual manipulation (Hinojosa, Sheu & Michel, 2003). A recent study also found that infant hand preference for acquiring objects is related to hand preference for role-differentiated bimanual manipulation (RDBM) during toddlerhood (Nelson, Campbell, & Michel, 2013). However, no research has examined the relations between hand preference for unimanual manipulations and RDBM during infancy. The aim of the current study was to examine the development of unimanual manipulations and the development of RDBMs across 9-to 14-month age period. It was predicted that hand preference for unimanual manipulations would predict hand preference for RDBMs. **Methods:** Thirty infants were observed during a play situation in which a researcher presented objects to an infant while seated at the table. During the unimanual manipulation portion, 17 pairs of identical objects were placed in the infant's hands in monthly sessions. During the RDBM task, 32 objects were placed on the table within reaching distance of the infant. RDBM actions were coded when infants used one hand to stabilize an object and the other hand to manipulate them. The hand that has an active manipulating role on an object was coded as the preferred hand. Video recordings were analyzed for the number of unimanual and RDBMs that the infant performed during each monthly session. Ten infants with a left-hand preference, right-hand preference, no hand preference for unimanual manipulations were examined. Hierarchical linear modeling was used to create trajectories of each of the behaviors across the 9-to 14-month period and

to analyze the relation between the intercepts and slopes of these trajectories. Unimanual hand preference was calculated using the Handedness Index: $HI = (R-L)/(R+L)^{1/2}$. The right hand proportion of RDBM was calculated using the Handedness Index $[R/(R+L)]$. Results: Descriptive analysis showed that both no preference and right hand preference groups increase in their proportion of right hand RDBMs (see Fig. 1). A one-way ANOVA found a significant main effect of unimanual hand preference on proportion of right hand RDBM, $F(2, 14) = 4.03$, $p = .04$ (see Fig. 2). Post-Hoc test revealed a significant difference between the right and no preference group, $p = .04$. Conclusions: The no preference group performed a higher proportion of right RDBM actions than the right hand group. Infants with no hand preference for unimanual increase their right hand usage from 9-14 months (time period where RDBMs are observed). The no preference infants are likely performing more right handed RDBMs than the RH infants because they are continuing to build skill with their right hand. The right hand infants already have a higher skill ability with their right hand as evidenced by their acquisition and unimanual performance.

P3-A-9 FLEXIBILITY IN ACTION: HOW INFANTS AND ADULTS NAVIGATE UNDER A BARRIER

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Introduction: Behavioral flexibility--the ability to tailor motor actions to changing body-environment relations--is critical for adaptive, functional performance. Navigating the everyday environment requires the ability to generate a wide repertoire of locomotor actions, select the appropriate action for the current situation, and implement it accurately and efficiently (Bernstein, 1996). Method: We assessed flexibility of motor actions for navigating under barriers normalized to each participant's standing height (overhead, eye-, chest-, thigh-, and knee-heights, presented in random order with multiple trials/height). All barriers were passable, but different locomotor actions were required depending on the barrier height. Participants could walk normally under overhead barriers, but they needed to duck or squat for the eye- and chest-height barriers, crawl for thigh height, and belly crawl at knee height. For each barrier height, we compared the range of locomotor actions, the appropriateness of actions selected, and the accuracy and efficiency of implementation in adults ($N=14$), 17-month-old experienced walkers ($N=20$), 12-month-old novice walkers ($N=12$), and 12-month-old experienced crawlers ($N=15$). Range of actions: Silhouettes in Figure 1A show the locomotor actions we observed. All

participants displayed a range in locomotor actions (bar graphs in Figure 1A). However, excluding avoidance, adults exhibited a wider repertoire of actions ($M=6.1$) than infants ($M_s=5.0, 3.8$, and 2.5 for 17- and 12-month-old walkers, and 12-month-old crawlers, respectively), all $p_s<.043$. Seventeen-month-old walkers displayed more actions compared to 12-month-old infants, $p<.024$ and 12-month-old walkers displayed more actions than crawlers, $p=.001$. Action selected: Participants at all ages selected actions in accordance with barrier height and got to the other side (Figure 1B). However, infants sometimes used actions that were "lower" than required (e.g., crawling when ducking would suffice) and infants (mainly 12-month-olds) sometimes avoided, although all had viable actions in their repertoires. Accuracy: We considered accuracy in terms of frequency of head bumps on the barrier (Figure 1C). Adults planned and implemented their actions accurately, never colliding their head in preparation of or while going under the barrier. Infants, however, frequently bumped their heads, while trying out multiple postures (8.7%-41.4% across barrier heights) and while implementing the selected locomotor action that allowed them to navigate under the barrier (13.0%-78.4% across barrier heights). Efficiency: We considered efficiency in terms of latency and number of postural transitions (Figures 2A-B). Adults quickly completed each trial and only transitioned to an alternative action when necessary. Infants took longer and tested multiple postures (sitting, squatting, crawling, etc.) prior to selecting an appropriate action, $p_s<.022$. Efficiency was worse in 12-month-old walkers compared to 17-month-olds, $p<.047$. Conclusion: Adults displayed tremendous flexibility: They chose an adaptive strategy at the right moment and executed it seamlessly without errors or superfluous effort. Infants did not display flexibility to the same extent. Although infants found an adequate posture to navigate under the barrier on most trials, their methods were error-prone and inefficient. With increased age and walking experience, infants showed greater evidence of behavioral flexibility.

P3-A-10 Infants Explore Different Movement Parameters to Learn a New Bimanual Coordination Pattern

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The development of skilled bimanual coordination is an important component of an infant's emerging behavioral repertoire. Research on such coordination with infants has primarily focused on reaching and grasping of objects or role-differentiated bimanual manipulation. Less common are analyses of continuous rhythmic movements such as

block-banging, hammering, or drumming. Rhythmic movements such as these have served as a paradigmatic system for the analysis of motor control in older children and adults. Within this paradigm, the upper limbs act as coupled oscillators that most easily perform in-phase (symmetrical) action. The intrinsic tendencies of these coupled oscillators must be countered in order for other phase relations to be produced. The dominant theoretical model ('HKB' model; Haken, Kelso, & Bunz, 1985), developed to explain phase changes in coordination patterns over short timescales, has not yet been tested over the longer developmental periods of infants first learning new coordination patterns. We examine here young children's exploration of different movement parameters when learning to perform an anti-phase rhythmic coordination pattern requiring inverse limb movement. We report the results of a longitudinal study in which eight toddlers 15-27 months of age were videorecorded as they engaged monthly in a bimanual drumming task with an adult model demonstrating either in-phase, anti-phase, or no drumming in different bouts within each session. We examined microgenetic and ontogenetic emergence and stability of the children's use of anti-phase coordination within a dynamical systems framework. In our sample, on average, each infant performed four bouts of bimanual drumming per month per condition and 17.15 cycles per bout. HLM analyses indicated that the infants exhibited an increase in the number of consecutive anti-phase cycles performed over time (estimate: 0.22, $F(1,199) = 9.25$, $p = .002$), demonstrating an increase to an average of 7.16 cycles in sequence when they were 27 months old. Based on motion analysis of individual children's drumming bouts, our findings also suggest that infants in this age range differentially exploit slowing their oscillation frequency and adjusting movement amplitude of one or both limbs to support change to anti-phase action. The modulation of these two parameters can occur within trials or across months, suggesting the complex interplay of different motor subsystems with cognitive and ecological constraints when learning a new coordination pattern. In light of these results, we develop a conceptual model as an extension of the HKB model and discuss possible implications for, and future directions of, early bimanual skill development.

P3-A-11 The sensorimotor development of naturalistic looking behavior in infants

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<p>Throughout the first year of life, infants increase the duration of their attention to objects during play, becoming resilient to distractions (Ruff & Lawson, 1990). Individual

differences in the development of this sustained attention predict learning and general cognitive capacities (Lansink, Mintz, Richards, 2000). Traditionally, human coders manually identified sustained attention (Ruff & Rothbart, 2001). However, recent research using wearable sensors encouraged computationally discrete quantifications of behavior. Such an approach revealed a rich sensorimotor repertoire underlying many behaviors, including sustained attention. Not exclusively cognitive, sustained attention is facilitated by motor activity (Yu & Smith, 2012). Prior results using head-mounted cameras suggest that infants reduce head movements while attending to an object, promoting a clean sensory input and facilitating word learning (Yu & Smith, 2016, 2012). Determining the role of reduced body movements in stabilizing attention is critical to understanding both typical and atypical development. The present aims are: 1) to elucidate the developmental trajectory of head stability during naturally-occurring instances of sustained attention and 2) to dissect the sensorimotor dynamics of head movement during sustained attention. A cohort of 35 children participated in a session of play with their parent while outfitted with a head-mounted eye-tracker and motion sensor. These children were brought in at 9, 12, 15, 18, 21, and 24 months of age. Instances of sustained attention were defined by a period of gaze to an object of 3 seconds or longer (Yu & Smith, 2016) resulting in a total of 3,308 periods of sustained attention. The frequency of sustained attention increased until 12 months of age, after which the number plateaued (Fig 1A). At all ages, the median duration of sustained attention was between 4 and 5 seconds (Figure 1B). Consistent with previous findings, these sustained attention bouts were associated with stabilized heads. Stereotyped patterns of head movement occurred during sustained attention across development. Less than 1 second before its onset, there was a sharp increase in the velocity of head position as the head and eyes moved to the attended object (Figure 2A). This is followed by a stabilizing deceleration of around 5 seconds. Infants exert greater control over their head movement as they develop: the maximum velocity at the onset of attention decreases (Figure 2B) while the duration of their head stabilization increases (Figure 2C). Further analyses show that these developmental differences are more marked when infants are not holding objects, as holding objects stabilizes head movements for younger infants. Ongoing analyses suggest that individual differences in bouts and durations of sustained attention within age groups are associated with decreased head movements at the onset of attention to an object. A large literature links many developmental disorders, particularly attentional ones, to developing sensory-motor systems. Thus, the importance of these findings is three-fold: First they provide new insights linking movement and attention in the early development of sustained attention. Second, they indicate an important role for

object holding in head stabilization and attention early in development. Third, they identify the critical timing of head stabilization near the onset of sustained attention.

P3-A-12 The Changing Sequential Organization of Object Exploration in the Second Year

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Everyday goal-directed actions--reaching to one's cup rather than one's computer mouse--require the coordination of object kind and location. Considerable evidence suggests that linking actions to the properties of objects develops incrementally in infancy. For example, as reaching develops, it becomes increasingly predictive of object properties as infants adjust grasp, orientation and reaching speed to match the object. Challenging reaching tasks show the difficulty of coordinating object and location information up to the first birthday. In the A-not-B task, infants first reach repeatedly to one location to retrieve an object, then watch that target object be hidden in a new location and when allowed to retrieve the object they typically reach back to the location where the object was first hidden. Although the traditional task used hidden targets, considerable research now shows that infants make this same error both when the target object is hidden (and has to be remembered) and when it is in plain view. The increasing object specificity of reaching actions and phenomena such as the A-not-B error with in-view objects leads to the following general hypothesis: Action is initially strongly linked to location and incrementally during infancy incorporates the perceptual properties that define object kinds. This hypothesis is generally accepted in the study of goal-directed action. The overarching idea behind the present study is that this developmental trend in object-directed action plays an important, broad role in cognitive development. The present study specifically examines a phenomenon known as the sequential touching of like kinds, a behavior that emerges in the second year. The central hypothesis motivating the present study is that the developmental origins of this phenomenon may be found in the increasing organization of actions not just by the locations of targets, but by the properties of those objects. In order to explore how space and similarity maybe organizing sequential reaches in the second year: two distinct kinds of objects were assembled into arrays as shown in Figure 1. Two objects in the array--one from each set--were near the midline of the array but offset in their similarity to the main instances of the category. The expectation was that all infants would often reach to these locations and by doing so would have the opportunity to reach to a near different object or to a more distant same

object. Twelve, 15 and 18 month olds were presented with these arrays. Figure 2 shows the pattern of transitions between locations by age. The 12-month olds reached to objects near each other-to the middle objects and to peripheral objects in same spatial clusters-with the next object reached to primarily determined by its proximity in space to the just previous reached to object. The 18-month olds showed a much greater influence of object similarity, with their sequential actions more strongly influenced by similarity of the objects and not just their location. This difference may reflect a developmental shift in which action goes from being guided by information that specifies the action to information at a categorical or contextual level.

P3-A-13 A Toys Story: Exploration, Discovery, Implementation, and Construction

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Children's homes and classrooms are filled with objects and clothing designed for use in a specific way--turning a doorknob, punching a straw through the hole of a juice container, twisting a toothpaste tube, zipping a jacket, and so on. The designed actions for everyday objects are obvious to adults because we already know how to use them, but the designed actions are not necessarily obvious to children. For example, a key is designed to fit into a keyhole, turn, and open a locked door. But it can also be used to cut open a box or scratch the paint off a car. For infants and young children, keys invite mouthing, shaking, and throwing. With so many possibilities for action, how do children converge on the designed action? We examined children's discovery of the designed actions of objects specifically designed for children--toys. We presented 56 children (12-60 months of age) and 19 adults with Squigz, a novel toy made of colorful, flexible, silicone designed for creative 3D construction (Figure 1). Each Squigz piece has suction cups at one or both ends, capable of sticking to a non-porous surface, or to each other. Children can perform non-designed actions with the Squigz (mouthing, fingering/bending the cups, banging, rolling), but only the designed action of applying pressure with the suction cup facing the tabletop or the suction cup of another piece will allow children to engage in 3-dimensional creative construction. We investigated the developmental progression in children's learning of the designed action to use the toy, and the real-time relations among exploration of non-designed actions, discovery and implementation of the designed action, and creative construction. Preliminary analyses show a developmental progression from primarily using non-designed actions in the youngest children to

primarily using the designed action in the oldest children (Figure 2). Twelve-month-olds enthusiastically explored the Squigz in non-designed ways such as mouthing, and rarely chanced upon the designed action. Between 18 and 24 months of age, children began by arranging and stacking pieces. Most eventually stumbled on the designed action by banging the Squigz against the table or two Squigz against each other so that they stuck, but rarely did both. After discovering the designed action, the satisfying popping noise and mechanical tension while pulling the Squigz from the table caused children to persevere on sticking and unsticking individual pieces to the table or creating a chain of Squigz. Between 30 and 48 months, children discovered the designed action faster in real time, but still perseverated with sticking pieces to table or building a chain. Finally, by 54 months children exploited the Squigz for 3-dimensional, creative construction, building structures more complex than a chain. Adults immediately created complex, 3-dimensional structures. The uniquely compelling properties of Squigz encouraged exploration of various actions--even in the youngest infants--and often led to inadvertent discovery of the designed action. Perceptual feedback kept children on task, eventually allowing them to exploit the toy as it was designed to be used.

P3-A-14 Reaching performance while sitting with and without support in infants with different levels of mobility

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Background: Previous research has shown that the provision of external support during sitting can positively impact reaching behavior in typically-developing infants (Bertenthal & von Hofsten, 1998; Grenier, 1981), and a greater level of sitting ability may be associated with better reaching performance (Harbourne et al., 2013; Rochat & Goubet, 1995). However, reaching and sitting have generally been studied as separate behaviors in infants at risk for developmental delays (Hadders-Algra et al., 2007; Heathcock et al., 2008; Toledo et al., 2011). The purposes of this study were to identify differences in reaching performance for infants with motor delays when sitting with and without support and to determine the relation between reaching behavior and infants' mobility level. Methods: Twenty infants (12 males) with mild delays in motor development were assessed 1-2 times at their homes (M=12.8±4.5 months). Current data represent a subset of completed

assessments from an ongoing longitudinal study, in which each infant is tested 5 times over the period of one year. Visits were selected where infants were able to sit independently and mobility level could be categorized as "Not Mobile" or "Mobile" (crawling or scooting). All infants were assessed in two positions (Figure 1 A-B): a) sitting in a supportive chair (supported sitting), and b) sitting on the floor (unsupported sitting). To encourage reaching behaviors, attractive toys were presented at the level of infants' hips, chest, and eyes with 20-second trials at each level. Assessments were video-recorded and behaviors were coded using Datavyu software. Outcome measures were: percent time infants touched toys unimanually or bimanually; and percent time infants visually explored objects. Generalized linear mixed modeling was performed. Results: Controlling for age and mobility level, the percent time contacting objects unimanually at hip level was greater in the supported sitting position compared to the unsupported sitting ($t(37)=-2.11$, $p=.0418$, $OR=.54$). There was a significant interaction effect between sitting position and mobility level for contacting objects bimanually ($t(38)=-2.09$, $p=.0431$, $OR=.39$) and looking while contacting objects bimanually ($t(38)=-2.48$, $p=.0179$, $OR=.37$) across all levels (Figure 2). Thus, for infants who were not mobile, bimanual contacts and bimanual contacts while looking were greater in the supported sitting position. In contrast, for infants who were mobile, bimanual contacts and bimanual contacts while looking were greater in the unsupported sitting position. Conclusions: In general, infants' reaching performance seems to benefit from external postural support. However, whereas external postural support allows for more sophisticated reaching behaviors for non-mobile sitters, it seems to inhibit more sophisticated bimanual and multimodal reaching behaviors for mobile sitters. Current results demonstrated a sophisticated interaction between infants' mobility level and the level of external postural support. They suggest that to facilitate the performance of bimanual and multimodal exploration of objects for infants with motor delays, external postural support should be provided during the emergence of sitting, but removed when infants become mobile. These findings might help to guide early interventions aimed at engaging infants at risk in perceptual-motor experiences and advancing their performance of reaching and sitting behaviors.

P3-A-15 Impact of Infants' Amount and Variability of Exploration on Means-End Problem Solving

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Introduction. Means-end problem solving (MEPS) entails the execution of an intentional sequence of actions performed on a means object to achieve a goal related to an end object (Brandone, 2015; Piaget, 1953; Willatts, 1999). Active exploration of the objects involved in means-end tasks and their relations, rather than passive observation of means-end performance, improved infants' understanding of goal-directedness in means-end tasks (Lobo & Galloway, 2008; O'Connor & Russell, 2015; Sommerville et al., 2008). The aim of this study was to determine whether the amount and/or variability of object exploration exhibited during MEPS would relate to learning/success in MEPS. Methods. Twenty-four infants born full-term (14 males; 37-42 weeks gestation, Mean = 39.4 ± 1.1) and 30 born preterm (10 males; 22-30 weeks gestation, Mean = 26.5 ± 1.7) were assessed longitudinally at 6, 9, 12, 18, and 24 months in two MEPS tasks: 1) towel task requiring pulling of a towel to attain a distant supported toy; 2) turntable task requiring rotation of a turntable to attain a distant supported toy. We comprehensively coded the behaviors observed (e.g., static touching, banging, lifting, pulling, spinning, looking at the means object; reaching for, looking at the end object). The total amount (percent of trial time engaged in any behavior) and variability (percent of potential behaviors actually performed) of object exploration performed by infants in each MEPS task were related to infants' success in the task using the Hierarchical Linear Modeling (Raudenbush et al., 2004). Results. With age, all infants increased the amount of exploration performed on the objects in both tasks (Towel: $t(188)=6.64$, $p<.001$, $d=0.97$; Turntable: $t(191)=2.11$, $p=.036$, $d=0.31$). More exploration at 6 months, and also around 12-18 months, was associated with MEPS success through 24 months (Table 1). The variability of exploration decreased after 6 months in the towel task ($t(192)=2.07$, $p=.040$, $d=0.30$) and after 12 months in the turntable task ($t(242)=3.61$, $p<.001$, $d=0.46$). Reduced variability at 18-24 months was significantly related to MEPS success (Table 1). Conclusions. The amount of early object exploration might serve as an indicator of early problem-solving ability or learning delays, with a higher amount of exploration suggesting typical development. We propose that engagement in a large repertoire of object exploration behaviors early in development allows infants to begin problem solving via performing behaviors, observing the consequences, and remembering action-consequence relations (Bremner, 2000; Gibson & Pick, 2000; Piaget, 1953; Touwen, 1978). As infants start distinguishing ends from means and understanding causation and consequences of their own actions, they select effective action sequences that result in successful problem solving, thus reducing the variability of their exploratory behaviors (Lobo & Galloway, 2008; O'Connor & Russell, 2015; Hadders-Algra, 2000; Piek, 2002). Therefore, whereas low levels of behavioral variability may be associated with learning delays at earlier ages (Babik et al., 2017;

Hadders-Algra, 2000; Lobo et al., 2015; Prechtel, 1990; Sporns & Edelman, 1993), high levels of behavioral variability might serve as a sign of learning delays at later ages (Piek, 2002).

P3-A-16 Mr. Potato Head: An Unlikely Friend for Studying the Effect of Weighted Arms on Scale Errors

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An interesting discrepancy has emerged in cognitive development: in tasks that tap similar knowledge, infants appear to have knowledge that older children fail to use. Recent research found that weights placed on children's arms during search tasks improved children's performance, suggesting that their performance relies on a complex interaction between cognitive, social, and motoric systems working together (Arterberry, Hespos, & Neal, 2017; Rivière & Lécuyer, 2008). The present study tested whether weighted arms would reduce scale errors in 24-month-olds. Scale errors are an attempt to perform an action on an object that is commonly associated with the larger version of that object such as trying to put on doll's clothes (Ware, 2006). Scale errors, a frequently observed cognitive mistake in children (DeLoache et al., 2004; Rosengren, Schein, & Gutierrez, 2009), may also reflect a reliance on this complex interaction. Specifically, we looked to see if scale errors can be induced in a laboratory setting and to see if factors, such as weighted wristbands, may contribute to the likelihood of making scale errors. We tested 21 children at 24 months of age. All children were asked to wear wristbands, half of which were weighted (163 g). Children were presented a disassembled Mr. Potato Head toy with all pieces, including a duplicate pair of glasses, shoes, and hat. Parents showed their children how to play with Mr. Potato Head, but without direct instruction regarding what to do with the duplicate pieces. Two research assistants, naïve to the weight condition, coded the number of scale errors made with the Mr. Potato Head pieces. Figure 1 shows an example of participants committing a scale errors with a Mr. Potato Head hat and glasses. Across weight conditions, participants committed an average of 1.38 scale errors (SD = 2.01). A 2 x 2 ANOVA with weight condition and sex revealed a significant main effect for weight condition, $F(1, 21) = 6.70$, $p = .019$, partial $\eta^2 = .28$, a significant main effect for sex, $F(1, 21) = 5.16$, $p = .036$, partial $\eta^2 = .23$, and a significant weight by sex interaction, $F(1, 21) = 9.79$, $p = .006$, partial $\eta^2 = .37$. The number of scale errors made by boys was equal across the two weight conditions, ($F(1, 17) = .37$, $p = .545$); however, girls in the no weight condition made significantly more scale errors than in the weight condition ($F(1, 17) = 10.11$, $p = .005$, partial $\eta^2 = .37$. See Figure 2. These results provide

evidence that Mr. Potato Head can be used to induce scale errors in a laboratory setting. Furthermore, these results suggest that weighted wristbands can help children integrate visual information such that they commit fewer scale errors. Our understanding of perception and action integration has the potential to help practitioners identify perception-action patterns that deviate from typical development and serve as a springboard for developing targeted interventions for young children diagnosed with motor and cognitive integration issues.

P3-A-17 Do Infants and Toddlers Demonstrate a Preference Toward Size or Weight when Selecting Toys to Carry During Free-Play?

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Intuitively, carrying a toy while walking may be difficult for newly walking infants. However, during home observations, newly walking infants fell less when carrying toys and preferred carrying small toys while walking (Karasik et al., 2012). Thus, infants may realize that carrying small toys may be beneficial for walking and may intentionally focus on the toy's size when selecting toys to carry. Do infants also factor the toy's weight into their decision-making? Attaching heavy weights (15% of body weight (BW)) to newly walking infants lead to more walking disruptions and less mature walking (Garciauirre et al., 2007); however, it is unknown if infants are aware of the potential negative impact of carrying heavy toys on their walking. Therefore, this study investigated what size and weight toys infants and toddlers select to carry and how these toy preferences may change with walking experience. Fifteen newly walking 13-month-old infants (3 males, Mean_age=13 m, 17 d, range: 13,2-13,30) and nine experienced walking 24-month-olds (3 females, Mean_age=23 m, 27 d, range: 23,19-24,6) participated in a 20-minute free-play session with their parent(s) during which they were encouraged to interact as naturally as possible. The parent(s)-child were provided with 18 toys that varied in size (small (size of child's hand), medium (larger than hand but smaller than head), large (size of child's head)) and weight (light (0.5-1.25lbs; 2-5% BW), medium (2-3lbs; 8-10% BW), heavy (3-4lbs; 12-15% BW)). Size and weight were decoupled; small, medium, and large toys could be any of the three weights. Using video recordings of the session, trained coders identified toy walking bouts consisting of at least four forward continuous steps and recorded toy size and weight for each bout. An Age (2) x Size (3) x Weight (3) repeated-measures ANOVA with Tukey corrections was conducted using proportion of time walking with a toy as the dependent measure (Table 1). There was an Age x Size x

Weight interaction ($F(8, 80)=5.03, p<0.001$). Thirteen-month-olds carried small-light toys for a greater proportion of time than any other size-weight combination (Figure 1). They also carried medium-light toys more often than any size-heavy weight combination and more often than medium sized-medium weighted toys. Twenty-four-month-olds carried all size-weight combinations for a similar proportion of time ($p's>0.70$). When comparing age groups, 13-month-olds carried small-light toys more often than 24-month-olds carried any size-weight combination. Overall, novice walkers appear to be aware of specific toy properties that are detrimental/ beneficial to walking and select toys to carry accordingly. They considered both size and weight, with small-light toys being their preference. These novice walkers avoided larger and heavier toys, suggesting they understand those toys may be detrimental to walking. Given that experienced walkers did not demonstrate a preference for size or weight, these factors may no longer be beneficial/detrimental to their walking. Future research should investigate how carrying differently sized or weighted toys directly impacts objective measures of walking in both new and experienced walkers.

P3-A-18 Sharing others' tactile experiences at 8 months of life: an EEG study

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Several adult studies have proved the existence of a shared neural circuit in the somatosensory cortices that responds to both the body being touched, and the sight of the body being touched (Keysers et al. 2010; Bolognini et al. 2014). Early in development, the sense of touch possesses high social and affective features, as infants both learn to explore the environment through touch, and receive continuous tactile sensations by their caregivers (Field, 2001). However, whether there may be a visuo-tactile mirror system supporting felt and observed touch is still poorly understood. In this study, we measured EEG desynchronization in the 6-8 Hz mu frequency range on centro-parietal electrodes (CP3,CP4) in 8 month-old infants under three experimental conditions. In the first condition, infants were stroked on their right hand by their mother (touch only condition); in the second condition, infants observed a human right hand of a live model being stroked by the left hand of the same individual (observe only condition); in the third condition, infants observed a human left hand approaching the right hand without touching it (action control condition). Preliminary results reveal within a 100-400 ms temporal window differential mu desynchronization (6-8Hz) of the somatosensory cortex contralateral to the hand being stroked solely to the touch only condition vs. the action

control condition, but not to the touch only condition vs. the observe only condition. This finding supports the view of an early emergence of a visuo-tactile mirror system that likely support infants' understanding of others' tactile sensations.

P3-A-19 A longitudinal assessment of infants' motor and language development using an automatic quantification method of motor skills

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Objectives: Recent advancement of sensing technology made it easier to quantify motion data even for infants. We have explored to establish an optimal way to quantify infants' fine and gross motor movements under limited restrictions (e.g. without marker). As we have already reported our methods with video recording and Kinect recording (Abe et al., 2016), the present study investigated effects of early motor skills on various cognitive development with a longitudinal design using this method. The development of motor function has a close correlation with cognitive function. For instance, time to begin to walk predicted the developmental level of both comprehensive and expressive language for children with ASD, suggesting a longitudinal impact of the early motor skills on the general development beyond modalities (Bedford et al. 2015). However, results of this line of studies are inconsistent and very little is known about the long-term interaction between motor development and cognitive development. The present longitudinal study clarifies the influence of infants' fine and gross motor skills at 12 months-old on the language development at 18 months-old by using quantitative and qualitative assessments of motor skills. **Methods:** Final data set of the motor task included fourteen infants (seven males). They participated in the motor experiment longitudinally at 12, 15 and 18 months-old. We also evaluated their language development using Japanese MacArthur communicative development inventory and general development with a standardized questionnaire. In the motor task, participants grasped a block, transferred it, and released it above a hole at least 6 trials. For this task, we used a lab-made equipment which increased infants' motivation and interests in the task under a natural setting. We evaluated 12-, 15- and 18-month-old infants' manipulation skills (e.g. grasping quality, DTL; duration from touching to lifting, moving path, speed) using video camera and kinect V2 during the grasp-release motion task. **Results & Conclusion:** Here we present primary results among various analyses. As 12 month-old infants showed obvious difference in releasing behavior, they were divided into two groups based on their releasing ability. We compared their language development between these two groups (i.e. R group and N

group who can and cannot release a block respectively). Although there was no significant difference of their language score at their age of 15-months-old, R group showed significantly higher scores than N group for their language comprehension and expressive vocabulary at their age of 18-months-old ($p < .05$). Correlation analysis for R group revealed a positive significant correlation between the grasping level at 12-months-old and gesture vocabulary (Fig. 1 (left)) and a positive significant correlation between the releasing level at 12-months-old and gesture vocabulary (Fig. 1 (right)). Furthermore, correlation analysis for N group revealed that DTL, which reflected the smooth grasping, had negative correlations to later expressive vocabulary at 2 different ages (Fig. 2). These findings revealed that the fine motor skill at 12-months-old predicted their language development, particularly their expressive vocabulary.

P3-A-20 Fragility of Haptic Memory in Human Full-Term Newborns

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Numerous studies have established that newborns can memorize tactile information about the specific features of an object with their hands and detect differences with another object. However, the robustness of haptic memory abilities has already been examined in preterm newborns and in full-term infants, but not yet in full-term newborns. This research is aimed to better understand the robustness of haptic memory abilities at birth by examining the effects of a change in the objects' temperature and haptic interference. Sixty-eight full-term newborns (mean postnatal age: 2.5 days) were included. The two experiments were conducted in three phases: habituation (repeated presentation of the same object, a prism or cylinder in the newborn's hand), discrimination (presentation of a novel object), and recognition (presentation of the familiar object). In Experiment 1, the change in the objects' temperature was controlled during the three phases. Results reveal that newborns can memorize specific features that differentiate prism and cylinder shapes by touch, and discriminate between them, but surprisingly they cannot recognize them after interference. As no significant effect of the temperature condition was observed in habituation, discrimination and recognition abilities, these findings suggest that discrimination abilities in newborns are rather determined by the detection of shape differences. Overall, it seems that the ontogenesis of haptic recognition memory is not linear. The developmental schedule is likely crucial for haptic development between 34 and 40 GW, with the loss of haptic recognition memory after interference to favor auditory and visual abilities at birth.

P3-A-21 The Digital Pacifier Enables Infants to Manipulate the Graphics Objects

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It is difficult for infants to interact with the outside world due to their physical ability restrictions. Therefore, infants are often regarded as passive observers in infant research so far, and few experiments, considering that infants are positive actors, have been studied. In this study, we are focusing on non-nutritive sucking which is thought to be more operable than the limbs for infants. Using the digital pacifier (the pacifier equipped with a photo reflector sensor) as an interface device, we conducted the experiment. It was designed to test whether infants would be able to manipulate the graphics objects on a screen by sucking, based on familiarized stimulus. In the study, twenty-six 8 to 10-month-old infants (10 female, 16 male) participated. The experiment consisted of a practice phase, a familiarization phase and a test phase. In the practice phase, a rectangle bar was shown at the center of the screen. There were two conditions about the motion of the bar; DOWN and UP. In DOWN condition, the bar went up automatically, but only when they intensely sucked the pacifier, the bar went down and vice versa in UP condition. The familiarization phase was designed to give the infants exposure to animation. Two circle balls on both sides of the screen and a rectangle bar at the center of the screen were presented, and one of the balls tried to jump over the bar to the opposite side repeatedly and finally touched the other ball. In the test phase, infants were shown the animation almost as same as the familiarization phase. The only difference was that infants could manipulate the bar height by sucking behavior as well as the practice phase. In DOWN condition, as infants sucked intensely the bar went down, so the one of the ball could jump over the bar and touched to the other ball (and vice versa in UP condition). In either condition, the sucking intensity was not appropriate, the jumping ball would be bounced by the bar and could not touch the ball in opposite side. In this phase, we continuously measured the sensor value of the digital pacifier. In the test phase, 8 to 10-month-old infants controlled the bar height by changing their sucking intensity so that the ball could jump over the bar. In other words, it was suggested that sucking behaviors could be changed to adapt to the stimulus they familiarized. We also found that the sucking intensity was significantly higher when the ball jumped over the bar than any other time. The result supports the novel view that infants instantaneously and precisely manipulate the graphics objects by sucking. The possibility is suggested that infants can use the digital pacifier to control outside world.

B: Developmental Neuroscience

P3-B-22 The Emerging Sensorimotor EEG Mu Rhythm during Observation of Facial Gestures in 6- to 9-week-old Infants

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A central problem of social cognition is, how does the brain encode others' actions and how do these systems develop? Part of the answer is hypothesized to lie in the brain's "neural mirroring systems." The electroencephalogram (EEG) mu rhythm (adult: 8-13 Hz), recorded from scalp regions overlying the sensorimotor cortex, exhibits mirroring properties: It desynchronizes (i.e., power decreases from baseline; a measure of neural activity) both when executing a goal-directed action and when observing someone else perform the same action (Muthukumaraswamy & Johnson, 2004). These findings, in conjunction with evidence from other neuroscience techniques, suggest a human brain homolog of mirror neurons found in the premotor cortex of rhesus macaque monkeys that fire during goal-directed action production and perception (Rizzolatti et al., 1996). It is unknown when human infants first exhibit mu rhythm desynchronization (MRD; suppression of EEG activity). Newborn rhesus macaque monkeys suppress 5-6 Hz EEG activity when observing and executing facial gestures (Ferrari et al., 2012). Recent evidence indicates that human infants also exhibit MRD when observing facial gestures by 9 months of age (Rayson et al., 2016, 2017). In the present study, we examined emerging sensorimotor EEG activity in 6- to 9-week-old infants engaged in a series of tongue protrusion (TP), mouth opening (MO), and neutral face (baseline) observation and execution trials (Ferrari et al., 2012; Meltzoff & Moore, 1992). Data collection is ongoing; preliminary analyses are based on usable data from 15 infants (8 females). Event-related desynchronization was computed with the equation $[(A-R)/R]*100$ (A=observation power; R=baseline power) at frontal (F7/F3/Fz/F4/F8), central (C3/C4), parietal (P7/P3/Pz/P4/P8), and occipital (O1/O2) sites. There was not sufficient artifact-free EEG data for examination of execution trials. Analyses focused on 2.5-4.5 Hz band based on evidence of peak MRD at approximately 3 Hz during prehension at 11 weeks of age (Berchicci et al., 2011). One-sample t-tests determined whether event-related desynchronization during observation trials was significantly less than zero (i.e., a significant decrease in mu rhythm from baseline). As seen in Figure 1, infants exhibited significant MRD at central (MO) and parietal (MO+TP) sites during the observation of facial gestures, but not during the observation of non-biological motion (i.e., spinning

versus still disc; see Table 1). Importantly, similar to findings with older infants, concurrent analyses of event-related desynchronization at occipital sites were non-significant for MO and TP gesture observation trials (see Table 1; Figure 1). These findings provide initial evidence that 6- to 9-week-old human infants exhibit 2.5-4.5 Hz MRD at central-parietal scalp sites during the observation of facial gestures. Previous investigations of infant MRD during the observation of facial gestures has not examined broader scalp topography beyond anterior/central and posterior/occipital regions (Ferrari et al., 2012; Rayson et al., 2016, 2017). Future analyses will determine whether this frequency band exhibits mirroring properties by including a larger sample with sufficient artifact-free gesture execution trials. Potential implications for the "Like-Me" developmental psychological framework (Meltzoff, 2007) will be discussed.

P3-B-23 Development of face, place, and object recognition systems in infants: Local selectivity and distributed networks emerge together

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Visual object recognition in adults is supported by the ventral occipital and temporal cortex, which contains regions that are selective for visual categories such as faces, places or objects, each with distinct connectivity to other brain areas. Here, we use neuroimaging to investigate how this system develops in infants, focussing on the relationship between local selectivity and distributed connectivity. Drawing on three existing theories, we hypothesize that this could progress in one of three ways: (1) networks could develop first and subsequently drive local specialization; (2) local specialization could develop first and subsequently drive network formation; and (3) local specialization and network connectivity could develop together. Recently, Deen et al. (2017) investigated local specialization in infants, using functional neuroimaging with fMRI and found local selectivity for faces and places, but not for objects. However, they did not characterize the development of the broader networks associated with these regions. Our goal, therefore, was to examine the development of the networks of the category-specific regions in infants in the same age range. We acquired MRI diffusion-weighted images in infants aged 2-9 months (N=11) and an adult control group (N=14). We used fMRI localisers from the Human Connectome Project (HCP) to define the most face, place and tool selective regions, which were: the fusiform complex, the ventromedial visual area 2, and ventromedial visual area 3, respectively. The white-matter connectivity of each of these

regions to the rest of the brain (346 cortical regions defined using the HCP atlas) was then measured using tractography on the diffusion-weighted images. To characterize the networks of the selective regions, we used machine learning (a linear-discriminant classifier with leave-one-subject-out cross-validation). As expected, in adults all three category-selective regions could be localised from their distinct signatures of connectivity ($p < 0.001$). Importantly, in infants, we found that three category-selective regions could be localised that had similar connectivity to the adults. However, while the face and place regions were as strongly detected in infants as they were in adults (difference, $p > 0.1$), the tool region was detected less accurately $p < 0.01$ (Fig. 1). We then examined the trajectory of development of these networks through the infant age range 2-9 months. We found that only the tool network experienced significant change over the first 9 months of postnatal life ($p < 0.01$) (Fig. 2). In summary, the broader networks associated with the category-selective regions were found to be completely or partially mature in infants. Some networks experienced a longer maturational time course, mirroring Deen et al's findings that face and place specific activation is present in infants, but the object selective system is less developed. These results support hypothesis (3), local functional specialization and network connectivity mature together.

P3-B-24 Early development of adaptive functioning in high-risk siblings and low-risk controls: a latent class growth curve analysis

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Adaptive behaviour describes how an individual responds to environmental demands. A diagnosis of Autism Spectrum Disorder (ASD) requires that symptoms cause clinically significant impairments in social, occupational, or other important areas of functioning (American Psychiatric Association, 2013), and deficits in adaptive functioning likely contribute to such suboptimal outcomes (Szatmari et al., 2015). Thus, the investigation of early development of adaptive skills can help to elucidate the different paths that infants can take developmentally. This study aims to identify homogeneous classes of infants based on early development of adaptive functioning on multiple domains in a population including infants at high risk for ASD (HR) and low-risk controls (LR). 247 infants were followed longitudinally on four visits between 8 and 36 months. Clinical outcome of HR siblings was established at 36 months (HR-Typical; HR-Atypical; HR-ASD). At each assessment, adaptive functioning was evaluated on 4 different domains using the Vineland Adaptive Behavior Scales (VABS): communication, daily living, motor, and social

domain. Latent class modeling was used to examine developmental trajectories regardless of clinical outcome, and latent class membership was related to cognitive development, as measured by the Mullen Scales of Early Learning; symptoms severity, as measured by the Autism Diagnostic Observation Schedule; and clinical outcome. Five classes were identified based on the latent class growth-curve analysis (Figure 1). Class 1 (5.9%) represents LR and HR-Typical infants with above-average adaptive skills, high level of cognitive development ($ELC=113\pm12$), and low symptoms scores. Class 2 (43.7%) represents LR and HR siblings showing normative adaptive functioning with increasing communication and decreasing motor skills. Cognitive development is normative ($ELC=106\pm21$), yet these infants show more restricted repetitive behaviour ($RRB=4.3\pm2.5$). Class 3 (10.7%) represents HR-Atypical and HR-ASD siblings with normative outcome in communication and daily living skills, below-average motor outcome, and decreasing social skills. Infants in this class show increased levels of repetitive behaviour ($RRB=5.1\pm2.7$), and lower but still normative developmental level ($ELC=88\pm20$). Class 4 (4.9%) represents HR-ASD with widespread delayed development of adaptive skills, especially in the social and communication domains; delayed cognitive development ($ELC=68\pm17$); and high levels of repetitive behaviour ($RRB=7.0\pm1.7$). Finally, class 5 (34.6%) represents LR and HR-Typical siblings with increasing adaptive functioning, above-average developmental level ($ELC=119\pm15$), and intermediate repetitive behaviour between class 1 and 2 ($RRB=3.9\pm2.5$). The present study examined early developmental trajectories of adaptive functioning across multiple domains without a priori classification of infants based on clinical outcome. We conclude that a 5-class model best describes our data. The exploratory investigation of inter-individual heterogeneity in such an unsupervised approach through latent class analysis provides a better insight into the variety of paths leading to different functional outcomes within typical development, and helps to improve the phenotypic characterisation of ASD. Differences among latent classes in cognitive development and ASD symptoms, and implications for future research will be discussed.

P3-B-25 Neuronal correlates of self-recognition in 18-month-olds

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The sense of self is thought to develop around 18 months and self-recognition is one of the first aspects that emerges (Rochat, et al., 2012). A fundamental marker of self-recognition is thought to be detection of temporal contingency in the visual feedback of

one's own actions (Sugiura et al., 2015). The only study investigating the neuronal correlates of self-recognition revealed different ERP components when 18-month-olds are presented with their own image or an image of another toddler, confirming findings from the Mirror Self-Recognition (MSR) task that it is around this age that infants become able to differentiate self from other (Stapel, et al., 2016). Studies with adults suggest that the temporo-parietal junction (TPJ) and the medial prefrontal cortex (mPFC) are two crucial brain areas associated with a sense of self (Molnar-Szakacs, et al., 2013). To date, little is known about brain regions that are implicated in an emerging sense of self. Functional near-infrared spectroscopy (fNIRS) provides an ideal opportunity to investigate this, because it can be used with awake and mobile infants. Thus in the present study, we used fNIRS to study brain regions which are involved in self-recognition in early development, by manipulating the temporal contingency of infants' felt and seen movements. 17 18-month-olds were included in the analysis. Infants were presented either with live videos of themselves or a video of themselves recorded few seconds before, while we measured brain activation from temporo-parietal and frontal cortex using fNIRS. All the participants were additionally tested with the MSR task (Amsterdam, 1972), with the aim of validating the fNIRS measure. Out of the 17 subjects included in the analysis, 7 participants were classified as 'recognisers' (Rs), 10 as 'non-recognizers' (NRs). Results show that Rs exhibited significant stronger activation than NRs in the Live vs Recorded condition in 3 adjacent channels over left TPJ ($ch12, t(16)=2.44, p=0.027$; $ch36, t(16)=2.30, p=0.038$; $ch37, t(16)=2.14, p=0.053$). To further explore the pattern of activation in Rs and NRs, we performed a cluster analysis within regions of high relevance for self-recognition (figure 1.A). Rs exhibited a stronger, but not significant, activation of right TPJ and mPFC and a significantly greater activation of left TPJ ($t(16)=2.12, p=0.049$) in the Live vs Recorded condition compared to NRs (figure 1.B). Figure 1.B shows that the pattern of stronger activation in the Live vs Recorded condition in Rs compared to NRs is presented in all the channels in the cluster analysis. Moreover, we observed the classical pattern of increased oxy- and decreased deoxy-haemoglobin over left TPJ, reflecting brain activation rather than artifacts (figure 2). This work suggests that Rs and NRs exhibited a different pattern of brain activation when looking at their own image live or pre-recorded. In particular, Rs engaged bilateral TPJ and mPFC compared with NRs, confirming the importance of these areas for self-recognition in infants as well as in adults. Furthermore, this work provides neuronal evidence of the importance of temporal contingency in the process of self-recognition. Although data collection is still on going, we think that these preliminary findings are promising in understanding the neuronal substrates of self-recognition, and for providing an additional measure of self-recognition that obviates the need for a manual response and may be applied at a younger age than the MSR.

P3-B-26 Investigation of the Peak Frequency and Topographic Specificity of the EEG Mu Rhythm at 6 and 12 months

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The neural mirroring system, which activates during both the perception and performance of goal-directed actions, is purported to support action understanding by mapping perceived actions onto a motor representation of the viewer (Gallese et al., 1996). The electroencephalogram (EEG) mu rhythm, recorded within the alpha frequency band over central-parietal sites, is an index of neural mirroring system activity. The mu rhythm desynchronizes (decreases in power relative to baseline) during observation and performance of goal-directed actions (Muthukumaraswamy & Johnson, 2004). Previous work suggests that waking EEG transitions from having widespread to more specific/concentrated activation during infancy (Fox et al., 1994). Furthermore, research indicates that the mu rhythm exhibits age-related increases in peak frequency during infancy and childhood (Berchicci et al., 2011; Thorpe et al., 2011), though these studies only reported activity during execution. The present study characterizes the frequency and regional specificity of the mu rhythm at 6 and 12 months during both observation and execution. EEG was recorded while participants grasped toys (execution), watched the experimenter perform this action (observation), and observed a spinning wheel (baseline). After excluding trials due to motor artifact and inattention, 14 six-month-olds and 19 twelve-month-olds had sufficient data for analysis. Event-related desynchronization [ERD; $\log_{10}(\text{task}/\text{baseline})$; Bernier et al., 2007] was calculated for 3-Hz-wide frequency bands (range: 2-13Hz) at frontal (F7/F3/Fz/F4/F8), central-parietal (C3/CP1/P3/P4/CP2/C4), and occipital (O1/O2) regions (Yoo et al., 2015). The peak mu frequency band (the band with strongest central-parietal ERD during execution) was identified for each participant and used for all subsequent analyses. There was no significant difference in peak frequency at 6 ($M=5.21\text{-}7.21\text{Hz}$) and 12 months ($M=5.32\text{-}7.32\text{Hz}$; $t<1$). During execution, MANOVAs revealed significant main effects of region at 6 [$F(2, 12)=10.63$, $p=.002$] and 12 [$F(2, 17)=18.48$, $p<.001$] months. Follow-up contrasts revealed topographic specificity at 12 months (central-parietal ERD was greater than both frontal and occipital ERD). However, 6-month ERD was similar at frontal and central-parietal regions. Similarly, during observation, ERD was specific to central-parietal regions, with a significant main effect of region, at 12 [$F(2, 17)=9.23$, $p=.002$] but not 6 months ($p=.22$; see Table 1). To determine the magnitude of ERD at 6 and 12 months, one-sample t-tests comparing execution and

observation ERD to zero (non-zero ERD indicates a significant change in power from baseline) were conducted at all regions. These demonstrated significant central-parietal ERD during action execution at both ages, but only 12-month-olds exhibited significant central-parietal ERD during observation (see Figure 1). Contrary to previous work (Berchicci et al., 2011), this study did not reveal age-related increases in peak mu frequency. However, we found different patterns of alpha activity at 6 and 12 months, with desynchronization within peak frequency bands during observation and execution being specific to central-parietal regions by 12 months. This transition may reflect changes in cortical organization in systems that underlie action understanding, which may occur as a result of motor experience (Fox et al., 1994). Data processing is ongoing and future analyses will include a larger sample.

P3-B-27 BabyRhythm an early neural window into infant's language skills

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Recently it has been proposed that cortical oscillations support the encoding and parsing of the energy (amplitude) modulations that are nested in speech (Giraud & Poeppel, 2012). Adult data suggest that the brain synchronizes cortical oscillations with temporal information at different rates in the speech signal, thereby "sampling" information in different frequency bands (delta, theta, beta, gamma) and analyzing the sensory information in parallel. Since the intelligibility of speech depends on the accurate alignment of the listener's brain rhythms with the acoustic/visual/motor rhythms being produced by the speaker, language acquisition should rely in part on the accuracy of neural entrainment to the speech signal. This "temporal sampling" hypothesis has been supported for children by electrophysiological (EEG) data in studies of developmental dyslexia. Neural auditory entrainment in the delta band is atypical in dyslexic children compared to typically-developing children (Power et al 2012, 2013, 2016). We combine these perspectives to provide a novel oscillatory theoretical approach to infant language acquisition: "temporal sampling" for infants. Our research project is the first longitudinal study of rhythmic oscillatory entrainment to speech by English-learning infants at different ages (2 months - 2.5 years). We measure oscillatory entrainment in the delta and theta bands using EEG while presenting stimuli with different complexity (resting state, simple drum beat, syllable repetition 'ta', and nursery rhymes), focusing on the neural accuracy of low-frequency phase locking (entrainment) and phase alignment at delta and

theta rates. We aim to assess the role of individual differences in oscillatory entrainment to the development of lexical representations by infants. We have designed six multi-modal rhythmic tests (audio, audio-visual EEG and eye-tracker and motor response with a motion capture) from 2 to 11 months combined with classical language development measures from 12 to 30 months such as the CDI) to ascertain the importance of oscillatory entrainment for language learning. We expect to generate a data-base of early neural and behavioural markers of linguistic development that could be applied across languages. We aim to test 100 infants in this cohort study, so far we have recruited 43 participants to the project yielding 180 scans (from 2mo to 1 year). Preliminary group analyses of the 2-month-old EEG session show entrainment when comparing the resting state condition to 2Hz syllables and the resting state condition to 2Hz drum. These data will be presented in more detail. Phase distribution analyses are ongoing and currently suggest a different pattern of phase locking for the syllable versus the drum. These preliminary observations should be confirmed but appear to support specialized neural processing of language stimuli. Crucially, we can observe clear individual phase locking for our infants in the power spectrum of the EEG recording, supporting this approach to early neural markers of language outcomes.

P3-B-28 Infant Fronto-parietal EEG Coherence Predicts Preschool Executive Function

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Frontal and parietal regions of the brain are known to be important for executive function (EF) development and are shown by brain imaging methods to be associated with concurrent performance on EF tasks in infancy and childhood (e.g., Bell, 2012; Klingberg, Forssberg, & Westerberg, 2006; Ullman, Almeida, & Klingberg, 2014). Less understood is the importance of early brain function, particularly connectivity between regions, to later EF development. The idea that individual differences in infant brain function are the foundation of executive function development is compelling and would allow for early intervention for children who are at risk for developing EF deficits (Colombo & Cheatham, 2006). There is an association between 10-month frontal EEG power, a measure of cortical activity, and preschool executive function (Kraybill & Bell, 2013), suggesting that infant brain function is predictive of later EF development. However, there is a dearth of literature examining longitudinal effects of neuroconnectivity on EF development. Functional connectivity between brain regions can be noninvasively measured using EEG coherence;

EEG coherence is calculated as the cross-correlation of power between two electrode sites. The value of EEG coherence over EEG power is that coherence allows the examination of interconnected brain networks. This study investigates if neuroconnectivity between frontal and parietal regions in infancy is associated with preschool EF. Data were collected during laboratory visits at 5 and 48 months as part of a larger, ongoing longitudinal study. During the 5-month visit with 275 infants, we collected baseline EEG for one minute while the infant sat in mother's lap and watched balls spin in a toy. At 48 months, 202 children returned to the laboratory and completed a battery of cognitive tasks including the 3 EF tasks of interest in this study: Dimension Change Card Sort (DCCS), Day/Night, and Forward Digit Span. EF variables were standardized, averaged for each participant and then standardized again to create a composite score. Children also completed the Peabody Picture Vocabulary Test (PPVT) at the 48-month appointment as a measure of verbal IQ and parents were asked to report the highest level of education the mother had completed, as there is substantial evidence that IQ and parental education are correlated with EF. The first step of a hierarchical regression analysis controlled for PPVT and maternal education and predicted EF performance at 48 months (Table 1). The second step of the regression added the variables of interest: infant EEG coherence between F3-P7 and F4-P8 electrode pairs and showed that F4-P8 accounted for unique variance in the model (Table 1). These findings support the hypothesis that infant fronto-parietal connectivity is associated with preschool EF, controlling for maternal education and verbal IQ. These individual differences in infant neuroconnectivity may be the foundation for later EF development. Discussion will include speculation about the laterality effects in the infant EEG for predicting later EF performance.

P3-B-29 Mother-Child Cortisol Attunement: Moderation by Income, Parenting, Anxiety, and Education

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Research suggests that physiological attunement between a mother and her child contributes to the organization of the child's stress response and regulatory processes early in a child's life (Feldman, 2007; Harriot & Waugh, 2002). However, the influence of moderating factors, such as environmental, psychosocial, and behavioral variables, on dyadic attunement is not well understood, as some studies have reported discrepant findings (e.g., Bernard et al., 2017). The current analysis extends the investigation of mother-child physiological attunement in a sample (N=267) of primarily low-income

Latina mothers and their 0-4-year-old children. Families were visited in their homes and mothers reported socioeconomic and demographic information, and completed a self-report measure of anxiety (Generalized Anxiety Disorder-7; Spitzer et al., 2006). Mothers also participated in a number of procedures, including a 10-min semi-structured free play interaction with her child, which was video-recorded and later coded for parenting behavior. Additionally, children participated in an emotion-induction task taken from the Laboratory Temperament Assessment Battery (LabTAB; Goldsmith & Rothbart, 1999), which was also video-recorded and later coded for child emotional reactivity. Saliva samples were collected from mothers and their children at four time points before and after the emotion-induction task and later assayed for the stress-related hormone cortisol. Multi-level modeling was used to assess mother-child cortisol attunement and moderators of this activity. Within-dyad attunement was indicated if a mother's cortisol activity predicted her child's cortisol activity across the four samples. Results revealed that on average mother-infant dyads did not display cortisol attunement, but this activity was moderated by several factors. Specifically, mothers who displayed higher levels of sensitive parenting and mothers who reported lower levels of anxiety each had cortisol responses that were more attuned to their child's cortisol response than less sensitive and higher-anxiety mothers, respectively. Furthermore, mothers who had lower levels of education and mothers with a lower income-to-needs ratio were each more attuned to their child's cortisol activity. Notably, these effects were observed while controlling for multiple relevant covariates including ethnicity, gender, mother and child age, child emotional reactivity, and time of day of saliva collection. Our findings suggest that higher levels of mother-child cortisol attunement are associated with both positive and negative aspects of socioeconomic, behavioral, and psychosocial factors. Further research is needed to better understand how mother-child cortisol attunement is mediated by these factors and its role in influencing child outcomes. These results contribute to research on physiological attunement in mother-child dyads and provide some insight into understanding the dynamics of mother-child physiological activity, particularly in contexts of risk and adversity.

P3-B-30 Negative affect is related to differential neural responses to social stimuli in infants

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A recent series of fNIRS studies has shed light on the cortical specialization for social information processing by robustly demonstrating the involvement of the posterior temporal lobe in the processing of social dynamic stimuli compared to non-social dynamic stimuli in young infants (Lloyd-Fox et al, 2009; 2011; 2013; 2014). However, the sensitivity of these neural correlates of social perception to genetic and environmental factors is less explored. In the present study we use fNIRS to investigate the impact of infant temperament, specifically Negative Affect, on early cortical specialization for processing social dynamic stimuli. Negative affect during infancy comprises behaviors such as frustration, sadness, social fear and poor soothability and has been associated with delayed social-cognitive development and behavioral problems later in life. In facial expression processing, temperament was linked to differential activation in frontal regions in infants (Martinot, Matheson, & De Haan, 2012; Ravicz et al, 2015). In older children, negative affect has also been related to activation and connectivity of the brain network for social perception. Based on these findings, infants with high levels of negative affect are expected to show reduced hemodynamic responses to dynamic social stimuli in temporal regions. Thirty-seven infants between 5 and 8 months of age provided usable data for our study. Our paradigm was identical to that used in a previous study by Lloyd-Fox and colleagues (Lloyd-Fox et al., 2009; Experiment 2). In a block design, infants watched video clips of Social dynamic and Non-social dynamic stimuli with static baseline stimuli in between. fNIRS data were recorded using a NIRx NIRScout 8x16 apparatus. Four sources and four detectors were positioned on each hemisphere (source-detector separation: 20 mm), defining 20 channels over bilateral frontal and temporal cortices. Negative affect was assessed by parental report using the Infant Behavior Questionnaire. Our results confirmed significant differential activation for the Social versus the Non-social dynamic condition in the right posterior-temporal region, with larger HbO responses in the Social dynamic condition, $t=3.15$, $p=.006$, see Figure 1. Age of the infants was not related to posterior temporal activation in response to social-dynamic compared to non-social dynamic stimuli, which indicates that selective processing of dynamic social stimuli remains stable between the ages of five and eight months and that the brain regions supporting this selective processing remain the same within this age range. Negative affect, however, was related to differential hemodynamic responses in the right posterior-temporal region. Infants with higher levels of negative affect showed less differentiation between the HbO-responses in Social vs Non-social conditions, $r=-.58$, $p=.007$, see Figure 2. This result confirms our hypothesis that high Negative Affect is negatively related to cortical specialization for social dynamic stimuli. Our results thus replicate previous findings on cortical specialization for social perception. Furthermore,

the decreased cortical sensitivity to social stimuli in infants who show high negative affect may be an early biomarker for later difficulties in social interaction.

P3-B-31 Comparing functional activation and connectivity between infants with and without risk for autism

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Behavioral signs of Autism Spectrum Disorder (ASD) are typically observable by the second year of life and a reliable diagnosis of ASD is possible by 2 to 3 years of age. Studying infants with familial risk for ASD allows for the investigation of early signs of ASD risk within the first year. Brain abnormalities such as hyper-connectivity within the first year may precede the overt signs of ASD that emerge later in life. In this preliminary study, we use functional near-infrared spectroscopy (fNIRS), an infant-friendly neuroimaging tool that is relatively robust against motion artifacts, to examine functional activation and connectivity during naturalistic social interactions in 9 high-risk (HR; older sibling with ASD) and 6 low-risk (LR; no family history of ASD) infants from 6 to 9 months of age. We obtained two 30-second baseline periods (pre/post-social) and a 5-minute social interaction period. Figure 1 shows the different experimental conditions. HR infants showed reduced right-hemispheric activation compared to LR infants. HR infants also had greater functional connectivity than LR infants during the pre- and post-social period and showed a drop in connectivity during the social period. Figure 2 compares pre/post social periods with the social interaction period for each group. *s indicates statistically significant differences between conditions. Our findings are consistent with previous work suggesting early differences in cortical activation and hyper-connectivity associated with familial risk for ASD, and highlight the promise of fNIRS in evaluating potential markers of ASD risk during naturalistic social contexts.

P3-B-32 Frontoparietal Connectivity at 5 and 10 Months

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There is converging biobehavioral evidence that frontoparietal connectivity is activated during inhibitory control (IC) tasks during infancy (EEG: Bell, 2012; NIRS: Baird et al., 2002;

phenylketonuria: Diamond et al., 1997; nonhuman primates: Diamond, 1990). Given ease of use, EEG coherence is a highly desirable brain imaging methodology during early development. With the spatial resolution of EEG, however, it is unclear which specific electrode pairings are optimal. The purpose of our study was to examine different frontal and parietal electrode pairings to determine which is most discriminating of the frontoparietal network. Three hundred infants participated as part of a longitudinal study focused on individual differences in early cognition. Our focus here is on the frontal-parietal EEG coherence recorded during an IC task at 5 mo and again at 10 mo. The IC task was the looking version of the A-not-B task (Bell, 2012). Infants watched as an experimenter hid a toy at one of two possible locations (A; nonreversal trials); gaze to the hiding location was broken during a brief delay; and then infants were allowed to look for the object. If infants responded correctly on two consecutive nonreversal trials, then the hiding location was switched (B; reversal trials). Testing continued until the infant made looking errors on two out of three trials. EEG was recorded during task performance, artifact scored, and power calculated for the infant alpha band (6-9 Hz), the dominant frequency band during infancy (Marshall et al., 2002). Coherence between medial frontal (F3, F4) and parietal (P3, P4), as well as between lateral frontal (F7, F8) and parietal electrode sites was computed using an algorithm by Saltzberg et al (1986). The task was parsed into 3 conditions: showing toy, hiding toy then breaking infant's gaze, and revealing toy after the infant looks at one of the locations. Table 1 summarizes results. MANOVA was used to examine age (5, 10), task condition (show, hide, reveal), and hemisphere (left, right). For F3/P3 and F4/P4 analyses, all possible main effects (age, condition, hemisphere) and interactions were significant, except for condition X hemisphere interaction. Higher frontoparietal coherence values were evident for older infants, right hemisphere, and the hide condition, which is the most cognitively challenging. The 3-way interaction (age X condition X hemi) mirrored main effects with the exception that the coherence value for the left hemisphere during the reveal condition was the same at 5 and 10 months. For the F7/P3 and F8/P4 analyses, only the main effect of age and age X condition interaction were significant, again with older infants having greater coherence. For the interaction, younger infants had greater coherence during reveal condition and older infants during hide condition. Our data demonstrate that EEG is an informative tool for studying early developing brain networks, as well as age-related differences in brain functioning. EEG coherence discriminated between frontoparietal networks using medial frontal versus lateral frontal electrodes paired with parietal sites. Our data suggest that medial frontal electrodes provided the greatest discrimination of the frontoparietal network during an infant IC task.

P3-B-33 What is the Most Important Predictor of Infant Self-Regulation in High-Risk Dyads? A Dominance Analysis

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The optimal development of self-regulation during the first year of life provides a strong foundation for later adult health and wealth. During the first year, self-regulation development begins to stabilize, demonstrating what the lifecourse health development framework (LCHD) calls a critical period. Critical periods are when events can "embed" themselves within a child's developing psychoneurobiological framework more deeply over time and when these are adverse events, the consequences can shift developmental trajectories towards adverse, difficult-to-treat phenotypes that manifest many years later. As such, researchers have identified factors of the infant's caregiving environment that help shape very early self-regulation development. These include maternal caregiving, maternal depression, and maternal parenting mindset (parenting self-efficacy or competence). Which of these factors most strongly predicts infant self-regulation, especially in high-risk, low resource settings, is unknown. Knowing this information could assist with the development of high-impact interventions for infants living in low-resource settings. The purpose of this study is to thus determine which factor in the infant's caregiving environment most strongly predicts infant self-regulation. Dominance analysis was used in the analysis to determine if maternal depression, maternal self-efficacy, or maternal warmth was the most important predictor of infant self-regulation in low SES settings. Maternal depression was measured with the Edinburgh Postnatal Depression Scale (EPDS), maternal self-efficacy with an infant-focused maternal report scale by Teti and Gelfand (1991), maternal caregiving warmth with the Home Observation for Measurement of the Environment (HOME), and infant self-regulation via maternal report from the Infant Behavior Questionnaire-Revised Very Short Form (IBQ) at 9-12 months of age. Control variables included infant race, maternal education, infant negative affect (via IBQ), infant cognition (via Bayley-III), infant sex, and infant age at self-regulation and cognition measurement. Out of 322 participants recruited from Women, Infant, Children (WIC) clinics from a parent study, $n = 138$ were eligible for inclusion. Mothers were primarily low-income: 83% had a yearly household income of less than \$30,000 USD. About 50% of the infants were Black and 50% were White. Regression analysis demonstrated that maternal self-efficacy was the only statistically significant predictor of infant self-regulation ($\beta = 0.09$, $SE = 0.02$, $p < .0001$, $d = .37$) and per dominance analysis, was also the most important predictor of infant self-regulation (% variance explained = 64.37), above maternal depression and warmth. However, the dominance analysis

reproducibility factor was less than .70 (general dominance reproducibility factors = .46 and .57), suggesting questionable reproducibility. This research demonstrates the importance of better understanding maternal self-efficacy, or maternal parenting mindset, in relation to infant self-regulation. The maternal mindset of parenting self-efficacy may represent unobserved, global parenting practices not measured by maternal warmth, as mindset can influence behaviors and can buffer one from the effects of poverty. Further research is warranted to determine the most important predictor of infant self-regulation in high-risk dyads, with higher reproducibility factors to help direct self-regulation optimizing interventions.

P3-B-34 Longitudinal Examination of Infant Cortisol Reactivity and Attachment Security at Three, Seven, and Fourteen Months Postpartum

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Separation stressors like the Still-Face Paradigm (SFP) and the Strange Situation Paradigm (SSP) reliably activate the infant hypothalamic-pituitary-adrenal (HPA) axis measured through salivary cortisol output. In both paradigms, infants have displayed varying patterns of cortisol reactivity from blunted responses to hyper-responsivity with a failure to return to baseline. Furthermore, trajectory patterns and baseline differences have been noted for infants with secure and insecure attachments, yet the link between cortisol reactivity during the SFP and attachment security is unknown. The goals of this study were to evaluate the trajectories of infant cortisol reactivity at 3, 7, and 14 months postpartum and their associations with attachment security. During the SFP conducted during home visits at 3 and 7 months, cortisol was measured during a baseline (arrival), following a 5-minute play episode, and 12- and 20-minutes following the completion of the SFP. During the SSP, cortisol was measured at baseline (arrival to the laboratory) and 15-, 30-, and 60-minutes following the infant's first separation from the mother. In line with previous research, we hypothesized that infants with insecure and disorganized attachments would show a cortisol hyper-reactivity response (increase from baseline after stressor with a failure to return to baseline levels). Furthermore, we predicted cortisol reactivity at 7 months during the SFP would be associated with attachment security but that there would be no link between 3-month cortisol reactivity and attachment security due to the early time point of postnatal HPA-axis development. Two mixed-model ANOVAs (4 attachment by 4 cortisol sample by 3 time point) revealed a main effect of cortisol ($\mu\text{g/dL}$) $F(2.73,$

213.10) = 7.87, $p < .001$, and a main effect of time $F(1.81, 140.82) = 20.80$, $p < .001$. There was also a significant interaction between cortisol and time $F(3.04, 237.01) = 5.64$, $p < .001$, indicating that cortisol levels differed across the four samples over time. Infants' cortisol reactivity during the SFP at 3 months differed ($p < .05$) between baseline ($M = 0.25$) and the first cortisol measurement post SFP ($M = 0.18$), and between baseline ($M = 0.25$) and 20-minutes post SFP ($M = 0.16$) (the second post SFP cortisol measurement) with declines in cortisol over time, but these did not differ by attachment security. There were no significant differences across samples at 7 or 14 months by attachment either, suggesting that cortisol reactivity may not be consolidated into organized trajectories consistent with attachment security until after an infant's first year.

P3-B-35 Is left inferior frontal cortex recruitment during infants' audiovisual processing language-specific?

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Recent research shows that 6-month-old infants recruit brain processes localized in left inferior frontal cortex (IFC) during audiovisual speech processing (Altvater-Mackensen & Grossmann, 2016). This work shows that left IFC responses are more pronounced when auditory and visual speech cues match in their segmental content (e.g., /a/ in both visual and auditory stream) when compared to when they mismatch (e.g., /a/ in visual and /o/ in auditory stream). Furthermore, infants' left IFC responses correlate with their attention to a speaker's mouth, indexing the reliance on visual speech information. Taken together, existing results suggest that IFC plays an important role during audiovisual integration in infancy. However, it is unclear whether IFC mainly serves to integrate multimodal information (e.g., Dehaene-Lambertz et al., 2006) or whether IFC activation is specifically related to speech processing (e.g., Kuhl et al., 2014). To shed more light on the role of IFC during infant audiovisual processing, we assessed infants' recruitment of IFC during processing of multimodal human speech syllables and monkey vocalisations using functional near-infrared spectroscopy (fNIRS). Eighteen six-month-olds were presented with videos of a female speaker producing /coo/- and /ba/-syllables and a monkey producing cooing and grunting sounds. Videos either matched or mismatched across modalities and were contrasted to an audiovisual baseline presenting bubbles and ringing noises (stimuli adapted from Grossmann et al., 2012; Altvater-Mackensen & Grossmann, 2016). Changes in oxy and deoxyhaemoglobin concentration in response to the stimuli were measured at frontal and prefrontal sites. In addition, we simultaneously recorded

eye tracking data to assess infants' attention to the speaker's mouth. Results will inform us about the domain-specificity of behavioural and neural correlates of infant audiovisual speech processing. Differential activation of IFC in response to audiovisual human speech as opposed to monkey vocalisations would suggest a domain-specific role for IFC in language learning and processing. Furthermore, results will reveal if there are differences in infants' (visual) attention to multimodal information, such as attention to a speaker's mouth, depending on whether vocalisations are presented by a human or a monkey, and how these differences relate to the underlying brain processes. We are currently carrying out the neuroimaging and statistical analysis using previously established routines. This study will shed new light on the neural basis of audio-visual speech processing in infants and critically inform existing accounts of left inferior frontal cortex function.

P3-B-36 Early Life Stress, Maternal Depression, and Neonatal Neural Connectivity

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Several studies have highlighted the impact of maternal depressive symptoms on neural connectivity in infants, suggesting a potential biological mechanism by which risk for depression may be transmitted across generations. However, it is unknown how early life stress, which is a transdiagnostic risk factor for psychiatric illness, may shape infant brain development, over and above the influence of maternal depression. The current study examined such associations in a prospective longitudinal study. Pregnant women were recruited from the community and the Emory Women's Mental Health Program, a tertiary clinic that provides psychiatric treatment to women during the peripartum period (see Table 1). Data on maternal depression (assessed via the Beck Depression Inventory) and stress exposure (i.e., the number of negative life events reported on the Life Experiences Survey) were prospectively collected pre- and postnatally. Within 6 weeks of birth, neonates completed a resting state functional MRI scan during natural sleep and a standardized neurobehavioral exam (the Neonatal Behavior Assessment Scale; NBAS). Two NBAS subscales reflecting early stress reactivity, a risk factor for depression, were used in analyses: state organization (which measures infant arousal and state lability) and state regulation (which measures infant ability to regulate his/her state in the face of increasing stimulation). Functional connectivity between the amygdala and medial prefrontal cortex (PFC) was examined given research that has linked this circuitry to the regulation of stress reactivity and depression risk. Regions of interest (ROI) were defined

using a neonatal labeling atlas (Shi et al., 2010) and the time series of all voxels in a given ROI were averaged to create an overall time series for that region. Functional connectivity strength was determined by correlating the time series of the right (R) and left (L) amygdala with each other and with the time series of the R and L dorsomedial PFC (dmPFC) and ventromedial PFC (vmPFC), respectively. These correlation coefficients were examined in association with maternal depression, stress, and neonatal behavior scores (see Table 2). Prenatal depression predicted weakened R amygdala-dmPFC connectivity. These results persisted after controlling for prenatal stress and postnatal depression (shown in Table 2). Greater stress during pregnancy was correlated with stronger L-R amygdala connectivity. These results persisted even after controlling for postnatal stress exposure and prenatal depressive symptoms ($r(13)=0.59$, $p=0.02$). Stronger L-R amygdala connectivity was additionally associated with less optimal state regulation during the neurobehavioral exam. Although L amygdala-vmPFC connectivity was not associated with maternal stress or depression, it did predict neonatal state regulation. These preliminary results suggest that prenatal stress and depression may yield differing impacts on the development of neural circuitry early in life, and that these effects are distinguishable from the influence of postnatal factors. Such findings highlight the need for large studies that can further disentangle the relative influence of stress and depression on child vulnerability for psychiatric illness.

P3-B-37 Affective responsivity to tactile stimuli impacts brain response to affective touch during infancy

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Affective touch activates a brain network responsible for processing social-emotional stimuli in infants, children and adults, with a core node in the posterior superior temporal sulcus (pSTS). pSTS is known to be a region highly susceptible to individual variability, namely in terms of tactile stimuli processing. However, little is known on how the brain processes tactile stimuli of different aversive patterns in infancy. The aim of this study was to research pSTS activations in response to tactile stimuli with different affective patterns. A sample of 12 months of age infants ($n=25$) were given affective and discriminative stimuli to the forearm for 10 seconds followed by 20 seconds of a rest period while they were looking at a silent movie. Brain activation was recorded in the pSTS for measures of oxy-hemoglobin (HbO₂) and deoxy-hemoglobin (Hbb). Behavioral responses to tactile stimuli were measured using the Infant-Toddler Sensory Profile. A significant

hemodynamic response increase to affective touch was observed in the pSTS for infants with decreased aversive responses to tactile stimuli. The findings suggest that the emergence of brain activity in the pSTS at 12-month-old for affective touch is modulated by individual differences in affective reaction towards touch.

P3-B-38 Maternal Pre-pregnancy body mass index is associated with fetal and toddler neurobehavior and neonatal brain connectivity

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Background: Higher maternal pre-pregnancy body mass index (BMI) is associated with poorer cognition, and increased risk of neuropsychiatric disorders, such as Autism Spectrum Disorders and Attention Deficit/Hyperactivity Disorders, in offspring. However, the mechanisms by which maternal pre-pregnancy BMI influences prenatal brain development are unknown. Furthermore, behavioral antecedents of the BMI-related neuropsychiatric outcomes are poorly characterized. To begin to characterize these brain and behavioral changes, we investigated pre-pregnancy BMI in relation to patterns of neurobehavioral development from the fetal to toddler period, and brain functional connectivity during the neonatal period. Methods: Seventy-two 3rd trimester pregnant women, aged 14 to 19, were recruited from Columbia University Medical Center. Their pre-pregnancy BMI was determined from chart extraction of weight and height. They received routine prenatal care and had no major health problems. At 34-37 weeks of gestation, the women underwent diagnostic evaluations and fetal assessments included heart rate (FHR) and heart rate variability (FHRV). At 14 months postmenstrual age the children participated in the Bayley Scales of Infant and Toddler Development, Third Edition (BSID-III). For 45 neonates, resting-state functional MRI were acquired and standard preprocessing was performed. Intrinsic connectivity distribution (ICD) was performed to measure global connectivity on the voxel level. Controlling for infant sex and age at scan, linear regression was used to relate pre-pregnancy BMI to neonatal ICD. Post-hoc seed connectivity was performed to explore which specific connections most likely contributed to the ICD findings. Results: All neonates were appropriate for gestational age (birthweight: 3206.9 ± 461.3 kg, gestational at birth: 39.3 ± 1.3 weeks) and were scanned at 42.5 ± 1.7 weeks postmenstrual age. The majority of participants were male (61.1%). Pre-pregnancy BMI was not correlated with birth weight or length, and was marginally significant with head circumference at birth ($r=0.24$, $p = 0.06$). Pre-pregnancy

BMI correlated positively with FHR ($r=0.39$; $p=0.02$) during the 3rd trimester, and the BSID-III Self-Direction ($r=0.61$, $p=0.001$) and Socialization ($r=0.45$, $p=0.02$) scales at 14 months. A positive correlation between pre-pregnancy BMI and global neonatal connectivity in the left thalamus was observed. Using the thalamic region as a seed, higher pre-pregnancy BMI was associated with greater local thalamic connectivity and lower fronto-thalamic connectivity. Conclusions: Similar to findings in adults in which BMI and the thalamus are associated, we observed this association across a generation - between maternal pre-pregnancy BMI and neonatal thalamic functional connectivity. The thalamus is involved in integration and regulation of sensorimotor processing. Maternal pre-pregnancy BMI also correlated positively with fetal behavioral indices of autonomic nervous development and measures of social and adaptive development on the BSID-III. Future research incorporating additional metabolic measures that may contribute to maternal BMI and prenatal brain development is needed to explain the role of pre-pregnancy BMI on neurodevelopment.

C: Perception

P3-C-39 Visual temporal integration windows are longer in 2-year-old toddlers with ASD

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Recent diagnostic criteria for Autism Spectrum Disorder (ASD) include sensory processing differences (APA, DSM-V). These symptoms have an important role in ASD etiology and 'downstream' social and cognitive processes (Robertson & Baron-Cohen, 2017). Previous work on visual spatial processing suggests that individuals with ASD focus on local image features at the expense of a global representation. Of course, spatial processing is just part of the story: the visual system receives a flow of information that must be organized, over time, into meaningful objects, scenes, and events. Indeed, a recent meta-analysis argued for a shift from spatial to temporal explanations for differences in perceptual organization, suggesting that individuals with ASD take longer to construct global representations (Van der Hallen et al., 2015). The period in which visual input is combined into a singular percept is the Temporal Integration Window (TIW). If two events fall within the same TIW, they are integrated; if they fall in different windows, they are segmented. Shorter TIWs, then, facilitate perceiving rapid change, and longer TIWs, information accrual. We measured TIWs in typically developing (TD) toddlers ($N=34$), and toddlers diagnosed with ASD ($N=13$), between 18-36 months, using an innovative visual search

task. Since this task used a pop-out target, no instructions were required. Instead, gaze was monitored, and a trial was considered correct if the target was fixated within the fixed presentation period. Trials consisted of a 4 s sequence of two displays (ABAB...), each exposed for a parametrically-varied stimulus-onset asynchrony (SOA). Each display had a 4x4 virtual grid that could be occupied by stimuli. On integration trials, Display A consisted of 8 half-circles, and Display B consisted of 9 half-circles in previously empty locations (Figure 1). The displays, viewed alone, had no visible target, but if integrated over time (A+B), two half-circles, one from from each display, aligned to form a full-circle integration target against a field of half-circles. So, if (and only if) a toddler perceptually integrated the displays would the target be visible and draw his/her gaze. On segmentation trials, Display A consisted of 15 half-circles, while Display B consisted of 15 complementary half-circles, plus one full-circle segmentation target. Combined, this appears as a field of undifferentiated circles, but if segmented, the circle target is visible (again, against a field of half circles). SOA was dependent on trial type (integration: 33 or 67 ms; segmentation: 133 or 267 ms), mixed within a block of 32 trials. Longer SOAs make the integration target harder to spot, but the segmentation target easier. This allowed us to pinpoint participants' TIWs by measuring the 'crossover point' where these two functions intersect (Wutz et al., 2016). TIWs in toddlers with ASD were significantly longer than in TD controls (ASD: M=104.7 ms, SD=32 ms; TD: M=86.6 ms, SD=22 ms; Figure 2). Slower temporal processing early on in ASD can have cascading consequences for processes that rely on well-adapted timing, such as visuomotor control, action sequence perception, and/or pragmatic aspects of communication, such as interactional synchrony.

P3-C-40 Spatially and height-pitch congruent sounds support young infants' perception of object persistence across occlusion

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As objects move, we track them and perceive their persistence even if other objects temporarily hide them, but young infants do not always perceive the continuity of temporarily hidden objects. Intermodal information can facilitate infants' perception of object persistence. For example, in the case of an object moving on a horizontal trajectory, congruent moving sound appears to enhance 4-month-olds' perception of continuity across occlusion (Bremner et al., 2012). Additionally, however, we know that 4-month-old infants spontaneously associate sound pitch with visual height (Walker et al., 2010) and it is possible that this correspondence would also support perception of object persistence.

Here, we examined the effect of presenting bi-modal (visual and auditory) sensory information, both congruently and incongruently, for a vertical moving object occlusion event, in two experiments. Sixty-eight 4-month-old infants (34 female) were tested for perception of persistence of an object moving up and down, passing at each translation behind a centrally placed occluder. Infants were exposed to these visual events accompanied by (a) no sound, (b) spatially co-located sound, or (c) congruent or (d) incongruent pitch-height correspondence sounds. Then, with the occluder removed, they were tested on continuous vs discontinuous object movement events (Figure 1). If they perceive the habituation trajectory as continuous, they should look more at the discontinuous test event. This preference was shown in experiments with spatially co-located sound, $F(1, 14) = 9.204$, $p = .009$, and congruent pitch-height sound, $F(1, 16) = 6.397$, $p = .022$, conditions. However, this was not found in the no sound ($p = .557$) or the incongruent pitch-height sound ($p = .481$) conditions. Overall, this suggests that infants' perception of the persistence of an object moving on a vertical trajectory can be supported by both spatially and pitch-height congruent sounds. These results highlight the importance of taking a multi-sensory approach to infant perceptual development.

P3-C-41 Sequence processing at birth: electrophysiological activity while listening to structured and random sequences of syllables

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Previous research has shown that since birth infants have remarkably abilities for the detection of regularities in sequentially presented information (Teinone et al. 2009, Bulf 2011, Kudo et al. 2011). Nevertheless, how this is implemented in the brain and the information infants actually extract from the input remains fully unknown. In a recent study using Near Infrared Spectroscopy (NIRS) by implementing a modified version of a well-established speech segmentation task (Saffran et al. 1996), we demonstrated that neonates can extract and recognize words from part-words after a brief familiarization (Flo et al. submitted). Moreover, we found functional connectivity patterns, which predicted learning and a different functional connectivity dynamics while neonates hear continuous flat speech built by concatenating four three-syllabic words vs. random syllables and resting state. However, due to the low temporal resolution of NIRS we could not investigate the relation between the temporal structure of the stimuli and the temporal structure of the brain activity. Recent studies on infants (Kabdebon et al. 2015) and adults (Ding et al. 2015) using EEG and MEG, show that even quite abstract temporal

patterns of the stimuli are reflected in the brain activity. In present the study, we used EEG to investigate the existence of brain activity locked to the words. In addition, we investigated, which information, infants encode and used to recognize the words after learning. We recorded EEG activity during (a) resting state, (b) while infants hear a random sequence of syllables, (c) during a familiarization with a structure stream of syllables built by concatenating four three-syllabic words, (d) and during the presentation of isolated test words after the structured familiarization. The test words violate (or not) the structure of the familiarization stream in different ways, enabling to investigate which information infants encode (Fig.1.A). In order to explore the link between the pattern of activity and the stimulus, we plan to perform an analysis of the activity in the frequency domains. We expect to find an increase in power at the frequency corresponding to the frequency rate of the syllables (4Hz) during the random and structured stream, and crucially an increase at the frequency rate corresponding to the words during the structured familiarization (1.33Hz). To investigate how the information is encoded we plan to analyze the Event Related Potentials (ERPs) towards the different test words. If a representation of the words is created -therefore, the first syllable should be encoded as such--we expect to find a differential response between Words and Part-words, and Words and Rule-words, while the activity towards Rule-words and Words should differ later. So far, we have tested 30 neonates (1-4 days-old). A preliminary analysis shows an increase in power at the frequency corresponding to the syllabic rate (4.00Hz) during the random and the structure streams, and a smaller increase at the frequency corresponding to the word rate (1.33Hz) during the structure stream (Fig.1.B). By using a special filter, a preliminary analysis shows a differential response for Words and Part-words (Fig.1.C).

P3-C-42 Detection of illusory contours: Eye-tracking data provides insight into young children's visual development.

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Visual processing of illusory contours is influenced by inducer size and spacing. The ratio between these two factors, defined as the support ratio, is related to interpolation strength and reaction time (Shipley & Kellman, 1992). Despite conflicting evidence regarding children's sensitivity to illusory contours, it appears that by 8 months of age, infants have the ability to perceive a Kanizsa square (Csibra, Davis, Spratling, & Johnson, 2000). Differences in children's sensitivity may be related to the size of the support ratios

used, and sensitivity appears to improve with age and experience (Otsuka et al., 2004; Sireteanu, 2000). Hadad, Mauer, and Lewis (2010) found that children show adult-like patterns by the age of 9, and that children under 6 years appear to process illusory contours differently than adults. Our current study was intended to develop a technique for testing illusory perception in children 2-6 years of age, by adapting a touchscreen task to an eye-tracking approach. The following experiments used support ratios ranging from 0.1 to 0.5. Exp. 1 was conducted with adults using a touchscreen. Participants were presented with a 5x4 array of Pac-Men arranged to display a Kanizsa square among other randomly oriented inducers. In addition to manipulating support ratio, we also manipulated the visual angle of the display in order to measure the effect of spatial frequency on illusory contour perception. Subjects performed the experiment with an accuracy of 99.5% across all support ratios. Given the overall high accuracy in Exp. 1, in Exp. 2 a mask replaced the array of Pac-Men after 400ms. Participants were instructed to touch the space where the Kanizsa square was located once the mask appeared. Adults showed the greatest decline in accuracy between the support ratios of 0.15 and 0.2. We are currently collecting data in children ages 2-6. We expect that younger children will show worse performance than adults and that the youngest children will require the higher support ratios in order to perceive the contour. In order to investigate this question in younger children and infants, Exp. 3 used the same stimuli as Exp. 2, but an eye-tracker measured performance. Participants are instructed to make a gaze-contingent response to the Kanizsa square in this test. Data collection is currently underway for Exp. 3 with adults and 2- to 6-year-old children. Saccades to the target square will be used to calculate response accuracy and timing. Based on previous research (Hadad et al., 2010; 2015; Otsuka et al., 2004), we expect an age-related decline in performance, particularly at lower support ratios as is seen with adults. Additionally, eye-tracking measures (e.g., initial saccade) may provide insights into online processing of illusory contours (Nayar, Franchak, Adolph & Kiorpes, 2015). Our data will provide more precise comparisons between young children and adult's perception of illusory contours and in the understanding of early perceptual development.

P3-C-43 Watch and Listen - a cross-cultural study of audio-visual-matching behavior in German and Swedish talking faces in early infancy

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Previous research has shown that perceptual narrowing as a consequence of experience plays a crucial role when infants acquire their native language. Prosody is posed as an early factor to differentiate between various languages. However, empirical evidence exists that young infants are able to discriminate languages by processing and integrating rather subtle language properties. The present study aimed to investigate how infants process two close languages, German and Swedish, differing not in prosody but in phonetic and phonological attributes. Based on the assumption that Swedish and German infants process these language cues similarly, we expect the 4.5-month-olds to increase their looking time to the silently talking face corresponding to the language they listened to before in case of their native as well as a non-native language. However, at 6 months of age, we expect that infants will look longer at the silently talking face corresponding to the language they listened to before in case of their native, but not in case of the non-native language, since their perception has been narrowed in direction to their mother tongue. We tracked eye-gaze of German and Swedish infants cross-culturally twice, first with 4.5 months ($n = 82$, $M = 138.96$ days, $SD = 4.35$, females = 43) and second with 6 months of age ($n = 82$, $M = 183.9$ days, $SD = 4.89$, females = 43) in an intersensory matching procedure. Infants watched and listened sequentially to side-by-side presentations of visual (mouth movements) and corresponding auditory fluent speech in their respective native or non-native language. In the test phase infants saw two faces with German or Swedish mouth movements presented side-by-side. Looking times indicated that even in close languages and in the absence of temporal synchrony, 4.5-month-old German and Swedish infants were able to match the fluent speech they listened to beforehand, to the corresponding mouth movements in their native as well as in the non-native language by fixating the corresponding face significantly longer ($t(81) = -2.855$, $p = .005$). The 6-month-old German infants were still able to match these audio-visual cues in their native ($t(20) = -2.599$, $p = .017$), but not in the non-native language anymore ($t(23) = .625$, $p = .538$), the same pattern as in the Swedish infants for their respective native ($t(15) = 2.255$, $p = .040$) and non-native-language ($t(20) = -1.303$, $p = .207$). A mixed ANOVA yielded a significant age (4.5 and 6 months) effect, as well as an age (4.5 and 6 months) \times condition (baseline and test trials) \times auditory group (Swedish and German) interaction ($F(1,78) = 6.326$, $p = .014$), indicating that after the infants listened to a certain language the 4.5-month-olds looked longer at the corresponding face, but the 6-month-olds only cross-modal match their native language, albeit reflected by a familiarity preference in the German and a novelty preference in the Swedish infants. Hence, it can be assumed that in addition to prosody, 4.5-month-old infants either rely on phonological and phonetic attributes or on subtle prosodic cues even in prosodically similar languages to cross-modal match them audio-visually. The current findings add

evidence for the emergence of perceptual narrowing and are discussed with regard to uni- and multisensory processing of particular language attributes. Finally, our data opens practical implications for early hearing aids.

P3-C-44 Development of category formation of face gender of other-race faces in 3-and 9-month-old infants

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Faces can be categorized along various dimensions (e.g., gender, race, etc.), and this ability develops early in infancy. The development of categorization is not linear, and is heavily influenced by real-life perceptual experience. For example, asymmetries are commonly reported in the development of categorization of face gender (Quinn, Yahr, Kuhn, Slater, & Pascalis, 2002; Ramsey, Langlois, & Marti, 2005) or face race (Anzures, Quinn, Pascalis, Slater, & Lee, 2010; Quinn, Lee, Pascalis, & Tanaka, 2016) likely due to infants' greater experience with female faces and with own-race faces (Rennels & Davis, 2008; Sugden, Mohamed-Ali, & Moulson, 2014). Thus, infants seems to demonstrate an advantage in processing the most frequently encountered categories, and increasing difficulties in discriminating individuals among unfrequently encountered categories (i.e., categorical perception, Anzures et al., 2010). So far, however, infant categorization studies have focused on facial attributes in isolation but the interaction between these attributes in the categorization process remains poorly understood. We investigated the interaction of two facial attributes, gender and race, in category formation. In particular, we examined the development of category formation for male and female other-race faces in 3, 9 and 12-month-old Caucasian infants. Thirty-six 3-month-olds, 36 9-month-olds, and 40 12-month-olds were familiarized with Asian male or female faces (presented at the rate of two per trial for four 15-s trials), and then tested with a novel exemplar from the familiarized category paired with a novel exemplar from a novel category (two 10-s trials). Initial findings showed asymmetrical patterns of behavior in all age groups (see Table 1). Three-month-olds did not show any novelty preference after familiarization with Asian male faces, but showed a preference for Asian female faces after familiarization with Asian female faces (i.e., familiarity preference). At first glance, this result suggests a preference for Asian female faces, as 3-month-olds typically display a preference for female faces (Quinn et al., 2002). However, several studies have shown that own-race female face preferences did not extend to other-race faces when preferences were assessed with

classical visual preference procedure, i.e., without familiarization phase (Liu et al., 2015; Quinn et al., 2008). A possibility is that familiarization with Asian female faces could have activated the representation of female faces leading to the emergence of a preference. By contrast, 9- and 12-month-olds familiarized with Asian male faces showed a novelty preference for a novel Asian female face, but showed no novelty preference for a novel Asian male face after familiarization with Asian female faces. These results suggest that infants formed a category of other-race female faces more inclusive than the category of other-race male faces, maybe indicating a representation of female faces more enriched than male faces due to their extensive experience with own-race female faces. Another interpretation is that the infants did not form any category because the female faces, by virtue being more frequently experienced, are more likely to be responded to as individuals and less likely to be responded to as a category. Overall, the findings suggest that even by the end of the first year infants are not fully able to form category representations of male and female other-race faces.

P3-C-45 The Development of Infants' Expectations for Event Timing

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The ability to process and incorporate temporal information into behaviour is necessary for functioning in our environment. Previous research has extended adults' temporal processing capacity onto infants (e.g., Addyman, Rocha, and Mareschal, 2014; Brannon, Libertus, Meck, & Woldorff, 2008; Colombo & Richman, 2002). For example, Adler, Haith, Arehart, and Lanthier (2008) demonstrated that infants can perceive and discriminate differences in the overall temporal rate at which events occur, but found no evidence that the infants could discriminate the timing of individual events. Little research, therefore, has examined young infants' capacity to discriminate the millisecond timing of individual events and then incorporate that temporal information into their behaviours, even though temporal parameters are inherent to any and all information that is processed. The present study examined 3- and 6-month-old infants' ability to process temporal durations of 700 and 1200 milliseconds by means of a task called the Visual Expectation Cueing Paradigm (Baker, Tse, Gerhardstein, & Adler, 2008). In this paradigm, two possible cues are randomly presented, but each one predicts with 100% validity the presentation of a target on a particular side of a screen, and infants' percentage of correct anticipatory saccades is measured. In the present study, two distinct time durations (700 and 1200 milliseconds) were applied with the same central visual cue, but each randomly applied

temporal duration parameter predicted a visual target appearing on either the left or the right of the screen. If 3- and 6-month-old infants could discriminate centrally-presented distinct temporal cues, then they would be able to correctly anticipate the location of succeeding targets at a rate above chance. Results indicated that 6- but not 3-month-old infants were able to successfully discriminate and incorporate temporal information into their visual expectations of temporally predictable events. That 3-month-old infants could not discriminate the distinct timing, consistent with what was found by Adler et al. (2008), suggests that there is a developmental transition in temporal processing between 3 and 6 months of age that may be due to maturation of the brain areas and the emergence of a functional demand for distinct millisecond time processing.

P3-C-46 Discrimination of Novel Objects in Infants and Adults

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Many research designs in developmental psychology use novel objects that researchers have created as a means to control infants' prior experience and the knowledge infants bring to the task (Horst & Hout, 2016). While we know that infants can discriminate stimuli differing in colour, shape and orientation, few studies have looked at how infants' abilities may be different from that of the adults who design novel stimuli. In part, this is because it is difficult to test infants in the long and extensive studies that are typically used with adults to establish the psychometric properties of stimuli (Huettenlocher and McMurray, 2010). Here we introduce a new task based on Ross-Sheehy (2003), that can be used with both adults and infants on the same stimuli and thereby enables comparison of discrimination with fine-grained stimulus changes. We also present data showing similarities and differences in the discrimination abilities of adults and infants in this task. Short trials consisting of 1) a gaze-contingent attention grabber, 2) a memory array, 3) a retention interval, 4) a test array, and 5) a movie reward (Figure 1) were presented to Infants between 12- and 30-months and adults. Three sets of novel objects with well-controlled metric shape, colour and orientation properties were constructed. Shapes were defined by radial frequency components (Zahn & Roskies, 1972) that provide an evenly parameterized similarity space without category boundaries. Colours were sampled from a 360° continuous space (CIE*Lab 1976). Rotating each shape around its major axes of elongation generated orientations. Each set differed only on the examined dimension and were all the same on the other two dimensions. Within the examined dimension, adjacent stimuli differed by 15 degrees for a total of four discrimination steps. Eyes and legs are added to the objects

to maintain infants' interest. There were 72 trials in 6 blocks that contained a test of each dimension and each step size. Ninety-four children and forty-three adults participated. Adults completed all 72 trials. Infants were run in as many trials as they would tolerate. The blocked design ensured that all infants contributed some data to all cells. Analysis compared looking to the change versus no-change side of the test array based on Areas of Interest (AOI) that surrounded each object. Mixed models including random items revealed adults discriminated objects differing by 15 degrees in shape, colour and orientation and looked more with increasing step size for all three dimensions (Figure 2). However, adults demonstrated overall less looking to the shape changes compared to the other dimensions, suggesting that discriminations in shape were harder. Mixed models including random subject effects revealed infants discriminated changes in colour and orientation at step size 3 (45°) and 4 (60°) but did not discriminate changes shape (Figure 2). Analysis of developmental differences is ongoing. Our work suggests important differences in discrimination by adults and infants with well controlled stimuli. It also demonstrates a new task to probe infant discrimination across multiple dimensions and fine-grained stimulus changes, for comparison across development.

P3-C-47 Infant Characteristics Predict Data Usability

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Despite having methodologies adapted to infant abilities, the data deletion rate in infant research is 25%. Studies published in *Infancy* within the last two years indicated data not included in analyses were often due to fussiness, being off task, and inability to calibrate eye-movements. If infants with certain characteristics are systematically excluded from data analyses, it would reveal how generalizable results are. We examined whether the following infant characteristics predicted calibration, providing useable data, and completing study tasks: demographics, temperament, physiology (respiratory sinus arrhythmia [RSA]), and motor development. Temperament and RSA indicate emotional reactivity and regulation (Richards, 1987; Rothbart et al., 1992) and changes in motor development influence behavior (Campos et al., 2000). We assessed 6- to 10-month-olds' (N = 235) visual preferences for and recognition of Black and White female and male faces. Prior to testing, parents completed surveys regarding their infant's temperament (Infant Behavior Questionnaire-Revised; Garstein & Rothbart, 2003), and motor development (Bodnarchuk & Eaton, 2004). During the tasks, we measured infant looking via Applied Science Laboratories D6 Desktop/Remote Eye Tracker and their respiratory

sinus arrhythmia using BioPac's MP150 system. Research assistants coded whether infants 1) were successfully calibrated; 2) provided full, partial, or no useable eye tracking data for each task; and 3) completed each task regardless of eye tracking data usability. Using Spearman's rho, we found only age, preterm status, surgency, and negative affect were significantly related to the dependent variables (Table 1). Using multinomial regression analyses, we examined how those four variables predicted our dependent measures. Only infants' preterm status predicted calibration, $X^2 = 7.68$, $p = .006$. We more often obtained successful calibration for full-term infants, $X^2 = 113.86$, $p < .0001$, $M = .87$, $SE = .02$, than preterm infants, $X^2 = 1.50$, $p = .221$, $M = .62$, $SE = .10$. Only surgency predicted useable data in the visual preference task, $X^2 = 7.79$, $p = .020$. Those who provided partial data had lower surgency than those providing full data, $p = .005$, or no data, $p = .023$ (Figure 1). Nothing predicted completing the visual preference task. Only negative affect predicted useable data in the recognition task, $X^2 = 13.64$, $p = .001$. Babies who provided partial data had significantly lower negative affect than those with no data, $p = .002$, but did not differ from those who provided full data (Figure 1). Only negative affect predicted who completed the recognition task, $X^2 = 8.77$, $p = .003$. Infants who completed the study had significantly lower negative affect, $M = 3.84$, $SE = .07$, than those who did not, $M = 4.27$, $SE = .13$, $p = .004$. Results suggest it will be more challenging to conduct eye-tracking studies with preterm infants than full-term infants given the difficulty in calibrating their eye movements. Moreover, because temperament predicts the amount of data infants provide, it suggests face recognition findings might not generalize as well to infants high in negative affect. These data provide insight regarding which infants' data get analyzed.

P3-C-48 Development of Korean infants' fricative perception: comparison across different vowel contexts

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The present study reports a unique set of data on early developmental pattern of Korean fricative contrast discrimination. In comparison to stop sound categories, only a few studies have tested infants' abilities to discriminate fricative sound categories. And these studies on fricative perception have been limited to English fricatives and small samples of English-learning infants (e.g., Eilers & Minifie, 1975; Eilers, Wilson, & Moore, 1977; Eilers, 1977). Unlike English and many other languages, Korean uses fricative contrasts that are both voiceless and voiced. No studies thus far have examined Korean infants' developmental pattern of these voiceless fricative contrasts. There have been some reports, however, on

the development of fricative sound production among Korean children (e.g., Kim & Stoel-Gammon, 2011), showing that the production of fricative sounds develops later compared to other sound categories and that Korean children's production of fricatives in [i] vowel context is mastered earlier than other vowel contexts, such as [a] (Cheon & Lee, 1999). Using a visual habituation-dishabituation paradigm (Stager & Werker, 1997), we tested 4-9-month-old Korean infants' ability to discriminate lenis fricative [s] from fortis fricative [s*], across two different vowel contexts, [a] and [i]. Similar to English fricatives, frication noise duration and aspiration duration are known to be the key acoustic cues in the categorization of these sounds. But unlike English, fundamental frequency does not play an important role in Korean fricative perception (Chang, 2013). We tested 21 4-6-month-olds and 23 7-9-month-olds on [sa]-[s*a] pair and found that only 7-9-month-olds looked longer at the switch trials than the same trials, indicating that they could discriminate these sounds. The younger group of infants' looking times between the same/switch trials were not reliably different, suggesting that their discrimination ability is not yet developed (see Figure 1). When additional 31 4-6-month-olds were tested on [si]-[s*i] pair, the results diverged by the infant's gender: while girls showed reliable difference in looking time, boys did not show any signs of clear discrimination of the fricative sound pair (see Figure 2). Tests on the older group are currently on-going and with 20 7-9-month-olds, tested thus far, we have not observed clear signs of [si]-[s*i] discrimination yet. The developmental pattern of voiceless [sa]-[s*a] fricative pair discrimination seems to be similar to that of English infants who were reported to begin distinguishing [s]-[z] sound categories after about 6 months (Eilers, Wilson, & Moore, 1977). Interestingly, these results show that Korean infants' discrimination of fricative sounds develops earlier than Korean lenis-aspirated stop distinction abilities that do not develop until 10 months (Choi et al., 2017). However, the mastery of fricative sound production lags behind stop sounds. With these findings, we will discuss the potential role of acoustic parameters and vowel contexts in the development of speech perception, and the role of maternal phonetic input to the child.

P3-C-49 Two-year-olds' expressive vocabulary and their mouth preference at 6 months of age: Effects of modality and familiarity

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Infants' attention to moving faces has been linked to language development. Young et al. (2009) reported that 6-month-old infants' visual preference to the mouth over eyes of

their mothers' faces predicted expressive language skills at 24 months. Familiarity of the speaker may offer a mechanism through which infants' visual and auditory attention is maintained in order to heighten the perceptual learning experience during mother-infant social interaction. However, prior research has varied greatly in the types of stimuli presented to infants, including infant- versus adult-directed speech, various modalities, and familiar versus unfamiliar speakers (e.g., Hunnius & Geuze, 2004; Lewkowicz & Hansen-Tift, 2012; Salley et al., 2010). The current study sought to tease apart the relative effects of modality, speech style, and familiarity by presenting 6-month-olds with either their own mothers' faces (Familiar group) or another woman's face (Unfamiliar group), while viewing a series of multimodal stimuli of ID and AD speech (audiovisual, visual-only with a silent video, and audio-only with a still image of the face). Infants' visual fixation patterns were tracked on a Tobii eye-tracker in three 10-s trials, and Eye-Mouth Index (EMI) scores were calculated as fixation duration to eyes versus mouth, with scores above .50 indicating Eye preference and below .50 indicating Mouth preference (Merin et al., 2007). Expressive language was assessed with the MacArthur-Bates CDI when the infants were 24-months-old ($n = 30$). We found a moderate negative correlation between expressive vocabulary size ($M=295$ words spoken, $SD=197$) and EMI score when viewing the ID visual-only (silent) videos ($M=.39$, $SD=.31$), $r(28) = -.39$, $p = .04$; that is, 6-month-olds with a Mouth preference had higher expressive vocabulary scores at 2 years of age (Figure 1). ID faces elicited attention to the mouth in these infants, despite the lack of ID audio (Shepard et al., 2012). When analyzed by familiarity, there was a strong negative correlation between expressive vocabulary size ($M=313$, $SD=201$) and EMI score of infants who viewed their own mothers' faces (Familiar group) during the ID audio-only still face ($M=.57$, $SD=.31$), $r(12) = -.57$, $p = .03$, but not for infants who viewed unfamiliar still-faces with ID audio ($M=.70$, $SD=.34$), $r(14) = .21$, $p = .44$ (Figure 2). Infants in the Familiar group who were stronger language learners may have recognized their mothers' ID audio, despite seeing her still face in the audio-only stimuli, and thus, their attention was directed to the language source--her mouth--regardless of its lack of movement. Finally, a strong negative correlation approached significance for expressive vocabulary size and average EMI score of infants across all of their mothers' ID stimuli ($M=.42$, $SD=.25$), $r(12) = -.52$, $p = .06$, but not for infants who viewed unfamiliar women in the ID stimuli ($M=.49$, $SD=.29$), $r(14) = -.14$, $p = .60$. Overall, these results suggest that the familiarity of a speaker is relevant when predicting expressive language development from infant visual preference.

P3-C-50 Using Multiple Cues in Phoneme Learning

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While 6-mo-olds are able to discriminate certain non-native and native speech sounds, they lose the ability to discriminate non-native contrasts and enhance discrimination of native contrasts by the end of the first year of life (Kuhl, 1979; Trehub, 1976; Werker & Tees, 1983, 1984; Tsushima et al., 1994; Khul et al., 2006). A sensitivity to the frequency distributions of phonetic tokens has been hypothesized to explain this perceptual narrowing in speech perception (a.k.a. distributional learning). Specifically, in babies, exposure to a bimodal frequency distribution (e.g. along a continuum from [da] to [ta], with highest frequencies at the ends of the distribution) leads to better discrimination of typical [da] & [ta] tokens compared to exposure to a unimodal distribution with a peak centered on the continuum (Maye, Werker, & Gerken, 2002). However, in the real-world, infants often face acoustic variations from multiple speakers. Little is known about how infants use the distributional information in these situations. In this study, we ask whether infants can integrate three different cues: frequency distribution, multiple speaker voices, and multiple speaker faces, in order to infer appropriate underlying phonemic categories. In Experiment 1, we replicated studies by Maye et al. (2002) and Yoshida, Pons, Maye, and Werker (2010) to examine infant's ability to use the distributional information. Six to 10-mo-olds were exposed to an eight-step continuum from Hindi [ba] to [pa], with a unimodal or bimodal distribution in familiarization, and tested for their sensitivity to alternating (e.g., tokens 3 & 6) and non-alternating (e.g. token 3 or 6) test trials from the continuum. In the second experiment, another group of 8-10-mo-olds was presented with two different faces accompanying two bimodal [ba]-[da] continua recorded by two speakers of Hindi in familiarization, and tested their sensitivity to the two types of test trials produced by a novel speaker. Data collection is ongoing. Preliminary results suggest that, in Experiment 1, infants in both conditions didn't show different looking times between alternating and non-alternating test trials (Figure 1 in left panel). In Experiment 2, although the similar results were observed as experiment 1, infants showed longer looking times in non-alternating than in alternating test trials (Figure 1 in right panel). If this pattern of results holds up, it would suggest that 8-10-mo-olds might be able to make inferences about phonemic categories by using multiple information sources. Additionally, we have developed a hybrid eye-tracking/video-coding paradigm in which looking time data is simultaneously acquired using a video-coding system and a remote eye tracker, allowing us to cross-validate our results. We will be discussing the reliability of our experimental results by comparing eye-tracking and video-coding data.

P3-C-51 Top-down information boosts infants' face perception

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Studies investigating the role of top-down information in infant learning have largely focused on top-down facilitation of visual search tasks, in which relevant cues enable infants to predict the location of an object and orient to it faster. These studies show that cues can affect infants' overt attention but do not show that top-down information can directly affect perception. This is a matter of both theoretical and functional importance as it would indicate that learned information can directly influence how sensory information is processed starting early in life through top-down neural connections (Emberson et al., 2015). In this study, we examined whether learning a novel audio-visual association can enable infants to boost their visual perception when the auditory cue is present. Twenty-seven infants from 10 to 13 months of age participated in the current study. They learned two audiovisual associations: between faces and Sound A (e.g., guitar C#), and between flowers and Sound B (e.g., tuba F). Then, we tested infants' visual perception of faces when they heard Sound A (Congruent condition) vs. Sound B (Incongruent condition). In each test trial, infants saw a string of visual masks on each side of a computer screen. A face image appeared briefly within the string of visual masks. The side and time of the face appearance were randomized across trials (Figure 1). A successful detection of the face would result in a visual preference to the side of screen where the face is present. Crucially, if infants can use Sound A to boost perception accordingly, they should exhibit better orienting to the side (e.g., longer looking) where the face is present compared to Sound B. Moreover, the face in the test trials was presented with 3 durations: 100, 150, and 200 ms, which allowed us to examine the top-down effect associated with various availability of bottom-up face signal. Both the congruency and face presentation durations were within-subject variables. To examine whether infants are able to detect the face at these presentation durations, a one-sample t-test comparing the proportional looking time to the face side ($\text{Time}[\text{face-side}] / (\text{Time}[\text{face-side}] + \text{Time}[\text{non-face-side}])$) against chance level (50%) was performed for each presentation duration condition. Results showed that infants reliably orient to the side of the screen where the face is presented with each the three presentation durations ($p \leq .011$). To determine how top-down information (i.e., sound congruency) affects face detection, a paired-sample t-test for each of the three presentation durations was performed (Figure 2). The congruency effect emerged when the face was shown for 200 ms ($p = .023$), with infants looking longer to the faces in the congruent than the incongruent condition ($p \geq .162$ for 100ms and 150ms durations). This congruency effect indicates that infants can use an auditory cue to boost visual perception directly rather than using this cue to guide

attention, as has been established in previous studies. More broadly, the current study extends current understanding of the relation between learning and perception in infants: learning does not merely develop concurrently with perception, but it also supports perception by offering the ability to swiftly adjust perception according to top-down information.

P3-C-52 Exploring the development of race categorization in preschoolers and adults with a morphing face card sorting task

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Background: The other-race effect (ORE) refers to a collection of observations that human process faces of own-race differently from faces of other unfamiliar races. In contrast to the abundant literature of ORE in children and adults, the other-race categorization advantage--people are generally faster at categorizing other-race faces-- is less well understood. The present study adopted bi-racial (East Asian and Caucasian) morph face images as stimuli, aiming to explore the development of race categorization in 3- to 7-year-old Taiwanese children and adults as a comparison group. **Methods:** A total of 64 3- to 7-year old children (36 females) and 60 adults participated the study. Two pairs of Caucasian and East Asian faces (2 males, 2 females), with a frontal pose and neutral expression, were morphed by FantaMorph 5.0. The morphed images were then oval-cropped and converted to greyscale. Four series of the morphed faces were created and printed out on a 3-inch by 5-inch cardboard paper. Each series contained 11 face images: A100/C0 (100% Asian), A90/C10, A20/C80, A30/C70, A60/C40, A50/C50, A40/C60, A30/C70, A20/C80, and A0/C100 (100% Caucasian). The race categorization task was conducted in a forced-choice fashion; both children and adults were asked to categorize each of the face images as either Asian or Caucasian by putting the cards (facing down) in two separate bins. The presentation sequence of the face image cards in a given set was randomized among participants. **Results.** Across all ages, the probability of sorting a face image to the "Asian" bin increased substantially as the morph level containing the Asian-parent increased, with 3 and 4-year-olds showing a shallower function and other children and adults exhibiting a shaper transition. Both the children and the adults categorized the 0%-40% Asian morphing faces as "Caucasian," whereas the 60%-100% Asian morphing faces as "Asian." Importantly, for the 50% face (physically half Asian and half Caucasian), the adults' and children's responses diverged significantly; adults tended to categorize the 50% morphing face as a "Caucasian" face, while 3- to 7-year-olds

consistently judged it to be more like an "Asian" face. This finding was further confirmed with the curve fitting procedures estimating the point of subjective equality (PSE) in children and adults. In sum, the present study revealed a developmental change in race categorization tendency between 3- to 7-year-old children and adults. The interplay between race categorization bias and the development of the other-race effect in preschool years will be further discussed.

P3-C-53 Phonetic discrimination in noise: infants' use of temporal acoustic information

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Speech perception requires efficient auditory mechanisms to track differences in the spectro-temporal cues differentiating phonetic contrasts. In adults, slow (< 16 Hz) temporal envelope cues (or amplitude modulation, AM) play the most important role in speech identification in quiet. The fast AM cues and the temporal fine structure (or frequency modulation, FM) play a more important role in noise. The present study aims to explore the role of AM cues on two different time scales (below and above 8 Hz) in phonetic discrimination in 3-month-old infants. Previous studies showed that the detection of AM may be mature around 3 months of age. Thus, 3-month-old infants may be able to discriminate phonetic contrasts on the basis of slow and fast AM cues. However, it is not clear whether infants are able to switch between slow and fast AM cues in different listening conditions. English syllables with different stop consonants are processed by two tone-excited vocoders to alter the temporal modulation rates. These vocoders selectively replace the original FM cues with pure tones in 32 frequency bands. The AM cues are extracted in each frequency band with two different cut-off frequencies: 256 Hz or 8 Hz. Participants are 3-month-olds (N=58) and 18-30-year-old adults (N=48) with no risk factors for hearing loss. An observer-based testing method is used to assess the ability of individuals to detect a change in consonants. Each participant has to detect a change in a repeating syllable from a non-target phonetic category to a target category: voiced, unvoiced, labial, coronal or velar (see Table 1). Discrimination is tested in quiet or in a speech-shaped noise (signal-to-noise ratio=-5 dB). When participants reach 80%-correct criterion in the AM-256 Hz condition, discrimination is assessed in the AM-8 Hz condition. The findings suggest that 3-month-old infants are able to use slow and fast AM cues to discriminate phonetic contrasts in quiet and in noise. However, results also suggest that phonetic discrimination is easier when fast AM cues are available in both noise and in

quiet (see Figure 1). It is thus unlikely that infants' performance is limited by immature temporal resolution. Nevertheless, more experience with the native language, and thus, with the acoustic cues related to syllabic rate, may improve the use of the slow AM cues for phonetic perception.

P3-C-55 "Greater" makes order visible. Representation of increasing and decreasing magnitude at birth

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In contrast to quantity matching and discrimination, ordinal knowledge in preverbal infants has received little attention. Although such knowledge was typically regarded as emerging during the first year of life through observation of transformations in the environment (e.g., Cooper, 1984), recent studies showed that, at 4 months, infants detect ordinal relationships within size-based sequences (Macchi Cassia et al., 2012) and number-based sequences (de Hevia et al., 2017), provided that magnitude changes follow an increasing order. Although infants needed a larger ratio (1:3) to encode numerical order compared to size order (1:2), in both cases they showed the same asymmetry signature in their sensitivity to ordinal relations, with a processing advantage for increasing over decreasing magnitude. A similar asymmetry signature in ordinal processing has been reported in monkeys, who generalize to new numbers a previously learned increasing order, but fail this generalization for decreasing order (Brannon & Terrace, 2000). The processing advantage for increasing order might have been selected during evolution because it is relevant for survival, and human infants might develop a processing advantage for the ordinal information entailed by looming stimuli as a result of the alerting effect associated to perceptual looming. To investigate the ontogenetic origins of ordinal knowledge, we investigated whether signatures of asymmetrical processing of magnitude information are apparent in 2-day-old infants by testing their ability to discriminate a reversal in ordinal direction following habituation to ascending or descending size-based sequences (Study 1) or sequences providing multiple converging (numerical and non-numerical) cues to ordinality (Study 2). Habituation sequences in Study 1 (N=32) included geometric shapes that increased or decreased in size, while test sequences included newly-sized bars that expanded/contracted along the horizontal axis. Newborns in Study 2 (N=32) were habituated to series of numerical displays (4-12-36; 6-18-54; 7-21-63) presented in ascending or descending order, and were tested with one new set of numerical displays (4-15-45) presented alternately in both ascending and

descending order. Continuous variables, like contour length, density, and total filled area, covaried with number (Fig.1). Data from each study were entered a 2 (habituation condition: ascending, descending) x 2 (test trial order: familiar-novel, novel-familiar) x 2 (test trial pair: first, second) x 2 (test trial type: novel, familiar) mixed ANOVA. The ANOVA for Study 1 did not reveal main effect or interactions involving the factor test trial type ($p > .20$). The ANOVA for Study 2 revealed a Habituation Condition x Test Trial Type interaction, $F(1,28) = 5.31$, $p = .029$: infants in the ascending condition looked longer to the novel ordinal relationships [t-test, $p = .024$], while infants in the descending condition looked equally long to the novel and familiar order [t-test, $p > .30$]. Results show that newborns were capable of detecting a reversal in ordinal direction only when multiple converging cues to ordinality were provided, and when ordinal relationships followed an ascending order. Together with evidence from older infants and non-human animals, these findings support the view of a continuity at both ontogenetic and phylogenetic levels of the underlying magnitude representation.

P3-C-56 Neural sensitivity to natural texture statistics in infancy

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During the first year of life, infant visual recognition becomes tuned to the statistics of visual experience. For example, infants' discrimination of faces is subject to perceptual narrowing: broad abilities to distinguish between faces belonging to out-group categories (non-human primate faces, e.g.) are lost late in the first year of life (Pascalis, de Haan & Nelson, 2002), leading to relatively "narrow" recognition abilities that are limited to faces that infants have frequently been exposed to. There are, of course, many other examples of statistical regularities in infant visual experience that could similarly lead to changes in sensitivity to complex patterns during the first year of life. Indeed, natural images considered broadly have lawful regularities that adult observers are sensitive to. For example, natural images obey a $1/f$ power law for spatial frequency that distinguishes random patches of natural scenes from truly random images (Field, 1999). Adult observers are also sensitive to contrast negation in natural scenes (Balas, 2012), suggesting that violations of local edge polarity also stand out as atypical of natural appearance. To what extent is the infant visual system also tuned to these regularities during the first year of life? In particular, do infants exhibit evidence of perceptual narrowing that ultimately excludes atypical images from fluent processing? We examined this question by measuring ERP responses (P400 and Nc) of 6-month-olds ($N=16$) and 9-month-olds ($N=16$)

to natural texture images and artificial textures created by applying a parametric texture synthesis (Portilla & Simoncelli, 2000) model to our original stimuli. Furthermore, we also applied contrast negation to both of these stimulus classes, allowing us to examine neural sensitivity to two distinct violations of natural appearance: contrast polarity and the loss of global structure following texture synthesis. We predicted that older infants would be sensitive to the difference between natural scenes and their contrast-negated/synthetic counterparts, but might exhibit no differences between different atypical categories. By contrast, we predicted that younger infants would be sensitive to contrast negation and texture synthesis independent of the other stimulus dimension. We tested these predictions by measuring the mean amplitude of the P400 component over occipital sensors and the Nc component over frontal-central sensors and carrying out a mixed-design 2x2x2 ANOVA with contrast polarity (positive/negative) and synthetic appearance (natural/synthetic) as within-subject factors and age group (6-mos./9-mos.) as a between-subjects factor. While the Nc did not exhibit sensitivity to any of these factors, we observed a significant two-way interaction between synthetic appearance and age group ($F(1,30)=4.34$, $p=0.046$, partial $\eta^2=0.126$) such that older infants were sensitive to synthetic appearance but younger infants were not. This outcome suggests that the infant visual system does become tuned to natural image statistics during the first year of life, but also that this process likely continues beyond the first year, as evidenced by the lack of sensitivity to contrast polarity. Thus, despite the ubiquity of natural textures in the visual environment, the developing visual system may learn lawful properties of the visual world on a slightly slower timescale.

P3-C-57 Medial axis structure supports object recognition in infancy

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The same object can produce vastly different images on the retina across changes in lighting, size and orientation. Yet humans come to be able to identify objects rapidly and with ease across all such variations. Prevailing models of vision suggest that successful identification depends on prior visual experience with an object from different viewpoints (Tarr & Bulthoff, 1998). From this perspective, recognition occurs when there is substantial image similarity between the current view of an object and previous views stored in memory. However, alternative models have proposed that recognition occurs with minimal viewpoint experience by creating a sparse, low-dimensional, summary representation of the objects (Biederman, 1987). Indeed, many species, including young

infants (Ruff, 1978) and newborn chicks (Wood, 2016), can recognize objects from previously unseen views. However, it remains unclear how the human visual system accomplishes this feat. In the current study, we assessed whether a model of object structure, based on the medial axis, supports object recognition in human infants. The medial axis is a good candidate model for object recognition because it describes an object's structure via a low-dimensional set of properties (an internal skeleton) that are fairly stable across different viewpoints (Kimia, 2003). Although recent behavioral and neuroimaging studies from our lab suggest that human adults extract the medial axis of objects, it is an open question as to whether the medial axis is extracted early in human development when object experience is far more limited. To this end, we tested for medial axis extraction of unfamiliar 3-D objects across large image-level changes. In Experiment 1, novel objects, matched for complexity, were generated and validated using similarity judgments from an adult sample ($N = 42$). Objects varied in medial axis and surface form (Fig 1a). Surface forms produce large image-level changes, without altering the medial axis. We found that the medial axis model predicted adult judgments, even when controlling for image-level similarity, $r = .27$, $p < 0.001$ (Fig 1b-c). In Experiment 2, infants ($N = 33$; Mage = 10.5 months) were tested in a habituation/dishabituation paradigm with a subset of distinct medial axis exemplars (determined by a cluster analysis) and two surface forms producing the largest image-level changes (determined by a computational model of image similarity). Each infant was habituated to a rotating object (across 60° in depth) and then tested with two objects, with either a familiar or novel medial axis (each test object presented 3 times; counterbalanced order). Crucially, both test objects differed in surface form from the habituated object, necessitating extraction of the medial axis for a successful match (Fig 2a). Results revealed that infants looked significantly longer at the object with the novel medial axis ($M = 7595.59$ ms) compared to the object with the familiar medial axis ($M = 5890.49$ ms, $p = 0.03$; $d = 0.36$, 24/33 infants; Fig 2b), suggesting that infants represented objects on the basis of their medial axis, not surface forms. These findings suggest that, beginning early in development, humans extract the medial axis of objects and, together with our adult findings, provide evidence for continuity of a structural model of object perception.

P3-C-58 What is the Role of Mothers? Infants and Toddlers' Smart Devices Consumption: Maternal Factors as Moderators

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The use of digital media has become a ubiquitous part of our lives and continues to rise. Digital media use is also common among young children, and they are more frequently exposed to smart devices, such as smartphones and tablets. They are becoming 'digital natives' (Shin & Li, 2017). Some researchers, therefore, have begun to assess amount and frequency of digital media use by infants and toddlers, to our knowledge, almost no research exists on what the maternal factors, which lead to young children's overindulgence related to smart devices use. With respect to the young consumers, the role of mothers was noted as one of the most influential factors. Several studies explored the effects of mothers' own media practices and mothers' attitudes towards media on their young children's media use (Lauricella et al., 2015). Specifically, mothers' avid media use as well as positive perceptions about the influence of media on their development was associated with their greater use of media as a parenting tool, and it finally affected to children's high levels of media indulgence. Further, emotional efficacy of mother in relation to their parenting, such as parenting efficacy, plays a role in children's media use, so possibly, digital media may be more indulged by children with mothers with lower levels of parenting efficacy. As a result, this study aimed to examine how mothers' positive perceptions about the impact of media on babies and toddlers' development, and their own parental efficacy moderate the association between mothers' dependency on smart devices and young children's overindulgence in smart devices. The sample consisted of 278 Korean young children aged below 36 months, their mothers completed questionnaires. Measures were included mothers' dependency on smart devices (Lee, 2016), mothers' perception about the impact of smart devices on children (Kwon, 2005), mothers' parenting efficacy (Gross & Rocissano, 1998), and young children's overindulgence in smart devices (Lee, Jung, & Kim, 2015). Hierarchical regression analyses were conducted to examine the relations among variables. Mothers' age, educational attainment, and monthly household income were considered as covariates. Interaction effects were detected as illustrated in Figure 1 & 2. Mothers' dependency on smart devices were significantly related to infants and toddlers' overindulgence in smart devices, and the associations were moderated by mothers' perception about the influence of digital media use on young children's cognitive development, and by mothers' parenting efficacy only related to children's education, respectively. Findings from this study suggest that mothers' smart devices use plays an important role in developing young children's media use, and that both mothers' more positive perceptions about the media impact on children's cognitive development, and their less efficacy in educating children were more susceptible to the children's overindulgence in smart devices use. Based on results, implications related to the parent's zeal for promoting young children's cognitive development from early years of life, and the significant role of mothers' emotional

efficacy regarding parenting, both of which essential to preparing for infants and toddlers' future success in current digital world, will be discussed more in depth.

D: Communication and Language

P3-D-59 Comparing bilingual and monolingual toddlers' sensitivity to coarticulation during spoken word recognition

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The speech input that listeners receive is variable. For example, sounds' articulatory gestures overlaps with adjacent sounds' gestures (Browman & Goldstein, 1989), a phenomenon called coarticulation. While studies with adults showed that coarticulation contributes to word recognition, few studies looked at this with children. For example, Zamuner et al. (2016) found that monolingual English-speaking children (2-3 years-of-age) use coarticulation during word recognition as measured by a looking-while-listening paradigm. However, if we limit research to English, we may misestimate children's skills, as coarticulation and its predictability differ across languages. For example, in English, vowels are nasalized (coarticulated) before nasal consonants (e.g., vowels are produced differently in 'hat' vs. 'han'). However, in French nasal and an oral vowels define lexical distinctions (e.g. paon /pɑ̃/ 'peacock' vs. pas /pa/ 'step'). To have a broader idea of how children process coarticulation, one could investigate whether English-French bilingual children perceive and process nasalization differently than monolinguals, given the different status across the two languages. For example, English-French bilingual children may use nasalization cues when processing English words, as the learner would be exposed to phonetic and phonemic vowel nasality. Studies with bilinguals provide an opportunity to see how two differing levels of phonetic/phonemic awareness interact in the mind (Byers-Heinlein & Fennell, 2014). The current study investigates the interpretation of English nasalized vowels in English-French bilinguals (2-3 years-of-age) during spoken word recognition, and compares the results to published data from monolinguals. Six pairs of words containing a vowel and a nasal consonant (e.g. bone) or an oral consonant (e.g. boat) were chosen, with corresponding images. Vowels were spliced from a non-nasalized word (boat) onto another token (boat) - same-splice - or from a nasalized word (bone) onto a non-nasalized word (boat) - cross-splice. Nine bilingual children (30% to 50% exposure to French for two years or more; Mage = 34 months) completed the looking-while-listening task: an auditory word was presented simultaneously with the images (target - boat - or competitor - bone) while eye

movements were recorded. Figure 1 presents data from monolinguals and bilinguals. Bilinguals' peak in fixations to the target in the same-splice condition is reached earlier (1200 ms after word onset) than monolinguals (1500 ms). Furthermore, the proportions of fixations (%fix) to the target in the cross-splice condition are lower for the bilinguals than for the monolinguals; it seems like bilinguals fixate more the nasalized image (bone) than monolinguals between 700 and 1100 ms, suggesting greater sensitivity to vowel nasalization for bilinguals. Although preliminary, these results indicate differences in how bilinguals process vowels compared to monolinguals (e.g. earlier peak). Furthermore, results suggest that English-French bilingual children are more sensitive to nasalization. Because they are exposed to coarticulatory and contrastive vowel nasalization, their sensitivity may be greater than monolinguals. Not only do they use vowel nasalization to recognize words in English, but they also pay attention to this characteristic in French to discriminate words. This can be taken as evidence of the interaction between multiple languages in bilingual children.

P3-D-60 A Pediatrician Based Intervention to promote language development

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While there are many interventions to facilitate language development for toddlers, few have been documented for pre linguistic infants. A recent study by Suskind et al. (2015) showed significant benefits in parent-toddler interactions after intensive intervention. We adapted Suskind's questionnaire to investigate the effectiveness of a simple book-giving intervention for parents at their infants' 6- and 12- months old well baby visits. We hypothesized that having pediatricians counsel parents to read/share the books with their infants would shift perceptions toward more positive parent-infant interactions. Forty-five families from two pediatric practices in a Shenandoah Valley county have participated in the ongoing investigation. Thirty-five (35) parents and 10 (control group) parents participated. At each infants' 6-month well-baby checkup, a nurse practitioner administered the short questionnaire with 7 statements about parent role perception in (1) promoting infant-directed speech (IDS), (5) reading to their infants, and (1) infant television/video exposure, on a 5-point Likert scale (smaller numbers indicated disagreement). Parents were also given a package of age-appropriate books donated by libraries and local Rotarians. The pediatricians then emphasized the importance of reading for infant language development. When the families returned for the 12-month well-baby

checkup, the nurse practitioner administered the same survey and parents were given another package of appropriate books. We did not directly compare the intervention and control groups since we only have seven complete returned surveys from the controls. By the time of this presentation, we hope to have sufficient questionnaires to make this comparison and to analyze the data by socioeconomic status. Results- Figure 1 documents analysis of parent responses on the two questionnaires. Although variable, the parents significantly shifted their perceptions about IDS across the 6 months, but in a more negative direction. Ratings for the use of books as part of an infant's life were also variable, but no statistical changes occurred between the 6- and 12-month well-baby visits for either the intervention or control groups, suggesting the simple donation of books at the 6-month well-baby checkup, along with pediatrician counsel, did not shift parent attitudes about reading to their babies. Finally, an overwhelmingly negative view of television's role in word learning became even more negative over the 6 months. Conclusion: We concluded that this simple pediatrician intervention did not positively shift parents' perceptions and that more direct interventions are needed to impact the language-learning environments of infants.

P3-D-61 Assessment of Individual Phoneme Discrimination Performance in Dutch Infants using the Hybrid Visual Fixation Paradigm

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Experimental studies assessing infants' perceptual skills often use a paradigm with listening time as the dependent variable. A difference in average listening time between stimuli (conditions) A and B is taken to indicate that infants can detect the difference. Much of our current knowledge of infants' development of speech perception is based on this methodology. Such findings, are based on group results that often include high variation in listening times and a limited number of test trials. This makes it difficult to interpret the data, especially when small sample groups are used. To assess discrimination at the individual level, Houston, Horn, Qi, Ting & Gao (2007) developed the Hybrid Visual Fixation paradigm. This paradigm, containing a habituation and test phase, includes more test trials than typically used in habituation studies, allowing individual analysis. Houston et al. (2007) assessed word discrimination. For each infant, listening times to ten non-alternating (e.g. boodup-boodup) and four alternating (e.g. seepug-boodup) trials were entered in a regression analysis (see Figure 1 for the formula). Eight out of ten 9-month-old infants were able to significantly discriminate between these pseudowords. Their

design and analysis thus seem suitable for assessing individual performance in word discrimination. We applied this design to infants' phoneme discrimination: we used a Dutch vowel contrast (/a:/-/e:/), a vowel contrast that should be easy to discern. Six-to-10-month-old Dutch infants ($n = 117$) were habituated on /fa:p/ or /fe:/p/. After habituation, they were presented with four alternating (e.g. /fa:p-fe:p/) and eight non-alternating trials (e.g. /fe:p-fe:p/). Group level results show discrimination of the contrast: there is a robust effect of Trial Type (alternating, non-alternating) in a mixed-model analysis, $F(1, 916) = 62.59$, $p < .001$, with longer listening times to alternating trials. To assess individual performance, we used the same regression model as Houston et al. (2007, Figure 1). Listening times and statistical outcomes per infant are reported in Table 1. Individual analyses show that listening times to alternating-non-alternating trials were only significant for 15% (18/117). The percentages of infants with a significant difference in listening times is 22% in the 10-month-olds compared to 13% at 6 and 11% at 8 months. This percentage does not come near the 80% that Houston and colleagues obtained. Age cannot (fully) explain the differences between our findings and those of Houston et al. The analysis used cannot account for this difference either, as we were able to replicate the findings on the original data by Houston et al. (bottom Table 1). In sum, although infants were able to discriminate the phoneme contrast at group level, only a small percentage was able to do so on the basis of individual analysis. This might be due to the difference in stimuli between Houston et al.'s study (word) and ours (phoneme). Additionally, the statistical methods used might not be sensitive enough: We are currently investigating whether Bayesian modeling is a better approach to obtain individual outcomes.

P3-D-62 A Comparison of Lexical-Semantic Processing in Monolingual and Bilingual Toddlers

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A common approach in bilingual first language acquisition research is to use monolingual development as a standard of comparison yet few studies contrast bilingual development with monolingual development in each language. The present study compares lexical-semantic processing in Spanish- and English-learning monolinguals and bilinguals longitudinally at 18 and 24 months of age. We asked whether bilinguals and monolinguals have distinct developmental timelines for the emergence of lexical-semantic priming, a proxy for lexical-semantic organization, and how this is related to vocabulary size.

Participants were bilingual Spanish-English ($N = 32$, $M = 18;17$, range = 17;15 - 20;21), monolingual Spanish ($N = 32$, $M = 18;18$, range = 17;21 - 20;6), and English monolingual toddlers ($N = 41$, $M = 18;7$, range = 17;9 - 19;3). Receptive vocabulary size in English and Spanish was assessed directly using the Computerized Comprehension Task (CCT, Friend et al., 2003; 2008; 2012). Lexical-semantic priming was assessed using a modified Intermodal Preferential Looking Paradigm (Arias-Trejo & Plunkett, 2009, see Figure 1). Children saw target and distractor image pairs in two conditions: the image pairs were preceded by a word either semantically related or unrelated to the target. Lexical-semantic primes were presented in both the dominant and non-dominant language for the bilingual sample. Our first question concerned the developmental emergence of lexical-semantic priming across monolingual and bilingual children. A significant priming effect obtained at 24 but not 18 months for English monolinguals and bilinguals, such that toddlers looked longer to the target during semantically related relative to unrelated trials (English monolinguals: $t(20) = -2.36$, $p = .02$; bilinguals: $F(1, 252) = 3.44$, $p = .06$). Spanish monolinguals, however did not exhibit lexical-semantic priming at either time point. Next we examined the influence of vocabulary size on the speed of lexical-semantic priming. Vocabulary size significantly predicted looking times in English monolinguals and Spanish-English bilinguals at 18, but not 24, months of age (English mono: $LRT = 15.80$, $p < .001$; bilinguals: $F(1, 28) = 4.23$, $p = .04$). Conversely, vocabulary size predicted looking time in Spanish monolinguals at 24, but not 18, months of age ($LRT = 8.14$, $p = .004$, Table 1). The present findings suggest that lexical-semantic development follows a similar course in monolingual English and Spanish-English bilingual children. However, bilingual lexical-semantic development is accelerated relative to that of Spanish monolingual children. A possible explanation for these findings centers on the majority language environment inhabited by these three samples. For children for whom at least one language aligns with the majority language (i.e., English), lexical-semantic development between 18 and 24 months proceeds at a similar pace. In this sense, bilinguals are neither special nor different. However, for children for whom primary language exposure occurs only in the minority language (i.e., Spanish), lexical-semantic development is attenuated relative to bilinguals. In this sense, bilinguals are different than their monolingual peers but not special.

P3-D-63 Predicting Communication Risk Before 12 months with ISCBS: Outcomes for Autism, Language, Physical/Sensory Disabilities

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Background: Most assessments measure early intentional communication such as gestures beginning around 9-12 months, and little is known about earlier signs of atypical development. An infant assessment is needed with a broad range of temptations for testing multiple sub-domains of communication in infants before 12 months who are not yet intentional communicators. The Infant Social and Communication Behavior Scales (ISCBS) is a dynamic assessment of pre-intentional communication in infants 2-12 months that is based on research-based predictors of communication and appropriate for infants with known disabilities. Research Questions: - Does the ISCBS discriminate infants between 2-12 months who later demonstrate communication impairments from those who do not? - Which ISCBS communication behaviors and/or domains distinguish infants with communication risk from pre-intentional infants with typical development? Participants: 207 infants at 2-12 months (mean = 6.82 months, 105 Male 102 Female), 185 with no known risk factors at birth. By age 3, 142 children were within typical limits, and 65 had disabilities: 33 language and/or speech disorders, 10 autism (ASD), 5 behavioral disorders, 15 physical/sensory processing disorders, 2 complex communication needs. Procedure: Infant - Home Administration: 18 different ISCBS social, toy, and communicative temptations, Mullen & Vineland scales. Coders scored presence or absence of 31 infant behaviors per temptation in the ISCBS. Each raw score was converted to a ratio. ISCBS behaviors scored by temptation were grouped into eight domains: emergent communication, affect, attention, engagement, anticipation, reciprocity, mastery, motivation, and exploration. Follow-up at 3 years - Home Administration: Mullen, Vineland, CELF-P, Goldman-Fristoe, Vineland, ADOS-2, Language samples. Results/Discussion: Autism. Infants with ASD shower poorer types and quality of vocalizations & vocal imitation, worse than infants with speech/language impairments. Significant reciprocity difficulties were seen in gesture, vocal, and play action imitation. Infants with ASD had less positive affect toward people or objects, but gaze behaviors were not impaired in most contexts. Infants with ASD showed poorer coordination and persistence of play actions in object play, and less response to calling the child's name, but more attention to visual information. All of these are consistent with characteristics of ASD. Speech/Language Disorders. Infants with S/L disorders produced more positive affect and response to sound than TD peers, which may be a compensation for lower gesture production. Infants with S/L disorders did not act and expect an adult reaction within joint play as well as peers. Impaired skills in functional/stacking play, object permanence, intentional gestures, or responding to receptive communication tasks with books or people may reflect general symbolic delays in development. Children with physical/sensory disorders showed significantly poorer skills than TD infants in variables

of physical or attention processing, but not communication-specific items on the ISCBS. Conclusion: The ISCBS is effective at discriminating characteristics that indicate risk for developing speech/language, ASD or physical/sensory disabilities as young as 2-12 months.

P3-D-64 How infants perceive human movement

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It is well established that infants understand goal-directed actions that directly engage with physical objects (Woodward, 1998; Gerson & Woodward, 2012). However, less is known about how infants process empty-handed movements - movements in which objects are not manipulated. Recent work shows that adults and children categorize empty-handed movements as either meaningful gestures or movements produced for the sake of movement using contextual cues (Novack et al., 2016; Schachner & Carey, 2013; Wakefield et al., 2017). For example, the presence of objects and spoken language increase the likelihood that an empty-handed movement will be interpreted as meaningful gesture. The present studies test whether infants process empty-handed movements using these same cues. Based on a paradigm developed by Woodward (1998), in Study 1, infants were familiarized to reaching events before seeing a split screen preferential looking test that showed reaches to either a novel object or a novel location (Figure 1, Study 1). Reaching events involved a) actions on objects, b) empty-handed movements near objects, c) empty-handed movements near objects in the presence of speech, d) empty-handed movements without objects. Prior findings show that infants show a preference for novel-goal reaches over novel-location reaches (e.g., Woodward, 1998), and if infants could process empty-handed movement as gesture, this same looking pattern would be expected. We found this pattern only when empty-handed movements were performed in the presence of objects and speech. This suggests that by 18 months, infants are able to see empty-handed movements as meaningful with the help of contextual cues. However, infants in this study did not have any predictions for empty-handed movement without objects. These results highlight an unexpected finding. Differences in the location of empty-handed movement should be easy to locate even for infants at this age. Study 2 (Figure 1) built on the findings of Study 1, with two additional changes. First, we contrasted the gesture speech condition with a movement speech condition, with the rationale that infants may need more contextual cues to successfully

process movement without objects. Second, we controlled the reach types (ipsilateral vs. contralateral) after Study 1 uncovered a contralateral reach preference. The goals of Study 2 are (1) replicate the Gesture Speech condition from Study 1, and (2) ask whether adding speech to movement will lead infants to focus on movement patterns when there are no objects. Preliminary findings ($n=30$) replicate Study 1. Infants who saw a gesture directed toward an object with speech ($n=15$) looked longer at the novel-object reach (Figure 2, $m=0.55$, $se=0.16$, 11 infants show effect) than the novel-location reach, suggesting that they regard empty-handed movement accompanied by speech as goal-directed. However, infants who saw empty-handed movements without objects present, even with the addition of speech, still failed to show a novelty preference (Figure 2, $m=0.49$, $se=0.13$). Data collections is ongoing, and further research should investigate how this understanding may be associated with comprehension of symbolic and iconic gestures. In addition, further research should look into under what kinds of contexts the movements (without objects) are perceived as meaningful.

P3-D-65 Early gesture development and its correlation with language comprehension and production in Mandarin-speaking infants

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Introduction. Gesture is one of the communication skills that emerge earlier than language during the infancy. Previous studies have shown that early gesture development is related to language development, moreover, is a predictor to following language performance (e.g., Goldin-Meadow, 2007). It suggested that the gesture laid a foundation of language and assisted the language learning by sharing similar learning mechanism like the symbolic-understanding (e.g., Blake, 2000; Rowe et al., 2009). The developmental trend of infant gestures has been well revealed, such as the deictic gesture developing earlier than the symbolic gesture. However, those studies are mostly done in infants in western societies, such as English, French and Italian. The performance of infants in eastern society, such as Mandarin Chinese, has rarely been examined. **Purposes.** This study aimed to investigate the trend of gesture development and its relationship with language comprehension and production in Mandarin-speaking infants aged from 8 to 16 months. **Methods.** 757 infants with typical development were investigated by a well-normed caregiver questionnaire, Mandarin-Chinese Communicative Development Inventory (MCDI-T). Each item was disputed and analyzed according to each gesture and language categories, which is deictic gesture (Gesture A), early representational gestures (Gesture

B), gesture without object manipulate (Gesture C), gesture with object manipulate (Gesture D), parent and imitating other adult actions (Gesture E), symbolic gesture (Gesture F), and vocabulary comprehension and production. The correlations among the measures of gestures and language were examined. Both gender effect and mother's education level were being considered in the analysis. Results. The development trend of the gesture performance has been clearly shown by the significant age effects across times (Fig. 1). At 8 month, infants showed the most scores on Gesture A (34.11%) and the least on Gesture E (5.52%). At 1 year old, infants performed more than 50% items in Gesture A (73.33%), Gesture B (57.03%) and Gesture C (56.88%). At 16 months, infants reached over 50% in 5 gesture categories except Gesture E (43.61%). The significant gender effect was show in early gesture development, that is, girls performed much more early gestures than boys in the early months ($p = .005$). When examining the relationship between gesture and language, gestures were middle to high correlated with both vocabulary comprehension ($r = .71$; $r = .65$) and production ($r = .44$) (Table 1). Interestingly, the Common Nouns are closely related to the total gestures ($r = .62$), as well as Verbs ($r = .66$) and the vocabularies in Games and routines ($r = .70$). Discussion & Conclusion. These findings support that 8 to 16 month Mandarin-speaking infants demonstrate a clear gesture development trend during infancy as shown in western societies. The early gesture development is highly correlated with early language development, especially the vocabulary comprehension of verbs, common nouns, and games-routine. These close correlations between gesture and language may be routed by transferring similar communication messages of symbol and moreover, the action and social interaction during the early communication development.

P3-D-66 Exploring Statistical Learning in an Iambic Language

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By their first birthday, infants demonstrate sensitivity to language-general (e.g., transitional probability (TP) between syllables) and language-specific cues (e.g., stress pattern of their native language) during word segmentation. As infants gain more experience with their native language, they come to rely on language-specific cues to identify words boundaries (e.g., Thiessen & Saffran, 2003). However, in natural languages, language-general and language-specific cues often provide redundant information regarding word boundaries. For example, in English, disyllabic words tend to have both strong internal co-occurrence statistics and a trochaic (strong/weak) stress pattern. Infants

may benefit from these redundant cues during speech segmentation. Interestingly, much of the recent work on tracking TP information in natural language has been conducted using Italian (e.g., Pelucchi, Hay, & Saffran, 2009a), which like English, puts stress on the initial syllable of disyllabic words. In this study and follow-up works, 8-month-old English-learning infants are able to use TP information to extract trochaic words with high internal co-occurrence statistics (HTP) from a fluent Italian speech stream. However, we do not know whether infants are able to track statistics in natural language input if they are not provided with additional redundant cues to word boundaries. In the present study, we used Farsi, a phonologically more unfamiliar natural speech stream, that has a predominantly iambic (i.e., weak/strong) stress pattern. We tested 8-month-old English-learning infants' ability to extract iambs from continuous speech. In Experiment 1, we familiarized infants ($n=20$) with a series of Farsi sentences that had four embedded target words: two words had high internal TP (HTP, $TP = 1.0$) and two had low TP (LTP, $TP = .33$). Half of the infants were randomly assigned to a counterbalanced language where HTP and LTP words were switched. We tested discrimination of HTP from LTP words using the Head-turn Preference Procedure immediately following familiarization. The results of this experiment showed no significant preference for either HTP or LTP words. Based on results from Experiment 1, we could not determine whether infants had failed to extract HTP words altogether or if they simply did not differentiate them from LTP words that were heard equally in the corpus. Therefore, in Experiment 2, we tested infants ($n=22$) with an easier contrast: HTP words vs. novel words (i.e., Farsi words composed of syllables that never occurred in the corpus). Again, infants failed to differentiate the words at test. Interestingly, we found significant opposite preferences in the two counterbalanced languages, highlighting the importance of running studies with counterbalanced languages to ensure that results are not based on individual token preferences. Currently, we are running follow-up conditions to investigate what is driving the present pattern of results. Specifically, we are interested in whether native language experience with English makes extracting iambs from natural languages difficult, or rather, whether English-learning infants struggle to track statistics in a language such as Farsi because the sounds in the language are too unfamiliar.

P3-D-67 French-learning 20-month-olds learn Cantonese (pseudo)words in an object manipulation task

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It is widely established that infants' perceptual sensibility becomes attuned to native phonetic categories in their first year of life (Kuhl et al., 1992; Polka & Werker, 1994; Werker & Tees, 1983; among others), which impacts their perception of nonnative phonetic categories, making it more difficult to acquire a nonnative language/accents (Burnham, 1986; Mulak et al., 2013). Using an object manipulation task, Bijeljac-Babic et al. (2009) showed that French-learning monolingual 20-month-olds can learn novel words newly taught in English. However, given the typological similarity of French and English, the present study explored whether such abilities could extend to a more distant language, and more specifically if French-learning infants who were raised in a nontonal monolingual environment can still succeed the task if a tone language, Cantonese, is used instead. Twenty-four French-learning 20-month-olds were taught new words in French and in Cantonese by two experimenters who were native speakers of the corresponding languages. Infants were tested with the object manipulation task in 8 word-learning trials (4 in French, 4 in Cantonese). In each trial, two different novel objects were presented to the infants and named six times with distinct pseudowords, e.g., sim1/kun6, before being placed on the table. Sixteen pseudowords were combined to make 8 pairs and used in the 2 languages (that is, the same words were used in both languages, counterbalanced across infants and pronounced in the corresponding phonology), and created with different consonants, vowels, and tones in Cantonese to maximize infant's possibility of distinguishing and learning them. Then the experimenter presented a third object, named it three times with one of the pseudowords, e.g., sim1, put it into a box, and asked the infant to put another sim1 into the box. The experiment began with two French training trials (using known words) and two French word-learning trials, followed by two Cantonese training trials and four Cantonese word-learning trials, and ended with another two word-learning trials in French. To help infants better understand the task, the Cantonese training trials used the same familiar objects and French words that were used in the French training trials, and these French familiar words were embedded in Cantonese utterances. The results show that infants chose the correct objects 60.42% of time for the French word-learning trials ($p = .02$), and 62.50% of time for the Cantonese word-learning trials ($p = .001$), both above chance level (Figure 1). Further, there was no significant difference in their performance between the two language conditions. These findings indicate that monolingual French-learning 20-month-olds are able to identify and learn novel words newly taught in a tone language, Cantonese, even though the sound patterns and language structures are distant from their native language. Our study provides further evidence on infants' flexibility and adaptation in lexical development. Following-up studies will explore whether such word-learning abilities extend to situations in which the

two words taught in the same trial differ only by a consonant, a vowel or a tone, which will provide data on the links between phonological and lexical processing.

P3-D-68 Let Me Tell You a Story: The Effect of Accent Pre-Exposure on 13- to 15-Month-Olds' Word Recognition

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To deal with phonetic variability children must understand phonological constancy, i.e., that despite phonetic differences in pronunciation, such as accents, a given word remains the same (Best et al., 2009). Previous research suggested children aged 15-months and younger have not grasped phonological constancy (Best et al., 2009). However, Best and colleagues (2016) examined differences in 19-month-old childrens' listening preference for familiar versus unfamiliar words in their native Australian English accent (AusE) versus an unfamiliar Cockney English accent (CknE). One group had been pre-exposed to CknE 5-months earlier in a previous test whilst the other group was naive. Results indicated children with pre-exposure had a significantly larger listening preference for familiar words (Best et al., 2016). Whilst a significant finding, it did not address whether pre-exposure to an accent within a study could immediately benefit word recognition. We investigated whether pre-exposure to an unfamiliar accent would benefit familiar word recognition in immediate word tests. Using the Chicken Little Story two accent pre-exposure groups were created. One group was pre-exposed to CknE and another pre-exposed to AusE. Both groups were expected to display a listening preference for familiar words over unfamiliar words in both an AusE and CknE word test (Best et al., 2016). If pre-exposure was immediately beneficial, children pre-exposed to CknE were expected to have a significantly greater listening preference for familiar words in the CknE word test compared to participants pre-exposed to AusE (Best et al., 2016). Thirty-eight AusE-learning 13- to 15-month-olds ($M=13.8$; $SD = 0.615$; 19 females) were randomly assigned to either the CknE or AusE pre-exposure group. The word recognition tests were the same used in Best and colleagues (2009, 2016). Each participant completed two eight-trial tests, one with all words spoken in AusE and one with all words spoken in CknE. For each test, four trials included familiar words (i.e., toddler words) and four trials included unfamiliar words (i.e., adult words) in alternating order. Word test accent order was counterbalanced. A mixed effects linear model revealed a significant main effect of word familiarity in the CknE word test between children pre-exposed to CknE and children pre-exposed to AusE. As illustrated in Figure 1 children pre-exposed to CknE significantly preferred listening to

familiar over unfamiliar words ($t(71) = 5.17, p < .0001$). Figure 2 illustrates the significant three-way interaction among pre-exposure accent, familiar vs. unfamiliar words, and word test accent, $F(1, 536.83) = 4.56, p < .05$. Paired-samples t-tests showed that children pre-exposed to CknE preferred familiar words in both the AusE ($t(71) = 5.10, p < .0001$) and CknE word test ($t(71) = 5.18, p < .0001$). However, children pre-exposed to AusE only preferred familiar words in the native AusE word test ($t(71) = 4.05, p < .001$). The results suggest that pre-exposure to the unfamiliar accent immediately benefitted familiar word recognition in the unfamiliar accent. This study contributes to infant research exploring effective word recognition by demonstrating that despite phonetic variation, young children may benefit from experience with different accents and speakers in learning to recognise words. Understanding this process enables more effective teaching of language, especially for children with language delays.

P3-D-69 Discourse structure and multimodal grounding of speech acts in maternal speech to 12-month-old infants

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Caregivers' speech to prelinguistic infants contains discourse with systematic relations across successive utterances and between the linguistic and physical worlds. Sequential structure promotes learning of syntax (Onnis, Waterfall, & Edelman, 2008) and word learning (Schwab & Lew-Williams, 2016) by aiding comparison of related inputs and reducing memory demands. The physical context contributes associations between words and specific objects (e.g. Trueswell et al., 2016; Smith & Yu, 2008), but also broader associations between speech act types and activities (Hoff-Ginsberg, 1991; Gros-Louis, West, & King, 2016), and utterances that respond to infant actions, which are related to faster language development (Tamis-LeMonda et al., 2001). Sequential and cross-modal structure also mutually reinforce each other. For example, discourse continuity facilitates mapping of utterances to referents because adjacent utterances often share a referent (Frank, Tenenbaum, & Fernald, 2013). However, little is known about how connected discourse and physical grounding jointly structure infants' experience with linguistic functions ranging from directing infants' attention to narrating ongoing actions or describing objects. In the current study, we observed 38 mother-infant dyads at 12 months in free play with toys. We transcribed the mother's speech and tagged utterances containing declaratives, imperatives, questions, talk about action, talk about attention, object descriptions, affirmations, social routines, object names, and the infant's name. We

also coded infants' gaze at toys and at the mother's face, and infants' handling of toys. We then investigated the sequential and cross-modal regularities that characterize infant-directed speech. First, we examined which utterance content types tend to follow others in sequences, thus mapping out typical "paths" in maternal discourse (Fig. 1). Next, we investigated associations between utterance content types and infants' gaze targets and object handling (Fig. 2). Finally, we used logistic regression models to estimate the degree of predictability of each content type based on previous utterance content, the infants' concurrent gaze target and object handling, or both. Results show that infant-directed discourse is repetitive for all content types, indicating that continuity is a general property of infant-directed speech. We identified favored transitions between content types that illustrate mothers' use of speech acts in structured sequences. For instance, mothers transitioned from capturing infants' attention, to directing attention to a target before providing declarative comments. Associations between utterances and infant actions showed that attention-related utterances (infant's name, imperatives and talk about attention) were related to infants' disengagement states; object descriptions were associated with gaze at objects (more than object names), and affirmations were associated with gaze at the mother's face--all independently of any specific word-object associations. Overall, predictive modeling showed that sequential structure is a stronger predictor than gaze and object handling for all content types except for infant's name and affirmation, which tend to anchor connected discourse sequences rather than occur embedded in them. Descriptions and object names were the most predictable content type, suggesting that discourse sequences could facilitate processing of highly informative utterances.

P3-D-70 A Longitudinal Study of Early Vocabulary Development in Children with Williams Syndrome

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Introduction: Studies with typically developing (TD) children have shown that variations in early vocabulary are highly predictive of later vocabulary and other aspects of language development (e.g., Rescorla, 2002, 2013). In the present study we examined the generalizability of these findings to children with Williams syndrome (WS), a rare neurodevelopmental disorder associated with intellectual disability that is caused by a microdeletion of 26 - 28 genes on chromosome 7q11.23. In particular, we examined the relation between expressive vocabulary at 24 months of age and both expressive

vocabulary and grammatical development at 48 months of age. Method: Forty-seven children (22 girls, 25 boys) with genetically-confirmed classic WS deletions participated in the study. Mean chronological age at Time 1 was 24.46 months (SD = .29, range = 23.95 - 25.00). At Time 2, mean chronological age was 48.51 months (SD = .28, range = 47.97 - 49.00). The MacArthur-Bates Communicative Development Inventory: Words and Sentences (CDI; Fenson et al., 2007) was used to evaluate the children's expressive vocabulary (maximum = 680 words) at 24 and 48 months and their sentence complexity (maximum = 37 complex sentences) at 48 months. To assess their nonverbal reasoning ability at 48 months, the children completed the Visual Reception scale of the Mullen Scales of Early Learning (MSEL; Mullen, 1995). Results: Children's expressive vocabulary varied considerably at 24 months (M = 39.66 words, SD = 44.23; range; 0 - 176). The same was true for all measures at 48 months: expressive vocabulary (M = 403.38 words, SD = 216.69; range: 0 - 679); sentence complexity (M = 15.89 complex sentences, SD = 14.21, range: 0 - 37); and MSEL Visual Reception (Mean T-score = 33.64, SD = 12.21, range: 20 - 56). Expressive vocabulary at 24 months was significantly correlated with both expressive vocabulary at 48 months ($r = .67, p < .001$) and sentence complexity at 48 months ($r = .68, p < .001$). The results of multiple regression analyses indicated that, together, expressive vocabulary at 24 months and nonverbal reasoning ability at 48 months accounted for a substantial amount of variance in both expressive vocabulary at 48 months (Adjusted $R^2 = .54, F(2, 44) = 27.56, p < .001$) and sentence complexity at 48 months (Adjusted $R^2 = .57, F(2, 44) = 31.24, p < .001$), with both predictor variables contributing significantly to the variance accounted for in both dependent variables ($ps < .012$). Conclusions: In line with what has been found for TD children, there is wide variation in expressive vocabulary size among children with WS even when children are within 1 month of each other in chronological age. These individual differences in expressive vocabulary are relatively stable over the 2-year period from 24 - 48 months. Combined with individual differences in nonverbal reasoning ability, individual differences in expressive vocabulary at 24 months significantly predicted both expressive vocabulary size and grammatical complexity 2 years later. Theoretical and practical implications of these findings will be discussed.

P3-D-71 Audiovisual Speech Influences Lexical Retrieval for Correctly Pronounced and Mispronounced Words

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Infants are born into the world's blooming, buzzing confusion and are tasked with making sense of their surroundings. One robust strategy for perceptual learning in early development is to attend to information that is redundant across multiple sensory modalities (Bahrick & Lickliter, 2000). Beyond early perceptual development, multimodal redundancies may facilitate other aspects of development, notably language learning. Human communication is necessarily multimodal, such that specific facial movements must be made in order to articulate speech sounds. In fact, the extant literature on audiovisual speech perception suggests that infants and young children are sensitive to the redundant audiovisual nature of human speech. What is less well known, however, is how visual speech information is represented in early development. Early lexical representations have been traditionally studied by measuring children's accuracy and reaction time to find a familiar object after hearing it labeled. In a two-object forced choice task with correctly pronounced (e.g., baby) and mispronounced words (e.g., vaby), Swingley & Aslin (2000) found that compared to correctly pronounced words, mispronunciations impaired but did not inhibit lexical retrieval. These findings suggest that young children have robust lexical representations for known words, and are able to overcome mispronounced auditory information and accurately identify the correct target objects. In this project, our aim is to replicate and extend Swingley & Aslin's (2000) mispronunciation paradigm for audiovisual speech stimuli. In doing so, we address how audiovisual speech affects susceptibility to mispronunciations. In our pilot experiment, 22 18- to 23-month-old infants saw a speaker's face articulating a correctly pronounced or a mispronounced target word in the context of a carrier phrase (e.g., Where's the [Target Word]! Can you find it?). We then assessed the infants' proportion of correct looking and reaction time to the correct referent object in the presence of another distractor object (Figure 1). Using the same analysis window as Swingley & Aslin (367-2000 ms after word onset), accuracy responses for both correctly pronounced and mispronounced words were at chance (CP=55%, MP=54%). Additionally, reaction times (CP=908 ms, MP=1145 ms) were approximated 200 milliseconds slower than the reaction times reported in Swingley & Aslin (2000). The audiovisual nature of the task presented here may put different task demands on the infants, as compared to the auditory-only version of this task. In light of longer reaction times in the audiovisual task, we analyzed a second, later accuracy window (500-2200 ms after word onset). Results from the late accuracy window suggest that infants are above chance for correctly pronounced trials ($M=61\%$, $t(21)=2.54$, $p<.05$), but still at chance for mispronounced trials ($M=49\%$, see Figure 2). Taken together, our results suggest that audiovisual mispronunciations may be more disruptive than auditory-only mispronunciations. This project is informative for future procedural and data analysis protocols using audiovisual speech, as infants may take longer to disengage

from multimodal input. Thus, looking analysis windows may have to change as a result of differential task demands. Additional data collection and analyses are in progress. (489 words)

P3-D-72 Thirteen-Month-Olds' Comprehension of Multiple Labels for the Same Object

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Learning a language involves the ability to acquire words from several different lexical categories, each with a distinctive type of meaning. For instance, English learners must come to understand that count nouns (e.g., "dog") extend to all objects of a given category, but that proper names (e.g., "Fido") should be restricted to individual objects. Additionally, learners must come to acquire multiple words from different lexical categories for the same object (e.g., a dog can be labeled both "dog" and "Fido"). Previous research leaves the origin of these abilities unknown. By 17 to 20 months, infants appropriately extend novel words modeled grammatically as count nouns and proper names (Bélanger & Hall, 2006; Macnamara, 1982), but words that are count nouns and proper names in the adult language appear months earlier in infants' productive (Macnamara, 1982) and receptive (Bergelson & Swingley, 2012; Tincoff & Jusczyk, 1999) vocabularies. It is not yet known whether infants extend their earliest count nouns and proper names appropriately and distinctively or whether they can learn multiple labels for the same object. We are addressing these questions using a looking-time task that probes 13- to 14-month-olds' (N = 40 out of a planned 48) comprehension of count nouns and proper names for their family pets. All participants had a family pet (dog or cat) at home and had caregivers who reported using both a count noun and a proper name to refer to it. On each trial of the task, infants saw one of two pairs of photographs on a television screen. The across-category pair showed the pet paired with an animal of a different category (e.g., pet dog with cat). The within-category pair showed the pet paired with a different animal of the same category (e.g., pet dog with different dog). We measured infants' looking behavior upon seeing each pair under three conditions: silent baseline trials, proper name test trials (hearing the proper name for a pet), and count noun test trials (hearing the count noun for a pet's category). If infants extend proper names and count nouns appropriately and can learn both words for the same object, we predicted the following results: When infants saw the across-category pair, we expected an increase (compared to baseline trials) in looking to the pet on both proper name and count noun

test trials. In contrast, when infants saw the within-category pair, we expected an increase (compared to baseline trials) in looking to the pet on proper name test trials, but not on count noun test trials. Preliminary results support both predictions (see Figures 1 and 2): Infants appropriately appear to restrict the proper name to their pet but to extend the count noun to another animal of the same category. The results advance our understanding of early lexical development by offering tentative support for the claim that soon after their first birthday, infants have (1) a distinct referential understanding of familiar proper names and count nouns and (2) the cognitive flexibility to acquire two words (with different referential properties) for the same object.

P3-D-73 Learning the little things: How referential salience impacts 2.5-year-olds' cross-situational verb-learning

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Children often encounter new verbs in referential contexts that offer many potential meanings. Cross-situational information could help children resolve this referential ambiguity: recent evidence suggests that under at least some circumstances, 2.5-year-olds can identify verbs' referents by tracking the scene elements that consistently co-occur with the verbs across uses (Scott & Fisher, 2012). However, prior cross-situational word-learning studies presented children with candidate referent sets that were equally high in perceptual salience. Children's vocabularies also include verbs that describe low-salience referents, and in real life such referents might occur in the presence of more interesting referential alternatives. This raises two questions. Can children use cross-situational information to identify low-salience referents for novel verbs? Can they do so when confronted with candidate event-referents of differing perceptual salience? In Experiment 1, 2.5-year-olds encountered 4 novel intransitive verbs; two referred to high-salience actions and two referred to low-salience actions (salience was determined by the magnitude of pixel displacement during the action; Fig-1). Children first saw 12 training trials in which a novel high-salience and a novel low-salience action were accompanied by two novel intransitive verbs. Across trials, each verb occurred six times and the only cue to its intended referent was the consistency with which it accompanied each action. Following training, children received 4 test trials, one for each verb, in which they heard a novel verb and saw its intended referent and a distracter referent of opposing salience. We calculated the time children looked at the target and distracter events during each test trial (Fig-2). The results of mixed-effects models suggested that across the four trials,

event (target, distractor) was not a significant predictor of children's looking behavior, $\beta = -.10$, $SE = .24$, $\chi^2(1) = .16$, $p = .69$. Instead, children spent more time looking at the high salience events regardless of whether they were the target or distractor, $\beta = 1.58$, $SE = .22$, $\chi^2(1) = 47.94$, $p < .001$. A similar pattern emerged during training: across trials, children spent the majority of their time looking toward the high-salience events. These results suggest two possibilities. Perhaps children's interest in the high-salience events during training prevented them from gathering cross-situational information about the verbs' referents. Alternatively, children may have gathered sufficient cross-situational information to identify the verbs' referents, but this learning was masked by their interest in the high-salience events in the test trials. Experiment 2 sought to disentangle these possibilities. 2.5-year-olds received identical training trials as in Experiment 1. However, they then viewed four test trials in which the target and distracter events were of equivalent salience. Across the four test trials, children looked at the target referent significantly longer than the distracter event, $\beta = .81$, $SE = .20$, $\chi^2(1) = 16.85$, $p < .001$. This pattern emerged for all four verbs. These results suggest that 2.5-year-olds can use cross-situational information to identify low-salience referents for intransitive verbs, even when they co-occur with high-salience alternatives. However, this learning is easily masked by interest in more salient events.

P3-D-74 The influences of infant-directed reading and singing on word learning

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Infants must learn language entirely through listening to their surrounding linguistic environment. Previous work has shown that parent-child book reading increases children's vocabulary (e.g. Farrant & Zubrick, 2012; 2013). Reading has many properties that could be responsible for this boost. First, books often include pictures of the objects they refer to, providing visual access to named objects and facilitating word learning (Arlin et al., 1978). Furthermore, books provide repetition of the same words and syntactic structures upon multiple readings, aiding learning (Horst, Parsons, & Bryan, 2011). Input source also affects word learning, with Kuhl et al. (2003) reporting that 9- to 10-month-old infants learn better from live humans than recordings. Reading and singing share many features. Like reading, singing captures the attention of both speaker and listener, directing attention to the same words, concepts and/or images. Further, both involve repetition of words and ideas that are consistent over time and context. Despite similarities, singing has not been extensively investigated for its effects on word learning.

This study aims to fill this gap by comparing reading and singing effects on infant vocabulary development. We examined how the relative frequency of different utterance-types affects word learning, how these effects varied by input source (electronic or human), and whether the differences in reading's and singing's effects related to whether words' referents were visually observable, i.e. 'object present'. We used the SEEDLingS corpus, a longitudinal collection of monthly naturalistic audio- and video-recordings from 44 infants between 6-17 months. This corpus includes all object words spoken to and by the infant, what utterance-type the word occurred in, whether the object was present, and the speaker. We analyzed infants' object-word input from reading and singing utterances, using children's own word production at 17 months as the outcome measure. We separately examined the number of nouns heard in reading and singing, and the proportion of the total noun input these utterance-types made up. Reading had increased lexical diversity relative to singing (reading type-token ratio=0.54; singing=0.40) and a higher proportion of object presence ($t=-9.74$, $p<.0001$; Figure 1). Both the quantity and proportion of reading infants heard correlated significantly with their own 17-month production (Spearman's $\rho_{\text{quantity}}=.37$; $\rho_{\text{proportion}}=.32$; both $p<.05$). In comparison, while the quantity of nouns heard in singing correlated with total child utterances at 17 months ($\rho_{\text{frequency}}=.35$, $p<.05$; Figure 2), the proportion of singing did not ($p>.05$). The source of the singing or reading input (i.e. human vs. electronic), did not predict 17-month total child utterances ($\rho=.10-.14$, ns). Reading appears to benefit vocabulary development and speech production more directly than singing, despite sharing many features in common. The greater lexical diversity, in addition to the greater object presence in reading may explain reading's advantage. These findings further support claims that reading improves vocabulary development, and shows that with these utterance types, electronic sources of input may be equivalent. Thus, these results reiterate a key role for reading in the early input, and add the novel result that singing input too is linked with infants' language production.

P3-D-75 Does multi-accent exposure in infancy slow vocabulary growth?

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Many studies have tried to understand how bilingual environments affect children's language development, specifically vocabulary development. However, there has been very little work examining vocabulary development in monolingual children exposed to more than one variety, or accent, of the native language at home. It is evident that

exposure to accent variability, either at home or in the lab, affects children's speech processing (e.g. Buckler, Oczak-Arsic, Siddiqui, & Johnson, 2017; Floccia, Delle Luche, Durrant, Butler, & Goslin, 2012; Potter & Saffran, 2017). For example, young toddlers who regularly hear multiple accents of their native language in their home environment recognize words more slowly than their peers with less varied input, however, this difference appears to resolve as children near their third birthday (Buckler et al., 2017). Here, in the first study of its kind, we present a large-scale investigation of whether increased accent variability in the child's home environment affects vocabulary development. If the speech processing abilities of children with extensive exposure to accent variability are truly less efficient than (as opposed to simply different from) mono-accented toddlers', we predict that this will have an impact on the rate of vocabulary growth. The MacArthur-Bates CDI was used to measure vocabulary size. To date we have collected data from 524 children at different ages between 11 and 35-months-old (see Fig. 1 for distribution of participants by age), and we plan to increase this number by at least 50% in the coming months, particularly in the 27-30 month age range. Parents completed the CDI, in addition to a detailed questionnaire about their child's linguistic environment and family demographic information. All children are monolingual, being exposed to English at least 80% of the time. Mono-accented children (N=279) have minimal exposure to accents other than Canadian English. Multi-accented children (N=245) have extensive exposure to other varieties of English alongside Canadian English. Other varieties included both native (e.g. Australian English) and non-native (e.g. Spanish-accented English) accents of English. Some multi-accented children heard a mixture of different accent types (i.e. both native and non-native varieties). Preliminary data (Fig. 1) suggest that initial vocabulary growth is similar for both mono-and multi-accented infants. From 18 months of age the rate of vocabulary development in mono-accented toddlers appears to be more rapid than in multi-accented toddlers. However, as toddlers approach their third birthday any differences in vocabulary size disappear. This pattern potentially mirrors word recognition skills (Buckler et al., 2017). Interestingly, the nature of the accent that children are exposed to does not appear to play a role; there is no difference in vocabulary development between children exposed to native or non-native varieties of English (Fig. 2). This suggests that it is exposure to accent variability per se that drives the difference, and not that multi-accented children are learning from non-native, and potentially less proficient speakers of English with a smaller vocabulary. Furthermore, our results suggest that although exposure to accent variability may have an impact on the trajectory of vocabulary development, it does not impact upon final attainment.

P3-D-76 The origins of the Consonant bias in word recognition: The case of Spanish-learning infants

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Consonants are more important than vowels in words, as evidenced by a greater reliance on consonants over vowels in lexical tasks, i.e. a consonant bias (Nespor et al, 2003). In adulthood it is attested in all modalities, many tasks and languages (Cutler et al. 2000). As a potentially crucial mechanism of early lexical acquisition, the consonant bias has been the focus of recent word processing studies on how and when it develops (Nazzi et al., 2016). Results in French and Italian show a switch from a vowel bias at 5-6 months to a consonant bias by 11-12 months (Bouchon et al., 2015; Hochmann et al., 2011; Zesiger & Jöhr, 2011), and 8 months in French (Nishibayashi & Nazzi, 2016). In English no early vowel bias was found and the consonant bias emerges relatively lately (24-30 months: Mani & Plunkett 2007, 2010; Floccia et al., 2014). These crosslinguistic variations in the consonant bias' emergence suggest that the contribution of this bias in word learning depends native input. To narrow down the list of factors that determine an early consonant bias (lexical, phonological, acoustic, C/V inventories repertoires etc...), it is crucial to investigate new languages and various age groups, preferably with the same method in order to better compare ages and languages. Using a method that previously revealed a consonant bias in French-learning 11 month-olds (Poltrock & Nazzi, 2015), the current study will compare the sensitivity to consonant vs.vowel changes in words, in Spanish learners, at 3 ages: 5 - 8½ and 12 months (n = 24/age group). This study involves 2 tasks, Familiarity and Conflict, and uses an eye-tracking gaze-contingent preferential-looking procedure (4 trials/condition), as follows. ? In the Familiarity task, infants were presented with words vs. non-words. o Words: 18 most frequent disyllabic consonant-initial words extracted from Spanish infant-directed speech corpora (CHILDES; e.g. leche, i.e. milk). o Non-words: built by recombining words' syllables (e.g. machi) o Results show a preference for words over non-words ($F(1, 37) = 5.95, p = .020$), and no interaction with age, confirming the familiarity of the highly frequent words (Figure 1) ? In the Conflict task infants were presented with words' consonant- vs. vowel-mispronunciations. o Results yielded a Condition \times Age interaction ($F(2,62) = 12.07, p < .0009$) due to a vowel bias at 5 months (t-test), and a significant consonant bias at 12 months (t-test) (Figure 2). First, these preliminary results (the study will be completed for the conference) show for the first time that 5 months-olds prefer frequent words over non-words. Second, the switch from a vowel bias at 5 months to a consonant bias at 12 months previously found in French and Italian is confirmed in Spanish, another Romance language, with a simpler vocalic system.

This demonstrates that the initial strategies infants use in their quest for words vary crosslinguistically and that it is crucial to further investigate the cues in the native input that determine when the consonant bias emerges to contribute to infants' lexical acquisition.

P3-D-77 Word-form familiarity aids infants' word segmentation

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Infants as early as 7.5 months of age can segment words from a fluent speech stream (Jusczyk & Aslin, 1995) and are able to store these word-form representations in long-term memory (Jusczyk & Hohne, 1997). Furthermore, familiarity with a word-form helps infants segment similar sounding words from the speech stream (Altvater-Mackensen & Mani, 2013): infants were familiarized with a word, e.g., Löffel and then tested on their segmentation of a similar-sounding word, i.e., Löffel from the speech stream. Infants showed improved segmentation of words that sounded similar to previously familiarized words. In the current study, we extend this finding to examine whether infants' prior familiarity with words helps infants segment similar-sounding words from the speech stream. Thus, we ask whether infants familiar with the word bed, are better able to segment a similar-sounding word, i.e., beck from the speech stream. 7-month-old monolingual infants (n=28) heard sentences containing either pseudo-words (e.g., Beck, Wimse) that resembled words already familiar to the infant (i.e., Bett; bed, Windel; nappy), hereafter referred to as related words, or novel pseudo-words that did not overlap phonologically with any words known to the infant, hereafter referred to as unrelated words. Once infants accumulated 100s of listening time to the sentences, they were presented with trials containing repeated isolated tokens of either the related words, or the unrelated words. We measured the amount of time infants spent listening to the two kinds of words as an index of their segmentation of these words. We tested infants' comprehension of the two familiar words by presenting them with images depicting the two words and directing them to look at the targets, i.e., Bett/Windel. The proportion of time spent looking at the target post-labelling was taken as an index of their comprehension of the words. Finally, to examine whether infants accepted Beck as an appropriate pronunciation of the familiar word, Bett, we also presented infants with trials where they saw the two images and heard the related pseudo-words. Infants listened significantly longer to the unrelated words relative to the related words (Figure 1), $t(27) = -2.56$, $p = .016$, $d = -0.34$, suggesting that they were better able to segment the related

words, i.e., words that sounded similar to familiar words, from the speech stream. Infants showed comprehension of the familiar words tested in the current experiment by looking longer at the target images upon hearing the label for these images ($F(1, 13)=4.66, p=.05$). They did not look significantly longer at the target upon hearing the related words, suggesting that infants did not accept the related words as appropriate pronunciations of the familiar word ($p>.05$). The results suggest that infants are able to use their familiarity with words learned in their natural environment (e.g., at home) to segment similar-sounding words from the speech stream. Thus word-form familiarity-based segmentation is a powerful mechanism that can drive infants' rapid vocabulary growth. Furthermore, 7-month-old infants already comprehend simple frequent words and are able to distinguish them from subtle mispronunciations of these words.

P3-D-78 Can visual cues facilitate word segmentation in young infants below 6 months of age?

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Adult studies have revealed that the presence of visual referents aligned with target words of an artificial language can facilitate word extraction. In infant studies, the use of visual cues aligned with word boundaries did not seem to enhance word segmentation skills in 7.5- to 9 month-old infants, when segmentation ability seems to be well established (Thiessen, 2010). The aim of the present study was to explore the contribution of visual cues to the emergence of word segmentation skills in younger infants, tested with a version of the Head-Turn Preference Procedure (HPP), familiarized with natural language passages and tested on word lists. Previous research had revealed that monosyllabic word segmentation was already present in 6-month-olds, with infants showing the expected familiarity preference in the test phase. The present study was centered on the comparison between two age groups, 6- and 4.5-month-old infants, the former, but not yet the latter, having shown emergent word-form segmentation skills in an auditory only task. We hypothesized that the presence of visual cues moving aligned with word onsets could enhance word segmentation skills in 6-month-olds by showing either a more robust effect or a change of the preference pattern, from familiarity to novelty, a trend already observed when testing older, relatively more experienced language learners. As for the younger age group, if visual cues facilitate word extraction, first positive evidence of word segmentation would be found; however, the need to integrate both visual and auditory information in this task might be too demanding, in which case no benefit would be

observed. A sample of N=37 participants, divided into two age groups (N=17 four-month-olds, and N=20 six-month-olds) were tested. The procedure was adapted from the classical HPP to be suitable for an eye-tracking technology (Tobii X120). Infants were placed on a special seat facing a monitor. During familiarization trials two distinct shapes were on screen, each one looming aligned with the onset of the target words from the passages. After a total of 10 trials allowing for 20 presentations of each target word from two alternating passages, the test phase began. Attention time to a flashing red dot was measured for a total of 12 test trials in which two familiar and two novel words were presented in three consecutive blocks. While no differences in the behavior during the familiarization phase were found, a significant word type (novel, familiar) x age group (4.5 and 6 mo.) interaction was found ($p = 0.039$), the older group showing a preference for the novel words and no preference in the younger group. These results indicate that while 6 month-olds do benefit from the presence of visual cues signaling word boundaries, no such benefit could be found at a younger age when word segmentation skills are just emerging and the link between our artificial visual cues and word units embedded in fluent speech might not be easily captured. Further research is needed to gain a better understanding of the constraints affecting the emergence of word segmentation skills in four-month-olds.

P3-D-79 Segmentation of Vowel-Initial Words from Continuous Speech in Infancy

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Infants' early speech segmentation abilities are initially restricted to the segmentation of consonant-initial words: English-learning infants, for example, have not been found to segment vowel-initial words before the age of 13.5 months (Mattys & Jusczyk, 2001; Nazzi et al. 2006) unless they occur in phrase-initial or phrase-final position (Seidl & Johnson, 2008), and French-learning infants only succeed to recognize vowel-initial words at the age of 24 months (Babineau & Shi, 2014). Different accounts can explain this development: First, under a phonetic view (Mattys & Jusczyk, 2001; Seidl & Johnson, 2008), word boundaries are easier to detect in consonant-initial compared to vowel-initial words because a word onset is acoustically more saliently marked by consonants (especially plosives). Second, under a phonological view (Babineau & Shi, 2014), a universal bias for consonant-initial syllables is at play early in development. The present study investigates a third account, namely the effect of input language. The ratio of vowel- versus consonant-initial words in the input language is language-specific. German offers

an interesting comparison because compared to English the number of vowel-initial words is higher: Counts based on CELEX word types (Baayen et al., 1996) revealed that 82 percent of all English but only 75 percent of all German words are consonant-initial. If input frequency is yet another relevant factor, German-learning infants should be able to segment vowel-initial words earlier than their English-learning peers. In a first experiment, we tested forty 11-month-olds (age range: 10.6-11.5 months). Using a HPP setup, each infant was familiarized with different tokens of either a vowel-initial (e.g. uger) or consonant-initial nonword (e.g. luger). At test, infants heard two types of text passages, one of which contained the familiarized target embedded in a nonword carrier (e.g. tiluger), the other a novel nonword (e.g. panotel). Other factors influencing word segmentation such as metrical stress and prosody were kept constant. Our text passages consisted completely of nonword utterances that were spoken naturally with a German-sounding pronunciation. Results revealed that 11-month-olds preferred passages containing the familiarized target ($p < .05$) without an influence of the familiarization (vowel- or consonant-initial) and no interactions (see Figure). This suggests that German-learning infants segment vowel-initial words at an earlier age than English-learning infants. In a second experiment, we currently test 8-month-olds (age range: 7.5-8.4 months) to explore the developmental path of vowel-initial segmentation abilities in German-learning infants. A preliminary analysis over the first (12 of 20) tested infants did not reveal a preference for one text passage type over the other at this younger age (see Figure). If this result remains once data collection is completed, this will suggest that also German-learning infants need to develop the ability to segment vowel-initial words, but they do so at an earlier age. The current study supports the view that the developmental trajectory of acquiring the ability to segment vowel-initial words is language-specific, and that input frequency plays a role. The study highlights the relevance of cross-linguistic comparisons of infant behavior and input characteristics for gaining a better understanding of early language acquisition mechanisms.

P3-D-80 Detection of a language switch from a talking face: evidence from monolingual and bilingual infants.

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Early studies using auditory material have shown that newborn infants can already discriminate between rhythmically distant languages (Nazzi, Bertoncini, & Mehler, 1998). The discrimination between rhythmically close languages emerges around 4 months of

age (Bosch & Sebastian-Galles, 2001; Molnar, Gervain, & Carreiras, 2014). However, these studies concern the auditory aspect of language only, and yet infants experience is made of dynamic audiovisual faces that provide both auditory and visual redundant information. Importantly, infants' ability to detect a language switch from a speaker remains fairly unexplored. This question is particularly relevant for infants growing up in bilingual contexts, considering they can be exposed to speakers switching languages. The present study addresses this question by comparing monolingual and bilingual infants in an adaptation of the habituation-switch procedure, using utterances produced by a trilingual female speaker. A total of 24 four-month-old infants (12 from a Catalan-Spanish bilingual environment, 12 from a Catalan/Spanish monolingual environment) were habituated to a face talking in their native language. In the test phase, the same speaker switched to a rhythmically close language (Switch 1; either Catalan or Spanish), and to a rhythmically distant language (Switch 2; English). Attention recovery was used to measure language switch detection. Considering that seeing the same face after the language switch might modulate the attention recovery effect, we hypothesised that 1) infants would more easily detect the switch to the distant language than to the close one, and more specifically 2) monolingual infants would recover their attention in both language switches, whereas bilingual infants might show reduced sensitivity to a language switch that involves their two native languages. Results revealed that, as expected, both bilingual and monolingual infants detected the switch from their native language to English ($F(24)=7.379$, $p=.012$). Crucially, when the switch involved a close language, bilingual infants did not show evidence of detection whereas monolingual infants showed a marginal effect ($t(11)=0.63$, $p=.541$; $t(11)=1.83$, $p=.07$; respectively). This study suggests that whilst 4-month-old monolingual infants seem to detect the switch to both a rhythmically close and distant language, Catalan-Spanish bilingual infants do not seem to notice when people switch between their two languages, which is highly significant since it has been shown they can discriminate among them auditorily. Further studies are needed to better understand the factors that explain this distinct behaviour between auditory only and audiovisual switch detection. A possible interpretation could be that bilingual infants -being used to people code-switching- will show no attention recovery when the talking face switches to a language that is familiar to them. Code-switching measures from the infants' caretakers could help us clarify this interpretation.

P3-D-81 Recognising familiar words in two accents at 14 months enhances recognition of different words by the same talkers at 19 months

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Australian 14 and 19 month-olds recognize familiar words spoken in Australian English (AusE), but fail with the unfamiliar non-native Jamaican English (JaME) accent when vowels differ categorically from AusE. Yet both ages succeed with JaME when the vowels differ sub-categorically, and both ages succeed with the unfamiliar Cockney English (CknE) whether the consonants differ from AusE either sub-categorically or categorically (Best et al., ICIS 2014a-b, 2016a). But how do young children adapt to phonetic variation across accents or talkers? Such adaptation would certainly improve efficiency of word recognition "in the wild," where such variation is frequent. One possibility is that they benefit from experience with the speech characteristics of talkers they have heard before, as adults do. Such an advantage would indicate that toddlers form phonological abstractions about talkers' spoken words that extend to "untrained" novel words by those talkers, as adults do (e.g., Cutler, 2010; McQueen et al., 2006). Therefore, in follow-up tests, we examined whether pre-exposure to words by multiple talkers of two accents (AusE [native]; CknE [non-native]) might benefit later recognition of different sets of words by those same talkers. We have reported preliminary findings indicating that prior exposure to the two sets of talkers at 14 months did enhance recognition of other words by those talkers at 19 months (Best et al., 2016b, 2017). However, our sample of pre-exposed 19-month-olds was relatively small. For the present study, we nearly substantially increased our sample size of pre-exposed toddlers to find whether the effect would hold up. We used the task and stimuli from our prior AusE/CknE word recognition studies. Two groups of 19 month olds completed two tests of listening preferences for toddler words over adult words, one test in native AusE, the other in CknE. The target words displayed categorical consonant differences between AusE and CknE; three female speakers of each accent produced the stimuli. One group ($n = 24$) was naïve to the task and talkers at the time of testing. The other group (pre-exposed: $n = 21$) had participated 5 months earlier (14 months) in a parallel study using different word sets with sub-categorical consonant differences between the accents, produced by the same talkers. The pre-exposed group's brief exposure to the same talkers but different words at 14 months did indeed enhance recognition of the novel words at 19 months, relative to the naïve 19-month-olds' performance. Although both groups showed reliable listening preferences for toddler words over adult words (WordSet main effect, $F(1,43) = 15.9428$, $p = 0.0001$), the preference was significantly larger in the experienced group (WordSet x Group interaction, $F(1,43) = 4.203$, $p = 0.046$; see Figure 1). Thus, it was confirmed that prior exposure to the same talkers of the two accents enhanced recognition of new sets of words by the same talkers even 5 months later. These findings provide important new insights into the stability of episodic memory for specific talkers in the second year, even for previously unfamiliar

accents. Implications for early word representations, phonological development, and infant memory and retrieval will be discussed.

P3-D-82 Language processing efficiency at 2 years links to executive function and language skills at 4 years in Spanish-speaking children

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Being "ready for school" involves the ability to communicate effectively through language and also to display appropriate executive functioning (EF), i.e., the regulation of attention, emotions and behavior in the service of learning. It is also well-established that disparities in SES are associated with differences among children in both language and EF (Hackman et al., 2015; Hart & Risley, 1995), as well as in long-term academic achievement (Fitzpatrick et al., 2014). Many Latino children in the US come from lower-socioeconomic (SES) backgrounds and lack critical school-readiness skills, placing them at increased risk for poor academic outcomes. Only a few studies have examined links between language and EF skills in Spanish speakers (Lonigan et al. 2015; Peredo et al., 2015), and little is known about the early precursors of these skills in Spanish-learning children under 2 years of age. An important early skill with cascading consequences for school-relevant outcomes is language processing speed, the efficiency with which young children use multiple cues to meaning as a sentence unfolds in time (Fernald et al., 2008). Using the "looking-while-listening" (LWL) task with English- and Spanish-speakers, individual differences in language processing speed have been linked to vocabulary (Fernald & Marchman, 2012), as well as to later language and cognitive outcomes (Marchman & Fernald, 2008; Marchman et al., 2017). Here, we ask whether performance on the LWL task at 25 months is associated with both EF and language outcomes at 54 months. Participants were 69 children from lower-SES primarily Spanish-speaking families (Table 1). At 25 months, children's Spanish-language processing speed was assessed in the LWL task. The toddler sat on the caregiver's lap and viewed two pictures of familiar objects while a pre-recorded voice directed their attention to one of the pictures (e.g., ¿Dónde está el perro?). Reaction Time (RT) reflected the speed with which children shifted from the incorrect to the correct picture. At 54 months, Spanish expressive language was assessed using the CELF-4. EF skills were assessed with the comprehensive EF Touch battery of inhibitory control, working memory, and attention-shifting tasks (Fitzpatrick et al., 2014). To derive a composite EF index, scores were z-scored and averaged. As expected, speed of processing (RT) familiar Spanish words at 25 months was related to Spanish expressive language skill

at 54 months ($r = -.45$, $p < .001$). Mean RT was also related to children's EF ($r = -.29$, $p = .02$). Next we investigated the hypothesis that EF mediates the relation between early processing efficiency and later language skills, controlling for SES, child's age, and Spanish exposure at 54 months. Figure 1 shows that the relation between early processing speed and expressive language skill is mediated by EF, $ab = .011$, BC CI $[-.0260, -.0022]$. These findings reveal that children's early language processing efficiency relates to later language abilities, at least partially, by strengthening children's EF skills. Thus early processing skill at 2 years builds the foundation for later linguistic development, while also promoting a broad range of skills that place children in a better position to learn when they enter school.

P3-D-83 Word learning in the wild and the impact of talker variability in daily life

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Emerging results point to a relationship between environmental variability and early language acquisition on various levels. Most prominently, the amount of talk infants hear has been positively linked to their vocabulary development (Hart & Risley, 1995). It is yet unclear whether multiple talkers in the environment lead to more input and thus better vocabulary outcomes, while at the same time more talkers also add more pronunciation variability. The latter might be problematic, because infants might have to first develop robust phonological representations before they can learn different pronunciations of one word efficiently. Thus, it is an open question whether being habitually exposed to multiple talkers, possibly with accented speech, helps or hinders lexical development. To assess how general talker variability in infants' daily life as well as whether or not they hear accented speech influences their budding lexicon, we tested to what extent these two variables predict known word recognition in the lab. We tested two French-learning age groups, 11-month-olds ($n = 51$) and 16-month-olds ($n = 47$) in their recognition of 2 known words ("biberon" babybottle and "chien" dog) in a looking-while-listening task. Parents additionally reported details of their household size, daycare arrangements, and social engagements to estimate the number of talkers in their child's input. We also asked whether talkers had a noticeable accent. Parental reports of infants' receptive vocabulary size served as a proxy for linguistic development. We analyzed the eye tracking data following standard protocols: Our dependent variable is empirical logit of target looks in a 1s time-window, determined in a consistent way across age-groups as the 1000 ms time-window surrounding the peak of the word recognition curve, i.e. after target word

onset. This resulted in a time-window of 200-1200 ms after word onset for 11-month-olds, and 1000-2000 ms for 16-month-olds. The dependent variable and the predictors (log normalized number of speakers, presence of accented speech, vocabulary) were entered into a linear mixed model using R. Our results (Figure 1) show that the younger age group is negatively affected by variable input, be it due to talker variability or accented speech, while the older age group shows no significant effects. More precisely, 11-month-olds' word recognition response is significantly modulated by the presence of accented speech ($p=.047$) and this factor interacts with the number of talkers in infants' input ($p=.026$). The main effect of number of talkers was marginally significant ($p=.087$). No effects or interactions reached significance in the older age group. Taken together, our data indicate that less experienced language learners might rely on a few talkers to learn words, whereas advanced learners can contend with variability in their input and thus are not negatively affected by it. Further research is needed to explore the consequences of talker variability and accented speech on infants' input, both on the acoustic level and in terms of quantity and diversity of words and sentences. This study underlines that there may be meaningful differences in infants' path into language caused by their environment, and specifically who talks to them.

P3-D-84 Does prematurity differently affect early lexical perception and production abilities?

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Throughout childhood, different measures of language assessment reveal that toddlers born preterm perform below their fullterm counterparts in lexical comprehension (Caravale et al., 2005; Saavalainen et al., 2006) and production (Foster-Cohen et al., 2007; Gayraud & Kern, 2007; Saavalainen et al., 2006; Sansavini et al., 2011). However, exploration of early lexical acquisition remains limited. Here, we first explore whether preterm infants recognize familiar word-forms at the same postnatal age (11 months) as their fullterm peers or whether they show some delays in early recognition (Experiment 1). Second, we compare the size of their word productions to the normative percentiles according to their postnatal or maturational age, testing them around 24 months, the age at which most clinicians stop correcting for prematurity (Experiment 2). Experiment 1 replicated Poltrock and Nazzi (2015) baseline HPP experiment on word-form recognition, presenting preterm infants with a list of familiar words and a list of pseudowords. The participants were 20 healthy preterm infants (3 very preterm; 17 moderate/late) with a

mean postnatal age of 11 months. These preterms had longer orientation times to the familiar words ($M = 8.54$ s) than the pseudowords ($M = 7.19$ s, $p = .02$; Figure 1), a pattern of preference found in 15 infants ($p = .021$, binomial test). Experiment 2 used the French adaptation of the MCDI (Kern, 2003) to evaluate 27 healthy preterm children (7 very preterm; 20 moderate and late preterm) with a mean postnatal age of 25;06 months (mean maturational age of 23;14 months). For each preterm child, number of words produced were transformed into two percentiles, one based on postnatal age, one based on maturational age. Mean percentile was 38.5 for postnatal age and 51.5 for maturational age. χ^2 analyses revealed that the percentile distribution of the preterms differed from the normative data for postnatal ($p = .006$) but not maturational ($p = .14$) age (Figure 2). Similarly, Wilcoxon signed rank tests revealed that the median percentile for the preterms differed from the fullterm median (50th percentile) for postnatal ($p = .037$) but not maturational ($p = .80$) age. However, about a quarter of the preterms fell within the 10th percentile, whether postnatal (26%) or maturational (22%) age was used. The present findings demonstrate that (mainly moderate and late preterms) preterm infants recognize familiar word-forms at 11 months of postnatal age, the same age at which it emerges in their fullterm peers. However, at 24 months, word production abilities of (mainly moderate and late preterms) preterm infants lag behind that of their postnatal age fullterm peers, falling within fullterm norms when correcting for prematurity using maturational age. Furthermore, our findings confirm a high incidence of preterms in the 10th percentile, a word production level considered by some authors (Charollais et al., 2014; Sansavini et al., 2006) as a sign of risk for later language outcomes. Taken together, our findings suggest that the impact of prematurity on language acquisition is not uniform, and possibly, that lexical abilities are differentially affected at the perceptual and productive levels.

P3-D-86 Using infant-directed speech to convey meaning: prosodic correlates to visual properties of objects

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Despite traditional assumptions that prosody contributes only to the structural organisation of spoken language, increasing evidence suggests that it plays a fundamental role in the communication and interpretation of ambiguous word meaning. Specifically, recent research suggests that speakers manipulate prosody in a way that reflects known crossmodal correspondence between visual and auditory sensory channels, such as the relationship between auditory pitch and visual brightness (i.e.

higher-pitched sounds are associated with brighter objects than their lower-pitched counterparts). Given the prosodically rich and variable nature of infant-directed speech (IDS) in the company of novel language users, we predict that users of IDS manipulate prosody in an attempt to convey semantic information paralinguistically. To further establish how prosody is used in this enterprise, we explored the extent to which infant-directed speakers talk about novel objects that differ in one of five visual dimensions: size, angularity, brightness, height and thinness (all of which have been found to elicit visual-auditory crossmodal correspondences). In this experiment, adult users of IDS verbalised simple sentences containing a novel word (e.g. "Look at the timu one.") in the presence or absence of meaning. The findings throw light on the functional significance of crossmodal correspondences in IDS.

P3-D-87 Early social preferences for native-language speakers: influence of unfamiliar foreign and regional accents in 6-month-old infants

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Early attentional biases toward particular congeners have important developmental outcomes regarding social learning and language acquisition. A number of studies showed that at an early age, infants do selectively allocate their attention to certain congeners based on various physical, behavioral as well as language cues. From the first days, infants prefer their mother's voice and their native language, which drives their attention towards their native group. However, a language is not homogeneous and children may encounter tremendous variation in the language spoken around them. The way infants perceive and process variation - such as phonetic and prosodic features that characterize a speaker's pronunciation according to his/her geographical origin - remains little explored in language acquisition. The present study aimed to investigate the perception of accents in French monolingual infants of 5-6 months exposed to standard French since their birth (Rennes, France). Using looking time experiments, the infants watched alternating films of two adult females (one text with target words enhancing regional variations, said in an infant-directed speech style). The familiarization was preceded (baseline) and followed (test) by a silent trial with the pictures of speakers side by side. To take into account inter-individual variability, we used 4 speakers per language category: speakers born and living in the Rennes area (standard French), speakers born

and living in the south of France (regional accent, Marseille), and speakers from the United States living in France for under a year (foreign accent). In a validation test, 20 naïve adults rated and validated the presence, strength and geographical origin of the speakers' accents as well as their social attractiveness. The infants' looking time toward each speaker was coded off-line by a blind observer (Noldus Observer©). Each infant participated only once, in one experiment. In a first experiment, we investigated whether infants (N = 32, mean age = 5 months 22 days, range 5:15-5:27) looked preferentially at an adult who spoke their familiar non-accented French compared to an adult who spoke a Southern accented French. Our results revealed no preference during the familiarization or the test trial. Subtle regional variation did not seem to induce 5-6-month-old infants' attentional biases. In a second ongoing experiment, we investigated whether infants (n= 24 / 32, mean age = 5 months 20 days, range 5:11-5:29) looked preferentially at an adult who spoke their familiar non-accented French compared to an adult who spoke French with a foreign accent. In previous studies, monolingual children exhibit biases for individuals speaking their native language without a foreign accent. On the contrary, our preliminary results revealed a tendency in favor of American speakers during the test trial. This result was in line with the social evaluation made by adults who rated more positively the American than the French speakers. American infant-directed speech is an exaggerative form of IDS and may be an attractive speech style even for other-language infants. Future studies should take into account the diversity of cues that may orient early infants' attentional biases and their complex interplay.

P3-D-88 The 'landscape of talk' in home language environments of Spanish-speaking families with young children

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How much caregivers talk to their children has profound implications for children's language learning. Children from lower-socioeconomic (SES) families tend to hear less child-directed speech (CDS) than children from higher-SES backgrounds, which is associated with poorer language and academic outcomes (Hart & Risley, 1995). Many studies have observed caregiver-child interactions during contexts such as play or book reading in a laboratory setting, and some have examined interactions at home during dressing routines or mealtimes (Hoff-Ginsberg, 1991). Recently, Tamis Le-Monda et al. (2017) examined in-home spontaneous contexts over 45 min in middle-high-SES English-speaking families. Yet, we know little about how often such contexts are represented

spontaneously over a typical day, especially in lower-SES, non-English-speaking families. We recorded caregiver-child interactions in Spanish-speaking families from diverse SES backgrounds, capturing spontaneous periods of dense talk using the LENA technology. Taking 3 hrs of each recording with the most adult talk, we examined the frequency distribution per child of five primarily-CDS contexts (Unstructured Interactions, Meals, Books, Play, Routines), asking whether amount of talk differed across contexts, and whether talk was related to child language outcomes. Participants were 87 lower-SES Spanish-speaking families with 25-month-old children. Native Spanish-speaking coders listened to the 3 highest-density hrs of each day-long LENA recording, focusing on those segments with the highest adult word counts (AWC), and classified 18 10-min interactions into one of 5 CDS contexts. Children's online understanding of familiar Spanish words (Accuracy and RT) was assessed with the "looking-while-listening" (LWL) procedure, and parents reported their child's vocabulary size (Spanish MB-CDI). Figure 1 shows the mean proportion of different contexts per child (line) and mean AWC counts per context (bar). The most frequently occurring context was Unstructured Interactions, while Books and Routines occurred infrequently. In fact, fewer than half the children had any Books contexts at all. Mean AWC was significantly higher in Books than all other contexts ($t_s > 6.48$, $p_s < .001$), with no differences among the other contexts ($t_s < 1.13$, $p_s > .79$). Intercorrelations in AWCs across contexts were significant ($r_s = .45-.87$), indicating that children who heard more talk in one context also heard more talk in other contexts. Finally, those children who heard more talk overall were faster ($r = -.37$, $p < .001$) and more accurate ($r = .33$, $p = .002$) in the LWL task. Average amount of talk was uncorrelated with reported vocabulary size ($r = .11$). Ongoing analyses explore patterns of talk across the different contexts, whether AWC differs within context type as a function of whether caregivers and children are jointly interacting, and the quality of caregiver talk. This is a first look at the "landscapes of talk" in spontaneous, in-home interactions between Spanish-speaking parents and their 2-yr-old children. Periods of dense talk frequently occurred in unstructured interactions, rather than in traditional laboratory contexts. Children heard the most caregiver talk during book reading, which was relatively infrequent. These results provide insights into when and how Spanish-speaking caregivers spontaneously talk to their children and can inform ways to support rich caregiver-child engagement in families from diverse backgrounds.

P3-D-89 First impressions matter: Infants' visual attention to bilingual speakers depends on the language they hear first

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INTRODUCTION: Early social-linguistic experiences impact infants' visual social attention, face processing in particular. For instance, 4-12-month-old bilingual infants--relative to monolinguals--look longer at the mouths of talking faces, whether speaking a familiar or an unfamiliar language (Pons et al., 2015). However, it is unknown how attention to familiar versus unfamiliar linguistic stimuli may vary during the period of rapid language growth between 15 and 24 months. Here, we examine how linguistically diverse infants' visual social attention to facial features (e.g., eyes vs. mouth) may be modulated by familiarity with the language being spoken. **PARTICIPANTS:** 15- to 24-month-old monolinguals ($n=28$; $Mage=19.83$, $SDage=3.01$) and bilinguals ($n=22$; $Mage=20.44$, $SDage=3.10$) participated. Bilingual infants were exposed to English 20-80% of the day ($M=57.45\%$, $SD=17.96\%$); monolingual infants were exposed to English 90-100% of the day ($M=96.96\%$, $SD=4.24\%$). **METHOD:** We recorded infants' eye movements as they viewed six 20-25 second videos of two female English-Armenian bilingual speakers talking alternately to each other and to the infant in infant-directed speech. The dialogue in three videos was in Armenian--an unfamiliar language for all infants; the other three videos were in English. The women did not mix or switch between languages during any of the videos. Video order was pseudorandomized for each infant; no more than two consecutive videos were presented in the same language. Dwell time to the women's faces was our primary measure of attention; the relative amount of time spent looking at speakers' mouths versus eyes (ME-Index) served as a second dependent measure. **RESULTS:** There were no reliable differences in face dwell times or ME-index between monolingual and bilingual infants ($ps > .05$). The difference in time spent viewing Armenian ($M=69.84\%$, $SD=20.98\%$) and English ($M=75.41\%$, $SD=19.68\%$) videos was marginally significant, $F(1,48)=3.64$, $p=0.06$. Percent dwell time to speakers' faces differed by trial and video language, $F(2,88)=3.73$, $p=.028$, partial $\eta^2=.078$ (Figure 1). When infants' first trial was in Armenian, dwell times to the speakers' faces did not differ across the two languages. In contrast, when infants' first trial was in English, dwell times to subsequent videos in either language increased. There were also differences in viewing patterns across trials in the ME-Index, $F(2,88)=3.509$, $p=.034$, partial $\eta^2=.074$ (Figure 2). When the first trial was in Armenian, infants looked relatively more to speakers' eyes in Armenian videos, but shifted attention to the mouth of the speaker in the third English video. When the first trial was in English, infants shifted their attention from the eyes of the speaker to more towards the mouth of the speaker by the third video of each language. **DISCUSSION:** During their first encounter with bilingual speakers, infants' visual attention was modulated by the order in which they heard a familiar (English) or unfamiliar (Armenian) language. Infants--regardless of their language background--may modulate their visual

social attention as they learn more about speakers' language backgrounds and identify when they can or cannot understand a speaker. Infants' attention to social-linguistic contexts may thus be affected by the initial linguistic information provided by a new speaker.

P3-D-90 Phonological features in the developing mental lexicon: Eye-tracking evidence from 18-month-olds

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No two utterances of a word are identical in terms of acoustic properties, even if uttered by the same speaker. Word recognition therefore must rely on a flexible mental representation. Even though it has been suggested that infants' representations of word forms may be phonologically underspecified (e.g., Jusczyk, 1993), other work indicates that 18-month-olds' representations of familiar words are detailed (Bailey & Plunkett, 2002). Lahiri & Reetz's (2010) Featurally Underspecified Lexicon (FUL), a model of adult word recognition, assumes the place of articulation is underspecified for coronal sounds such as [n] or [d] but specified for noncoronals such as [m] and [b]. This leads to specific predictions regarding mispronunciation sensitivity: "Nurse" being pronounced as "*murse" (non-specified feature missing) should be less detrimental to recognition than "mouse" pronounced as "*nouse" (specified feature missing). Evidence from adults is consistent with this prediction (Roberts et al., 2013). Here, we tested whether 18-month-old infants exhibit such an asymmetry, using a mispronunciation task in an eye tracking paradigm. We presented 18-month-olds (N=22) with a sequence of 48 trials, each containing a spoken word followed by a pair of images (on screen for 2000 ms). Spoken words were either correct or incorrect pronunciations of words beginning with a coronal ([n], [d] or [t]) or a noncoronal ([m], [b], [p]), e.g. "dog" and its mispronunciation "*bog". Each pair of images consisted of the named target and a novel item (e.g., an axolotl). Each subject saw each image pair three times: with accurate and inaccurate pronunciation, and with a novel non-word (e.g., "marl") to ensure that novel objects were perceived as potentially named referents. We hypothesized that mispronunciations would elicit more looks towards the novel item than accurate pronunciations (White & Morgan, 2008). Eye movements were recorded with a Tobii TX300 eye tracker (at 120 Hz). Roughly half the trials began with a fixation to the target and the other half to the novel item. Time to disengage from this fixation was assessed using growth curve analysis (Mirman, 2014) to model looking between 800 and 2000 ms after picture onset (see Figures 1 (target-first

trials) and 2 (novel-first trials) for model predictions and data). We fitted 2nd-order polynomials to the proportion of looking directed at the first item, with fixed effects Pronunciation (correct, incorrect, novel) and Onset sound (coronal, noncoronal), and Participant as random effect. Results indicated that infants were sensitive to mispronunciation of both coronal and non-coronal sounds. However, mispronunciations of noncoronals (e.g., "boat" as "doat") had a stronger mispronunciation effect. For target-first trials, infants disengaged more rapidly for noncoronal mispronunciations (Interaction Pronunciation x Onset: $p < .001$). For novel-first trials, infants remained on this item longer for noncoronal mispronunciations, but disengaged equally fast for accurate and mispronounced coronals (Contrasts: Coronals - correct vs. mispronounced: $p > .97$; Noncoronals - correct vs. mispronounced: $p < .001$). We conclude that while 18-month-olds are sensitive to mispronunciation of coronals and noncoronals, the asymmetry predicted by FUL is present from early on in development.

P3-D-91 On the way to talk about motion events: A longitudinal study

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Children as early as 12 months can discriminate changes in event components such as manner (how an action is performed) and path (trajectory of an action) (Pulverman et al., 2008). Research suggests that individual differences in nonlinguistic event categorization are related to children's later motion verb comprehension (Konishi et al., 2016). We ask whether (1) children's early understanding of event components predict how they talk about motion events and (2) different event components (path and manner) used in speech are predicted differentially by early understanding of these constructs. Twenty-nine Turkish-learning children were tested at three time points. At Time 1, using preferential looking paradigm, children (Mage=14.61 months) were presented a video where they were familiarized to a woman performing a motion event (e.g., walking upstairs). At test, on a split-screen, children viewed a novel path paired with the familiar event (walking upstairs vs. walking downstairs), then a novel manner paired with the same event (walking upstairs vs. running upstairs) (see Table 1). At Time 2, (Mage=25.16 months), children were tested on their receptive language skills via Turkish-Receptive-Language-Test (TIFALDI-R). At Time 3, children (Mage=34.91 months) described 12 videos depicting motion events with different path and manner combinations (e.g., climb up). Descriptions of motion events were coded based on path and manner information. Depending on the path and manner use, sentences were categorized as either manner-

only (e.g., the girl is jumping), path-only (e.g., she's entering), manner + path (e.g., the girl is jumping over). Descriptions were also categorized according to any manner information (either coupled with path or not i.e. she is jumping down, she is jumping) or any path information (either coupled with manner or not i.e. she is going down, she is crawling under the map) used (see Table 2). Results indicated that novelty preference for path and manner change at Time 1 predicted manner-only descriptions at Time 3 ($\beta = -.61$, $p = .012$). That is, children who discriminated changes in path and manner at Time 1 used less manner-only descriptions in their speech. For path-only or manner + path descriptions, the models were not significant. Finally, novelty preference for path and manner change at Time 1 significantly predicted any path descriptions at Time 3 ($\beta = .62$, $p = .013$). Children who discriminated changes in path and manner at Time 1, talked about path of the motion more at Time 3. No such relation was found for any manner descriptions. Neither age at Time 3 nor the receptive vocabulary assessed at Time 2 was a significant predictor in any of the models. Overall, the results showed that early understanding of event components selectively predicts how young children describe motion events. As children discriminated path and manner more proficiently, they tended to use less manner-only and more path-only descriptions. Since path is the core component in a given motion event and Turkish is a path-salient language that encodes path of motion in the main verb (Talmy, 1985), children with greater novelty preference for path and manner, talked about path, i.e. the core schema of an event, more frequently.

P3-D-92 The development of response to social directives in infants later diagnosed with ASD

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Researchers examine the emergence of Autism Spectrum Disorder (ASD) in infancy by studying the younger siblings of children already diagnosed with ASD. These infants have a heightened risk (HR) of developing ASD themselves. Previous studies have found early-appearing differences in social attention between HR infants later diagnosed with ASD (HR-ASD) and their non-ASD counterparts (Sullivan et al., 2007; Presmanes et al., 2007). However, these studies examined data from only a few time points and did not analyze growth over time. The present study extends the literature on social attention in HR-ASD infants by: 1) measuring the growth trajectory of social attention in HR infants; 2) comparing the growth trajectories of HR-ASD infants to HR infants with language delay and with no diagnosis. Participants were 94 HR infants who were visited monthly at

home as part of a larger study. The Early Social Communication Scale (ESCS; Mundy et al., 1996) was administered monthly from 8 to 14 months and at 18 months. This study examined performance on two tasks within the ESCS, which assess infants' responses to social directives. The first was a low demand task, in which an experimenter pointed to a nearby book (book trials). The second was a high demand task, in which an experimenter pointed to a distal poster (poster trials). Both tasks were administered 4 times per assessment (i.e. 8 trials total). The infant was scored as "passing" the trial if they looked at the object of the social directive (i.e. the book or poster respectively). The proportion of passed trials was calculated for each task-type. At 36 months, 15 HR infants received an ASD diagnosis (HR-ASD), 20 HR infants had significant language delay (HR-LD), and 59 were developing typically (No Diagnosis; HR-ND). Growth trajectories were analyzed using Hierarchical Linear Modeling (HLM). As seen in Figure 1, by 18 months all outcome groups were very successful in following the low demand social directive--they looked to the book on around 80% of trials. No group differences were apparent. However, for the high demand task HR-ASD infants displayed a significantly slower ($p=0.021$) growth rate ($\beta = 1.24$) than the HR-ND group ($\beta = 3.714$). By 18 months, HR-ND infants successfully followed the experimenter's point on about 60% of trials. In contrast, the HR-ASD infants followed the point only about 25% of the time. Results suggest that the low demand task--following a proximal point--is readily accomplished by HR-ASD infants. However, striking differences were apparent in the high demand task: following a point to a distal location. This may be because the high demand task requires infants to disengage their attention from their immediate field of vision. A great deal of research on infant development in ASD has focused on social attention (e.g. Jones et al., 2014)--the present findings suggest that these behaviors should also be considered within the context of task-demand, i.e. the extent to which infants must refocus in order to establish shared, social attention.

P3-D-93 Naming enhances subsequent learning: Semi-supervised learning in infancy

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Language plays a powerful role in infant categorization: specifically, providing a common name for a set of distinct individuals enhances infants' ability to form a category that unites them (c.f., Graham et al., 2012; Plunkett et al., 2008; Waxman & Markow, 1995). In daily life, however, caregivers label only a small minority of the category exemplars infants

encounter. How then, can we reconcile the power of labels with their relative scarcity in infant experience? One potential resolution to this paradox is that learners can use labeled exemplars to better learn from unlabeled exemplars. Labeling a subset of category members may initiate the process of categorization, with labeled exemplars serving as a foundation for learning from subsequent unlabeled exemplars. This strategy, known as "semi-supervised learning" (SSL), has been extensively documented in machine learning (Zhu, 2005), adult category learning (Gibson et al., 2013), and to a lesser extent, older children's learning as well (Kalish et al., 2015). Here, we asked whether 2-year-olds can take advantage of this efficient strategy. To do so, we updated a classic object categorization task (see Figure 1). During a familiarization phase, children in all conditions observed six category exemplars, one at a time, for 3 seconds each. At test, all children viewed two exemplars presented simultaneously in silence: a new member of the familiarized category and a member of a novel category. What varied across conditions was how the familiarization exemplars were named (Fully Supervised: all 6 named, Unsupervised: none named, Semi-supervised: first 2 named, Reversed SSL: final 2 named). The results demonstrate that 2-year-olds show a robust capacity for semi-supervised learning. As predicted, infants in the Fully Supervised and Semi-supervised conditions formed the object category, performing significantly above chance ($p < .05$). In contrast, those in the Unsupervised and Reversed SSL conditions were indistinguishable from chance. Infants' failure in the Reversed SSL condition suggests a constraint on infants' semi-supervised learning abilities: the unlabeled exemplars must occur after the labeled exemplars in order to be successfully integrated into the category. Strikingly similar patterns emerged from the time-course of infants' looking during the test trial (see Figure 2). Even on this more precise measure of performance, the Fully Supervised and Semi-supervised groups were indistinguishable at every time-point. Moreover, the Semi-supervised condition diverged from its Reversed control condition in precisely the time period during which the Fully Supervised condition diverged from the Unsupervised condition, $p \leq .05$. This indicates that whether children heard names for all exemplars (Fully Supervised) or only the first two (Semi-supervised), they were equally efficient in categorizing the test stimuli. Thus, while labeling only the first two exemplars proved as beneficial for categorization as labeling all of them, labeling the final two exemplars did not facilitate categorization. This provides evidence that labels are instrumental to initiating the process of category formation--inviting children to form a category. Once this invitation has been issued, infants learn equally well from labeled or unlabeled exemplars. Thus, the power of naming extends beyond the specific individuals named, enabling children to better learn from future exemplars.

P3-D-94 Language, personal pronouns, and social understanding from two to three: a longitudinal study in children acquiring Czech

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Language development is an important predictor of false-belief understanding, which emerges at about 4 years of age (e. g. Milligan et al., 2007). Links between language and social understanding can be shown earlier: person-referring pronouns are of special interest. Differentiating persons in language may relate to social cognition, since the person-referring pronouns require a stable representation of self and others. At the same time, pronouns are closed-class elements that may depend on sufficient development of grammatical skills (cf. Naigles et al., 2016, Markova & Smolík 2014). We conducted a two-round longitudinal study examining linguistic development, several aspects of social cognition, and the mastery of speaker and addressee (I/You) reference in Czech toddlers. The key questions were: 1) Is early use of person-referring devices related to social cognition and linguistic development?; 2) Does early use of these person-referring elements predict the performance in later social-cognitive tasks, above and beyond the early language skills? The children were 29 months (28 to 32) in the first round, and 43 months (42 to 47) in the second round. At the time of abstract submission, 49 children participated in both rounds (out of 66 seen at the first round). Five tasks addressed person reference in production and comprehension at 29 months; and one production task at 43 months. Social cognition at 29 months was assessed with tasks examining visual perspective, pretense and intention understanding. At 43 months, social cognition was assessed by a false-belief task and two visual perspective tasks. At both ages, linguistic development was assessed by a picture-comprehension lexical task and a receptive grammar task (Bishop, 2003); at 29 months, MLU values were also available. The results were analyzed using regression analyses and path analysis, first examining the overall patterns using aggregate scores for language, social cognition, and linguistic person reference (see Table 1). A path model (see Figure 1) confirmed that person reference is related to both social cognition and language development at 29 months. The model showed predictive effects of language on later social cognition, and no effect of early social cognition on later general language. Early person reference was positively related to later person reference, but not to language or social cognition. Interestingly, the early language performance had a negative relation to later mastery of person reference. Subsequent regression analyses showed that each of the second-round social understanding tasks (false belief and visual perspective tasks) was significantly related to the first-round language scores. Our results show that person reference at 29 months is

related to both social-cognitive and linguistic development. At 43 months, the relation to social cognition is no longer present, perhaps because person reference is well mastered. Person reference at 43 months is positively related to earlier person reference, and negatively related to earlier language skills. This probably reflects the loosening relation between person reference and general language skills in the fourth year of life. Additionally, our results support the finding that early linguistic development predicts later false-belief understanding, and extend this conclusion to visual perspective taking.

P3-D-95 Variation in home language input is linked to predictive language processing

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Disparities in young children's language input are implicated in language learning disparities. For example, Weisleder and Fernald (2013) find that toddlers who hear less language input tend to have smaller vocabularies than those who hear more language input. Results also reveal disparities in real-time language processing, such that low-input toddlers are slower and less accurate in comprehending familiar words. Moreover, these results indicate that language processing mediates the link between toddlers' language input and subsequent vocabulary size. Together, these findings suggest that external factors (i.e., language input, socioeconomic status) and internal factors (i.e., language processing) interact to create disparities in children's learning trajectories. We hypothesized that a particular aspect of language processing - prediction - may play a role in explaining language learning disparities. Prediction refers to the ability to anticipate upcoming information in speech, and a number of theories propose that prediction is a key language learning mechanism (e.g., Christiansen & Chater, 2015). Supporting this view, toddlers can predict during language processing, and those that do predict tend to have larger vocabularies (Mani & Huettig, 2012). Thus, understanding differences in toddlers' prediction abilities could further our understanding of language learning disparities. Akin to prior findings (Weisleder & Fernald, 2013), we hypothesized that toddlers who hear more language input would be more likely to predict during language processing. We recruited 28- to 32-month-old toddlers (n=30) from families with widely varying annual household incomes (range = \$20,000-\$200,000). We tested toddlers in two eye-tracking tasks. In the first task, toddlers viewed pairs of referents (e.g., cookie, book) and heard sentences with informative verbs that could be used to predict the target (e.g., Eat the cookie), and neutral sentences (e.g., Look at the cookie). In the

second task, toddlers viewed pairs of referents (e.g., two cookies, one apple) and heard sentences with informative number marking (e.g., There are the nice cookies), and neutral sentences (e.g., Look at the nice cookies). We measured toddlers' looks to the target referent over time during each sentence. To evaluate whether differences in language input are linked to prediction abilities, we used LENA technology to record each family at home for one full day. We divided toddlers into a High-Input group and a Low-Input group based on a median split of language input (Table 1). In the first eye-tracking task, we found an interaction of condition and time for High-Input ($F(1,15)=2.97$, $p<0.001$) but not Low-Input toddlers ($F(1,15)=0.66$, $p=0.83$). In the second eye-tracking task, we again found an interaction of condition and time for High-Input ($F(1,15)=1.75$, $p=0.04$) but not Low-Input toddlers ($F(1,15)=0.56$, $p=0.90$). Whereas High-Input toddlers used informative verb semantics and number marking to predict the upcoming noun, Low-Input toddlers did not (Figure 1). Together, the present findings suggest that differences in language input influence the extent to which toddlers predict during language processing. If prediction is a key language learning mechanism, then differences in prediction abilities, in combination with differences in familiar word recognition, may play a role in creating divergent language learning trajectories.

P3-D-96 Setting Boundaries: Prepositions but not Verbs Heighten Infants' Perception of Ground-Path Distinctions in Dynamic Events

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Infants from varying linguistic backgrounds show sensitivity to a range of event components early in life, but later narrow their sensitivity to events lexicalized in their native language (Goksun et al., 2011). Languages have different ways of encoding events in relational terms. For example, in Japanese, two distinct verbs are necessary to describe a person crossing a bounded ground (e.g., a road) versus an unbounded ground (e.g., a field) while in English, the same verb crossing describes both types of grounds (Goksun et al., 2011). Both English- and Japanese-reared 14-month-olds are equally sensitive to Japanese ground-path distinctions in nonlinguistic events, but by 19 months, English-reared infants lose the ability to notice these distinctions (Goksun et al., 2011; Konishi, 2015). However, this dampening effect is malleable; Konishi (2015) resurrected English-reared 23-month-olds' ground-path distinctions by pairing two different ground types

with distinct novel-spatial prepositions used in sentences. Prepositions were effective in heightening ground-path distinctions that had previously been lost, which may be due to the fact some English prepositions encode ground-path information (e.g., over). A remaining question is whether a similar ground-path distinction could be resurrected using novel verbs rather than prepositions. English verbs rarely encode path but mainly encode manner, which could make this task difficult. Additionally, the few path verbs that do exist in English are acquired later in development as they are less common (Selimis & Katis, 2010). To explore whether verbs, like prepositions, could heighten English-reared infants' sensitivity to Japanese ground-path distinctions, we showed 20 infants aged 21 to 25 months (Mage = 22.48, 9 female) the same videos used in Konishi (2015) with linguistic prompts featuring verbs rather than prepositions. Videos of a woman crossing three bounded and three unbounded ground types were paired with the novel verbs *toking* and *keeting*, respectively (see Figure 1). Infants then saw three more scenes of only one of the ground types presented in silence. Ground type in these three reminder trials was counterbalanced across children. At test, infants saw a new bounded ground and a new unbounded ground in silence. We used the preferential looking paradigm (Golinkoff et al., 2013) to measure infants' preference for the novel ground type during test trials to determine whether infants could distinguish between ground types. A repeated-measures ANOVA comparing infants' average proportion of looking time to the novel ($M = .48$, $SD = .12$) or familiar ($M = .52$, $SD = .12$) ground type during test trials did not yield a significant difference, $F(1,19)=1.65$, $p=.21$. These results suggest that novel prepositions, but not novel verbs, resurrect 22-month-old's ability to distinguish Japanese ground-path distinctions. This finding is likely due to the fact that English ground-path distinctions tend to be encoded in prepositions rather than verbs, which typically encode manner information. This work suggests that a) children recognize which word class encodes which types of concepts; and b) non-native construals of events can be recovered under the influence of language.

P3-D-97 Multi-modal coordination of vocal and gaze behavior in mother-infant dyads across the first year of life

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Introduction: Research examining parent-infant interaction indicates a close connection between parent and infant vocal and gaze behavior (Van Egeren, Barratt, & Roach, 2001). The coordination of vocalizations and gaze has implications for social communication

development, as vocalizations that occur before and during looks to objects may provide optimal moments for establishing joint attention and for infant word learning (Goldstein, Schwade, Briesch, & Syal, 2010; Masur, 1982). The present study examined the development of the coordination of vocal and gaze behavior by analyzing how mothers and infants timed their object directed vocalizations (ODVs; i.e., vocalizations that occur during looks to objects) with their partner's gaze behavior across the first year of life. Methods: Thirty mother-infant dyads were videotaped playing together with standard toys when infants were 3, 6, 9, and 12 months old. Individual vocalization and gaze behaviors were coded on a moment-to-moment basis, and instances of ODVs were determined by combining coded vocalization and gaze streams. Table 1 describes two variables used to examine coordination of ODVs and gaze. To determine whether frequency of coordination exceeded chance levels, randomized baselines were created by shuffling mother and infant coded behavior streams, calculating coordination measures from shuffled data, and subtracting the randomized baseline from the true frequency. Developmental trajectories of coordination were analyzed using hierarchical linear modeling. Results: Figure 1 displays the adjusted coordination frequencies for infant gaze following mother ODV (1a), mother gaze following infant ODV (1b), infant ODV following mother gaze (1c), and mother ODV following infant gaze (1d). The frequency with which mothers and infants followed partners' ODVs with looks to that location was greater than expected by chance, and revealed no significant developmental change. Infants were more likely to follow mothers' ODVs with gaze shifts ($\beta_{00} = 5.25$) than mothers were to follow infant ODVs ($\beta_{00} = 1.79$). Both mothers and infants followed partner's gaze to an object with an ODV toward that object significantly more than expected by chance at 3 months. However, while mothers and infants looked similar to one another at 3 months, only mothers increased over time, such that by 12 months they were following infants' gaze shifts with ODVs approximately 10 times more than expected by chance. Conclusions: Mothers and infants displayed different patterns of development, indicating that they may be using multi-modal coordination in distinctive ways. Specifically, infants were more likely to follow ODVs with gaze shifts, suggesting that infants use mothers' directed vocalizations as a pathway to simultaneous attention to objects, while mothers, whose relative height gives them a more global view of the interaction, may be less reliant on infant vocalizations in establishing coordinated attention. Mothers, on the other hand, increased the frequency with which they responded to an infant gaze shift by vocalizing, a change that was not paralleled by infants. Maternal vocal responses to infant gaze shifts may become especially important as infants begin developing language, as they create opportunities for mothers to provide labels or descriptors of the object of infants' focus (Gros-Louis et al., 2006).

P3-D-99 Mother's with postnatal depression are less affective and talk less to pre-linguistic infants

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Mother's with postnatal depression are less affective and talk less to pre-linguistic infants
Lam-Cassettari, C1. & Kohlhoff, J2,3. 1The MARCS Institute for Brain, Behaviour & Development, Western Sydney University, Australia 2 Karitane, Australia 3Faculty of Medicine, School of Psychiatry, University of New South Wales, Australia Attuned social interaction provides a foundation for healthy child development. A key feature of early parent-child interactions is the special speech style caregivers use to communicate with infants, known as infant directed speech (IDS). IDS is typically characterized by an exaggerated pitch and pitch range, high positive affect and slower speech rate (Cristia, 2013). However, when mothers suffer from postnatal depression, their IDS has been shown to have a limited pitch range (e.g., Kaplan et al., 2001). A reduction in the quality of IDS may have long-term consequences on infant's interest in conversations and social interactions with their mother, and negatively affect infant development. This study examines differences in the expression of vocal affect and the number of words spoken by depressed (scored > 13 on the Edinburgh Postnatal Depression Scale) and non-depressed mothers and their pre-linguistic infants. Thirty-two Australian mother-infant dyads were audio-recorded during a 5-minute free play session in the MARCS Institute Babylab or a treatment room at a parenting service provider, Karitane. These audio-recordings were then assessed for affective quality in a ratings study, and quantity of speech using a hidden markov model toolkit. On average, infants of non-depressed mothers were aged 25.6 weeks (N = 13, 8 girls), and infants of depressed mothers were aged 22.7 weeks (N = 13, 7 girls). A ratings study was conducted to determine whether adult listeners could hear a difference in the expression of vocal affect in mothers with and without postnatal depression. Audio-recordings were cleaned (infant vocalisations/noise/non-speech sounds were removed) and a 30-second sample of speech was extracted and low-pass filtered to remove segmental information and leave prosodic information intact (see Kitamura & Burnham, 2003). Twenty first year Psychology students rated the level of emotional valence and arousal on i) a continuous x-y axis for the duration that the audio segment played, and ii) a 7-point likert scale. The number of words spoken by mothers was extracted using a hidden markov model toolkit in MATLAB, and the number of infant vocalisations was calculated manually. T-tests showed that non-

depressed mothers were rated with significantly higher levels of emotional valence and arousal compared to depressed mothers on the continuous and fixed rating scales ($p < .05$, see Figure 1). Non-depressed mothers used significantly more IDS than depressed mothers (mean 300 vs. 150 words, $p < .05$). Infants of non-depressed mothers also made more attempts at vocalisations than infants of depressed mothers (mean 14 vs. 5 words, $p < .05$). These findings highlight adverse effects of postnatal depression on both quality and quantity of IDS when compared to IDS of non-depressed mothers. They also identify two aspects of IDS that require further investigation to determine whether they are amenable to change through interventions for mothers with PND; the expression of vocal affect and quantity of speech input.

P3-D-100 Hearing parents adjust auditory, visual and tactile cues as a function of child hearing status

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Introduction: The aim of this project is to determine whether specific aspects of parent-child early interaction can be supported through the use of multimodal communication cues (e.g., auditory, visual, tactile). In particular, the ability to establish joint attention is now widely acknowledged to be a critical component of the language learning process, and lack of this ability has developmental implications. People often establish shared attentional focus by speaking to one another. Not surprisingly, research on typical language development indicates that caregivers provide a social scaffold through communication that supports a child's attentional allocation. This can be through verbal communication in hearing-hearing dyads, or through manual communication in deaf-deaf dyads. But how does this process unfold when a deaf child interacts with a hearing caregiver who does not know sign language? This is exactly the situation that arises in many families when a child is born or becomes deaf early in life. We were able to work with such dyads in a university hospital's hearing clinic at which deaf children were being evaluated for cochlear implant candidacy. **Study Aims:** This study investigates whether and to what degree hearing parents accommodate their deaf children's hearing status by using modalities beyond the auditory one to establish joint attention, and compare this to the nature of the communication used between hearing parents and their hearing children. The longterm goal of the study is to determine whether differential levels of such accommodation are a contributing factor to the variable language outcomes observed in pediatric cochlear implant users. Our more immediate goal, and the one that will be

reported here, is to compare the amount of uni- vs. multimodal communication used in the two dyad types when joint attention is established successfully, or is not. **Methods:** This study examines multimodal communication between hearing parents and their children (hearing children = 9; deaf children = 9) during a free play task. Specifically, we coded parents' use of uni- and multimodal cues to establish joint attention with their children. In addition to the modalities used, these behaviors were coded as either successful or failed attempts to initiate joint attention on the part of the parent. Dyad types were compared for overall use of multimodal - auditory, visual, and tactile - attention establishing cues, and for number of successful and failed bids for joint attention. **Results and Discussion:** We compared the number of modalities used during bids for joint attention across the dyad types, as well as the number of successful vs. failed attempts by the parent to establish joint attention. Analyses indicate that hearing parents accommodate their deaf children by employing modalities of communication beyond the auditory one and that they do so more than parents of hearing children. We focus our interpretation of the results on how hearing parents differentially accommodate their hearing and deaf children to successfully engage them in joint attention. These findings extend our understanding of how joint attention is established between parents and their preverbal children, regardless of the children's hearing status.

P3-D-101 Maternal touch and speech during face-to-face interactions with 3-month-old infants

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Until recently, studies on preverbal communication tended to focus on vocal characteristics, paying little attention to the role of nonverbal sensory modalities in Infant-Directed-Speech (IDS) and vocal communication. Thus, even though recent research has shown that IDS is associated with modified expression in other modalities (Meyer et al., 2011; Nomikou & Rohlfing, 2011; Gogate, Maganti & Bahrick, 2015), little is known about the ways in which touch and voice are coordinated when parents communicate with their infant. The aim of this study was to analyze how maternal voice and touch are associated in infant-directed communication with 3-month-old infants. We filmed 20 mothers' spontaneous interactions with their full-term, healthy 2-to-4-month-old infants in their home environment. Two-minute sequences were selected and analyzed for each dyad in order to quantify mothers' tactile and vocal behaviors, such as the extent of verbalization, semantic and prosodic characteristics of maternal utterances and types of touch. Both

vocal and tactile behaviors were coded on the basis of ongoing behaviors. Two separate types of utterances were considered: utterances isolated from touch when utterances were separated from touch (time window > 2 s) and synchronous utterances when utterances and touch overlapped (totally or partially). An utterance was defined as the production of vocal sound that was either continuous or included unvoiced segments of less than 300ms. Results confirm previous studies showing a significant predominance of affectionate touch (51.6% of total number of touches) over stimulating touch (28.2%) at this age. We also found significant lower pitch of maternal utterances when voice and touch overlapped compared to isolated utterances. In addition, in isolated utterances, mothers used significantly more agentive vocabulary (55.6%) to address their infant compared to when the utterances and touches overlapped (44.4%). Lastly, mothers used significantly more nonsense words when they associated touch with speech (57.3%) compared to isolated utterances (42.7%). These results suggest that temporal association between tactile and vocal behaviors influences semantic and acoustic characteristics of maternal IDS. It is possible that the expression of positive affiliative emotion is transferred from touch to speech when utterances are not associated with touch. Emotional characteristics of IDS may not be modality specific. Further research is needed to better understand the way vocal and tactile behaviors are coordinated and the precise function of touch when associated with IDS.

P3-D-102 Parenting Styles and Language: An Exploration of Goodness of Fit for Risky Temperament Profiles

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Research on links between infant temperament and language development have provided researchers with greater insight into possible contributors to language development. For instance, 13-month infant temperament is predictive of 20-month productive vocabulary; with both high negative affectivity and low effortful control leading to attenuated language outcomes (Dixon & Shore, 1997; Dixon & Smith, 2000). Infant temperament may also impact parenting style (cf. Chess & Thomas, 1986). Research on the consonance and dissonance between infant temperament and parenting style suggests that the goodness of fit between the two is likely to impact the quality of developmental outcomes (Thomas & Chess, 1977; Carey & McDevitt, 1995). Surprisingly, there is little literature looking at links between parenting style and children's language development. The purpose of the present investigation was to explore whether parenting

styles were associated with language development, but especially whether particular temperamental profiles might moderate any relationship between parenting style and infant vocabulary development. 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 the Parental Authority Questionnaire (PAQ). The IBQ-R produced three overarching superdimensions: surgency, negative affectivity, and effortful control, which were used to identify two temperamental profiles. An "at-risk" profile was characterized by high scores on negative affectivity and low scores on effortful control, while a "buffered" profile was characterized by the converse. Total productive vocabulary was derived from the MCDI-WG, and the PAQ produced scores on three parenting dimensions: authoritative, authoritarian, and permissive. We first tested associations between parenting style scores and productive vocabulary; however, only permissive parenting was associated with language ($N = 70$, $r = .31$, $p = .01$). We next evaluated whether this relationship differed as a function of a "risky" versus "buffered" temperament profile. We found that there were no permissive parenting-language associations in the buffered group ($N = 22$, $r = .26$, $p = n.s.$); however, there was a strong association in the "risky" temperament group ($N = 21$, $r = .54$, $p = .01$). That a permissive parenting style was positively associated with language production was unexpected. We reasoned that if anything, parents scoring high on authoritative parenting would be most likely to have linguistically advanced infants. Nevertheless, should these results withstand replication, they suggest that a parenting style characterized by high support and low control (e.g., permissive parenting style) is best suited for infants who are high in negative affectivity and low in effortful control. For instance, children high in negative affectivity may thrive best when in a supportive language learning environment that presents little to no linguistic corrections when speaking aloud.

P3-D-103 A cross-linguistic comparison of word teaching strategies between Korean- and English-speaking mothers

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Mothers across cultures adopt similar acoustic characteristics in addressing their children but differ in their strategies in teaching words. For example, differences in English as "noun-dominant" relative to more "verb-dominant" languages like Korean and Japanese could yield variations in maternal speech style (Gopnik & Choi, 1990). This paper

investigates the effects of structural differences in Korean as a head-final and English as a head-initial language on the mothers' word teaching strategies. We show that Korean mothers often present target words in the utterance-initial position, but they also repeat target words at the end of an utterance significantly more frequently than American mothers. When introducing new words, American mothers place them on exaggerated pitch peaks in the utterance-final position (Fernald & Mazzie, 1991). Cross-linguistically, the right-edge of an utterance is a privileged position, with prominence rendered by utterance-final lengthening and exaggerated pitch movement. This position, however, is usually occupied by a verb in Korean. This would mean that Korean-learning infants do not benefit from the right-edge prominence in learning nouns. Korean mothers, however, might still take advantage of the prominence of the utterance-final position by, for example, repeating target nouns at the end of an utterance similar to the English tag-question. We thus investigated how Korean mothers present focused words to their children in comparison to American mothers. We extracted the target words from corpora Korean and English and coded them with regard to their position in the utterance and the presence of repetition. The Korean corpus was constructed by recording 35 mothers spontaneously interacting with their children of three age group: 0;9 (12 dyads), 1;1 (11 dyads), and 2;3 (12 dyads). Matching data of American mother-child dyads were selected from the CHILDES database (MacWhinney, 2000). We then coded the position (isolated, utterance-initial, utterance-final) and the presence of repetition (tagged, within-utterance, nearby-utterance). We conducted multiple regression analyses. The results indicates that age and language significantly predicts the use of repetition ($R^2=.35$, $F(3, 66)=11.9$, $p<0.001$). Korean had a higher rate of repetition than English ($\beta=21.9$, $p<0.01$), and it decreased with age ($\beta=-8.2$, $p<0.05$). Both the ratio of tag-repetition and within-utterance repetition was explained by language, with Korean having a significantly higher rate of them than English ($p<0.001$). An interaction between age and language ($\beta=-3.7$, $p<0.001$) indicates that the ratio of tag-repetition is higher in speech to Korean younger children (Figure 1). The placement of focused words in the utterance-initial position is explained by language ($R^2=.76$, $F(3, 66)=70.59$, $p<0.001$). The placement of focus at the right-edge, however, was explained both by language and age ($R^2=.83$, $F(3, 66)=106.2$, $p<0.001$). An interaction between language and age ($\beta=4.9$, $p<0.5$) indicates that the ratio of focused words occurring at the right-edge is lower in speech to Korean older children (Figure 2). It thus suggests that Korean mothers do make efforts to take advantage of the edge-prominence of the final position by repeating target words at the end of the utterance because making use of the right-edge of an utterance to teach focused nouns is hardly possible in Korean.

P3-D-104 Sixteen-month-olds understand the link between words and mental representations of their referents without contextual support

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A proto-understanding of reference to absent entities emerges around 12 months (e.g., Liszkowski et al., 2007). Infants begin to point to cues associated with a recently hidden object to refer to it (anchored absent reference). Twelve- and 16-month-olds recognize properties of recently removed objects (Saylor, 2004). Fourteen- to 20-month-olds interpret verbal requests for displaced objects, using social information for disambiguation (Saylor & Ganea, 2007). These findings demonstrate that infants display a nascent understanding of absent reference when provided with rich contextual support when an object is displaced. When and how do infants begin to understand unanchored absent reference (without contextual support) and to retrieve mental representations of objects upon just hearing their labels? Hendrickson and Sundara (2017) developed an auditory-visual priming paradigm that investigated infants' understanding of absent reference with minimal contextual support. During the pre-test, infants watched images of four objects in silence. Then, they listened to passages containing labels of two of the previously displayed objects, while looking at an unrelated image. Infants' preference for looking at the referents of those labels was subsequently measured in an infant-controlled procedure. Fourteen-month-olds were able to correctly identify the referents of labels they had heard in the passages. We asked whether infants understand absent reference with no contextual support. We modified Hendrickson and Sundara's procedure by removing the pre-exposure. Fourteen- and 16-month-olds were tested in a preferential looking procedure. On each of four trials, infants listened to a single passage of six sentences, each containing a target word, (e.g., "shoe") while viewing a checkerboard pattern. Then the target referent (image of a shoe) and the distractor appeared on the screen. We measured infants' proportional looking time to the target. Each object was the target on one trial and the distractor on another trial, allowing us to eliminate the baseline looking preference measurement and avoid priming. We analyzed infants' looking time to the referent during 3 seconds from the onset of the image display. Only 16-month-olds performed significantly above chance (Figure 1), suggesting that listening to the passages activated their mental representations of the referents. These results are the first to show that by 16 months, infants retrieve mental representations of objects upon just hearing their labels, without any previous experimental exposure to the objects. Our findings are consistent with broader knowledge about the development of infants' communication about absent entities. By 15-16 months infants use communicative

gestures and gaze to refer to displaced objects or highly familiar absent caregivers (Saylor & Baldwin, 2004; Saylor, 2004), suggesting that they recognize that communication requires referring to absent or concealed objects. Our results add to this body of literature by showing that 16-month-olds represent these objects without priming. While it is an open question whether infants appreciate the communicative nature of such reference, we suggest that infants' understanding of absent reference reaches its "unanchored" form by 16 months and is linked to infants' social communicative development.

P3-D-105 From notes to words: Information transfer between music and speech in infant learning

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Given language's complexity, infants must exploit all cues available for learning, including statistical regularities in the input (Saffran et al., 1996). Prior experience can facilitate statistical learning; infants exposed to a list of isolated disyllabic words were better able to segment a language made up of disyllabic words (where the only cues to word boundaries came from the statistical co-occurrences between syllables) than infants exposed to trisyllabic words, and vice versa (Lew-Williams & Saffran, 2012). Thus, experience with words endowed infants with expectations necessary for learning in a challenging context. We tested whether musical experience could support infants' ability to detect patterns in language. Music evokes a similar neural response to human speech (Tallal & Gaab, 2006), and infants have demonstrated use of statistical learning with musical stimuli (Saffran et al., 1998), so we hypothesized that relevant music experience could facilitate infants' language learning. We also tested whether the type of music to which infants were exposed could differentially impact learning. Infants pay more attention to human speech than other sounds (Spence & Decasper, 1987), and stringed instruments evoke a similar neural response to human speech compared to other instruments (Levy et al., 2003). We hypothesized that exposing infants to music from a stringed instrument (cello) would facilitate learning compared to a non-stringed instrument's music (trumpet). **Methods.** We adapted Lew-Williams' and Saffran's (2012) 3-phase paradigm, where infants only demonstrated successful learning after relevant experience. During the Pre-exposure phase, infants heard musical tones played either by a cello or a trumpet. The notes were grouped in units of two to mimic the structure of disyllabic words; half of the infants heard each instrument. In the Segmentation phase, infants heard the artificial language, consisting of four nonsense disyllabic words. In the

test phase, we used the Headturn Preference Procedure to measure infants' looking to Words from the language vs. Part-words that spanned word boundaries. In Exp 1, monolingual 9-11m infants (n=45) heard 60 musical tone pairs. In Exp 2, infants (n=48) heard 120 musical tone pairs. Results. Mixed ANOVAs (Instrument: Cello vs. Trumpet, Test Type: Word vs. Part-word) showed that infants in both experiments preferred words over part-words [Exp 1: $F(1,43)=8.20$, $p<.05$; Experiment 2: $F(1,46)=4.11$, $p<.05$]. There was a marginal interaction between Instrument and Test type in Exp 2 [$F(1,46)=3.21$, $p=.08$]; contrary to our hypothesis, infants displayed marginally better learning following exposure to Trumpet materials. However, there was no interaction in Experiment 1 [$F(1,43)=1.41$, $p=.73$], suggesting that learning was similar for both instruments. Discussion. These results provide evidence that infants can use musical experience to help them learn language. If music can facilitate infants' ability to determine the boundaries in a language, it could be influencing other ways they learn to perceive the world. Overall, we demonstrated that cross-domain learning is possible between music and language, and that experience with music may affect infant language learning.

P3-D-106 Building more than communication: Longitudinal relations between reciprocal interactions, language and executive function

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Social interactions between infants and their caregivers can provide opportunity not only for vocabulary development, but for self-regulation of children's attention and behavior. Prior research has found the quality of dyadic exchange to be a better predictor of vocabulary than the quantity of language (Hirsh-Pasek et al., 2015). In that study, quality was measured through the communication foundation (CF), parent-child interaction characterized by bouts of shared attention infused with symbols, scripted patterns of behavior and fluid, balanced conversation. Indicators of quality and reciprocity during parent-child interaction, such as CF, may be relevant for the development of cognitive skills other than language, such as executive function (EF). EF is defined by control attention and behavior (Diamond, 2013) and appears crucial to school adjustment (Raver et al., 2013). Here, we ask how the communication foundation established during infancy relates to children's later executive function, beyond its impact on language development. This study examines whether the shared variance in aspects of 24-month communication foundation predicted language at 36-months and 54-month executive function, with the goal of parceling the longitudinal effects of communication foundation (CF) on EF,

controlling for language. We examine how the latent construct of CF at 24-months relates with language at 36-months, and EF at 54-months. We hypothesize that CF predicts EF and that language mediates this relationship. Drawn from the NICHD Study of Early Child Care and Youth Development, 187 parent-child dyads were rated on three behaviors that comprise the communication foundation: symbol-infused joint engagement (SIJE), fluency and connectedness (FCC) and routines and rituals (RR; Hirsh-Pasek et al., 2015) during the three-box task, a semi-naturalistic interaction in which parent and infant play with a book and toys (Vandell, 1979). Expressive and comprehensive vocabulary at 36-months was assessed using the Reynell Developmental Language Scales (Reynell, 1991). Executive function (EF) was assessed using the Continuous Performance Task (Rosvold, et al., 1956) to measure sustained attention, the Woodcock-Johnson-Memory for Sentences subtest (McGrew, et al., 1991) to measure verbal working memory, and the Delay of Gratification Task, (Mischel, 1974; 1981) to measure behavioral inhibition. Structural equation modeling (SEM) predicted the longitudinal paths from 24-month CF to 36-month language to 54-month EF measures, controlling for parenting (refer to figure 1). Fit indices suggested acceptable fit ($\chi^2(10)=14.307$, $p=0.159$, CFI=0.989, TLI=0.973, RMSEA=0.048). Measures of 24-month SIJE, RR and FCC significantly load together into the unitary latent CF variable. Direct effects were found between CF and vocabulary and between vocabulary and EF. Indirect effect analyses indicate the relations between CF and EF are not mediated by comprehensive vocabulary suggesting that differences in CF accounted for variance in EF at school-entry. However, expressive vocabulary fully accounted for the variance in behavioral inhibition and working memory attributed to CF. Only the relationship between CF and sustained attention was not mediated by expressive language (see Table 1 for standardized path coefficients). These findings elucidate potential for parenting interventions to promote language and executive function.

P3-D-107 Selective Attention to the Mouth of a Talking Face in Japanese-learning infants and toddlers

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Introduction Monolingual English infants demonstrate an attentional shift to a mouth from eyes between 4 and 8 months of age in audiovisual speech perception (Lewkowicz & Hansen-Tift., 2012). This selective attention to the mouth disappears at 12 months of age for native language presentation but remains if infants have to process non-native language. Therefore, the mouth gaze behavior presumably indicates a strategic access to

redundant audiovisual cues when infants tackle speech signals in which they have no expertise. Audiovisual speech matching is somewhat delayed in Japanese infants (Mugitani et al., 2004), and Japanese children rely less on visual speech (Sekiyama & Burnham, 2008). These cross-cultural differences stimulated us to explore the development of mouth gaze behavior in the Japanese-learning population. Method The participants were 6-, 8-, 10-, 12-, and 18-month-old Japanese infants (N= 16 for each age), 2- and 3-year-old toddlers (N= 20 for each age), and adults (N= 12). In the experiment, each participant viewed video clips of a female speaker who uttered 10-s short stories under three noise conditions to control speech signal uncertainty: noise-free, with mild noise (SNR= 4), and with strong noise (SNR= -4). Each video clip was presented once in a row in either ascending or descending order of noise volume. The order was counterbalanced across participants. An eye tracker (Tobii X 120, sampling rate= 120Hz) recorded eye gaze trajectories of participants. We also assessed the vocabulary size of participant in the toddler groups using a Japanese version of MacArthur-Bates Communicative Development Inventories. Result Areas of interest (AOIs) were defined as the eye and mouth regions. The proportion of total looking times (PTLT) for each AOI was calculated. A three-way-ANOVA (age group \times noise condition \times AOI) indicated significant second-order interaction ($F(14, 248) = 1.75, p < .05$). Subsequent analysis revealed significant simple interactions of age group \times AOI for all noise conditions ($ps < .05$). The simple-simple effects of AOIs ($ps < .05$) revealed that 6- and 8-month-old infants and adults looked longer at eye regions than at mouth regions in all noise conditions, whereas 10-month-old infants did so only in the mild noise condition (fig. 1). Selective attention to the mouth was observed only in the strong noise condition for the three-year-old toddlers. In the noise-free condition, they looked at eye areas. Twelve- and 18-month-old infants and 2-year-old toddlers looked at both AOIs equivalently. Partial correlation controlling for age indicated that higher expressive language scores in toddlers were negatively associated with mouth-looking behavior in the mild noise condition ($r = -.40, p < .01$). Discussion Japanese infants lose selective attention to eye area in a course of development just as English learning infants do, but the shift occurs later and in a milder fashion. In contrast to English-learning infants, the Japanese infants in this study did not exhibit selective attention to the mouth even in linguistically challenging situations with noise. Clear selective attention to the mouth in 3-year-old toddlers in the strong noise condition presumably indicated reliance on audiovisual redundancy to process uncertain speech signals at this age, which may be relevant to the fact that language skills and attention to the mouth were negatively correlated in toddlers in the mild noise condition.

P3-D-108 Distractibility during play predicts 17-month-olds' familiar word recognition in noise

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Noise in the speech signal interferes with speech perception, particularly among children (e.g., Newman, 2005). The quality of children's linguistic input influences their language development. Because noise is increasingly ubiquitous in the environment, it is important to understand difficulties children have recognizing speech in noise. Noise can interfere with speech perception via degrading and drawing attention away from the speech signal (Brungart, 2001; Mattys et al., 2012). Because attentional control develops through young adulthood, we propose children's difficulty perceiving speech in noise is primarily due to the latter. Thus, we compared children's word recognition in noise to their distractibility in a play session.

Eleven 17-month-olds ($M = 17.15$ mos; $SD = 0.61$; 8 females) completed a word recognition task in which they saw two images on the screen (e.g., a ball and a truck) while an audio recording directed them to look at one image (Look at the ball!). Speech was masked by noise that overlapped or did not overlap in frequency with the spoken word, and that had a steady-state or varying amplitude envelope. We calculated children's proportional looking to the named versus unnamed image. Participants then completed two two-minute play sessions. In the first, children played with a toy in the absence of distractors. In the second, children played with a different toy while short distractor video clips played at intervals. We measured the proportion of time children attended to the toys and distractor clips, the average number of looks to the clips, and average latency to look at the screen once a video began and away once it ended.

Proportion looking to the named image during the word recognition task was entered in a mixed-effects linear model with fixed effects of noise frequency (overlapping, nonoverlapping) and amplitude envelope (steady-state, varying) in a factorial design, along with the play session predictors. Random intercepts for participants were included. There were no effects of the different noise characteristics, though a one-sample t-test showed looking to the named image overall was above chance ($M = 0.54$; $SD = 0.09$; $t[43] = 2.83$; $p = .007$, 95% CI [0.51, 0.57]). As shown below, performance in several aspects of the play session predicted word recognition.

These preliminary results seem to support the interpretation that greater distractibility leads to worse word recognition in noise. The more time that infants played with the toys during the distractor condition (i.e., the less distracted they were by the distractors), the

more they looked to the named image during the word recognition task. Likewise, attention to the distractor clips negatively correlated with word recognition performance. Shorter latency to and longer latency away from the distractor clips correlated with greater looking to the named image in the word recognition task, though the estimated effects of these factors are relatively small and highly collinear with other distractibility measures. Ongoing data collection will clarify whether infants' distractibility corresponds to their recognition of words despite masking by specific noise characteristics, or whether it corresponds more generally to word recognition in noise ability. </p>

P3-D-109 Distributional phonetic learning alters neural responses in 5 month olds

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Over the first year of life, infants undergo a period of perceptual attunement, during which their ability to discriminate non-native phonetic contrasts declines and they improve on native phonetic contrast discrimination. Previous research has shown infants are able to track the statistics of phoneme distributions and that this may facilitate both the collapsing of non-native phonetic boundaries and enhance the discrimination of non-native and difficult native contrasts (Maye et al. 2002; Maye et al. 2008; Yoshida et al. 2010). Liquid speech sound production in Japan shows a unimodal distribution (Lotto et al. 2004), and Japanese infants discrimination of this contrast declines, while English exposed infant discrimination along this liquid consonant boundary improves over the first year of life (Kuhl et al. 2006). Using electroencephalography (EEG), we investigate whether neuronal responses to 'ra' and 'la' sounds are modulated by exposure to either a bimodal or unimodal sound distribution spanning the [r]~[l] phoneme space. Since infants will encounter much higher variability among speech sounds in the natural environment than those used in previous distributional learning studies, we drew our distributions from a speech sound continuum with 140 unique sound tokens. Methods: English monolingual 5 month old infants were familiarized to either a unimodal or bimodal distribution of ra-la speech sounds for 2.3 minutes (Figure 1). During the subsequent test phase, an ERP oddball task was used to assess infants discrimination between 'ra' and 'la' tokens. EEG activity during both familiarization and test were collected using a 64-channel HydroCel Geodesic Net. Results: ERP analysis was performed on NetStation. ERPs to both the standard and deviant sounds were generated for each infant (data analysis are on-going, for a final n = 24 in each condition; preliminary analysis: bimodal, n = 12; unimodal, n = 12; Figure 2) and difference waves were calculated by subtracting the standard from

deviant ERPs. Previous infant research has shown that the mismatch response generated by exposure to a deviant stimuli occurs after 400 ms (Dehaene-Lambertz & Gliga 2004). The area under the curve (AUC) for the time period between 400-800ms following stimulus presentation was significantly different between the bimodal and unimodal exposure conditions (Unpaired t test, $p = 0.0258$). Conclusions: Preliminary results are the first to show that brief exposure to a liquid sound distribution is sufficient to alter neuronal responses to subsequent 'ra'/'la' speech sounds. These findings are consistent with previous reports showing that speech sound distributions alter infants phonetic discrimination, and in addition demonstrate changes in neuronal processing which may underlie previously described changes in behavior. Our findings also show that infants are able to extract the underlying statistics from a phoneme distribution containing many unique sound token exemplars -- suggesting that infants are able to pull out the statistical properties based on acoustic similarity of sounds as opposed to repetition in presentation. This situation better captures speech sound distributions in the real world, where infants encounter a high degree of variability in the speech signal even from the same individual.

P3-D-110 Introducing BITTSy: Behavioral Infant & Toddler Testing System

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BITTSy (the Behavioral Infant & Toddler Testing System), was created to fill a need for a multi-paradigm experimental testing platform for infants that can be implemented consistently across multiple testing sites. BITTSy is capable of running key infant behavioral testing paradigms, including Headturn Preference Procedure [HPP], Preferential Looking, and Visual Fixation/Habituation, through the same interface. BITTSy is the first standardized system to support headturn preference procedures, and the first with the capability to combine this paradigm with other methods in a single testing session. BITTSy is a freely available, standardized system that is compatible with modern Windows operating systems. It uses only off-the-shelf hardware/wiring, making it easy to set up for researchers across a variety of settings (including those without technical support staff). As the first such system for HPP, BITTSy provides advantages to both current and new users of the paradigm, allowing for easier setup, improved functionality, and greater consistency in cross-site data collection. BITTSy is capable of presenting images, videos, and audio files through single or multiple monitors and loudspeakers, as well as controlling an array of lights (e.g. for HPP). Study procedures are specified through

a structured but highly customizable protocol file, which implements built-in functions, such as randomly choosing a stimulus, displaying it, and waiting for an end condition such as an experimenter's keypress or a looking time requirement to be met. Through its protocol specification system, BITTSy allows for a greater degree of flexibility and control over the experiment structure and progression, for HPP as well as preferential looking and visual fixation procedures. BITTSy has recently entered a beta testing phase at multiple sites and is being prepared for release. We welcome the opportunity to demonstrate BITTSy and collect a list of researchers interested in using it when it becomes fully available.

P3-D-111 Syntactic Development Delay in Mandarin-speaking Late Talkers

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Introduction and Purpose The syntax abilities are important to overall language development. Previous study showed that late-talking children (LT) aged 18 to 24 months failed to combine words spontaneously, and performed a higher rate of ungrammatical and shorter sentences (Rescorla et al., 1997; Rescorla & Lee, 2001; Rescorla & Roberts, 2002). Although LT performed delay in syntax, the early development of different grammatical forms and the relationship between syntax and expressive vocabulary of Mandarin-speaking LT have not been examined. This study examined the emergent syntactic development of Mandarin late talkers (LT) and compared it with typical language development children (TLD). **Methods:** 24 LT children aged at 24 months were assessed and followed up at 30 and 36 month of ages. The inclusive criteria for LT is: the PR score of expressive vocabulary at age 24 month ≤ 15 , and that for TLD is >20 . Three groups of age-matched TLD children participated as the controls at 24, 30, and 36 months of age. 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 included: "Verbs", "Negatives", "Causes-effects sentences", "Possessive/Objective/Demonstrative", "Adverb/ Adjectives", "Morphology", and "Interrogative". In addition, the total scores of expressive vocabulary and MLU were analyzed. **Results:** For the total score of syntax, results reveal significant main effect of age ($F=329.281, p<.01$) and groups ($F=961.369, p<.01$), but no significant interaction between age and groups ($F=2.627, p=.078$) (see figure 1). For the total score of expressive

vocabulary, significant main effects of age ($F=181.585$, $p<.01$) and groups ($F=41.725$, $p<.01$) were shown, but no significant interaction ($F=1.867$, $p=.160$). For MLU, results reveal significant main effect of age ($F=74.962$, $p<.01$) and groups ($F=673.026$, $p<.01$), and no significant interaction ($F=1.049$, $p=.355$). The average score of each syntactic form from high to low for TLD group is as follow: "Morphology", "Negative", "Possessive/Objective/Demonstrative", "Verbs", "Adverb/Adjective", "Causes-effects sentences" and "Interrogative". The average score of each syntactic form from high to low for LT group is as follow: "Negative", "Morphology", "Possessive/Objective/Demonstrative", "Verbs", "Adverb/Adjective", "Causes-effects sentences" and "Interrogative". For the correlation analysis, as controlling age, the results showed that syntactic score is significantly correlated with expressive vocabulary ($r=.814$, $p<.01$), and MLU ($r=.606$, $p<.01$). Among 7 grammatical forms, "Negative" is the most significantly correlated to the total score of syntax ($r=.909$, $p<.01$). "Possessive/ Objective/ Demonstrative" is the most significantly correlated to the total score of expressive vocabulary ($r=.742$, $p<.01$) and MLU ($r=.584$, $p<.01$). Conclusions: The patterns of syntactic development in Mandarin-speaking infants are well observed by using MCDI-T from 24-36- months. It is found that LT group performed significantly poorly than the TLD group on all of syntax measures across 24 to 36-month. However, the development orders of different grammatical forms are similar between LT and TLD groups.

P3-D-112 Inclusion for Preschoolers with Autism: New Insights Using LENA in Urban Classrooms

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Background: Early intervention (EI) can dramatically improve long-term outcomes for children with autism spectrum disorder (ASD; National Research Council, 2001), but little research compares features of usual care in community-based EI services (Parsons et al., 2011). Increased social engagement and pragmatic communication are two of the most important outcomes to target in children with ASD. Inclusion settings, in which most classmates don't have ASD, may increase opportunities for social engagement and pragmatic communication. On the other hand, autism-only (AO) and mixed-disability (MD) settings may offer more autism-specific instruction and supports for these two outcomes. Identifying differences among these settings could guide placement decisions

for children with ASD, particularly if one setting provides more opportunities for language modeling and social interaction than the others. Objectives: To assess natural language production by children with ASD, classmates, and teachers in three classroom settings (AO, MD, inclusion), and quantify conversational opportunities using wearable audio-recording devices (LENA; Xu et al., 2009). Methods: Audio recordings (~20 minutes) were collected from 53 children with ASD (12 female) in 17 urban preschool classrooms (Table 1). All verbalizations produced by or directed towards the participant from peers and teachers during an unstructured "free play" sample were identified and categorized using a reliable human-coding pipeline (shown to be more accurate than LENA software in a preschool setting). Data were analyzed using linear and generalized mixed effects regression models. Results: Participant speech volubility (amount of verbalization during free play) was positively correlated with expressive language scores on the Mullen, Pearson's $r=.89$, $p=.0006$, $d=3.90$, and adaptive functioning scores, $r=.46$, $p=.001$, $d=1.04$. All children heard speech from their teachers during free play, and teacher volubility did not differ by setting ($F(2,50)=1.39$, $p=.26$). Peer speech was directed to 22 participants during free play. Significantly more peer talk was directed towards children in inclusion and MD settings than children in AO settings, with the greatest amount of peer speech in inclusion settings (Figure 1; $\chi^2=12.44$, $p=.002$; $d=2.28$). Across all classrooms, peers talked more with participants who produced more words themselves ($z=2.82$, $p=.005$). Discussion: Standardized assessments of language and adaptive behavior correlate with speech volubility, suggesting that they capture the same construct of child expressiveness. The correlation between volubility and adaptive functioning suggests that natural language adds information about school-readiness. Children in inclusion classrooms had the most peer talk directed toward them, without compromising the amount of teacher talk directed towards them. Child volubility predicts language input from classmates, suggesting that peer input could partially explain why children with better language demonstrate greater cognitive growth in inclusive settings (Nahmias, Kase, & Mandell, 2014). Conclusion: This study is the first to provide real-world evidence of increased language input from peers in inclusion settings. Further research is needed to understand the impact of increased peer interactions for children with ASD of varying social and cognitive profiles, and to identify intervention strategies that facilitate conversation (Chang & Locke, 2016).

P3-D-113 Early walker? or ?Early talker?? The effects of Infant Locomotor status on Infant Language acquisition

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Were you an 'early walker' or an 'early talker'? The link between infants' motor development and language acquisition has been subject to investigation for more than four decades (Tipps, Mira, & Cairns, 1981; Thelen, 1995; Iverson, 2010). Long-standing speculation and discussions among parents and researchers have led to assumptions that infants cannot develop both language and motor developmental milestones simultaneously (Tipps, Mira, & Cairns, 1981). Infants are therefore, commonly characterised as either 'early walkers' or 'early talkers'. In more recent years, however, a longitudinal study challenged such understanding by highlighting a significant increase in language acquisition with walking onset as reported by parental questionnaires (Walle & Campos, 2014). Nevertheless, various studies have highlighted the discrepancies existing between parental report vocabulary measures and vocabulary tasks. Inconsistencies can be found in both directions, parents, underestimate or overestimate their infant's vocabulary (e.g., Tomasello & Mervis, 1994; Houston-Price, Mather, & Sakkalou 2007). This is particularly important since parents' perceptions of their infant's language acquisition have been shown to be influenced by locomotor changes (Iverson, 2010). The present study, therefore, aimed to further examine the influence of locomotor status (crawler vs. walker) on infant language acquisition using both parental questionnaires and preferential looking task measures. Preliminary results of 26 British English-monolingual infants' (aged 9 to 17 months) are reported here. Infant's receptive and productive vocabulary was measured prior to the testing session using the 'Oxford Communicative Developmental Inventory' (CDI). Infants were tested using a preferential looking paradigm in relation to whether parents had reported words known and unknown. Using a Tobii eyetracker TX300, we recorded infants' eye movements while they were watching eight videos; four pairs of reported known words and four pairs of reported unknown words. Preliminary results analyzing the proportion of target looking showed a significant positive relationship between infant vocabulary scores and motor ability thus, supporting the idea that there is an increase in infant's vocabulary when they start walking. However, results also revealed that parents of walkers were more accurate at reporting words their infant was familiar with than parents of crawlers. This suggests parental discrepancies when estimating words their infant understood to be a consequence of infant locomotor status. The present study provides primary evidence not only for the links between infants' language acquisition and motor development but also for the accuracy of parental questionnaires and the effects infant locomotor status has on parental perceptions of infants' language abilities. Tentative explanations for the findings implying infant walking onset influences parents' accuracy at reporting infant vocabulary

are considered (e.g. environmental; socio-environmental; maternal behaviour; increased interactions) and discussed.

P3-D-114 Infants' expectations about infant-directed and adult-directed communications

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Across cultures, adults engage in infant-directed speech (IDS) when they address infants. Compared to adult-directed speech (ADS), IDS is characterized as having higher pitch and more melodic features (e.g., Fernald, 1989). Several studies show that infants prefer IDS over ADS (e.g., Fernald, 1985; Werker & McLeod, 1989). Further, infants also attend more to individuals, who previously produced IDS (Schachner & Hannon, 2011). Here, we explore whether infants expect IDS to be directed at infants and ADS to adults. Spanish or Catalan hearing monolingual infants (12-15 months, $N = 16$) were first familiarized with three characters, two of which represented adults and one represented an infant (e.g., Johnson, Dweck, & Chen 2007; Spokes & Spelke, 2017). In each of three familiarization videos, these characters appeared one by one, each produced a vocalization (laughter) and then they all moved together in synchrony. After the familiarization phase, infants received 8 test trials (2 blocks). In these trials, infants saw either two adults or one adult and one infant facing each other and the same adult produced either IDS or ADS across trials (Speech segments were either in Spanish or Catalan depending on the native language of the infant). Thus, half of the trials were "inconsistent", such that infants saw the adult addressing the infant with ADS, or the other adult with IDS. The other half of the trials were "consistent", such that infants saw the adult addressing the infant with IDS, or the other adult with ADS (See Figure 1). Trial durations were fixed for familiarization phase (~40 s) and were infant-controlled for the test phase (up to 40 s). Overall, infants' looking times to consistent and inconsistent videos did not differ ($F(1, 30) = 1.24, p > .2$). However, we found a significant interaction between infants' looking times to consistent and inconsistent videos and the block (First or Second) ($F(1, 30) = 7.6, p < .05$). Separate analyses of the first and the second blocks revealed that infants did not look longer to inconsistent compared to consistent events in the first block ($t(15) = -1.15, p > .2$), but they did so in the second block ($t(15) = 2.74, p < .05$) (See Figure 2). These findings suggest that infants might have certain expectations regarding whom IDS and ADS should be directed to. The block effects might be due to familiarization and test trials being rather different (i.e., infants saw the characters speak for the first time during the test trials).

Infants' looking patterns might also be driven by the content of the speech in IDS and ADS. Thus, testing another group of infants with a language other than their native language would be informative. Testing younger infants might also help understanding the role of exposure in infants' expectations regarding IDS and ADS communications.

P3-D-115 A meta-analysis of mispronunciation sensitivity in infancy

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As infants rapidly expand their receptive lexicon in their second year of life, they must not only learn which distinct combinations of sounds map onto distinct objects but also be flexible enough to account for variability in the signal (e.g. speakers, accents). Using the Intermodal Preferential Looking Procedure (IPLP; Golinkoff, Hirsh-Pasek, Cauley, & Gordon, 1987), two decades of research has examined infants' recognition of correctly pronounced (dog) and mispronounced (tog) words. We consider three potential possibilities for how mispronunciation sensitivity might change as infants become native speakers: a) sensitivity decreasing with development (Theory 1; Best 1994); b) sensitivity increasing with development (Theory 2; Curtin & Werker, 2007); and c) sensitivity unmodulated by development (Theory 3; as yet not discussed in the literature). We furthermore examine different experimental factors that may modulate infant mispronunciation sensitivity, such as the number of phonological features changed in the mispronounced word: mispronunciation sensitivity is thought to increase with more phonological features changed (White & Morgan, 2008); and familiarity with the distractor image: using an unfamiliar distractor image, and thus a possible referent, paired with an image of the target word may provide a more reliable estimate of mispronunciation sensitivity (Mani & Plunkett, 2011). In a meta-analysis, we capture how sensitivity to mispronunciations changes as infants mature, focusing on experiments testing infants using IPLP. We analyzed the results from 32 papers reporting on data from infants aged 6 to 31 months. Experimental factors were also coded, including number of phonological features changed (1, 2, 3) and distractor image familiarity (unfamiliar, familiar). An examination of effect sizes (Figure 1) revealed consistent recognition of correctly pronounced words (Hedges' $g = 0.91$, $SE = 0.12$, $p < .0001$; no age effect) and an overall mispronunciation effect ($\beta = 0.25$, $SE = 0.06$, $p < .001$; no age effect). We then compared the effect size Hedges' g for correct pronunciations with mispronunciations (Hedges' $g = 0.50$, $SE = 0.03$, $p < .0001$; no age effect), which shows that although infants fixate the target object significantly more when presented with correct pronunciations compared to

mispronunciations. There was no effect of number of features changed in mispronounced words (all p 's $> .05$). Experiments using an unfamiliar distractor had increased mispronunciation sensitivity in comparison to experiments using a familiar distractor ($\beta = 0.18$, $SE = 0.09$, $p < .05$; Figure 2). Looks to the target elicited by correctly pronounced and mispronounced words stay constant as infants age. Furthermore, comparing correctly pronounced and mispronounced words revealed that mispronunciation sensitivity stays the same as infants age (Theory 3). Contrary to our predictions, increasing the number of features changed did not result in a larger sensitivity to mispronunciations. The use of unfamiliar distractor images elicits a greater effect of mispronunciation sensitivity. Taken together, these results have important implications for our understanding of the development of the infants' phono-lexical processing and suggest that this processing is more flexible in the face of variability in the speech signal.

P3-D-116 BEHAVIOR PROBLEMS OF TODDLERS BORN PRETERM DIFFERENTIATED BY BRONCHOPULMONARY DYSPLASIA

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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). Besides the preterm birth, other clinical risks need to be examined to better understand the behavior problems in this vulnerable population. The aim of the present study was to compare the behavior problems among groups of toddlers born preterm according the presence of bronchopulmonary dysplasia. The sample included 136 toddlers born preterm; of these, 58 (43%) toddlers presented bronchopulmonary dysplasia (PBPD), and 78 (57%) did not present bronchopulmonary dysplasia (NBPD). Neonatal characteristics were evaluated through analysis of the medical records. The toddlers were followed in a multidisciplinary program in a tertiary public university hospital, and the mothers were interviewed using the Child Behavior Checklist 11/2-5 years (CBCL - Achenbach & Rescorla, 2000), for behavior assessment of toddlers at 18 to 36 months of age. The statistical descriptive analysis and the t-test for comparison between groups 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 behavior problems outcomes, presenting mainly normal behavior

profile; 67% of PBPD toddlers and 64% of NBPD toddlers presented normal behavior. The score means for the groups of toddlers were total problems scale (PBPD = 55 [± 11]; NBPD = 56 [± 9], $p = 0.45$), internalizing behavior problems scale (PBPD = 53 [± 11]; NBPD = 53 [± 10], $p = 0.68$), and externalizing behavior problems scale (PBPD = 57 [± 11]; NBPD = 57 [± 10], $p = 0.46$). The findings showed that toddlers born preterm presented similar pattern of behavior problems, independently of the presence of a chronic disease related to premature birth. The follow-up program for toddlers born preterm and their families could offer positive parenting educational practices strengthening the developmental process of these vulnerable toddlers.

P3-D-117 Touch Facilitates Object Categorization

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As infants mature, symbolic flexibility decreases (Mackenzie, Graham, & Curtin, 2011; Namy & Waxman, 1998; Woodward & Hoyne, 1999). For example, young infants categorize objects with non-speech stimuli at 3 months, but lose this ability as they age (Ferry et al., 2013). We examined the mechanisms underlying this decrease in symbolic flexibility, using a paradigm in which infants have been shown to consistently categorize (Ferry et al., 2010) with linguistic, but not non-linguistic sounds (Fulkerson & Waxman, 2007). Since words become more frequent and complex over development while non-linguistic sounds remain stable, this loss in symbolic flexibility may be attributable to input frequency (Figure 1). Alternatively, since words are used in social contexts, a loss in symbolic flexibility could be attributable to a developing preference to learn from social input (Ferguson & Waxman, 2016). We adjudicated between these hypotheses by exploring infants' ability to categorize using touch: a highly social signal (Jean & Stack, 2009) that diminishes in use during infancy (Ferber et al., 2008). If loss of symbolic flexibility is driven by input frequency, then older infants should be less able to use touch to inform categorization. However, if loss in symbolic flexibility is related to growing sensitivity to social signals, then older infants should be better able to use touch to inform categorization. Participants included 27 (10 female) healthy, full-term 3.6- to 6-month-olds ($M=5.03$, $SD=0.80$) and 24 (13 female) 6.5- to 9-month-olds ($M=7.79$, $SD=0.71$). In familiarization, infants were presented with touches on their right knee while they looked at pictures of fish or dinosaurs (Figure 2). At test, a new familiar exemplar (another dinosaur) and a novel exemplar (a fish) appeared side by side in silence while infants' eye gaze was video-recorded. Familiarization and test trials were coded to examine infant

preference. Stimuli in familiarization were equally engaging to infants in both groups, $t(49)=0.58$, $p=0.57$. To examine performance at test, a novelty-preference score was calculated for each infant by dividing the looking time to the novel exemplar by total looking time. A novelty-preference score greater than chance indicated category formation. Infants in the older age group demonstrated a reliable novelty-preference, ($M=.55$, $SD=.13$); $t(23)=2.07$, $p=0.04$, while those in the younger group performed at chance, ($M=.49$, $SD=.14$); $t(26)=-.06$, $p=.94$. We further calculated the number of infants who showed a novelty-preference score above .50. At 6.5-9 months, 17 out of 24 showed a novelty-preference ($p=.06$), whereas, at 3.6-6 months, only 10 out of 27 infants showed a novelty-preference ($p=.25$). Our findings suggest that older, but not younger infants can use touch to form object categories. These data provide support for the hypothesis that the social nature of the input (not frequency) facilitates categorization. Additional support for this idea comes from Ferguson and Waxman (2016) in which young infants show use of non-linguistic stimuli for categorization when they are presented in rich social contexts. In sum, we find further support for the idea that infants are more driven by quality than by quantity of input in their early language acquisition.

E: Attention, Memory, and Learning

P3-E-118 Differences in Mothers' and Fathers' Attention-Recruiting Strategies during Shared Book-Reading

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Shared book reading between parents and children is often the target of intervention due to its facilitation of language acquisition, pre-reading skills, and joint attention (Bus, van IJzendoorn, & Pellegrini, 1995). However, book reading with infants can often present parents with the challenge of keeping their infants on task and engaged for the duration of the reading session. Parents employ various strategies such as restraint and physical proximity to initiate their children's engagement and re-engage them if they begin to lose interest. Additionally, some research has indicated that attachment security may play a role in children's willingness to pay attention to the book with the parent (Bus & van IJzendoorn, 1995). Although research has examined cultural and socioeconomic differences in the verbal content and strategies involved in book-reading (Bus, Leseman, & Keultjes, 2000; Pellegrini, Perlmutter, Galda, & Brody, 1990), there is little research on differential patterns of attention-recruiting strategies used by mothers and fathers when infants are distracted. It is likely that mothers and fathers may use physical and verbal

strategies differently, given that mothers and fathers often embody different caretaking roles, different levels of attachment security, and relate to their children in different ways. In order to address the question of if mothers and fathers employ different strategies to retain and regain their children's attention during book-reading, I will analyze videotaped book-reading sessions of 20 fourteen-month old children (10 boys, 10 girls) with their mothers and fathers (40 dyadic sessions in total), randomly selected from a larger New York City sample of 129 first-time parents in heterosexual cohabitating relationships. A combination of frequency and duration coding was used to mark the amount of time the child spends disengaged from the book reading and the physical proximity of the child to the parent, the frequency of physical (i.e., grabbing, restraining) and verbal redirections from the parent, and the frequency of attention-recruiting verbalizations (i.e., "look" statements), including dialogic reading strategies (i.e., "who", "what", "why" questions) (Bloom-Hoffman, O'Neil-Pirozzi, & Cutting, 2006; Ninio & Bruner, 1978). I will conduct a series of ordinary least squares regressions examining the relationship between parent attention-recruiting strategies and parent gender, while controlling for the child's disengagement, the child's proximity to the parent, and demographic characteristics of the dyads (i.e., income, race/ethnicity). Preliminary results on a subsample of 5 children (10 dyadic interactions) demonstrate evidence suggesting that mothers may be more likely than fathers to utilize physical strategies such as restraint and grabbing to re-engage their children, net of the child's time spent struggling or disengaged during the reading activity ($\beta = 0.50$, $p = .074$). Although the currently completed sample lacks statistical power to model with full controls, there is preliminary evidence of gender difference in attention-recruiting strategies during parent-child book-reading. These findings contribute to the shared book reading literature to suggest that intervention recommendations should account for behavioral differences between mothers and fathers and leverage their existing strategies.

P3-E-119 Individual differences in the quality of night sleep influence infants' preparedness for learning the following day

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"Sufficient and efficient" sleep is crucial for optimal functioning (Gruber, et al., 2014, p.1517). For example, the more efficient infants' sleep, the higher their scores on parent reports of problem-solving abilities or on a standardized cognitive assessment (Gibson,

Elder & Gander, 2012; Scher, 2005). However, to date no studies have examined the relation between quality of night sleep and infants' preparedness for learning the next day. The current study assessed the link between individual differences in night sleep and infants' ability to solve a novel locomotor problem. New walkers ($n=15$; mean age=13.93 mos) who were within a week of having given up crawling participated. At the start of the two-day experiment, infants wore an actigraph, a wristwatch-like activity monitor, on their ankle overnight. The actigraph is a computerized movement detector which provides a noninvasive measure of sleep by recording movement in 1 minute epochs (Ambulatory Monitoring, Ardsley, NY, USA). This data is downloaded and translated into sleep parameters by customized software. For the purpose of this report, the following parameters were included in the analysis: sleep duration (sleep onset to morning wake), number of wake episodes, sleep efficiency (amount of time spent sleeping out of total duration), and activity (mean activity level per minute of sleep)(Scher, Tirosh, & Lavie, 1998). The next morning, an experimenter taught infants to solve a task involving crawling through a nylon tunnel. All infants started upright on two feet at the opening of the tunnel and were encouraged to reach a caregiver at the other end. Novice walkers find it challenging to switch between walking and crawling, making navigating a shoulder-height tunnel a challenge. The training consisted of a 15-step protocol that includes 3 sets of 5 task-relevant prompts: standing at the start of the tunnel, placement on hands and knees, and rolling a toy through the tunnel to demonstrate the path. The session ended once infants successfully crawled through the tunnel or reached 15 prompts, whichever came first. Coders documented how many steps in the training protocol infants needed and how many exploratory postural shifts infants made before entering the tunnel. Data collection is ongoing; preliminary results are presented in Figure 1. The more fragmented infants' sleep, the more they shifted their posture before entering the tunnel, $r=.52$, $p<.05$. Other observed trends were negative relationships between duration of night sleep and postural shifts and between sleep efficiency and postural shifts, suggesting that infants with better quality night sleep were more likely to explore efficiently. Interestingly, the number of steps it took infants to solve the problem was distributed at the extremes: many or few (no moderate), seemingly regardless of sleep quality. Future analyses will examine whether prior tunnel experience mediates sleep's impact on efficiency of learning. These findings suggest that longer sleep duration and good consolidated nocturnal sleep prepare infants for the learning challenges of the following day. Thus, sleep quality provides a window for studying infants' daytime learning and functioning (Scher, 2005).

P3-E-120 Contributions of Look Duration to Novelty Preferences Throughout the First Year

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Researchers have been assessing infant attention skills, concept formation, language skills, and perceptual abilities using novelty preference data for almost 60 years. There has been little work done, however, to identify how infants produce novelty preferences. Infants could adjust gaze direction, preferentially shifting gaze away from familiar stimuli to see novel stimuli, or they could adjust look duration, producing longer looks for novel rather than familiar stimuli. Measures typically reported in novelty preference studies, including percent looking at novel stimuli, do not clarify whether gaze shifts and look duration independently or collectively account for novelty preferences. Data from a cross-sectional study were therefore analyzed to clarify how infants produce novelty preferences. Two questions were addressed: First, what looking measures contribute to novelty preferences? And second, do contributions change throughout the first year? Data were collected from 72 infants tested with a serial paired-comparison task. All infants completed 40 trials; a novel stimulus (presented once during the session) and a familiar stimulus (presented 40 times) appeared on each trial. Infants saw 8-sec videos of either moving geometric shapes or rotating toys. A standard multiple regression analysis was run. The dependent variable was percent novel based on time spent looking at novel stimuli throughout the session. Predictor variables were age (3, 5, 7, or 9 months) and 4 composite scores: (1) duration bias that compared differences in look duration for novel vs. familiar stimuli, (2) frequency bias that compared the number of looks directed at novel vs. familiar stimuli, (3) gaze shift bias that compared differences in how often infants shifted gaze after looking at novel vs. familiar stimuli, and (4) perseveration bias that compared differences in how often infants looked back to novel vs. familiar stimuli after looking away from the display. Regression results were significantly different from zero: $R^2 = .83$ and adjusted $R^2 = .81$, $F(5, 71) = 62.05$, $p < .001$ (95% CI for R^2 [.72, .85]). The composite score for look duration accounted for 72% of the variance in percent novel, with differences in look number accounting for another 11%. Together, gaze shift and perseveration biases accounted for only 0.6% of the variance. Data listed in Table 1 indicate that differences in look duration were strongly correlated with percent novel at 5, 7, and 9 months. Infants produced novelty preferences by looking longer at novel stimuli by age 5 months, with look duration alone accounting for 85% of the variation in novelty preferences by age 9 months. Look number and gaze shift rates also contributed minimally to percent novel, but this effect was found only at 7 months. Infants produced

more looks to novel stimuli by perseverating at 3 and 5 months, with older infants using gaze shifts as well as perseverations to look more often at novel stimuli. In summary, data indicate that infants produce novelty preferences by primarily controlling look duration throughout the first year. Stimulus novelty appears to affect how long infants look at stimuli but seems to have little affect on where infants look. The key to infants exploring new events seems to be their ability to extend look duration.

P3-E-121 A new approach for assessing infant visual short-term memory

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Previous work demonstrates rapid improvements in infant visual short-term memory (STM) during the first year of life (e.g., Ross-Sheehy, Oakes, & Luck, 2003). However, quantitative assessment of visual STM capacity based on passive change-detections tasks is difficult, as it is currently unclear how visual dynamics during change-detection are related to visual STM representations. This is further exacerbated by uncertainty regarding memory mechanisms engaged by passive change-detection tasks, and their relation to mechanisms engaged by explicit change-detection tasks typically used in adults. In this poster, we will highlight a novel approach to assessing individual differences visual STM in both infants and adults (Ross-Sheehy & Eschman, under review). We will present eye tracking data collected from infants during a passive change-detection task, and adults during an explicit change-detection task. These results demonstrate that visual dynamics (i.e., saccades, fixations, switching & pupilometry) are systematically related to correct and incorrect responses in adults, potentially facilitating assessments of visual STM capacity in preverbal infants. Infants (5-, 8-, and 11-months) and adults viewed change-detection arrays consisting of 1-4 colored circles (see figure 1). Each trial began with a 1000ms sample array, followed by a 500ms retention interval, and finally a 3000ms test array that was either the same as the sample array or different (i.e., one circle changed color). Gaze and pupil diameter were sampled continuously at 300Hz during the task, and adults additionally responded via button press. Results replicate previous findings (e.g., Ross-Sheehy, Oakes & Luck, 2003), revealing substantial improvement in change-detection from 5- to 11-months. Moreover, infant and adult visual dynamics are qualitatively similar, suggesting passive change-detection tasks may elicit similar STM mechanisms as adult explicit change-detection tasks. Finally, results reveal unique visual dynamics associated with correct and incorrect behavioral responses in adults (Ross-Sheehy & Eschman, under

review) - an important finding that may eventually facilitate assessments of visual STM capacity in infants.

P3-E-122 Early neurodevelopment of infant attention

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Infancy is a period of rapid neurological and behavioral development. Specifically, infants' ability to sustain attention to stimuli develops in conjunction with the refinement of the orienting network in the frontoparietal regions (Rothbart et al., 2011). Sustained attention plays a key role in the regulation of emotions; an enhanced ability to sustain attention results in better self-regulatory behaviors later in development (Johansson et al., 2015). Understanding neural mechanisms underlying attention may help us better understand infant brain and behavior development. The white matter (WM) in the brain connects regions of grey matter, allowing for efficient transmission of neural signals. Diffusion Tensor Imaging (DTI) offers quantitative measures of the structural integrity of WM, including fractional anisotropy (FA). We used FA to examine WM in tracts relating to the orienting network, namely the corpus callosum, cingulum, uncinate and superior longitudinal and inferior fronto-occipital fasciculi. We hypothesized that infants with higher WM integrity (FA) early in life would exhibit higher rates of sustained attention to novel stimuli at 6 months of age. We also expected infants with higher FA to show more affective interest towards the stimuli during the task. Mothers (N =149) were recruited during pregnancy to study how early maternal stress and adversity impact infant neural and cognitive-emotional development. Infants underwent magnetic resonance imaging (MRI) and data were fit to a diffusion tensor model to calculate FA at 1-month of age. Infant attention was assessed at 6 months of age using a puppet task to measure sustained attention (Cuevas & Bell, 2014). Infants were presented with two puppets fashioned with bells and large eyes in three 60-second trials; however, trials ended early if the infant looked away from the stimuli for at least three seconds. Duration of looking at the puppets and affective interest during the task were scored. All analyses controlled for infant sex and age at time of scan. As predicted, infants with higher FA in the left corpus callosum and right cingulum showed increased duration of looking towards the stimuli ($B=.334$, $p<.001$; $B=.260$, $p=.011$, respectively). FA reductions in the corpus callosum have been implicated in children with ADHD, while FA increases in the cingulum bundle are later associated with executive functioning, decision-making, and emotion

(Langevin et al., 2014; Heilbronner & Haber, 2014). Infants with higher FA in the left cingulum and left superior longitudinal fasciculus showed increased levels of affective interest during the task ($B=.228$, $p=.023$; $B=.217$, $p=.046$, respectively), while infants with higher FA in the right uncinate fasciculus showed decreased levels ($B= -.201$, $p=.05$). The uncinate fasciculus is often implicated in affective development, but our findings may be due to its slow developmental timeframe (Olson et al., 2015). No significant results were found for the inferior fronto-occipital fasciculus. Lateral differences are discussed. These results highlight the importance of early infant brain development in later attentional behaviors and suggest that refinement of the orienting network as early as one month of age promotes enhanced sustained attention at six months of age.

P3-E-123 The relationship between feature and spatial visual attention tasks

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Visual attention develops significantly over the first postnatal months, as indicated by developmental changes in visual search (Kwon et al., 2016) and spatial cuing tasks (Ross-Sheehy et al., 2015). However, little work has been conducted to examine how attentional processes engaged in different tasks are related across development. Here we evaluate the relationship between performance on a feature-based visual attention task and performance on a spatial-attention task. We tested 82 infants, distributed between 5 and 12 months of age, with a feature-based visual search task and a spatial cuing task (Infants Orienting with Attention, IOWA; Ross-Sheehy et al., 2015) (see Fig 1). In our visual search task, arrays containing one target (e.g., a clock) and 5 identical distractors (e.g., bananas) were presented on 3-s trials (see Fig 1). In the IOWA task, a brief spatial cue was presented (one or two black dots that appeared for 100 ms to the left or right of fixation) followed by the presentation of an attractive target (e.g., a balloon). The target could appear on the same side as the cue (valid trials), on the opposite side of the cue (invalid trials), following cues in both locations (double cue trials), or following no cue (control trials). Infants' responding on these trials reflect spatial attentional processes. Some aspects of infants' performance in each of these tasks changed over age. In visual search, infant age in days was correlated with the proportion of trials in which the infants fixated the target first, $r = .33$, $p < .05$ and the proportion of time devoted to looking at the target, $r = .55$, $p < .001$, measures of how effective the target is at capturing and holding attention. However, the latency to fixate the target was not correlated with age, suggesting that some aspects of attention in this task did not change. In the IOWA task, infants' mean

response time (latency to cue collapsed across trial type) was negatively correlated with age, $r = -.34$, $p < .01$, indicating that with increased age infants were generally faster to fixate the target. The proportion of invalid trials that infants incorrectly fixated the cue location (but not the target) was not correlated with age, suggesting that the ability to inhibit the cue did not change over this age range. Our primary analyses examined the relation between feature-based and spatial attention. A correlation between latency to the target in visual search and the proportion of incorrect responses to invalid trials in the IOWA task was correlated, $r = .27$, $p < .05$. Infants who had more difficulty inhibiting the cue in the IOWA task were also slower to fixate the target (perhaps because of difficulty inhibiting the distractors) in the visual search task. Taken together, these results suggest that both feature-based and spatial attention skills develop over this age range, and that these two types of attention appear to be related. As infants develop, they become better able to control their visual attention in the face of both feature and spatial competition.

P3-E-124 Effect of Multimodal Attention-Getter Pace on Infant Attention and Heart Rate

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Background Capturing and sustaining attention is a concern when conducting infant research. As attention declines, infants can become fussy resulting in significant data loss. To address this, an increasing number of studies have employed attention-getters (AGs) between trials to redirect attention to the task. Although AGs vary, they are typically dynamic and multimodal, often with corresponding visual and auditory stimuli. Despite the frequent use of AGs, relatively little is known about their influence on infants' state of attention. An investigation by Domsch, Thomas, and Lohaus (2010) revealed that AGs not only capture attention, but also produce decelerations in heart rate (HR) during habituation and faster dishabituation in a subsequent task, indicating changes in attentional state and enhanced stimulus processing. The current study was designed to determine the AG pace (fast, medium, slow) that most effectively captures attention and whether the AGs elicit an attentional state and facilitate learning. **Method** Four-month-old infants were presented with one of three AG conditions: fast-paced (1 Hz), medium-paced (0.5 Hz), and slow-paced (0.25 Hz). The 10-second AG was a green dot on a white background that loomed and contracted in synchrony with a beep (170 ms). The beep occurred when the circle reached the largest point and appeared to change direction.

Infants were familiarized with a colorful stimulus for 30 seconds, followed by testing for discrimination of the familiarized stimulus from a novel stimulus using a partial-lag design. Measures of looking behavior and heart rate were used to explore the effects of differentially paced AGs. Analyses and Preliminary Results Planned analyses will be implemented when condition ns are more balanced; however, preliminary results for the AG session of 35 infants are described below. Looking Behavior. To determine the effect of AG pace type (fast, medium, slow), an ANOVA on look duration will be conducted for the AG session, familiarization, and discrimination. Preliminary results indicate that looking did not differ significantly in the fast-paced ($M=7.71$), medium-paced ($M=7.75$), and slow-paced AG ($M=7.03$), $p>.05$. Heart rate. Looking was parsed into HR-defined phases: orienting (OR), sustained attention (SA), and attention termination (AT). An AG type (fast, medium, slow) x HR phase (OR, SA, AT) mixed-model ANOVA will be run on looking time during the AG session, familiarization, and discrimination. Preliminary results are presented in Figure 1. To examine whether the AGs effectively elicited an attentional state (i.e. a decrease in HR), we will compare HR before and during the AG session in an AG type (fast, medium, slow) x baseline (before AG, during AG) mixed-model analysis. Preliminary results are presented in Table 1. The influence of AG on HR will be further investigated with an AG type (fast, medium, slow) ANOVA on average HR for the AG session, familiarization, and testing. Conclusion Preliminary results suggest that despite similar look durations for all AG paces, there may be differences in how much of that time is spend in OR, SA, and AT. Further data collection and analysis will provide insight into the AG pace that effectively captures attention and has the potential to facilitate learning.

P3-E-125 Pupillometry uncovers the role of focused attention in Visual Working Memory

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Focused attention, which is controlled in a volitional, purposeful manner, is a critical cognitive component of higher-level Executive Functions. The interaction between focused attention and Visual Working Memory (VWM) processes in infancy has been studied using heart rate measurements (Lansink & Richards, 1997) and ERP (Richards, 2003; Reynolds & Richards, 2005). Following up on our earlier work (Cheng et al., 2016), the present study examines this link using pupillometry in 13-month-old infants. We used a Delayed Match Retrieval (DMR) paradigm (Kaldy et al., 2016) to test infants' VWM for object-location bindings by measuring their anticipatory gaze responses and concurrent

pupil dilation, using an eye-tracker. Task-evoked pupil responses (TEPR) have a long history as a sensitive, moment-to-moment measure of focused attention and cognitive effort. Indeed, greater dilation has been shown to correlate with better WM performance in adults and older children (e.g., Kahneman, 1966; Johnson et al., 2014). In Experiment 1, we examined the relationship between focused attention and VWM performance in young infants. 11-15-month-old infants participated (N=20, mean age: 13.3 months). Familiar objects (e.g., a ball and a car) were presented on the faces of virtual cards. Two such cards were shown, then flipped face-down. After that, a third card was shown, whose face matched one of the previously-shown cards. After a brief delay, the matching card was revealed, accompanied by a reward animation. Gaze and TEPR was measured throughout the task. VWM performance was calculated as the percentage of trials where the first anticipatory look during the delay period was to the correct (matching) card. Overall, performance was significantly above chance (58% correct, $p < 0.010$). We then examined the TEPR during encoding (the phase of a trial when the two to-be-remembered cards are exposed) and found that VWM performance was correlated with TEPR: overall, correct trials had significantly greater TEPR during encoding than incorrect trials, and participants with higher performance had significantly greater TEPR during encoding. In Experiment 2, we tested whether the familiarity of the to-be-encoded information would influence infants' VWM performance. To control for perceptual salience, we used the same stimuli as in Experiment 1, but presented upside-down. Preliminary data (N=13) suggests that 13-month-old infants cannot perform above chance with these stimuli. After study completion, we expect TEPR during encoding to reflect greater engagement with these stimuli due to their novelty, but a weak or absent correlation with performance (since effort may be expended in a task-irrelevant manner). Overall, we found 1) 13-month-old infants performed better in our VWM task with familiar stimuli; 2) just as in adults, greater focused attention during encoding, as measured by pupillometry, leads to better subsequent VWM performance in infants.

P3-E-126 The Effect of Parental Linguistic Input on Toddlers' Visual Attention: A Comparison between Toddlers with and without Hearing Loss

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Parent-child interactions are multimodal, often involving coordinated exchanges of auditory and visual information between the two parties. These coordinated, multimodal interactions are crucial for early social, cognitive, and language development. But what

happens if one modality is degraded or lost? In this study, we investigate the role of sensory systems in coordinated interactions and attention by studying children with hearing loss and compare them to normal-hearing children. We examined how linguistic input provided by parents affected toddlers' visual attention when parents either led or followed children's attention during joint object play. Three groups of toddlers (aged 13-37 months) and their parents participated in the study. These children were toddlers with hearing loss (HL group), normal-hearing controls matched on chronological age (CA group), and normal-hearing controls matched on hearing age (HA group). During the play session, we recorded parents' speech as well as children's gazes using head-mounted eye-trackers. Parents' speech about objects were divided into 3 categories: utterances providing information about objects, questions, and directives. Parents of older children (i.e., the HL and CA groups) were more likely to provide information about objects than parents of younger children (i.e., the HA group). On the other hand, parents in both HL and HA groups were more likely to produce directives than parents in the CA group. We then asked whether different types of parental utterances affected children's visual attention when parents either led or followed children's attentional state during object play. We measured the lengths of children's gazes associated with different types of utterances and compared the gaze lengths against baseline. For the two older groups (i.e., HL and CA groups), all utterance types were effective in extending children's gazes to objects, no matter whether parents led or followed children's attention (see Figure 1 for parent-led scenarios & Figure 2 for child-led scenarios). However, the effects were less pronounced in the HL group. For the HA group, gazes associated with utterances providing information were longer than baseline only when parents followed children's attention, but not when parents led their attention. This provides new evidence that, for these very young toddlers, following their attentional state may be a more efficient way in sustaining their attention than directing their focus of attention. The current study showed that, regardless of whether parents led or followed children's attention, all utterance types extended HL group's attention to objects. Interestingly, the effects of different linguistic input on the attention of children with HL more closely resembled the patterns seen in the CA group than in the HA group. Our findings suggest that children's real-time attentional states are influenced by multiple factors. They also point to the possibility that there may be multiple pathways for intervention that can be used to support learning. By showing the temporal unfolding of children's gaze behaviors in relation to parent's language behaviors, our study offers a process account of how different types of parental utterances affect children's attention. The results also shed light on children's learning of object concepts and object names.

P3-E-127 Infants' learning of non-adjacent regularities from visual sequences

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Our ability to rapidly extract structured sequential information from the environment is an important underpinning of many complex behaviours - from language development and social interaction to intuitive decision making and music cognition - and many studies have investigated its ontogenetic roots. For example, when exposed to speech sequences, infants have been shown to extract transitional probabilities between adjacent elements (statistical learning; Saffran et al., 1996) and to extract and generalize high-order rules between adjacent (rule learning of ABB and AAB patterns; Marcus et al., 1999) and non-adjacent elements (rule learning of ABA patterns; Marcus et al., 1999). Infants can also learn statistical relations among non-adjacent speech sounds (AXB artificial grammars; Gomez, 2002). Statistical and rule learning abilities (e.g., Kirkham et al., 2002; Johnson et al., 2009) are present also in the visual domain, but it is not known if infants can learn non-adjacent repetitions in visual inputs using the AXB grammars developed by Gomez (2002). Here, we investigated infants' ability to extract structures from AXB grammars in visual sequences of unfamiliar elements (geometrical shapes and arrays of dots). Assessing infants' ability to extract AXB grammars in the visual domain is crucial to understand whether the underlying learning mechanisms are specific for language acquisition or domain general. We tested 21 infants (M age = 12.61 months, SD = 1.58). Infants were habituated to a series of 3-item arrays; each item appeared individually and remained on the screen until all items were visible for 1 s. In a test for infants' nonadjacent dependency learning from speech sequences, Gomez (2002) used syllables for items in initial and final positions and nonwords for the medial position. In the present study, the first and last items were one of two shapes (i.e., AXB and CXD; see Figure 1), and the second item was drawn from a set of 18 arrays of dots. Thus items in initial and final positions and items in medial position were drawn from different categories, similar to the Gomez (2002) protocol, perhaps facilitating detection of non-adjacent relations. Following habituation, infants were tested with 3-item arrays in which initial and final positions were switched (novel) or consistent (familiar). There were 6 test trials, alternating between novel and familiar sequences. A 2 (first test trial: novel vs. familiar) x 3 (test trial pair: first, second, or third) x 2 (test trial type: novel vs. familiar) mixed ANOVA revealed a main effect of test trial type, $F(1,19) = 7.00$; $p = .016$, $\eta^2 = .269$, due to longer looking toward novel sequences at test ($M = 9.37$ s; $SEM = 0.10$) relative to familiar sequences ($M = 7.35$ s; $SEM = 0.57$). There were no other significant effects, $ps > .168$. The results indicate that infants are able to discriminate between novel and familiar sequences, demonstrating that infants

are able to extract non-adjacent dependencies also in visual domain, as they can in the auditory domain, at least with speech sounds (Gomez, 2002).

P3-E-128 Fast mapping in 16-month-old infants: Now you see it, now you don't

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Central to vocabulary acquisition is infants' ability to rapidly map words on to meanings and store these representations strongly so that they persist from one naming moment to the next. Although previous research has shown that infants can fast map a word on to an object in as little as one trial (Spiegel & Halberda, 2011), it is less clear how strongly young children represent these initial word-object mappings (Horst & Samuelson, 2008). When a child learns a word-object mapping in one trial, how easily disrupted is their memory for that word-object mapping? In this study, we examined the robustness of infants' learning of word-object mappings from one naming encounter by measuring the effects of task disruptions on learning. In Experiment 1, 16-month-old infants ($N = 16$, Mean age = 15.96, $SD = 0.55$) were familiarized with a target object and a distractor object, each at a specific location (e.g., the target object always to the left of the child's midline, and the distractor object always to the right of the child's midline), and unnamed. Then, infants were provided with one naming moment where the target object was the only object in view, placed at the location where it was experienced during familiarization, and labeled explicitly for the child, "That's a modi!" After the single naming moment, infants were again shown both objects, one last time, at their respective locations and unnamed. Four test trials immediately followed: the target and distractor were placed in a bowl and the child was asked to "Get the modi!" Infants in Experiment 1 successfully fast mapped the name and object, reliably choosing the target object above chance ($M = 0.70$, $SD = 0.25$, $t(15) = 3.08$, $p = 0.0077$). In Experiment 2, two conditions examined the robustness of infants' learning by presenting a disruption during the task. Critically, the disruption was introduced after familiarization but before naming, and again after naming but before test, so that familiarization and the naming event remained the same as in Experiment 1. In the Visual Disruption condition ($N = 15$), infants were presented with a panel of bright lights before and after the naming event. In the Movement Disruption condition ($N = 16$), infants' posture was shifted briefly (e.g., from sitting to standing and back to sitting) before and after the naming event. Neither group of infants showed evidence of fast mapping (Visual Disruption: $M = 0.43$, $SD = 0.31$, $t(14) = -0.84$, $p = 0.41$; Movement Disruption: $M = 0.56$, $SD = 0.36$, $t(15) = 0.64$, $p = 0.53$). Infants who experienced a

disruption (Experiment 2) performed worse than infants who did not experience a disruption (Experiment 1; $t(34) = 2.19, p = 0.04$). Together, the results demonstrate that although infants are capable of fast mapping a word to an object from one naming encounter, learning is quite fragile and easily disrupted. Currently, we are measuring looking behavior during the task to understand if individual differences in attention are linked the effects of disruption on learning.

P3-E-129 Infant and mother's attention during joint exploration of a puzzle

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Joint attention, periods of time when children and their parents focus on the same target, develops during infancy and early childhood and is important for children's cognitive and language development. Researchers have explored the development and contextual influences on joint attention and found that joint attention often follows parent object manipulation (Deák et al., 2017) and is moderated by infant motor skills (Franchak et al., 2017). Recent work has shown that during parent-child interactions, infants and toddlers look at hands more than faces and that gazes at hands may provide an entry to joint parent-child attention for young children (Yu & Smith, 2013; 2017). We used head-mounted eye-tracking to assess visual and manual behaviors of 39 8- to 10-month-old infants and their mothers as they engaged with an age-appropriate 6-piece puzzle (see Figure 1) for approximately three minutes. We coded each partner's touches to the puzzle, and their looks to the puzzle, their partner's face, and their partner's hand. Periods of joint attention to the puzzle were frequent; infants and mothers spent approximately 39% of the time in joint attention. In addition, the variability in the amount of joint attention was correlated with the proportion of time infants spent touching the puzzle, $r = -.35, p = .03$. Infants spent more time touching the puzzle when dyads engaged in less joint attention, suggesting that mothers may be less inclined to follow their infants' attention when the infant is contentedly manipulating the puzzle. Infants and mothers distributed their attention during the task differently. Consistent with the literature, we found that mothers spent an equal proportion of time looking at their infant's face ($M = .14, SD = .09$) and hands ($M = .16, SD = .10$), $p < .05$; infants spent a higher proportion of time looking at their mother's hands ($M = .12, SD = .08$) than at their mother's face ($M = .03, SD = .04$), $t(39) = 6.09, p < .001$. This difference may reflect, at least in part, the fact that mothers spent 33% of the time displaying puzzle pieces to infants. Indeed, the proportion of time that mothers spent displaying the puzzle was significantly correlated with the infants'

looking at the mother's hand, $r = .35$, $p = .03$, as was the proportion of time that mothers spent looking at the puzzle, $r = .33$, $p = .04$ (see Figure 2). Thus, the more attentive mothers were to the puzzle (either looking at it or manipulating it), the more infants spent looking at mother's hands. Consistent with other work, our findings suggest that mothers may use object manipulation as a means to bid infants' attention which may draw both partners attention to hands and to a joint attention episode. Ongoing analyses are examining the temporal contingencies between maternal and infant behaviors. This will allow us to provide deeper understanding of infant- and mother-led periods of joint attention, and the role of manual activity--and attention to such activity--in joint attention of parents and infants.

P3-E-130 The effect of attend-to me signals on young infants' visual short-term memory for object identity

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We examined infants' visual short-term (VSTM) performance using a one-shot change detection task. In this task, infants first are presented with a brief sample array with two differently colored items (500 ms); next, the screen is blank for a brief retention period (300 ms); finally, the two items reappear for 2000 ms for a test period in which one item has changed color and the other item has not. If infants encode the color of one or both items during the sample they should prefer the novel color during test. Oakes et al. (2013) found that when arrays included two items approximately equal in their "attend-to-me" signal (i.e., both square, same size), 8-month-old infants, but not 6-month-old infants, preferred the novel item. In the real world, however, items vary in many ways that influence their attend-to-me signal, or salience. We asked whether young infants would encode the features (e.g., color) of and detect changes in an item with a strong attend-to-me signal in the one-shot task. We tested 4-month-old ($n = 22$) and 8.5-month-old ($n = 23$) infants in a one-shot change detection task in which one of the two items rotated during the sample phase; the other item was stationary (see Figure 1). Both items were stationary during test. On half the trials, the previously rotated item changed color from sample to test; on the other trials the item that did not rotate changed. If infants are drawn to the rotation, but do not encode other features of the item, they should have a similar preference for the previously rotating item both when it has or has not changed color. If, however, infants encode information (i.e., color) about the rotating item, they will show a stronger preference for previously rotating items that changed than for previously

rotating items that did not change. An age by trial type (rotating item changed, non-rotating item changed) ANOVA revealed only a main effect of trial type, $F(1,43) = 21.77$, $p < .001$, $\eta^2 = .329$. Infants had a stronger preference for the previously rotating item when it changed color ($M = .79$, $SD = .19$) than when it did not ($M = .60$, $SD = .22$) (see Figure 2). Paired t -tests at each age confirmed this difference was significant at both 4 months, $t(21) = 2.5$, $p = .021$, and 8.5 months, $t(22) = 4.08$, $p < .001$. In addition, comparison of each of the four preference scores to chance (.50) revealed that 4-month-old infants preferred the previously rotating item significantly more than expected by chance in both types of trials, $t(21) = 7.06$, $p < .0001$, and $t(21) = 3.27$, $p < .01$., whereas 8.5-month-old infants only preferred the previously rotating item at levels greater than chance when it changed color from sample to test, $t(22) = 7.55$, $p < .0001$. In summary, infants at 4 and 8.5 months appeared to encode the features of an item with a strong attend-to-me signal in a one-shot change detection task.

P3-E-131 When One Exemplar Behaves Like Many

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Structure-mapping theory proposes that children can abstract new relations when they can align the relation structure across examples (Gentner & Medina, 1998). Research has found that relational abstraction requires comparison of two or more exemplars (Christie & Gentner, 2010; Catrambone & Holyoak, 1989). Consistent with this generalization, Ferry, Hespos, and Gentner (2015) found that 7-month-olds could learn to abstract a same or different relation from a series of alignable exemplars, but not from a single exemplar. Likewise, research has shown that infants are able to abstract linguistic structures when given multiple exemplars (e.g. Gerken & Boltt, 2008; Marcus, et al., 1999). However, Gerken, Dawson, Chatila, and Tenenbaum (2015) found that 9-month-old infants generalized a phoneme structure (AAB, ABA) to new words after hearing repetitions of only a single novel word (e.g., le-le-di). Two possibilities might explain this surprising result. First, in a hypothesis-testing framework, it could be that experience with a native language results in highlighting rare linguistic structures, making even one of these unusual examples a suspicious coincidence that can be generalized (Gerken, et al., 2015). A second possibility is that early in infancy, encoding processes are somewhat variable; thus, infants unfamiliar with a stimulus might encode each repetition as a highly similar but distinct exemplar of the target structure. In this scenario, multiple exposures would support relational abstraction, because the infant would experience a series of highly

similar, alignable pairs. If this proposal is correct, it makes a counter-intuitive prediction that young infants, who have less efficient visual processes, may be able to generalize from repetitions of a single exemplar, because they perceive variability in the input. In contrast, older infants, with more consistent encoding strategies, would experience the series as repetition of a single item, and would not show generalization. To test whether 3-, 7- or 9-month-old infants could abstract the same or different relation from a single exemplar, we used a habituation/dishabituation paradigm modeled on Ferry, et al. (2015) except we presented only a single repeated exemplar in habituation trials (see Figure 1). Our findings are consistent with the prediction that 3- but not 7- to - 9-month-olds would abstract the relation from a single repeated exemplar (see Figure 2). Seven- and 9-month-olds recognized a pair they had seen in habituation, $t(35) = 49.13$, $p < .001$, but did not discriminate between novel and familiar relations when they were instantiated with new objects, $t(36) < 1$, $p = .65$. In contrast, 3-month-olds both recognized the habituation pair, $t(34) = 6.78$, $p = .013$, and discriminated between novel and familiar relations in new object pairs, $t(34) = 2.05$, $p = .048$. This suggests that repeating a single exemplar allowed younger infants to form a relational abstraction. Taken together, these findings support the theory that alignment at the learner's level is critical for abstraction of relational structure. Further, they show how the development of attentional and encoding processes can interact with this learning mechanism.

P3-E-132 Joint Attention between Infants and Parents Predicts Executive Functioning and Academic Readiness in Low-Income Communities

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Infant neurodevelopment is especially susceptible to early life stress and poverty (Finegood et al., 2017). Specifically, early adversity has been associated with later neurocognitive deficits in children (Clearfield and Jedd, 2013). While there are many paths by which poverty likely affects cognitive development, parenting is one of the most important mediators of this relation (Guo and Harris, 2000). Research suggests that the quality of parent-child interactions are diminished among families living in low-income, high-stress environments (McLeod and Shanahan, 1993). Importantly, emerging research has found that joint attention between parents and their infants is associated with better subsequent attentional control (Niedźwiecka, Ramotowska, and Tomalski, 2017). However, research has yet to sufficiently study how the development of joint attention in poverty may shape subsequent cognitive development across childhood. To address

these gaps in the literature, we used data from a large, longitudinal sample (N=1,292) of children and their parents living in rural poverty (Vernon-Feagans and Cox, 2013) to investigate how joint attention in infancy relates to executive functioning and academic readiness in early childhood in contexts of socioeconomic adversity. At 24 months, joint attention was measured during a parent-child book reading task. At 35, 48 and 58 months executive functioning was measured with a standardized battery of tests assessing inhibition, working memory and attention shifting. At 48 months academic readiness was assessed with the Peabody Picture Vocabulary Test (PPVT) and the Test of Preschool Early Literacy (TOPEL). Results from our regression analyses indicated that joint attention was correlated with poverty-related risk, such that higher risk was associated with fewer instances of joint attention at 24 months. Further, joint attention at 24 months was positively associated with executive functioning at 35, 48 and 58 months. In addition, joint attention was positively associated with both the PPVT and TOPEL at 48 months. These results suggest that joint attention between parents and infants is negatively associated with early exposure to poverty-related risk, and that joint attention in infancy predicts higher executive functioning across early childhood and verbal academic readiness in preschool. These findings lend support to the idea that early parent-infant joint attention scaffold the development of cognitive abilities for children living in contexts of adversity. Further research is needed to better elucidate the specific mechanisms behind joint attention and its potential role as a mediator of early life adversity on later neurocognitive outcomes in low-income communities.

P3-E-240 Television program comprehensibility and distractibility in 24-month children

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Distractibility during television viewing may be used to examine children's attention. There is increasing cognitive engagement that holds fixation towards the television as long as attention is engaged by the program content. The program comprehensibility or age-appropriateness are determinants of attention engagement. The present study examined the effect of program comprehensibility on distractibility in 24-month-old children by using a variety of audio-visual television programs. The ages of the children were 24 months. There were 7 conditions of 15 participants each (N = 105). The conditions were the presentation for 6 min of a known comprehensible and age-appropriate Sesame Street program (FTB: "Follow that Bird"), and the presentation for 6 min of one of several audio-visual stimuli that varied in language and format. These include programs such as:

Backward speech FTB; Spanish-language FTB; English-Elmo; Mandarin-Elmo; Richard Scarry; Blues Clues; synchronized geometric patterns and audio wave file sounds. Distractors were presented on an adjacent TV screen at irregular intervals for 5 s. Distraction latency, distraction probability, and signal detection parameters were dependent variables. The independent variables were the type of foreground stimulus and the duration of the look at the occurrence of distractor onset. First, there was a main effect of foreground stimulus type on distraction latency and probability. Figure 1 shows the average distraction RT and probability as a function of stimulus type. The "Follow that Bird" had the longer RTs and smaller distraction probability than the "Geometry-Waves", Richard Scarry, or Backward-FTB. The larger RT and smaller distraction probability indicate more attention engagement to the FTB. Somewhat surprising, both the Elmo-English and Elmo-Mandarin TV programs showed the most attention engagement for all stimuli. The FTB program showed more attention engagement than the less comprehensible program for all but the Elmo video. Second, for all stimuli types, the longer the look was in progress before distractor onset, the less likely the infants were distracted by the peripheral presentation. Figure 2 shows distraction probability as a function of the duration of the look at distractor onset, separately for the comprehensible FTB and the other stimuli. The pattern of lower probability with increasing look duration was similar for both stimulus types. Figure 2 also shows the signal detection parameter, c , as a function of the duration of the look. The decreasing negative values across look durations indicate a bias against responding. The bias against responding (β , c) increased as a function of look length, whereas measures of sensitivity (d') were not different across prior look duration or comprehensibility conditions. These results confirm the relation between distractibility and comprehensibility. The more comprehensible and age-appropriate stimulus, "Follow that Bird", elicited enhanced attention (distraction latency and probability) compared with the other stimuli. The exception to this were the "Elmo" videos. Perhaps these videos are especially age-appropriate, even so far as to over-ride the mismatch between the child's language and the Mandarin language. Signal detection analysis revealed an increasing bias against responding accounted for the look duration effect.

F: Cognitive Development

P3-F-133 Surprise Induces Persistent Multi-Object Hypothesis Testing in Infants

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Infants discriminate possible from impossible events, looking longer at events that adults also find surprising. Beyond merely detecting surprising events, infants also exhibit increased exploration and enhanced learning as a consequence of surprise (Stahl & Feigenson, 2015). In these studies, infants who saw an object violate physical principles (e.g., float in mid-air) preferred to explore that object over a novel distractor, when tested immediately following the surprising violation. But outside the laboratory, surprising events often involve interactions between multiple entities. An open question is whether surprise causes infants to seek information not just from the most salient object in an event, but also to other relevant objects, and whether such early information-seeking behaviors test hypotheses involving multiple objects. Furthermore, it remains unknown whether surprise affects infants' exploration for longer durations following the surprising event, or in novel test contexts. To address these questions, we showed 20 13-month-old infants either a surprising or expected event involving object identity. Infants either watched a shoe placed into a bucket, and then dumped out (Expected) or a shoe placed into the bucket, and a duck dumped out (Violation). We measured infants' visual and manual exploration of the object (shoe/duck) and bucket immediately afterwards. Then, after several minutes, we moved infants into a new room and measured their behaviors. First, we found that infants in the violation condition looked longer at the event outcome than infants in the expected condition, $t(18) = 2.48$, $p = .02$, confirming that they detected the surprising event. Next, we gave infants the opportunity to freely explore the bucket and the shoe/duck. We found that infants who saw the expected event showed a baseline preference to explore the object (shoe/duck). In contrast, infants who saw the violation event explored both objects, even preferring the bucket. This exploration difference obtained for both visual, $F(1,18) = 5.74$, $p = .028$, and manual exploration, $F(1,18) = 11.57$, $p = .003$ (Figure 1). What accounts for this preference reversal? Closer examination of exploratory behaviors revealed that infants in both conditions sometimes engaged in exploratory behaviors not directly relevant to the identify-change event (mouthing and banging the object/bucket). However, infants in the violation condition produced many more behaviors directly relevant to the surprising event: putting the object in the bucket, $t(18) = 1.63$, $p = .12$ and overturning the bucket, $t(18) = 2.14$, $p < .05$ (Figure 2)--these actions involved testing causal relationships across both objects. Expectancy violations therefore appeared to cause infants to systematically seek information from multiple objects, potentially testing hypotheses for the surprising event they saw. Finally, we found that differences in infants' surprise-induced exploration persisted over time and space; when tested later and in a new room, only infants in the violation condition demonstrated persistent interest in exploring the bucket, $t(17) = 2.12$, $p < .05$. Together, these findings

suggest that in the wake of surprising events, infants seek out relevant information in a way that is both systematic and persistent.

P3-F-134 Twelve-month-olds individuate agents on the basis of their social relations

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Literature suggests that infants' vocabulary of social relations is governed by distinct relational models (RM; Thomsen & Carey, 2013). These RMs are taken to be mutually incompatible, each providing particular coordination rules that specify how the interactions between agents should be patterned over time (Fiske, 1992). As such, different RMs should not co-occur within the same relation. Across 5 looking-time studies, we explored whether 12-month-olds apply such "principle of relational consistency" (PRC) by testing how they interpret an ambiguous situation with respect to the number of social relations that an agent participated in when interacting with another agent following incompatible RMs. To this end, we used giving and taking actions, which were shown to cue different RMs (equality matching vs communal sharing; Tatone & Csibra, 2014). If infants follow the PRC, they should expect giving and taking not to occur within the same social relation, as this would indicate mutually exclusive RMs. Experiment 1 consisted of 2 familiarization phases (A, B) and a test phase across which infants saw a stage with a central occluder. In familiarization A, infants were introduced to transferring events involving an agent emerging from behind the occluder and either giving or taking an object to/from a patient. In familiarization B, infants saw the occluder being lifted to reveal 1 or 2 agents behind it. At test, infants saw a new agent performing the two transferring actions with a new patient (e.g., giving, moving behind the occluder, and re-emerging to take). At the end of the second action, the occluder was removed to reveal one or two identical agents. Infants looked longer at the the single-agent outcome, suggesting that they inferred two agents (Giver and Taker) behind the occluder instead of a single one (Giver-Taker), consistently with the PRC. Two further experiments confirmed that infants' longer looking to the two-agents outcome did not reflect assumptions about the temporal stability of individual traits (e.g., once a Giver, always a Giver) or efficiency (e.g., agents should approach the patient via the same path): infants failed to individuate two agents when shown two patients each targeted by a different action (Exp. 2) or a single patient targeted by the same action carried out via two different paths (Exp. 3). Two final experiments investigated infants' use of featural and relational information for agent

individuation. Infants did not show evidence of individuation when two featurally different agents each targeted the patient with a giving action (Exp. 4), but they did so when these agents targeted the patient with different actions (one giving, the other taking: Exp. 5). This suggests that information about RMs (cued by the two transferring actions) was prioritized over featural information for the purpose of tracking how many agents the patient interacted with. Our results support the hypothesis that infants' naive social theory conforms to the PRC, as evinced by infants' propensity to infer two social relations to avoid representing a single relation based on mutually contradictory RMs. Moreover, these findings corroborate the proposal that giving and taking prime different social relations based on incompatible coordination rules.

P3-F-135 Method of Hiding Affects Search Errors in 20- to 22-Month-Olds

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During the first year, visual testing methods suggest earlier competence in representing the location of occluded objects than search methods, for well-known reasons involving immature executive functions (e.g., motor planning, inhibitory motor control). Researchers have recently discovered that experimenter social cues also affect children's searching during the first year (Topal et al., 2008). We know less about manual search in the second year, when executive issues are of less concern. We tested 20- to 22-month-olds to determine whether the experimenter's hiding behaviors might serve as social cues that the child could imitate when searching. We also tested whether visual anticipation of the object's reappearance was in advance of searching. The apparatus contained two doors, each opening to a different room. The doors were mounted on the front wall of the apparatus, which could be raised and lowered to reveal both rooms simultaneously. A different toy was used on each trial. In the Hide/Search task (two trials), the experimenter opened a door, placed a toy in a room, and closed the door. In Reveal/Search (four to six trials), she raised the front wall to show the child both rooms with a toy in one room on the spot that would be directly behind the closed door, and then lowered the front wall. In both tasks, children were allowed to search, but were first familiarized with the "rule" that they should open only one door, which meant that opening the incorrect door resulted in not obtaining the toy on that trial. Children almost always opened only one door per trial. In Reveal/Look (two trials), we tested children's anticipatory looking. This task was identical to Reveal/Search except that after the front wall was lowered, children watched as the experimenter began to open both doors simultaneously, saying, "I'm

going to show you where it is. I wonder where it is." We recorded the amount of time children looked at each door before the toy was revealed. Across three studies, each task was presented two different times (once first; $N_s = 10$ to 14 per task). All findings replicated both between- and within-subjects. Children searched correctly over 80% of the time in Hide/Search, but searched randomly in Reveal/Search, suggesting that they succeeded in Hide/Search by imitating the experimenter's hiding behavior of opening and reaching in that doorway. On trial 1 of Reveal/Look, over 85% showed correct anticipatory looking, but on trial 2, 64% (Study 2) to 83% (Study 3) looked back to where they had seen a different toy reappear on trial 1. Anticipatory looking was more accurate than searching at this age, and it is surprising that children did not use visual anticipation to guide search in the Reveal/Search task. Nevertheless, anticipatory looking was not accurate on the second trial. Searches were most influenced by having observed the experimenter's active hiding behaviors. We discuss the possibility that children might initially use social cues to search for hidden objects, before they learn to use anticipatory looking to develop objective search strategies.

P3-F-136 Investigating the symmetry in an acquired association in pre-verbal infants

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Symbolic associations in human children and adults are based on forming equivalence classes which includes three main relations between the tokens. 1) $A = A$ (Reflexivity), if 2) $A \rightarrow B$ and $B \rightarrow C$ then $A \rightarrow C$ (Transitivity) and 3) if $A \rightarrow B$ then $B \rightarrow A$ or Symmetry (1). Extensive studies on non-human primates have demonstrated success in Reflexivity and Transitivity in several species but a consistent failure in Symmetry in any given association. Comprehension of symmetry can be a key contribution to linking abstract words to their corresponding tokens and later on in coupling writing forms of words to their spoken form (2). However to our knowledge it hasn't been investigated whether infants are capable of spontaneously reversing the direction of an association to any extent. In two EEG studies we investigated if 5-month-old infants are capable of applying symmetry in the context of word-learning. In the first study we trained 2 groups of 25 infants, two pairs of word-categories (bird or vehicle). At each trial infants were presented with a word and an image. The critical consideration was to introduce a 1 s delay between the word and the image. In one group infants were trained by always presenting the word before the image (Word-Image group) and in the other group infants were trained by

viewing the image before the word (Image-Word group). In the test blocks 70% of trials were the same as in the training and in the other 30% they were presented either with the incongruent trials in the original direction or the congruent and incongruent trials in the reversed direction. We observed significant clusters of electrodes in both of the trained directions while comparing the congruent and incongruent trials, with the word-image group showing stronger statistics. We also observed significant clusters between congruent and incongruent trials of the reversed direction, however less significant than the trained directions. In a 2nd experiment, a comparative study between infants, adult humans and adult macaques, we sought to train each participant 4 pairs of word-images, 2 being in a word-image direction and the other 2 in an image-word direction, with a similar 1 s of delay between the two stimuli at each trial. Each infant received 3 training videos on 3 consecutive days at home via YouTube and on the test day was being tested either on the trained or the reversed direction of each single pair in a similar ERP design as in experiment one. The results in a group of 35 5-month-old infants follow the pattern of results in study 1 that infants show a late surprise effect if the pairs are being violated either in the trained or in the reversed direction. We also used frequency tagging in both studies as an extra measure to compare the conditions. The overall results suggest that contrary to the consistent failure of non-human animals, infants can readily apply symmetry on the associations and reverse it as early as they observe the first stimulus in the reversed order. 1. Sidman and Tailby 1982 2. T. Medam, et al, Anim Cogn, 2016,

P3-F-137 How do infants identify novel moral individuals? Self-propulsion or agency alone is not a sufficient cue

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Research over the past 10 years indicates that infants possess a rudimentary moral sense and hold at least a few expectations about how individuals will be treated by others (moral rights) and will treat others (moral duties). But how do infants identify these individuals with moral rights and duties (henceforth moral individuals)? To address this question, we focused on the case of fairness. Recent findings indicate that infants expect windfall resources to be divided equally (a) between two humans, (b) between two self-propelled characters that share morphological or linguistic features with humans (e.g., have a face or produce human speech), but not (c) between two inanimate objects. These results leave open many questions about how infants identify novel entities as moral individuals. Here, we first presented 14-month-old infants with two similar brightly patterned boxes that

bore no morphological or linguistic resemblance to humans; across three conditions, the boxes were shown to be animate (i.e., both self-propelled and agentive), only self-propelled, or only agentive. Next, the boxes served as potential recipients in a resource-allocation scenario. Of interest was whether infants would perceive the boxes as deserving of fair treatment in all three conditions or only in some of the conditions. Infants faced a puppet-stage apparatus and received two familiarization trials that differed across conditions. At the start of each trial in the animate condition, the two boxes stood on the apparatus floor, near the back wall. The boxes first moved forward (self-propulsion) and then beeped to each other in a contingent manner, as though having a conversation (agency). In the self-propelled condition, one box moved forward and beeped in one familiarization trial, and the other box did the same in the other trial. The boxes thus never held a conversation, so that their beeps appeared to be randomly generated noises. In the agentive condition, the boxes did hold a conversation in each familiarization trial, but they never moved: they simply stood in their forward positions throughout the trials. In each condition, a human experimenter observed the boxes from a side window during the familiarization trials, to establish that she, too, was aware of the boxes' properties. Following the familiarization trials, all infants received the same test trials (order was counterbalanced). The boxes stood in their forward positions, and the experimenter brought in and distributed two identical toys, giving either one toy to each box (fair event) or both toys to the same box (unfair event). Infants in the animate condition looked significantly longer at the unfair than at the fair event, whereas infants in self-propelled and agentive conditions looked equally at the two events. Thus, by 14 months of age, infants perceive novel animate entities without any morphological or linguistic resemblance to humans as moral individuals entitled to an equal share of a windfall resource. By contrast, infants hold no particular expectation about the fair treatment of novel entities that are only self-propelled or only agentive. Infants thus expect fairness to apply to animate kinds, but not to other kinds.

P3-F-138 Causal Perception of Michottian Launching Events by Toddlers with Williams Syndrome?

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Introduction After six months of age, typically developing (TD) infants respond to Michottian launching events based on causality (causal vs. non-causal) rather than perceptual cues (spatial and/or temporal changes) (Cohen & Amsel, 1998), indicating an

understanding of physical causality. The purpose of this study was to investigate the perception of causality in launching events by toddlers with Williams syndrome (WS). WS is a rare genetic disorder characterized by cognitive, motoric, and linguistic delays. People with WS struggle with spatial and temporal processing (e.g. Atkinson et al., 2006; Mervis & John, 2010), both of which are important in processing launching events. This is the first investigation of causal perception by individuals with WS at any age.

Methods

Participants. Eleven 12- to - 35-month-olds with genetically-confirmed classic WS deletions (5 females, Mage = 23.34 months, SD = 6.18) participated. Mean Mullen Scales of Early Learning (MSEL; Mullen, 1995) Early Learning Composite (ELC; similar to developmental quotient, DQ) was 63.3 (SD = 11.1), indicating mild developmental delay.

Procedure. Participants were tested in a causal perception task previously used to study TD infants (Holt et al., 2017). Participants were habituated to one of two non-causal Michottian launching events (delay or gap) (see Figure 1) followed by three test events: familiar (e.g., delay), novel non-causal (e.g., gap), and causal. Test order was counterbalanced across participants. An experimenter, in real time, recorded looking times. If the toddlers perceived causality, they should dishabituate to the causal event (which is novel conceptually and includes only one perceptual change) but should not dishabituate to the novel non-causal event (which is familiar conceptually but involves changes in both spatial and temporal cues). Results Looking times during the three test trials are shown in Figure 2. Wilcoxon signed-ranks tests indicated that, overall, the toddlers with WS did not respond on the basis of causality. They dishabituated to the perceptually novel, non-causal test ($Z = 2.67, p = .008$) while showing no difference in looking time to the causal and familiar tests ($Z = 0.80, p = .42$). At the individual level, this pattern of processing was shown by 7 participants (63.6%). Four participants (36.6%) exhibited the response pattern that is consistent with understanding causality, i.e., dishabituating only to the causal test event (see Fig. 2b). Age did not differ between participants that demonstrated causal understanding (Mdn = 24.20) and those that did not (Mdn = 24.31, $U = 12.00, p = .79$).

Discussion Causal perception is delayed in WS and not reliably present until after the first 2-3 years of life. Although the pattern of findings makes it clear that the toddlers in our study could monitor differences in time and space (both of these cues differed in the gap and delay non-causal events), as a group they did not use that information to abstract the causal vs. non-causal nature of the events. Data collection is ongoing. We plan to explore possible relations between causal perception and other aspects of cognition, motor development, and linguistic abilities in toddlers with WS.

P3-F-139 A new measure of causal inference in young infants using the blicket detector task

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There has been a dearth of research on causal inference in infants despite its potential to shed light on the origins of this cognitive ability. Past studies have showed that by 24 months of age, children can infer whether an object acts as a cause in a simple causal system (Meltzoff, Waismeyer, & Gopnik, 2012; Sobel & Kirkham, 2006). In such studies, children often need to intervene on the system directly to demonstrate that they understand the task. Moreover, studies that examined causal inference in infants as young as 5 and 8 months of age (Sobel & Kirkham, 2006, 2007) used experimental designs that deviate significantly from the blicket detector task, which is the canonical paradigm for causal inference. The aim of the current study was to develop measures to trace the emergence of causal inference in early infancy in a blicket detector task. In the first part of the study (hereby called blicket preference), infants were shown two toy blocks and then saw that one block made the machine emit light and play music while the other one did not. In the second part, the same infants observed the classic screening-off condition (Sobel & Kirkham, 2006) in which one block activated the machine, the other one did not, and the two blocks together activated the machine. After each complete demonstration, infants were given 10 seconds to interact with the entire setup. The first part of the study was piloted with infants between 5 and 26 months of age ($N = 26$), using the first object that the infant touched during test as the dependent measure. A median split of the available ages yielded two groups: infants younger than 8 months ($n = 8$) and those who are at or older than 8 months ($n = 11$). A Pearson Chi square test was conducted with age and first touch as the two categorical variables ($\chi^2 = 3.91$, $p = 0.048$): Infants at or older than 8 months were more likely to touch the blicket first during test (9 out of 11) than those younger than 8 months (3 out of 8). We are currently developing and testing new, implicit measures of causal inference, including but not limited to: the object that infants look at first, touch first, and hold first, as well as looking time, touching time, and holding time for each of the two objects. Follow-up studies will be presented with more complicated versions of the blicket detector task--including indirect screening and backward blocking--to outline the developmental progression of causal inference with increasing task complexity during early infancy.

P3-F-140 Cognitive and Social-Emotional Development in Early Childhood: A Comparison of Center-based Care Versus Home-Visiting

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Young children growing up in low-income homes often face barriers to receiving high quality childcare (Loeb, Fuller, Kagan, & Carrol, 2004). However, Early Head Start (EHS) has been found to improve cognitive (Ayoub et al., 2009) and social-emotional development (Love et al., 2005). EHS offers families both center-based care and home-visiting services (Vogel et al., 2006, p. xxiv); both seem to support children's development (Gordon, Colaner, Usdansky, & Melgar, 2013). Yet differences in the type of care may be related to outcomes in different developmental domains (Golas, Horm, & Caruso, 2006). Cognitive development seems to be enhanced in center-based programs (Ayoub et al., 2009), while social-emotional development has been found to be better supported in the home environment (Love et al., 2005). While both program types appear to be beneficial (Raikes et al., 2006; Pinto et al., 2013), few studies have compared outcomes across childcare contexts (Golas et al., 2006). This study focused on the following questions: Do cognitive and social-emotional development among children receiving home-visiting services differ from development in those enrolled in center-based care? and, Are there demographic differences, for example, parent age or level of education, between parents who enroll their children in a center-based versus home-based Early Head Start setting, that can aid programs in supporting children's developmental outcomes? Participants were 14 children recruited from two toddler classrooms in an EHS center, located in a lower-income urban area of the North-Eastern US. Seven children who had attended center-based care at age two and seven children who had received home-visiting services during their second year of life were included in the sample. Children in both groups were evaluated on a standardized measure of cognitive development (Bayley-III; Bayley, 2006) and a social-emotional outcome measure (BITSEA; Briggs-Gowan & Carter, 2002). Parents were asked to complete a questionnaire to provide demographic data and information on parenting behaviors. In preliminary analyses, scores from the Bayley-III and BITSEA were tabulated according to study group, and t-tests were used to test for significant differences across groups. Sensitivity analyses examined whether differences observed remained after accounting for sample differences between groups such as receipt of special education services. Information from the parent questionnaire was also tabulated, and analyzed for any differences between the two groups. Subsequent analyses will examine whether parental differences account for differences in child outcomes between the two groups. Results indicated that, on average, children who had received a year of

center-based care at age 2 scored higher on cognitive skills than their counterparts who received home-visiting services. These results held true even when potential confounding variables were controlled for; having an IEP and aging out of the Bayley III. On the other hand, social-emotional development was found to be similar in both groups. Additionally, family literacy habits and frequency of parental play were correlated with both cognitive and social emotional development. Subsequent analyses will be performed in a larger sample, and preliminary findings suggest that programs may enhance cognitive development in children through emphasis on center-based services at age two.

P3-F-141 Prediction in Infants and Adults: A Pupillometry Study

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At the center of human cognition is learning: Why we behave and think as we do can be traced back to information learned from our environment. Although learning is often discussed as a single process, there are multiple psychological processes, such as attention, memory and prediction, that interact. The current study focuses on how prediction, or the ability to use past experiences to generate expectations about future sensory input, influences infant learning. Majority of what we know about prediction comes from research with adults. We know that predictions can be correct or incorrect and each has the potential to support incremental cognitive changes. However, it is unknown whether this represents an ability that is continuous or whether an infant's ability to learn and predict is different from an adult's. The goal of this study is to provide the first direct comparison of prediction and prediction error across infants and adults. We used pupillometry because it is one of the few methods that allows for the recording of the same physiological response in an identical behavioral paradigm across these disparate age groups. Furthermore, pupil diameter has been shown to be a marker of uncertainty and surprise in adults, both of which reflect learning and prediction. We measured infants' and adults' pupil dilation response (PDR) as they completed an implicit learning task. We found significantly larger PDR for omission trials (i.e. trials that violated participants' predictions) compared to present trials (i.e. trials that confirmed participants' predictions) in both infants and adults. Furthermore, we used a learning model to examine the trial-by-trial changes of prediction and prediction error. The learning model demonstrated similar time-course and magnitude of this response across age groups suggesting a life-span continuity of mechanism in prediction and statistical learning.

P3-F-142 Labels in infants' object categorization: Facilitative, or merely non-disruptive?

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Previous research has claimed that both labels and novel communicative signals (such as beeps used in a communicative context) can facilitate object categorization in 6-month-olds, and that such effects can be attributed to their communicative nature (e.g., Balaban & Waxman, 1995; Ferguson & Waxman, 2016). Yet, other research has shown that young infants can form categories simply based on visual information in the absence of any auditory signals (e.g., Behl-Chadha, 1996; Quinn, Eimas & Rosenkrantz, 1993). Further, the auditory overshadowing hypothesis suggests that auditory input disrupts concurrent visual processing (and thus, categorization) in infants, with more familiar auditory signals interfering less (Sloutsky & Robinson, 2008). Therefore, two questions arise: (1) do communicative auditory signals truly facilitate categorization in 6-month-olds when compared to silence; and (2) can the comparable influence of labels and novel communicative signals be explained by familiarity with these auditory stimuli? The present study addressed these questions by familiarizing 6-month-old infants (N=28) on a sequence of animals (dinosaurs or fish) in silence and in the presence of pre-familiarized tone sequences. These stimuli have been used in previous studies to argue that labels and tones used in a communicative sense during familiarization enable infants to form categories (Ferguson & Waxman, 2016). Nevertheless, we found that infants in both conditions looked longer at an out-of-category object during test (silent: $t(11) = 3.25$, $p = .005$, $d = 1.02$; familiar tones: $t(12) = 2.31$, $p = .040$, $d = 0.64$; Figure 1), indicating successful categorization even in the absence of labels or communicative tones, and in the presence of familiar tones. These results are consistent with the auditory overshadowing hypothesis in showing that infants can form categories in silence, and that labels do not facilitate, but merely do not disrupt, categorization. Furthermore, our results also suggest that the effect of communicative tones is one of familiarity rather than communicative function. The findings in the present study warrant a reinterpretation of the results of previous studies using the same stimulus set, such that labels and familiar auditory signals do not facilitate, but, due to familiarity, also do not disrupt category formation in infants, whereas less familiar auditory signals disrupt categorization. An important implication of the findings of the present study is that it is vital to include appropriate control conditions in studies of linguistic effects on object categorization.

P3-F-143 Facilitative language techniques and neurocognitive development in preschool children with and without prelingual hearing loss

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Prelingual hearing loss and delayed access to spoken language place some deaf children with cochlear implants (CIs) at an elevated risk for delays in specific domains of neurocognitive functioning. The current study investigated the effect of prelingual hearing loss on the relationship between mother's linguistic input and children's neurocognitive (language and executive functioning, EF) skills. Two groups of preschoolers (aged 3-6 years) with and without prelingual hearing loss and their normal hearing (NH) mothers participated in the current study. As part of a larger longitudinal study, mother-child dyads participated in a 5-minute free-play session with age-appropriate toys in a laboratory setting. Mother-child play sessions were videotaped and transcribed by two independent observers. Maternal linguistic input was categorized as employing lower-level (i.e., imitation, closed-ended questions, linguistic mapping, directive, and comments) or higher-level (i.e., parallel talk, open-ended questions, expansion, and recast) facilitative language techniques (FLTs). Additionally, mothers completed the Learning, Executive, and Attention Functioning-Preschool (LEAF-P) scale, a downward extension of the LEAF (Castellanos et al., 2016) that assesses everyday EF and related learning skills in children aged 3 to 6 years. The LEAF-P contains 40 items, divided into two Cognitive-learning subscales (Comprehension and Conceptual Learning, Factual Memory) and six Cognitive-EF subscales (Attention, Processing Speed, Visual Spatial Organization, Sustained Sequential Processing, Working Memory, and Novel Problem Solving). Using the LEAF-P, parents rate the child's behavior on a 0 (never a problem) to 3 (very often a problem) point scale, such that higher scores on the LEAF indicate greater problems in EF and learning. Although both groups of children had comparable intelligence and language skills, NH mothers of CI users provided significantly more linguistic input [$M = 179.33$ (47.72)] than NH mothers of NH children [$M = 113.44$ (27.69), $p = .01$]. NH mothers of CI users also produced significantly more directives and closed-ended questions (comprising lower-level FLTs) than NH mothers of NH children ($p = .000$; $p = .003$, respectively) during the 5-minute play session. CI users, as compared to NH peers, were rated by their mothers as experiencing greater problems in the EF areas of Comprehension and Conceptual Learning ($p = .006$), Sustained Sequential Processing ($p = .017$), and Working Memory ($p = .004$). Correlational analyses revealed that higher-level

FLTs were associated with higher intelligence scores ($r = .55$, $p = .03$) and higher global language skills ($r = .87$, $p = .000$). Additionally, higher-level FLTs were associated with fewer parent-reported problems with Comprehension and Conceptual Learning ($r = -.51$, $p = .04$), Visual Spatial Organization ($r = -.54$, $p = .03$), and Novel Problem Solving ($r = -.56$, $p = .03$). Our findings suggest that mothers who employ higher-level FLTs during play scaffold children's language and EF skills. This is the first study to demonstrate that maternal FLTs are associated with preschool children's EF skills. These findings may provide an avenue for early, individualized clinical intervention for improving EF skills in prelingually deaf CI users.

P3-F-144 Young Infants Detect Qualitative, but not Quantitative, Fairness Violations

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Recent research on fairness in 9- to 10-month-old infants has yielded mixed findings. When a distributor divides two items between two similar recipients either equally (1:1) or unequally (2:0), infants look longer at the unequal outcome. However, when the distributor divides four items either equally (2:2) or unequally (3:1), infants look equally at these outcomes. One possible explanation for these divergent results is that young infants can detect fairness violations that involve a qualitative distinction (2:0, one recipient gets something and the other one gets nothing), but have difficulty processing fairness violations that involve a quantitative distinction (3:1, both recipients get something but in unequal amounts). Another possibility is that infants lack a sense of fairness and look longer at 2:0 than at 1:1 outcomes for incidental reasons. In all tasks that have tested infants with a qualitative distinction (2:0) to date, each item was always distributed one at a time, resulting in more interactions between the distributor and the advantaged recipient (2) than between the distributor and the disadvantaged recipient (0). In contrast, tasks that have tested infants with a quantitative distinction (3:1) have typically used a mode of distribution in which each recipient is given a plate of items, thus equating the number of interactions between the distributor and each recipient (1). This procedural difference raises the possibility that young infants simply attend to the interactions between the distributor and recipients and show enhanced attention when the distributor ignores one of the recipients. To evaluate these two possibilities, we presented 9- to 10-month-olds with resource-allocation scenarios in which an experimenter divided either two items (qualitative condition) or four items (quantitative condition) items between two animated puppets. In both conditions, the number of interactions between the distributor

and each recipient was kept equal (1). Infants in the qualitative condition were first familiarized to two identical penguin puppets dancing in windows in the back wall of a puppet-stage apparatus. In the test trial, an experimenter (E) divided two cookies either equally (1:1) or unequally (2:0) between two plates, and then she slid each plate in front of a penguin, thus interacting with each penguin exactly once. E then exited the apparatus, and the penguins looked down at their plates and paused. The quantitative condition was identical except that E divided four items between the two plates either equally (2:2) or unequally (3:1). Infants in the qualitative condition looked significantly longer at the unequal (2:0) than at the equal (1:1) outcome, whereas infants in the quantitative condition looked equally at the unequal (3:1) and equal (2:2) events. These and control results indicate that when the number of interactions between a distributor and recipients is kept constant, infants detect a fairness violation when shown an 2:0 unequal outcome, but not when shown a 3:1 unequal outcome. Our results thus support the first possibility raised above. Although young infants do possess a sense of fairness, they initially are limited to detecting qualitative (2:0) as opposed to quantitative (3:1) fairness violations in resource-allocation tasks.

P3-F-145 Is There Developmental Continuity in False Belief Understanding? A Longitudinal Study

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According to the mentalistic view of Theory of Mind (ToM), infants have an implicit false belief understanding, which can be measured when task demands are reduced. This view is currently at the center of a hot debate. Heyes (2014) and Ruffman (2014), among others, proposed that infants' responses in spontaneous, implicit tasks can be explained by low-level, domain-general learning mechanisms. As such, there is controversy as to whether the nonverbal, implicit tasks used in infancy measure the same ability as verbal, explicit tasks in childhood. The goal of the present study was to use a longitudinal design to determine the predictive nature of the "litmus test" of ToM abilities: false belief understanding. Two groups of infants were tested: a 14-month-old group and an 18-month-old group. The 14-month-old group was re-tested when they were 4 years old and the 18-month-old group was retested when they were 5 years old. False belief was assessed in infancy using the violation-of-expectation (VOE) paradigm. A within-subjects design was adopted so that looking time during the congruent trials could be compared to looking time during the incongruent trials in the same participant. An anticipatory-

looking task (from Thoermer, Sodian, Vuori, Perst, & Kristen, 2012) was used to assess implicit false belief tracking. Specifically, children's first saccade to the correct location was measured. Two explicit false belief tasks (contents and location; from Wellman & Liu, 2004) were used to assess explicit false belief. Infants passed this task if they were able to answer that the protagonist in the stories had a different (false) belief than their own. Infants' performance on the VOE false belief task did not predict their later performance on the implicit or explicit false belief tasks, failing to provide evidence for the continuity of false belief understanding. These results suggest that the tasks in infancy do not measure the same construct as the tasks in childhood. As expected, when measured concurrently in childhood, implicit false belief was not correlated with explicit false belief. As expected, the two explicit false belief tasks were positively correlated with each other. These results are in line with the two-systems theory of ToM development, which posits that implicit and explicit false belief are two separate constructs that develop in parallel to one another. The current findings are discussed in the context of the lean vs. rich interpretation of ToM debate.

P3-F-146 Spatiotemporal and conceptual object individuation are not integrated in 10-month-old infants

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Infant's ability to individuate objects is at the core of current theories of cognitive development (Carey, 2009). Ten-month-old infants can already use both spatiotemporal and conceptual/linguistic cues to enumerate and remember objects (e.g., Xu & Carey, 1996; Xu, 2002). What mechanisms support these capacities? Most theories state that all types of early object individuation are based on a unitary, pointer-based object representation (object file) system, and that spatiotemporal information should be always prioritised over conceptual information when the two are incompatible (Kibbe & Leslie, 2011). This view cannot explain various findings where infants failed to retain the location of an object (e.g., Yoon et al., 2008; Kuhlmeier et al., 2004). We hypothesise that conceptual and spatiotemporal object representations are not relying on the same underlying system, and that young infants would have trouble using spatiotemporal and conceptual individuation criteria simultaneously. We predict that in cases of conflict, conceptual descriptions are retained, while spatiotemporal information is lost. We report three studies with 10-month-old infants (N = 24 each) using the manual search object individuation paradigm (Van de Walle et al., 2000). In the presentation phase of the crucial

two-object conditions, two unfamiliar objects were placed on the top of an opaque box so that both were simultaneously visible. Then the objects were hidden in the box while one of them was placed in a hidden compartment where infants would not find it. Infants were then allowed sequentially search in the box for the objects. The dependent variables were search duration and number of reaches into the box after the first object was removed. These measures were compared to the one-object condition, in which a second object would not have been expected in the box. The three studies we conducted differed how the objects were presented to infants. Study 1 was a replication of the original study, where the objects were placed on the top of the box with no accompanying verbalisation. We found significantly longer search duration in the two-object (4.32 s) than in the one-object (2.71 s) condition ($t(23) = 2.914$, $p = .008$). In Study 2, the object pairs were labeled with the same novel label to induce conceptual object representation. We found no difference in search duration between the conditions (two-object: 3.69 s, one-object: 3.40 s). This is consistent with the prediction that the conceptual information, which indicated the presence of one kind of object, would override the spatiotemporal information about two entities. In Study 3, the two objects were labeled with different novel labels. Here, we expected that infants would again search longer for the second object in the two-object condition. This prediction was confirmed (two-object: 2.42 s, one-object: 1.72 s; $t(23) = 2.116$, $p = .045$), showing that infants' failure in Study 2 was not due to the linguistic input per se. This dataset provides evidence that spatiotemporal and conceptual information does not integrate seamlessly at 10 months of age.

P3-F-147 What's play got to do with it?: Associations between early play experiences and STEM achievement

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This study explored how parent report of children's spatial play and media use in the home relates to their performance on spatial and math assessments. There are reasons to believe that such links might exist. Children under 2 years of age spend on average 42 minutes a day using screen media (Common Sense Census, 2017) and 97% of children, most younger than 1 year, use mobile devices (Kabali et al., 2015). Children's television exposure at 29- and 53-months is linked to decreased academic achievement, including

math, at 10 years (Pagani et al., 2010). The frequency and quality of puzzle play in 2- to 4-year-olds predicted performance at 4.5 years on a mental rotation task (Levine et al., 2012), though touchscreen use was not related to spatial puzzle performance in toddlers (Moser et al., 2015). We asked how reported play with digital technology (e.g., smartphone, touchscreen tablet, computer games, TV-viewing) might influence early spatial and mathematics achievement. A second goal was to examine whether more diverse spatial play (e.g., tangrams, building blocks, K'NEX, puzzles) relates to spatial and math achievement. These are crucial questions given that spatial skills early in life predict achievement in mathematics (Mix & Cheng, 2012) and STEM disciplines (Wai et al., 2010). Yet children from low-SES backgrounds performed worse than other children on a spatial skills task by age 3 (Verdine et al., 2014). While reported block-building frequency (one type of spatial play) does not vary by SES (Jirout & Newcombe, 2015), lower-SES children use more media (Common Sense Census, 2017), which may dampen their cognitive (e.g., executive function) and language development (Anderson et al., 2017). We hypothesized that amount of media use would vary by maternal education (proxy for SES; Hoff, 2013) such that low-SES children would use more media, but spatial play would not vary. We expected less media use and more spatial play to be associated with better performance on spatial and math assessments. Over 150 3-year-olds (M_{age} = 42.12 months, SD = 3.50) were tested in Head Start and private preschools on 2D- and 3D-Tests of Spatial Assembly (TOSA; Verdine et al., 2017; see Figure 1) and math (Applied Problems, TEMA). Replicating previous findings (controlling for age and vocabulary), results indicate that frequency of media use varied by SES ($p = .001$) but spatial play did not. However, controlling for age, vocabulary, and maternal education (SES), children with less media use performed better on spatial assembly (2D-TOSA, $p = .002$; 3D-TOSA, $p = .047$) tasks. Low-SES children may be at a disadvantage by using more media because more the latter is associated with worse spatial skills. Surprisingly, frequency of spatial play did not relate to preschooler's concurrent spatial or math outcomes. However, spatial play frequency during preschool could predict later spatial and math achievement. Additionally, quality of play (e.g., on-task play; joint engagement) was not assessed and may be influential in spatial and math achievement. These findings have important developmental and educational implications for 0- to 3-year-olds because our results suggest that media use relates to spatial achievement and varies by SES.

P3-F-148 Developmental origins of future thought: Episodic future thinking in two-year-olds

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Episodic future thinking (EFT) is a fundamental cognitive process that allows us to plan for future events by retrieving relevant and applicable episodic memories and applying that information in service of a future goal. Previous research examining the development of EFT suggests that these abilities do not emerge until at least the fourth year of life (c.f. Atance & O'Neill, 2005). However, these studies required participants to imagine future scenarios and provide narratives of the events, and/or to possess existing knowledge (Busby & Suddendorf, 2005; Hayne et al., 2011; Prabhakar & Hudson, 2014), placing significant demands on language and prior knowledge, which may have masked younger children's competence. In the current study, we investigated episodic future thinking in 2-year-olds using a novel task designed to minimize language and knowledge requirements. Our task required children to deploy episodic information acquired over the course of the experiment in service of a future goal. The study proceeded in two phases: Familiarization and Episodic Future Thinking. First, during the Familiarization phase, we introduced children to a box with two transparent drawers embedded in it. Children were shown that the drawers could be opened by performing unique actions on each of two objects on top of the box: lifting and replacing a pom-pom, or sliding a pink cylinder in and out of another cylinder. Children were then introduced to two stuffed animals, Monkey and Lion, and were told that each animal had a favorite color (yellow and red, respectively). The experimenter then conducted a series of four demonstrations in which she baited one of the drawers with either a red or a yellow bead and asked children which action she should take to retrieve the bead for Monkey/Lion. As the beads were retrieved, the experimenter placed them in cups in front of each animal to help remind children of the association between animal and bead. Following Familiarization, children completed a series of 8 Episodic Future Thinking (EFT) trials. In these trials, the experimenter baited both drawers, one with a red bead and one with a yellow bead. She then asked children to retrieve a bead either for Monkey or for Lion (4 of each trial type; Figure 1). Crucially, since both doors were baited, children had to engage in episodic future thinking: they had to construct a plan to retrieve the correct bead using episodic information learned during Familiarization. Eleven 2-year-old children ($M = 29.91$ months, $SD = 3.65$ months; 3 girls) completed 8 EFT trials each (88 trials total). We computed each child's mean proportion correct across test trials. We found that children selected the correct action at rates significantly above chance (mean proportion correct = 0.65; $SD = 0.12$; $t(10) = 3.99$, $p = .003$; Figure 2). Our findings suggest that children are able to engage in EFT behaviors prior to 36-months, and suggest that the foundations of episodic future thinking may be present in toddlerhood.

P3-F-149 Learning about the motion properties of animates and inanimates

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The ability to distinguish between animates and inanimates is a cornerstone of cognitive development. Despite the impressive body of research on this topic (see Rakison & Poulin-Dubois, 2001), little is known about whether and at what age infants use self-propelled motion to distinguish people from inanimate objects. It is also unclear whether the mechanism or mechanisms that underpin this knowledge are domain-general (e.g., associative learning; Rakison & Lupyan, 2008) or domain-specific (e.g., core systems; Spelke & Kinzler, 2007). Thus, in three experiments we sought to: (1) to replicate the only study on this topic by Spelke, Phillips, and Woodward (1995) with 7-month-olds (Experiment 1); (2) to examine the developmental origins of this ability in 4-month-olds (Experiment 2); and (3) to examine on what basis 7- and 11-month-olds distinguish people from objects (Experiment 3). Using Spelke et al.'s (1995) procedure, we habituated 4- (Experiment 2; $n = 13$) and 7-month-olds (Experiment 1; $n = 32$) to events in which first a cartoon person or object moved behind a central screen and then a second, half-occluded person or object exited stage-right. Infants were then shown alternating Collision and No-Collision test events in which the second person or inanimate object moved following contact (Collision event) or no contact (No-collision event) from the first person or object. We predicted that infants should look longer at the No-Collision test event only in the Inanimate Object condition if they recognized that people but not objects are self-propelled. Preliminary analyses revealed that the 4-month-olds, $p < .01$, and the 7-month-olds, $p < .05$, looked longer at the No-Collision test event in the Inanimate Object condition than in the People condition. However, the 4-month-olds tended overall to look longer at the No-Collision events, $p < .001$, suggesting a preference for self-propulsion. Because the 4-month-olds in Experiment 1 failed to recognize that objects and people are governed by different motion constraints, Experiment 3 examined whether 7- ($n = 14$) and 11-month-olds ($n = 16$) represent people and object motion based on inborn "core-system" knowledge or a domain-general associative processing. Experiment 3 was identical to the previous experiments except that the people possessed object features (i.e., wheels) and the objects possessed people features (i.e., legs). Infants were predicted to look longer when the objects moved in the absence of contact--irrespective of their perceptual features--if they espoused a core system that encoded people and object motion. However, 7- (and, to a lesser extent, 11-month-olds) were predicted to look

longer at the No-Collision than the Collision event in the People condition--because the people possessed object features and may have been perceived as objects--if their motion knowledge is perceptually driven. Preliminary results revealed that the 7- and 11-month-olds looked longer at the No-Collision test event in the Inanimate Object condition than in the People condition, both p 's $< .005$. However, similar to the 4-month-olds in Experiment 2, the 7-month-olds preferred the No-Collision test event to the Collision event, $p < .05$. This research has implications for theories that discuss infants' developing knowledge about people and object motion.

P3-F-150 Six-month-olds' working memory for the objects of agent's goals

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By 6 months, infants can keep track of multiple hidden objects, and can remember the featural identity of at least one of them (Wynn, 1992; Kaldy & Leslie, 2005). For example, Kibbe and Leslie (2011) found that 6-month-olds who viewed two shapes hidden sequentially in two locations successfully remembered the shape of the object hidden last, but remembered only the existence, but not the shape, of the object hidden first. Also by 6 months, infants can represent the preferences of agents who repeatedly reach for one visible object over another, associating object identity with an agent's goal (Woodward, 1998), and can make predictive eye movements based on these goal representations (Cannon & Woodward, 2012). How do agents' object preferences impact how 6-month-old infants encode and represent hidden objects? We tested 42 6-month-olds infants using a modification of Kibbe and Leslie (2011). In four Familiarization trials, infants viewed an agent who watched two wooden shapes (disk and triangle), placed on a puppet stage, and then consistently demonstrated a preference for one of two shapes by grasping it (shape location counterbalanced across trials). During each of the four Test trials, the agent watched as the objects were placed behind opaque occluders, visible to the agent but hidden from the infant. The goal object was always hidden first. One of the screens was then removed, revealing either the original hidden object (control outcome) or the other object (swap outcome; within-subjects design). For half of the infants ($n=21$), the screen occluding the first-hidden (goal) object was removed, for the other half of the infants ($n=23$) the screen occluding the last-hidden object was removed (Figure 1). We used two measures to assess infants' processing of the goals and objects. First, we measured whether infants would make predicative gazes to the location of the hidden goal object before an object was revealed. We found that infants made anticipatory looks

to the goal location at rates significantly above chance (64% of trials; one sample t-test against 0.5, $p=0.02$), even though the goal object was not visible to infants. Second, we measured infants' looking time following the removal of the occluder. We found that infants looked equally at the swap and control outcomes regardless of whether infants were tested on the object hidden first or last ($p=0.8$), suggesting they failed to encode the features of either hidden object (Figure 2). Together, these results suggest that infants maintained in working memory an association between the agent and the location of her goal object, since they successfully anticipated where she should look for her goal even though the goal object's location changed across trials. However, maintaining this information may have come at a cost, since infants failed to notice when the features of either object were revealed to have changed, even though, in non-social contexts, 6-month-olds can remember at least one object identity. These results highlight the role of working memory in processing social information, and suggests that social information may be prioritized over object information in working memory.

P3-F-151 How do infants encode unexpected events? Steady state evoked potentials in 9-month-olds may tell.

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Infants form expectations about the physical and social world very early in their first year of life. Spelke and Kinzler (2007) assume four core knowledge domains for the representation of objects, actions, numbers and space, which are rooted in phylogeny and ontogeny and allow young infants to form predictions about regular events. Infants' expectations about their social and physical world are commonly measured by responses to violation of expectations (VOE) about physical events or actions, for example, in looking time paradigms (e.g., Stahl & Feigenson, 2015) or neuronal responses in the electroencephalogram (EEG; e.g., Reid et al., 2009). VOE offer a special learning opportunity and increase infants' exploration behavior (Stahl & Feigenson, 2015). Here, we look at infants' VOE response in steady state visually evoked potentials (SSVEPs), the response of visual cortex to a flickering stimulus corresponding to the frequency of the rhythmic stimulation. Since SSVEP signals are mute on muscle and movements artifacts, they may open up new avenues for the investigation of infants' neuronal processes. We presented 9-month-old infants ($N = 38$, 14 girls) with sequences of four core knowledge

domains (social action, number, solidity and cohesion) demonstrating a physically or socially expected or unexpected outcome (e.g., food is put on the head instead of the mouth; Figure 1). We flickered these sequences at infants' theta (4 Hz) or alpha (6 Hz, corresponding to alpha in infants, Hoehl et al., 2014) frequency (on and off frames of a CRT monitor). Specifically, we selected the theta and the alpha rhythm to elucidate the functional role of these frequency bands by entrained SSVEPs responses (cf. Köster et al., 2017). We expected power differences in the rhythmic response to the flickering stimuli at posterior electrodes (O1, Oz, O2, P3, P4, Pz, P7, P8) and an interaction of the outcome (expected vs. unexpected) with the driving frequency (theta vs. alpha). The visual brain entrainment elicited clear SSVEP responses in the respective driving frequency at posterior electrodes compared to baseline level, both $t(37) > 5.84$, $p < .001$ (Figure 2). Furthermore, we found a sharp increase in theta SSVEP power for unexpected compared to expected outcomes $t(37) = 3.29$, $p = .002$, but no difference was found in alpha SSVEP power, $p = .825$ (post-hoc t-tests following a significant interaction between frequency and outcome, $p = .022$). Visually entrained theta oscillations were highly sensitive to the encoding of unexpected events or VOE that can be related to learning (Stahl & Feigenson, 2015; 2017). Entrained alpha oscillations did not differ between conditions supporting its assumed role in attentional processing (Jensen & Mazaheri, 2010). Thus, we provided first evidence for a functional role of the 4 Hz theta rhythm in infants' encoding of unexpected events potentially reflecting a learning mechanism elicited for novel, unexpected outcomes. Furthermore, we demonstrated that SSVEPs can be used as a robust measure to investigate the functional role of neuronal rhythms in infants' learning.

P3-F-152 Pedagogical cues and action complexity affect transmission of information in two-year-old children

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It has been argued that both pedagogical communication (using explicit teaching-oriented verbal cues, direct eye contact, and child-directed speech; Csibra & Gergely, 2009) and intentional but non-pedagogical communication allow for learning to occur (e.g., Gopnik & Schulz, 2004). While receptivity to information presented using both intentional and pedagogical cues has been studied extensively, children's active transmission of information following these cues is understudied. For example, Vredenburg, Kushnir and Casasola (2015) showed that 2-year-olds are more likely to demonstrate an action to an adult after being shown it in a pedagogical than in an

intentional but non-pedagogical context, despite having learnt both actions equally well. In the current study we aimed to replicate this finding, and extend it by investigating whether manipulating action complexity as well as pedagogical cues when demonstrating an action selectively affects the likelihood of the action being shown to an ignorant adult.

Exp. 1. In a pre-test phase, 24-month-old children ($N = 20$) interacted with two unfamiliar adults who demonstrated to them two actions leading to a comparable outcome. One demonstrator showed an action in an intentional, but non-pedagogical manner, while the other showed another action in a pedagogical manner by using explicit verbal cues ("This is how you do it!"), direct eye contact, and child-directed speech. At test, the children were then encouraged to show an ignorant familiar adult who was not present during demonstrations how to play with the toy. We measured which action they performed first, as well as the time spent performing both actions at transmission. There were two trials with two novel toys, resulting in a total of four action demonstrations and two transmission phases. While children showed both actions during transmission, they were more likely to perform the pedagogically demonstrated action first (see Figure 1a). These results are in the same direction as the previous findings (Vredenburg, Kushnir, & Casasola, 2015), but no statistical analyses have been performed, as data collection is ongoing.

Exp. 2. To investigate how other factors mediate this effect, we manipulated both pedagogical demonstration and action complexity in a second experiment ($N = 31$). At pre-test, one demonstrator showed a simpler action in a non-pedagogical manner, while the other showed a more complex action in a pedagogical manner. As in Exp. 1, children showed both actions during transmission, but were significantly more likely to demonstrate the simple action first (see Figure 1b), even though it was presented without the explicit pedagogical cues ($t(30) = -2.68, p < 0.01$). Natural pedagogy theory (Csibra & Gergely, 2009) predicts that even when the action is more complex, children still transmit this action preferentially, as they have interpreted the action as kind-generalisable knowledge to be taught to another conspecific. However, as we found instead that less complex actions are transmitted preferentially, this may favour a salience-based interpretation of our findings. Pedagogical cues and ease of execution both enhance the saliency of an action, increasing the likelihood of children transmitting this action first. However, when pitted against each other, ease of execution wins.

P3-F-153 Maternal Depression and Mother-Infant Interactions in Mexican Origin Families

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Maternal depression is a common public health problem that affects mothers' and infants' mental and physical health. Maternal depression during the child's first year of life appears to be particularly detrimental to child behavioral outcomes (Bagner, Pettit, Lewinsohn, & Seeley, 2010). Depressed mothers tend to have more adjustment difficulties to their parental role which leads to higher parenting stress (Gelfand, Teti, & Fox, 1992). Mothers who experience heightened depressive symptomatology often exhibit lower quality parenting, which can result in disrupted infant sleep (Coldwell, Pike, & Dunn, 2006; Sadeh, Tikotzky, & Scher, 2009). Previous research has found a link between maternal depression and duration and frequency of awakenings in infant sleep (Warren, Howe, Simmens, & Dahl, 2006). These sleep disruptions lead to lower percentage of total infant sleep which is associated with reduced impulse control and working memory (Bernier, Carlson, Bordeleau, & Carter, 2010). Although the detrimental effects of maternal depression on infant development has been studied, no study has solely focused on Mexican origin (MO) mothers and infants to examine the relationship between maternal depression and sleep in this population. This gap in the literature is notable, considering MO mothers' increased risk of psychopathology due to heightened exposure to poverty and other stressors (Umaña-Taylor, Updegraff, & Gonzales-Backen, 2011). Further, minority children and children in poverty (such as MO children) are at increased risk of poor sleep quality and insufficient sleep quantity (El-Sheikh, Bagley, Keiley, Elmore-Staton, Chen, & Buckhalt, 2013). As expected, MO children face an increased risk of cognitive and behavioral problems due to their higher risk of being exposed to maternal depression in addition to being exposed to poverty (Pettersson & Albers, 2001; Brooks-Gunn & Duncan, 1997). Thus, it is possible that MO mothers' experience of depression and parenting stress might spillover to impact her child's well-being. We aim to test this hypothesis. In 2006 our team began assessing a sample of 674 MO youths in 5th grade. Those former 5th graders are beginning to have their own children. We are assessing this second generation ($n = 25$) of 6 months of age, examining the parental and contextual influences on child sleep. Sleep was objectively recorded via actigraphy across 8 nights (MicroMotion Logger, AMI) with mothers also subjectively reporting on sleep via diary each morning. Maternal depressive symptoms were assessed using the Center for Epidemiologic Studies Depression Scale (Radlof, 1977). Parenting stress was assessed using the Parental Stress Index Questionnaire (Abidin, 1990). We have collected data on 25 families and began coding sleep data this fall. We anticipate coded data on 60 families by June, 2018. Mothers' age ranged from 18-22 years old, with a household income between >5,000/year to 90,000/year (44% of families were below the poverty line). More than a quarter (28 percent) of the mothers were clinically depressed. Additionally, 28 percent of the mothers

were found to be clinically, significant parenting stress. Higher depressive symptoms were associated with increased parenting stress ($r= 0.485$, $p= 0.014$) and increased parental distress ($r= 0.620$, $p= 0.001$). Once sleep data are coded, future analyses will examine the relationships among maternal depression, parenting stress, and infant sleep.

P3-F-154 The postpartum insertion effect of the etonogestrel-releasing contraceptive implant on development of infants at age 12-15 months

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Reversible, effective and long-acting postpartum contraception is an important action to decrease the chance of unintended and rapid repeat pregnancy, especially in vulnerable populations. One of the limitations for recommending immediate postpartum insertion of the etonogestrel (ENG) implant is the absence of evidences of its effect on infant development. Thus, the objective of this study was to evaluate infant development when ENG implant was inserted immediately postpartum in their breastfeeding mother. Sixty-eight healthy and full-term newborns of healthy women who desired the ENG implant for contraception were randomized (block randomization) into two groups: Implant group (I, insertion of ENG implant after 1 or 2 days of the delivery, before the hospital discharge) and Control group (C, conventional insertion of ENG implant after 6 weeks of the delivery). The pairs of mother-child were followed-up for 15 months. The main outcome was the child development at 12 to 15 months of age, measured by Bayley Scales of Infant and Toddler Development, 3rd Ed. (Bayley-III®). The statistical descriptive analysis and the comparison between groups (independent t-test and Chi-square) were performed (SPSS, version 23.0, Il Chicago, USA). The level of significance was $p < 0.05$. All scores are presented as mean (\pm standard deviation). The sample consisted of 68 infants at 12-15 months of age [mean = 13 months (± 1)]; group I (53% of girls) and group C (58% of girls), from low-income families in a developing country. The infants were exclusively breastfed since birth or combined with supplementation. The results showed that both groups presented at least average scores (80-119 points) in the development scales at 12-15 months of age [Cognitive development, group I = 112 (± 10) vs. group C = 108 (± 12); Language, group I = 119 (± 8) vs. group C = 118 (± 9); Motor development, group I = 106 (± 11) vs. group C = 99 (± 14) and Social-emotional development, group I = 116 (± 12) vs. group C = 112 (± 12); all $p < 0.05$]. The classification was the following: Cognitive development, group I, 71% on average, 29% on superior / very superior and group C, 84% on average, 16% on superior / very superior; Language, group I, 96% on average, 4% on

superior and group C, 97% on average, 3% on superior; Motor development, group I, 90% on average, 10% on superior and group C, 86% on average, 14% on superior / very superior; and Social-emotional, group I, 53% on average, 47% on superior / very superior and group C, 74% on average, 16% on superior / very superior. In conclusion, there was no negative effect on the development of infants nurtured by mothers under contraceptive implant inserted immediately postpartum. Furthermore, there is no difference in the group of immediately insertion of ENG implant compared to the group of conventional insertion of ENG implant. It is a promising finding considering that this procedure can decrease the chance of unintended pregnancy without interfering in the development of the breastfeeding infants.

P3-F-155 Shared language cue in modulating imitative behaviors of young children

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We propose that shared-language signals informants' reliability in their potential to offer relevant information. We hypothesize that cognitively opaque action strategies will be acquired and retained better when presented ostensibly by demonstrators who are perceived as belonging to the children's own social group, and as such are evaluated as reliable epistemic sources. In contrast children should be more resistant to accept counterevidence even if it consists of an ostensibly demonstrated and more efficient alternative, when it originates from foreign-language speakers. Similarly children should be more flexible in accepting inefficient counterevidence from the demonstrators speaking their own language, despite acquiring the efficient action strategy first from the demonstrators speaking a foreign language. To test these hypotheses we employed an over-imitation paradigm by Hoehl et al., 2014. In Experiment 1 participants were 64 3- and 4-year-olds. They first saw an agent who demonstrated how to retrieve a sticker from a novel apparatus inefficiently (by performing a series of superfluous actions before presenting the relevant action). Subsequently, they saw a second demonstrator retrieving a sticker from the same apparatus efficiently (by performing the relevant-action only). Participants had their turn on the apparatus following each demonstration. We coded the number of irrelevant actions they imitated as a score for over-imitation in each imitation round. For half of the participants the first demonstrator was a speaker of their native-language and the second demonstrator was a foreign-language speaker, and vice-versa for the other half. A mixed ANOVA on over-imitation scores revealed a statistically

significant three way interaction between imitation round, condition and age, $F(1, 60) = 11.52$, $p = .001$, $\eta^2 = .16$. 3-year-olds corrected their inefficient strategy acquired from the first demonstrator independent of the demonstrator's social group membership. However, 4-year-olds corrected their inefficient strategy acquired from a foreigner after viewing the efficient demonstration from a native-language-speaker, but persisted in inefficient strategy acquired from the native-language-speaker despite efficient counterevidence provided by the foreigner. In experiment 2 participants were 32 3- and 4-year-olds. They first saw a foreign-language speaker who demonstrated how to retrieve a sticker from an apparatus efficiently. Later, they saw an inefficient demonstration by a native-language speaker. We found a statistically significant interaction between age and imitation round, $F(1, 30) = 5.99$, $p = .02$, $\eta^2 = .17$. There was no difference in 3-year olds' imitative behaviors in two imitation rounds, $t(15) = 1.69$, $p = .11$. However, 4-year olds imitated native-language speaker's inefficient demonstration despite first acquiring the efficient strategy from a foreigner, $t(15) = 4.2$, $p = .001$. These findings demonstrate that 4-year-olds construed inefficient demonstration despite shown later in time, as relevant to acquire when it was modeled by a native language speaker, despite acquiring the efficient action first from a foreigner. 3-year-olds did not show this flexibility, and persisted imitating the efficient action. Efficiency can be strong a cue guiding 3-year-olds' imitative behaviors in a novel task. Yet shared-language cue modulated 4-year-olds' imitative behaviors overriding the cue of efficiency.

P3-F-156 Poor early childhood development associated with poor sleep habits in a sample of Mexican children 24-36 months of age

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Objective: With this study, where psychologists, public health experts, demographers and social scientists collaborated, we aimed to explore the associations between early childhood development and children's sleep habits in a representative sample of women and young children attending primary healthcare units Mexico City. Methods: Trained fieldworkers collected information from a probabilistic sample of 339 children aged 24 to 36 months old and their mothers recruited at 42 (public) Ministry of Health clinics in Mexico City. After obtaining informed consent, computer-assisted questionnaires were applied by experienced fieldworkers to the mothers. Complex survey design, sampling, and analytic weights were taken into account in analyses. We constructed a sleep index for children using 8 questions about where the child sleeps, hours slept at night and

during naps, difficulty getting to sleep and interrupted sleep. Early childhood development was measured using the Ages & Stages (ASQ3) tool, adapted for application by interviewers to the child's mother. In our preliminary analysis, we used only the problem-solving (or cognitive) domain, which we dichotomized as a high or low developmental level (eliminating the middle level) using the Ages & Stages cutoff points for US populations. Mother's education, child age in months, child sex and whether the child had siblings were used as control variables. We report univariate and bivariate analysis of association; further analysis including definition of cut-off points of the ASQ3 tool for the Mexican population and logistic regression is currently in process. Results: Most of the mothers included in the sample had a junior high school (44%) or high school (29%) education and 80% were married/cohabiting. Mean child age was 30.11 months, 52% of the children were boys and 86% had no siblings. Most children (91%, 95%CI83-92%) had a high developmental level (i.e, they scored high) in problem solving. See table 1 for proportion of problem solving scores and other variables and table 2 for proportion of children's sleeping habits and other variables. For instance, more boys, only children and children with mothers with higher education levels had high problem-solving scores. Meanwhile, more girls, only children and children with mothers with higher education levels had good sleeping habits. In the logistic regression model, the different variables did not show statistically significant associations and the sleep habit variables had unclear trends. This may be due to the need to define cut off points specifically for the Mexican population; this analysis is ongoing and will be ready for the conference presentation. Conclusions: In methodological terms our study indicates that the Ages & Stages tool can be successfully adapted to measure early childhood development in large surveys, but that cut off points need to be defined for specific study populations. Educational and healthcare personnel need support in developing competencies for promoting healthy sleep. Our hope is that evidence generated in this study could be used to improve sleep health literacy in early childhood education and healthcare personnel, and thereby help them increase their capacity to address sleep problems in children and their families.

P3-F-157 Tactile social cognition: 9-month-olds' cardiac response to touch depends on their relationship with the person touching them

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Humans' sensitivity to social touch is likely to involve a class of unmyelinated afferents named C-tactile fibers. These fibers respond maximally to tactile stimulations having the

thermo-mechanical properties of caresses (medium velocity and human skin's temperature). It has been argued that C-tactile fibers are part of a neuro-cognitive system whose function is to build and maintain social relationships. To test this hypothesis in infants, we capitalize on a previous study showing that 9-month-olds' heart rate decreases more in response to a stroke of medium --rather than slow or fast-- velocity (Fairhurst et al., 2014). We test whether this physiological reaction is only determined by the tactile stimulations' mechanical properties, or whether it can be modulated by the relationship that infants have with the person touching them. Nine-month-olds ($N = 48$) were stimulated by stroking them with a brush at three different velocities (slow: 0.3cm/s, medium: 3cm/s or fast: 30cm/s). We tricked infants into believing that the brush was manipulated either by their parent or by an unfamiliar experimenter. In fact, it was a second experimenter --blind to Identity condition-- who delivered the stimulation. Results showed that a same tactile stimulation can result in different cardiac reactions in infants as a function of who they think is touching them. As figure 1 shows, when the tactile stimulation had a medium velocity, infant's mean heart rate decreased significantly more when they believed that their parent -rather than a stranger - stroke them ($t(15) = 2.952$, $p = 0.010$, $d = 0.738$). Furthermore, ANOVAs revealed that the effect of Identity (parent vs. stranger) on cardiac response was significantly stronger in the medium velocity condition than in the slow or fast velocity condition (all $ps < .02$). Complementary analyses performed on the ratio of signal change from baseline to tactile stimulation (Loggia et al., 2011) confirmed the analyses performed on mean heart rate. In short, infants react differently to the exact same tactile stimulation depending on who they think is touching them. This modulation of cardiac activity is likely to be caused by top-down influences on the processing of touch. It is only observable for a velocity of stimulation that activates C-tactile fibers maximally. Therefore, our study shows that nine-month-olds treat touch as a social contact, not just as a purely mechanical event. Furthermore, our data suggest that CT-fibers are likely to play a crucial role in bridging the gap between the perception of tactile stimulations and conceptual representations of social interactions and relationships from infancy on.

P3-F-158 Action effects and their influence on 7.5- and 11.5-month-olds' goal anticipations while observing manual grasping actions

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When infants observe actions that are in their own motor repertoire, they look at the action goal ahead of time and therefore anticipate the action outcome (e.g., Falck-Ytter, Gredebäck & von Hofsten, 2006; Kanakogi & Itakura, 2011). On the other hand, when they observe unfamiliar actions or actions by unfamiliar agents, infants tend to track the action reactively (e.g., Adam et al., 2016; Kanakogi & Itakura, 2011) and are only able to anticipate these actions when additional cues of agency are added (Adam, Reitenbach & Elsner, 2017). A possible explanation might be that with increasing experience with certain actions, infants start to use their knowledge of goal-directedness as a cue to anticipate the action goal of these actions (Southgate, 2013). Therefore, younger infants should need agency cues to anticipate the goal of an action they only have limited experience with, whereas more experienced infants should not be in need of additional cues. To investigate this hypothesis, we tested 7.5- (n = 32) and 11.5-month-old (n = 32) infants with an eye tracker in one of two conditions: We showed them a manual grasping action where the hand either approached a toy and lifted it up with a sound (salient action effect; effect condition), or where it approached the toy and froze in place upon arrival (no-effect condition). We also conducted a grasping test to ensure that all infants were able to perform grasping actions themselves. As expected, the 7.5-month-olds' gaze-arrival times indicated anticipatory looking to the action goal in the effect condition, but not in the no-effect condition. Furthermore, the 11-month-olds anticipated the action goal in both conditions. All of the infants passed the grasping test, which suggests that the ability to grasp does not necessarily enable the infants to anticipate the goal of a grasping action. Our study rather provides evidence that agency cues, such as salient action effects, play an important role for goal anticipation of a manual grasping action for less experienced observers, but become less important when infants become more experienced in grasping. In the light of these results, future studies should investigate the influence of action experience on goal anticipation in more detail.

P3-F-159 Elimination of alternatives in 12-month-olds

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The study aims to explore infants' logical abilities in general, and the presence of a certain inferential schema in particular. The paradigm follows the structure of an experiment developed for non-human animals (Call, 2004) investigating whether apes can use logical structures to represent the problems they are faced with. In a task requiring searching for a reward hidden in one of two boxes, apes could reach a solution via reasoning by

exclusion: once identifying the box that made no noise (signaling that is empty) they could use this information to infer that the reward is in the remaining box. It was proposed that while solving this task the animals must capture the structure of the events in terms of disjunctions and arrive to a solution deductively. In the present experiments 12-month-olds were exposed to a set of video-animated stimuli displaying two rattles in such a way that information about one allowed driving inference about the other. Each scene started with a character introducing a pair of new objects that could emit sounds when shaken. In each trial there is one object, however, that doesn't make noise. If the objects are shaken simultaneously, the "silent" item cannot be identified. After infants inspected the objects they could possibly form a hypothesis considering all alternatives ("either A is the rattle or B or both"). Then the identity of the silent object was revealed. Each trial terminated with the noise-making rattle moving in an interesting way that meant to be visually rewarding for the child. Before the appearance of the reward we had a static scene: this phase allowed us to collect anticipatory eye movements. In Experiment 1 participants saw four pairs of unfamiliar objects that differed in shape and color. Each pair was presented twice in two consecutive blocks. The analysis of the recorded eye movements suggests that infants did form expectations about the rewarding items: the second presentation of the pairs elicited anticipatory gaze shifts in the predicted direction. This result is in line with infants' ability to apply reasoning by exclusion and exploit the result of these inferences while learning about objects. In Experiment 2 each trial used a new pair of objects, preventing this way to learn about individual objects. This manipulation changed the result in anticipations documented in Experiment 1, and captured an advantage of orientation toward the noisy items in the second part of the experiment. Finally, in Experiment 3, where infants were presented with eight pairs of identical objects, no effect was detected suggesting that infant's difficulty in tracking the objects' identity prevented them to pick up the appropriate information to predict the location of the reward. Whether the elimination schema used by infants documented in Experiment 1 and 2 conforms to the structure of a disjunctive syllogism, or is congruent with some other heuristics (e.g. avoidance of containers that are silent if shaken, as it was also argued for the apes) remains a question for further experimentation.

P3-F-160 Non-nutritive Sucking Response to Temporal Stimuli and its Relationship with Temperament

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Sensitivity to temporal information has been measured through subjects' capacity to adapt or synchronize an endogenous rhythmic movement to an exogenous rhythmic stimulus. In one study Bobin-Bègue et al. (2006) used the non-nutritive sucking technique to evaluate newborn and 2-month-old infants. In their experiment, each participant was randomly assigned to one of two possible conditions, basically consisting on the presentation of a temporal tone and differentiated by a change on the rhythm of the stimuli, either by decelerating or accelerating the original rhythm. Results showed that 2 month-old infants were better synchronizing their tempo than newborn infants and also were more likely to decrease their sucking rhythm (make it slower). Those differences related with age were explained due to maturational aspects associated with inhibitory and self-control processes. In our present work we propose to link these motor responses to individual differences related with infant's temperament. Thus our hypothesis was that sucking patterns and responses to temporal stimuli would be associated to temperamental dimensions and sub dimensions. Twenty-nine 2 and 4-month-old infants participated in the study. We used the IBQ-R (Garstein & Rothbart, 2003) to evaluate temperament. Procedure was the same used by Bobin-Bègue et al. (2006) except that the average of the interval between each response was taken as the baseline (not the median). Infants were assigned to one of the two groups (i.e. acceleration or deceleration). For each participant, testing consisted of five phases: - SMT1: sucking was recorded during 110 Response intervals without any auditory stimulation. At the end of this phase, the average of the Response intervals was calculated. - Synchronization phase at 0% (S0): sucking was recorded while the child heard an auditory tempo at X ms (an auditory stimulation was made every X ms, X being the calculated average). - Slide phase: sucking was recorded while the tempo of the stimulation was altered according to the group. -- Acceleration: the tempo was progressively accelerated up to a final value of average plus 15%. -- Deceleration: the tempo was progressively decelerated to a final value of average minus 15%. - Synchronization phase at 15% (S15): sucking was recorded while the child heard an auditory tempo at either 15% faster (acceleration group) or 15% slower than the calculated average (deceleration group). - SMT2: sucking was recorded during without any auditory stimulation. Results showed that 2-month-old infants' sucking tempo was significantly faster and tended to accelerate, whereas the 4 month-old decelerate their sucking rhythm when listening to stimuli, thus replicating differences related with age. Furthermore, on a series of linear regressions we observed significant effects of temperamental dimensions (i.e. fear, cuddliness, soothability, duration of orienting, low intensity pleasure, high intensity pleasure and extraversion) on different sucking measures

of infants, including infants' capacity to synchronize to the exogenous temporal stimuli. Our findings suggest that temperament plays an important role on the regulation of temporal processing and rhythmic response very early in development.

P3-F-161 Infants can use several types of categorical information to bind objects to their locations

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When two featurally distinct objects are hidden behind two screens (one object per screen), young infants can bind each object to its location: When the screens are lowered, infants look significantly longer if the two objects have switched locations. The present research built on this finding to ask two questions. First, would 10-month-olds still succeed if both objects were placed side by side behind the same screen? If not, would infants perform better if the two objects were categorically distinct, as opposed to merely featurally distinct? Categorical information has been shown to support many aspects of infant cognition, and we reasoned that it might provide infants with more differentiated "handles" to tie each object to its location. At 10 months, infants do not spontaneously encode objects' basic-level categories, but they do encode other categorical descriptors, such as functional descriptors, boundary-based spatial descriptors, and event-role descriptors. Across experiments, we therefore examined whether infants would succeed in binding each object to its location if the objects received different functional (Experiment 2), boundary-based (Experiment 3), or event-role (Experiment 4) descriptors. In Experiment 1, infants were tested with two objects that differed only in their featural properties: a yellow cylinder and a blue dotted box. In two familiarization trials, an experimenter showed each object and then placed it behind the left or right end of a lowered screen (e.g., first familiarization: cylinder on left, box on right; second familiarization: box on left, cylinder on right). Two test trials started with the two objects side-by-side behind the lowered screen, as in familiarization. After 3 s, the screen was lifted to hide the objects. After 8 s, the screen was lowered again to reveal the objects either in the same locations (no-switch event) or switched locations (switch event). Infants looked about equally at the two test events, suggesting that they did not bind the objects to their left/right locations behind the screen. In Experiment 2, the two objects belonged to different functional categories: one was open like a container, whereas the other was closed like a block (e.g., open cylinder, closed box). In Experiment 3, a small wall separated the objects in familiarization, so that relative to this boundary, the objects now received

distinct spatial descriptors (e.g., cylinder to left of wall, box to right of wall). In Experiment 4, the objects played different event roles with respect to each other in familiarization (e.g., cylinder as occluder, box as occludee). In all three experiments, infants looked significantly longer at the switch than at the no-switch event, indicating that they were able to bind the objects to their locations. Control conditions supported this conclusion. Thus, when two objects are placed side-by-side behind a screen, 10-month-olds succeed at binding the objects to their locations if the objects are categorically distinct, and they can use several different types of categorical descriptors for this purpose. These results are consistent with findings from other areas of infant cognition and point to categorical information's privileged role in infants' representations of events.

P3-F-162 Phonological and Semantic Narrowing: Analogies or More in Language Acquisition?

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As different languages encode different components of dynamic events, language acquisition entails learning in what way the target language encodes events. Young infants appear to distinguish between many event components -- such as tight- vs. loose-fit (Hespos & Spelke, 2004), path vs. manner (Pulverman et al., 2008), and goal vs source (Lakusta et al., 2007). However, sensitivity to these components is weakened if they are not lexicalized in the ambient language (cf. Göksun et al., 2010). An example is found in the ground-path categories of Japanese that encode both the trajectory of the action and the ground on which it is performed (analogous to the verb climbing entailing a vertical extent). Both Japanese- and English-reared infants at 14 months distinguish between Japanese ground-path categories (i.e., bounded grounds like streets vs. unbounded grounds like fields) when shown dynamic events (similar to those seen in Figure 1). However, by 19 months of age, only Japanese-reared, but not English-reared, infants discriminate between the ground-path categories in visual events. The present study tested English-reared toddlers (23 to 25-months-old), first replicating the Göksun et al.'s (2010) finding that these children did not distinguish between Japanese ground-path categories using the Intermodal Preferential Looking Paradigm and visual fixation as the dependent variable (Experiment 1a). Then differential labels (Experiment 2b) for these Japanese ground-path categories were offered to children of the same age and these categories were recovered (Konishi et al., 2018). However, new research indicates that this was not the case for adults; they failed in two experiments (using Experiment 2b stimuli)

to distinguish between Japanese ground-path categories. Adults received instructions to select the event that was most similar to the last three post-training trials they saw. In two experiments, with the instructions increasingly explicit, adults could not perceive Japanese ground-path categories. These results, along with the developmental course of event perception illustrated earlier, strongly resemble the development of speech perception: infants in the first 6 months of life discriminate consonants that do not constitute the phonemic categories of their ambient language (e.g., Trehub, 1976), but later these non-native phonemic categories are significantly weakened under the influence of their language. Moreover, although the weakened sensitivity to foreign phonemic categories may be revived with a simple (less than) 10-minute familiarization training for infants less than 10 months of age (e.g., Yoshida et al., 2010), adults are reported to be resistant to such training (e.g., Ingvalson et al., 2012). This poster presents these data and lays out the controversial claim that semantic attunement occurs in much the same way as phonological attunement and has the same long-term implications for event perception as phonological attunement has for speech perception. We conclude that both phonological and semantic attunements are instances of "perceptual narrowing", a phenomenon in which earlier, broad perception is reduced as a function of experience. Finally, we discuss some implications of this position in L2 learning, bilingualism, and semantic accent.

P3-F-163 Individual features facilitate stimulus processing in a proto-arithmetic task in newborn domestic chicks

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Numerical cognition is defined as the capability to correctly estimate quantities and numerosities. Much evidence in the literature suggest that this ability may rely on an inborn core system allowing a spontaneous representation and computation of numerosities. Such core system might constitute the basis for the development of more complex numerical abilities. This hypothesis is strongly supported by research on human newborns and on one animal model, the domestic chick (Vallortigara, Regolin, Chiandetti, Rugani, 2010). Both newborns and chicks can solve simple numerical tasks from the very first days of life, even in the absence of numerical training. Previous studies showed that when chicks have the possibility to choose between two groups of objects identical to the ones they have been reared with, they approach the larger group. However, studies on numerical discrimination reported a limit related to the critical comparison 3vs.4, in which

most animals fail. A recent study (Rugani, Loconsole, Regolin, 2017) demonstrated that it is possible to enhance chicks' performance in the 3vs.4 comparison through the usage of a cognitive strategy, i.e., chunking. Here we aimed to investigate the effect of a different strategy, that is individual recognition, to test whether this can also facilitate discrimination. Three different experiments were carried out on separate groups of 4-day-old chicks. In Experiment 1 we replicated the 3vs.4 comparison with all identical stimuli (red squares) using a one-by-one presentation. Consistently with previous results, chicks performed at chance level ($M=54$; $ES=2.561$; $t(9)=1.562$; $p=0.153$). In Experiment 2 we added to the squared stimuli a set of symmetrically arranged (controlled for the up-down bias) face-like inner features. Each stimulus could be individually identified by the different geometrical shapes of its features. Chicks though were yet unable to discriminate 3vs.4 and their performance remained at chance level ($M=48.462$; $ES=3.462$; $t(12)=0.444$; $p=0.665$). In Experiment 3 stimuli were also individually different, but we made them asymmetrical along their horizontal axis (i.e., up vs. down) as the outline of the stimulus was an oval-shaped "face" with a long "neck" at the bottom. Moreover the internal features were also asymmetrically positioned (see the Figure depicting a chick's rearing condition). Previous studies showed that chicks are more likely to pay attention to this kind of stimuli, which may appear as more naturalistic (Rosa-Salva, Regolin, Vallortigara, 2010). Under this condition, chicks succeeded in discriminating the larger set ($M=62.083$; $ES=2.42$; $t(11)=4.993$; $p<0.001$). We hypothesized that providing stimuli which are more likely to attract chicks' attention as well as the opportunity to easily distinguish each stimulus through its peculiar features can reduce the cognitive effort involved in creating and then in comparing the mental representations of the sets of stimuli in the 3vs.4 discrimination. Overall, our results add to previous studies by suggesting that different cognitive strategies can be used to effectively enhance chicks' performance in numerical tasks.

P3-F-164 Relations Between Parents' Expressed Emotions and Child's Executive Functions Gathered from Five-Minute Speech Samples

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It is not an uncommon data collection practice within developmental psychology to ask parents of young children to talk about their child for five minutes. In the study of mental health, family members of mentally ill patients are often asked to provide similar speech samples about their ill family member. Using those speech samples, clinicians/researchers

have found that expressed emotions (i.e., critical/hostile attitudes, and emotional over-involvement) are related to and associated with risk of relapse and the outcome of psychiatric disorders. This methodology has not been applied to speech samples of parents of young children in a typically-developing population. In the present study, we apply the expressed emotions coding paradigm to parents' five-minute speech samples when their children are 14 months of age. We ask the following research questions: (1) Can the expressed emotions coding paradigm used in the study of mental health be used reliably and validly in the study of human development, and (2) Do parents' expressed emotions relate to aspects of parenting and child development, in specific Executive Functions. To address these questions, we leverage a sample of middle- to high-income first-time parents recruited from prenatal hospital visits and classes in New York City. A sample of $N=105$ speech samples were collected from parents of 14-month old infants who were prompted to give thoughts, attitudes and feelings about their child. These samples are coded for a number of different characteristics, including expressed emotions. Expressed emotions include critical comments (e.g., "She is very whiny"), emotional over-involvement (e.g., "I was so worried I couldn't sleep"), and quality of relationship (e.g., "We get along great"). The availability of these speech samples allows for unique insights into the thoughts, attitudes and feelings of new parents and their relationship to children's development. Preliminary analysis of partial data shows high variability within couples and between parents. A paired-samples t-test revealed that mothers made more critical comments ($t(25)=5.56$, $p<0.01$), comments that reflected emotional over-involvement ($t(25)=2.44$, $p=0.02$), and comments that reflected a positive relationship ($t(25)=2.08$, $p=0.048$) when compared to fathers. As well, trend-level results of an independent-samples t-test revealed that differences in the way parents speak about their children based on child gender. Mothers express higher levels of emotional over-involvement toward female children than male children ($t(68)=-1.97$, $p=.053$), but express having a more strongly positive relationship with male than female children ($t(68)=1.88$, $p=0.064$). In contrast, fathers express more strongly positive relationships toward female children as compared to male children ($t(26)=-1.79$, $p=.085$). We also found that mothers who gave more critical comments were more likely to be controlling in an observed puzzle-completion task ($r = .27$, $p = .046$) with children of both genders. At time of presentation, relations between parents' expressed emotions and child self-regulation and executive function will be examined. Implications for child-rearing on development will be discussed.

P3-F-165 Cognitive Flexibility Differences between Monolingual and Bilingual Children

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Purpose. To assess whether there was a difference in cognitive flexibility between 3- to 5-year-old monolinguals and bilinguals. Monolingual and bilingual children had participated as infants, and measures of their language exposure were collected during infancy and at the time of the cognitive flexibility test. **Methods.** 20 (3-year-olds 12 monolingual and 8 bilingual) and 30 5-year-olds (22 monolingual and 8 bilingual) were tested with a cue-based integration and interference paradigm, the Flexible Induction of Memory-Animates task (FIM-An; Deák & Wiseheart, 2015). The materials used were five sets of color pictures (12.5 x 12.5cm) of novel creatures holding novel objects in novel habitats. Each set had a standard image, and there were three comparison images on one of three properties: species, habitat, or held object. The fourth image was a distractor. During each of the 15 trials, children were asked to look at the pictures. The experimenter then described the standard image by saying for example "This is a zylow," "This lives in an ickus," or "This holds a dobe." The experimenter then indicated the comparison pictures and asked, "Which one of these lives in an ickus just like this one (pointing to the standard image)?" Each block featured a different phrase cue. Accuracy was coded as the number of cue- or rule-appropriate responses. A ratio score was calculated by dividing the number of correct switches the child made by 10 (the total number of possible switches). The Language Exposure Assessment Tool (LEAT) was used to assess language exposure (DeAnda, Bosch, Poulin-Dubois, Zesiger, & Friend, 2016). **Results.** A 2 (age: 3-year-olds, 5-year-olds) x 2 (language status: monolingual, bilingual) Analysis of Variance (ANOVA) indicated a main effect of age group, $F(1,46) = 63.9$, $p < .001$, partial $\eta^2 = .56$, and a main effect of language status, $F(1,46) = 4.61$, $p = .04$, partial $\eta^2 = .09$, but no interaction. Some children's language exposure varied from infancy to preschool shifting from balanced exposure to language 1 (L1) and language 2 (L2 (50:50) to less L2 exposure during preschool (e.g. 20% L2). We are currently examining whether changes in language exposure profiles from infancy to preschool contributes to performance on this task. **Discussion.** Cognitive flexibility increases as a function of age, replicating the original finding by Deák and colleagues, but there is also a main effect of bilingual status. At both age groups, bilinguals scored higher than monolinguals. This is one of the few studies of bilingual and monolingual preschoolers where prospective language exposure data has

been collected. The prospective nature of the study allows us to assess how trajectories of language exposure during early childhood are related to outcomes in preschoolers.

G: Social Development

P3-G-166 17-Month-Olds Do Not Revoke Trust from Unreliable Informants Providing Verbal Testimony

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From the second year, infants can use verbal testimony to update their mental representations of the visual world (Ganea et al., 2016; Galazka & Ganea, 2014). This ability allows them to efficiently incorporate newly learned information about previously learned entities. However, verbal testimony typically comes from other people, and thus comes with the possibility that it may not be true. In this case, updating should be inhibited. This may be difficult for infants, as prior research has demonstrated that up to age 3, children have a strong bias to trust verbal testimony (Jaswal, 2010) and do not inhibit verbal updating (Ganea, Koenig & Millett, 2011). Nevertheless, young infants revoke trust from unreliable informants in tasks that are both low in cognitive demands and use nonverbal testimony (e.g. eye gaze; Tummeltshammer et al., 2014). Thus, it may not be language, but rather task demands that lead children to trust unreliable verbal testimony. Here, we examined whether, in a low-demand task, infants might selectively inhibit verbal updating depending on the informant's history of reliability. Twenty-four infants (14;15 - 19;24, M = 17;00) were presented with a violation-of-expectation (VoE) updating paradigm following Ganea et al., 2016. Participants were presented with a video introducing either a male or female informant, who provided either reliable or unreliable testimony for the entire block. Each block contained four test trials in which the informant introduced a scene of a cat, dog, and bed. The scene was occluded, and the informant provided testimony about one of the animals moving to the bed (e.g. Now the cat is on the bed! The cat is on the bed!). The occluder was lifted, revealing either that exact outcome (Reliable condition) or the other animal on the bed (Unreliable condition). The infants were then shown a second block, with the other informant. Using eyetracking, looking time to the animal that changed location was measured in each condition, in each half of the block. We hypothesized that if infants inhibit updating when presented with an unreliable informant, they will show a VoE (longer looking in the Unreliable relative to the Reliable condition) only in the first half of the test block, but not the second half. Findings

demonstrated an interaction between reliability and block half ($F(1, 23) = 4.98, p = .036, \eta p^2 = .18$), such that as a proportion of total looking, participants looked longer at the animal that changed location in the Unreliable relative to the Reliable condition in the second half of the block (Figure 1). This suggests the opposite of our hypothesis: infants initially were not surprised by the incongruous outcomes, but then generated expectations about the visual scene (which were violated) despite the previous exposures to unreliable input. There was no effect of informant gender or block order, and the overall VoE was unrelated to age. Our results indicate that infants do not inhibit updating from verbal testimony when the informant is unreliable. However, they seem to not be initially biased to trust language, contra Jaswal's (2010) hypothesis.

P3-G-167 Proactive and Reactive Cosleeping Arrangements in Early Infancy and Maternal Well-Being

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Cosleeping, or the practice of sleeping with an infant in the parents' bed, room, or some combination of both, is a normative, accepted, and preferred infant sleeping arrangement in many non-Western and agrarian cultures around the world (Mindell et al., 2010). In the United States and much of the Western world, however, cosleeping is much less accepted, particularly if it persists beyond 6 months of age (Shimizu & Teti, in press). Cosleeping, has sometimes been characterized along a "proactive" vs. "reactive" dimension (Madansky & Edelbrock, 1990). Proactive cosleeping is identified when parents choose in advance to cosleep with their infant because they believe that doing so benefits the infants' well-being and security. Reactive cosleeping, by contrast, is identified when parents bring a distressed infant to the parents' room or bed as a way of calming and soothing the infant to sleep. The implications of engaging in cosleeping proactively vs. reactively are poorly understood, but it is reasonable to expect that higher family stress and more disrupted parent sleep would be more characteristic of reactive sleepers than proactive sleepers. The present study examined these differences, and also compared proactive and reactive cosleepers with consistent solitary sleepers on these same variables. Data for this study came from an NICHD-funded study ($N = 167$, 83% Caucasian) that examined parenting, sleep, and infant development across the first two years. This study focused on data collected when infants were 1, 3, and 6 months of age and included mothers' reports of positive and negative coparenting, mothers' emotional availability (Biringen, 2000) with infants at bedtime, mothers' sleep fragmentation (from actigraphy), maternal worries

about their infants' sleep, and infant sleep fragmentation. Nighttime videorecordings at each age point and were used to categorize infants as solitary sleepers (sleeping in a separate room by 6 months), proactive cosleepers (sleeping with parents throughout the night but not in reaction to infant distress), and reactive cosleepers (infants brought into the parents' room or bed in response to infant distress). Analyses of variance followed by Student Newman-Keuls post-hoc comparisons revealed that, at all age points, both proactive and the reactive co-sleepers did not differ from each other in positive coparenting but both had lower positive coparenting scores than solitary sleepers. At 1 and 3 months, proactive cosleepers reported worse negative coparenting than solitary sleepers. Proactive cosleepers also had the worst maternal bedtime EA scores at all three age points, which were significantly lower than the reactive cosleepers and the solitary sleepers. Lastly, at 3 and 6 months proactively sleeping mothers had significantly greater fragmented sleep than the reactive cosleepers and the solitary sleepers. No group differences were found for infant sleep fragmentation and for maternal worries about infant night waking. These findings indicated that mothers in solitary sleeping arrangements were the most well-functioning, and that, unexpectedly, mothers in proactive cosleeping arrangements, rather than in reactive sleeping arrangements, were the least well-functioning. Additional analyses will be conducted to examine mothers' preferences for and attitudes about their sleep arrangements to help interpret these differences.

P3-G-168 Investigating the Stability of Infancy Measures: Early sharing behavior uniquely predicts later preferences for fair individuals

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Within the first year of life, infants show rudimentary knowledge of fairness such that they expect resources to be distributed equally and prefer individuals that distribute resources equally over those that do so unequally. Additionally, there are individual differences in infants' fairness concerns at 12 to 15 months of age that are predicted by the manner in which infants share toys. Yet it remains unknown whether preferences for fair individuals persist into toddlerhood, and whether individual differences in infants' fairness expectations and sharing behavior predict later preferences for fair over unfair individuals. To answer this question we conducted a longitudinal study at 12/15 months of age and 21/24 months of age. At 12- and 15- months of age (N=64), infants participated in a violation of expectation task where their looking to fair and unfair resource distributions

were recorded; as a group infants showed enhanced attention to the unfair outcome, $t(65) = 2.44$, $p=.017$. Additionally, infants took part in a sharing task, where they could choose to share a preferred toy ($n = 14$) or act more selfishly by not sharing or sharing a non-preferred toy ($n=24$). At 21- and 24- months of age, 52 infants came back to the lab to test their preferences for fair or unfair individuals. Toddlers watched a live distribution event where the fair actor distributed resources equally and the unfair actor distributed resources unequally. Then, toddlers had the opportunity to choose between the two actors by taking an offered toy, helping, and sharing toys with one of the actors. As a group, toddlers preferentially chose the fair actor over the unfair actor, $t(43) = 3.51$, $p=.001$, suggesting that preferences for fair individuals persist into toddlerhood (See Figure 1). The central question of interest was whether individual differences in infancy (at 12 or 15 months) predict later fairness preferences in toddlerhood (at 21 or 24 months). Overall, infants who shared were significantly more likely to prefer the fair over the unfair actor as toddlers than infants who did not share, $t(42)=2.233$, $p=.031$. Furthermore, we found that infants who shared preferred toys were significantly more likely to prefer the fair over the unfair actor as toddlers than toddlers who refused to share or were more selfish in their sharing behavior in infancy (i.e., shared their non-preferred toy), $t(28)= 2.23$, $p=.034$ (See Figure 2). In contrast, earlier fairness expectations (assessed via looking time) were unrelated to later preferences for fair over unfair actors, $r(44)=0.0$, $p=1.0$. Our results suggest that early individual differences in infants' fairness expectations are unrelated to toddlers' preferences for fair versus unfair individuals, but the presence of sharing behavior can predict these later preferences. These findings may reflect that expectations and preferences do not always align. Specifically, even though 12- and 15-month-olds had different expectations for fairness (assessed through looking time) this did not map onto later preferences. However, earlier individual differences in prosocial behaviors did matter for later fairness preferences potentially reflecting early individual differences in other-oriented behaviors.

P3-G-169 Infants' preference for similar other's group

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A number of recent studies have attempted to identify whether infants manifest favoritism for their in-group - a bias typical of adults and even preschoolers. So far, studies assessing this issue have exposed infants to two individuals (people or puppets) - one with a characteristic shared by the participating infant (e.g., same language, same food-

preference) and the other with the contrasting characteristic - and then allowed infants to choose one of them (e.g., Kinzler, Dupoux, & Spelke, 2007; Mahajan & Wynn, 2012). Infants' systematic choice of the similar individual - or of an object offered by him/her - was taken as evidence for in-group favoritism. This conclusion, however, may be premature, as infants might have simply manifested favoritism towards an individual similar to them, but not necessarily to that individual's group. The present two studies attempt to assess the latter more directly. In Study 1, 30 1-year-olds ($M=14.6$ months) were exposed to a familiarization phase similar to that used by Mahajan & Wynn (2012). Namely, infants were given a choice between two types of food items - crackers and green-beans - and then watched a video of two puppets - each dressed in a distinctive color - tasting these same items. One of the puppets (Similar) expressed delight while tasting the food item the infant chose, and dislike while the tasting the other food. The other puppet (Different) expressed the opposite preferences. Infants then watched a subsequent scene in which six new puppets appeared, three of them wearing the same color as the Similar puppet, and the other three wearing the same color as the Different puppet (see Fig. 1). The experimenter pointed to one puppet of each "group", and told the infant that they came to play with him/her, at which point the experimenter brought out the actual two puppets for the infant to choose. We found that 21 of the 30 infants selected the puppet with the Similar puppet's color, (non-parametric, Binomial-test, $p<.05$). In other words, even though infants did not see the "choice" puppets express any food-preferences, they seem to have generalized their preference for the Similar puppet, to other puppets wearing the same color as the Similar puppet. In Study 2, currently under way, the first two phases are similar to those employed in Study 1. Subsequently, infants are exposed to four puppets - two wearing the same color as the Similar puppet and two wearing the same color as the Different puppet - as they engage in some game. The experimenter then encourages the infant to choose the group he/she would like to join. In other words, here the choice itself is not between individual puppets but between groups. Initial data with 10 infants reveal a pattern in the predicted direction. Taken together, these studies are beginning to provide more definitive evidence that already in their first year of life, infants manifest a preference towards groups who are similar to them.

P3-G-170 Discrimination of facial expressions in 5-month-old infants: an fNIRS study

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Infants' abilities to recognize human faces and to discriminate between facial expressions develop rapidly during the first year of life. Adult research demonstrated that the brain circuits involved in face and emotional face processing mechanisms are highly interacting (e.g., Vuilleumier & Pourtois, 2007). What we do not know is when and how these networks unfold in infancy. fNIRS has been successfully used to study infants' cortical responses to face stimuli. For instance, infant fNIRS research demonstrated that occipito-temporal areas are sensitive to faces at the age of five months (e.g. Nakato et al., 2009), while temporal and prefrontal brain regions are involved in visual emotion encoding mechanisms by seven months of age (e.g. Nakato et al., 2011; Fox et al., 2013). But can (parts of) the emotion-processing network already be active at an earlier age in which face sensitivity is observed? The current research presents five-month-old infants ($n=17$) with fearful and happy facial expressions and uses fNIRS to examine (1) which cortical areas are differentially involved in emotion processing; (2) and which cortical areas are emotion-independently activated by the view of faces at this age. We chose our multi-dense array to encompass a larger portion of the right hemisphere that also includes occipital and frontal regions. We analysed the maximum change in oxy-haemoglobin (HbO₂) in a repeated measures ANOVA with Emotion (2: fear, happy), Region (3: occipital, temporal and frontal regions) and Time window (2: early, late) as our independent variables. Preliminary results reveal a main effect of Region ($F(2,32)=3.67$, $p=0.037$) and a marginal interaction between Region and Emotion ($(F(2,32)=3.17$, $p=0.055$). Simpler ANOVAs split by region indicate that only the occipital region is activated regardless of type of facial expressions (i.e., intercept; $F(1,16)=7.91$; $p=0.012$; other regions, $p>0.32$). Furthermore, only for the temporal region we observed a main effect of Emotion ($F(1,16)=5.66$, $p=0.03$; other regions $p>0.19$): for this region, fearful faces elicited an increase in HbO₂ (mean fear: 0.14; $SD=0.45$), while happy facial expressions evoked a decrease in HbO₂ (mean happy: -0.26; $SD=0.49$). Our findings thus provide evidence that at five months, the face-processing network appears active (i.e., main effect of faces for the occipital region) while the emotion-processing network is only starting to emerge (i.e. rudimentary involvement of the right-temporal cortex for fearful faces, but no recruitment of frontal regions for happy faces). These results support the view that the emotion-processing network becomes functional between five and seven months of age (Leppänen & Nelson, 2009).

P3-G-171 Parenting Stress moderates the impact of treatment on Maternal Behavior: A report on a randomized control study

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This is a report on a randomized control study comparing Treatment as Usual (a once weekly standardized parenting group that meets over 10 weeks) with a novel Group Attachment-Based Intervention, GABI, (that meets for two hour session up to three times a week over 26 weeks). Each arm of the RCT aimed to provide support for at risk families with children between the ages of 0-3. The current report compares observations of mother-child interaction at six-month follow-up after the interventions ended, for each arm of the RCT. The question was whether parenting stress would moderate the impact of treatment on the mother-child interaction quality. The need for this study was highlighted by research findings that suggest parenting stress is related to a variety of negative parenting behaviors; impaired warmth, less responsiveness, and more authoritarian parenting styles (Muller-Nix et. al., 2004). Parenting stress also has negative implications for the child including; increased externalizing behavior, child attention problems, and delays in child's social relatedness (DuPaul et al., 2001). The sample consisted of 24 parent-child dyads, 12 of which received GABI and 12 who received Systematic Training for Effective Parenting (STEP) were less affected by parenting stress, six months after treatment. Of the 22 dyads, 12 (6 GABI and 6 STEP) had clinically significant levels of parenting stress as measured by the Parental Stress Index (PSI) (Abidin, 1995). Parenting behavior was measured using the Coding Interactive Behavior (CIB) system (Feldman, 1998). In accordance with previous studies, specific parenting stress index such as positive affect and acknowledgment were analyzed. The Coding of Interactive Behavior (CIB, Feldman et al.) was used to assess qualities of parent-child interaction. The results demonstrated that there was a significant difference in parenting behavior between highly-stressed GABI mothers and highly-stressed STEP mothers. Specifically GABI mothers had statically significant higher scores on positive affect and acknowledging. There was a trend for the GABI mothers to display less forcing behavior towards their infants. These results indicate that the GABI intervention is helping to thwart the negative effects parenting stress has on parenting behaviors. Mothers who received GABI had more positive interactions with their children even when feeling stressed in their role as a parent. The emphasis on both the parent and child in GABI helps to foster positive parent-child interactions that are stable over time.

P3-G-172 Infants' Empathic Behavior & Attachment Predicts Prosocial Outcomes at 5 Years

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Infants' Empathic Behavior & Attachment Predicts Prosocial Outcomes at 5 Years
Courtney Daum, Tonya Hansberry, Jeffrey Measelle Ph.D, Jennifer Ablow Ph.D
Childhood empathy strongly predicts later prosocial development (Eisenberg, Fabes & Spinard, 2015). Prosocial children are lower in externalizing behaviors, have higher self-esteem, and are dispositionally more positive (Eisenberg, Fabes & Spinard, 2015). There is a vast amount of research on the long-term outcomes of childhood empathy, though much less on the developmental origins of early empathy. Among the exceptions, several studies have shown that young children are already capable of exhibiting concern, distress, and positive affect in response to others' emotional state (Zahn-Waxler, & Robinson, 2005). Currently, much more work is needed that explores the form and function of empathy during infancy. Also, more work is needed to understand the extent to which early empathy anticipates children's later prosocial capacities at a time when such skills have a lasting influence on their socioemotional development like the transition to school. The current study had 2 short-term goals and 1 long-term goal. First, we sought to investigate early expressions of empathy during infancy as well as the contexts associated with individual differences in early empathy. Our prospective aim is to investigate the associations between empathy at 17 months and critical outcomes at age 5, including Theory of Mind performance, empathy, and prosocial behavior. Method: 105 at-risk mothers and their children (75% below U.S. poverty line) participated in a prospective study. Data for the present study came from 2 postpartum time points: 17 months and 5 years. At 17 months, infant empathy was assessed using a task that required mothers to read a sad story aloud and then to act sad as a result of the story. Infants' display of empathic behavior was coded using the Malts-Fetzer Child Empathy Coding system (Zahn-Waxler, & Robinson, 2005). At 17 months, infant attachment was assessed with the Strange Situation Procedure. At 5 years, children's Theory of Mind was assessed using standard false-belief tasks, and mothers completed ratings of their children's empathic and prosocial behaviors using the MacArthur Health and Behavior Questionnaire. Results & Discussion: Initial results suggest meaningful individual differences in infants' empathic behavior toward their mother. Specifically, 58.2% of the 17-month-old infants showed proactive, empathic concern for their mothers, while 22.9% were observed to display no empathy toward their mother, and 18.9% even exhibited forms of aggression toward their mother, $X^2(3) = 4.29, p = .03$. Results also suggest that infant attachment status may

account for differences in observed empathy at 17 months, $F(3) = 11.05$, $p = .000$. Specifically, infants with secure attachment were significantly more empathic towards their mother's distress during the empathy task as compared to insecure infants, and, in particular, insecure-disorganized infants. Structural equation modeling (SEM) analyses are underway to link early empathy with children's ToM performance, empathy, and prosocial behaviors at 5 years of age, with children's attachment status tested as a source of possible moderation.

P3-G-173 Maternal Perceived Control, Maternal RSA Suppression and Sensitive Parenting

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Maternal sensitivity has been associated with various infant developmental outcomes (e.g., Bonwell 2012); therefore, identifying its predictors is critical. Bugental et al., (1989, 1993) found that parents with low perceived control were more likely than others to exhibit negative parenting behavior and exaggerated autonomic nervous system reactivity (i.e., increased heart rate and skin conductance) during challenging parenting situations. However, Bugental et al. did not examine parasympathetic nervous system (PNS) suppression. Porges' (1995, 2007) polyvagal theory posits that the ventral vagal complex, allowing for PNS control of the heart, mediates engagement with the environment. Meta-analysis shows that increases in respiratory sinus arrhythmia (RSA) are associated with relaxation, whereas RSA suppression is associated with attending to environmental challenges (Graziano & Derefinko, 2013). Because maternal PNS reactivity is linked to maternal sensitivity (Miller et al., 2015), the present study explored the relationship between maternal perceived control and sensitivity, while investigating the moderating role of maternal PNS reactivity (as measured by RSA suppression) in the context of stress. A total of 135 mothers of six-month-old infants were drawn from a larger study. Mothers were primarily low-income (78% < \$30,000) and racial/ethnic minorities (41.1% African American, 12.9% Hispanic). Mothers were invited to complete a 2-hour standardized laboratory visit, which included the Still Face procedure (Tronick et al., 1978). Maternal RSA data were collected in 30-second epochs. Maternal RSA suppression scores were computed using baseline RSA to subtract RSA during two 3-minute episodes in which mothers were instructed to interact with infants both before and after a 1-minute still face. Maternal sensitivity was rated by two independent coders using the NICHD Early Child Care Research Network (1999) coding system. Sensitivity to distress, sensitivity to

non-distress and intrusiveness subscales were used. Maternal perceived control over caregiving was assessed using the Parent Attribution Test (Bugental et al., 1998). No significant correlations were found between variables except for those between sensitivity subscales. Three multiple regression models predicting maternal sensitivity to distress, sensitivity to non-distress, and intrusiveness were conducted separately. In the model predicting sensitivity to distress, neither main effects of maternal perceived control and RSA suppression nor the interaction between the two variables reached statistical significance (Table 1). Although there was no main effect of maternal perceived control and RSA suppression in models predicting sensitivity to non-distress and intrusiveness, a significant moderation effect of RSA suppression emerged for the two models ($B=.330$, $p=.011$; $B=-.211$, $p=.047$) (Table 1). Results showed that, as expected, higher perceived control was associated with higher sensitivity to non-distress and lower intrusiveness, but only when RSA suppression was high (Figure 1). These results suggest that higher maternal perceived control is associated with more positive parenting when mothers physiologically marshal resources (i.e., suppress PNS activation) to attend to the infant. Results may help explain meta-analytic findings suggesting interventions with a clear-cut behavioral (as opposed to representational) focus were most effective (Bakermans-Kranenburg et al., 2003).

P3-G-174 How do Infants Begin to Help Others in Everyday Life?

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How do infants begin to help others? Past laboratory studies have shown infants to help by early in the second year (Sommerville Schmidt, Yun, & Burns, 2013; Warneken & Tomasello, 2007). Theories make different assumptions about how infants begin to help others (Dahl, Waltzer, & Gross, in press). One proposal is that infants have a social interest in interacting with adults and that adults build on this interest by guiding infants to help at home. Another view is that infants begin helping independently of support from others, reflecting a natural tendency to help. A third possibility is that infants initially show no interest in participating but are requested to help by family members. Despite these diverging hypotheses, few studies have investigated how infants begin to help others in everyday life. The present tested these three views about everyday helping events around the second year of life. The main question concerned how helping situations typically begin. Do by infants first show interest in adults' activities, but do not help until caregivers guide them to do so (coded as "Guided" situations)? Do infants begin to help without

guidance from adults ("ChildInitiated")? Or do helping situations begin by caregivers requesting infant help without any prior interest in the activity from infants ("Directed")? Fifty-four families with infants (10-26 months, $M = 18$, $SD = 5.2$) participated in up to 15 weekly 2-hour home visits. Families were largely middle-class families living in the Western United States. During each visit, a researcher videotaped infants as they engaged in their everyday activities. In total, 2,995 situations in which infants helped or were encouraged to help were coded from videos. Nearly all participating infants (96%) helped at least once. The number of helping instances per visit increased with child age, binomial GLMM: $b=0.08$, $p<.001$ ($r=0.38$). Overall, guided situations were more common (45% of situations) than directed (26%) and child initiated (26%) situation. Importantly, even child initiated situations often included one or more forms of adult responses, such as indirect commands ("Do you want to help?" 39%) or thanking or praising (19%). However, the initiation of helping situations changed over time (Figure 1). Early in the second year, the most common type was situations in which caregivers guided infants' social interest toward helping (Guided), age^2 : $D(1)=46.18$, $p<.001$. Child initiated helping situations became increasingly common (ChildInitiated), age^3 : $D(1)=7.17$, $p=.007$. The frequency of situations in which parents directed infants to help without prior interest (Directed) first increased and later decreased, age^2 : $D(1)=7.26$, $p<.001$. The present study provides evidence about young children's helping related experiences. The youngest children most commonly got involved after orienting toward the adult activity and having adults guide them to help. However, with age, children increasingly began to initiate helping without explicit guidance or direction, consistent with laboratory research in the second year. The findings suggest that infants' and caregivers' motivations and actions jointly contribute to the emergence of helping in everyday life.

P3-G-175 Reenactment Revisited: Time Series Analysis of Eye Movements

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Previously we have shown that non-ostensive cues can sufficiently instigate gaze following in 20-month-olds (de Bordes et al., 2013). In the current study, we extended these findings to toddler's affordance realization ('reenactment') upon seeing a failed attempt with five different objects (Meltzoff, 1995). We tested reenactment skills of 61 toddlers ($\text{Mage} = 20$ months, $\text{SDage} = 17$ days) in three conditions (Figure 1), contrasting initial eye contact (EC) with initial eye-region salience (ES) and with initial masked eye region (NEC). After this initial phase, a model demonstrated the failed goal-attempt with

one of the objects (demonstration phase). Results show that toddlers were equally likely to reenact the target affordances when the eye region was made salient artificially as when actual eye contact was made, but not when the eye region was masked. This proved that making the eyes salient in a social way (i.e. by making eye-contact) can be just as effective for target affordance realization as making the eyes salient in a non-social way. We reasoned that attunement with the model's eyes, socially and non-socially, promoted toddlers' gaze following, which then increased the likelihood of acting out the target affordance (de Bordes et al., 2017). In order to better understand how attunement by making the model's eyes salient affects gaze following, we constructed time series of toddler's eye movements while they watched the demonstrations on a Tobii T60 eye-tracking system. We created time series of 1) toddler looking behavior towards the different Regions of Interest (ROIs) such as the model's eye-region and the goal location, and 2) the instances when a toddler looks at the model's eye region immediately followed by looking at a specific ROI (e.g. goal location). The latter might indicate a coordinated episode of gaze following. A close inspection and analysis of these time series will be presented, aimed at revealing the spatiotemporal structure of toddler's looking behavior during the demonstration phase. Specifically, in addition to other techniques, we applied Recurrent Quantification Analysis (RQA) on the eye-movement time series to test 1) which dynamical measures of gaze following are particularly informative, and 2) whether these measures differ between the conditions and between successful and unsuccessful trials with respect to reenacting the target affordance (Figure 2). Results reveal differences in the spatiotemporal structure of looking behavior between toddlers who are successful and those who are unsuccessful 'reenactors'. For instance, successful toddlers tend to follow gaze of the model more and switch less between ROIs. The results of the study will be discussed in the context of perceptual learning.

P3-G-176 Prosocial Behaviors of 10-Month-Old Infants with Social Evaluations as Predictors

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Prosocial behaviors foster cooperation, making them essential to successful social functioning. There is an increasing amount of literature suggesting that preverbal infants understand and can evaluate complex social interactions in others, including the positive and negative evaluation of goal-meeting and goal-hindering behaviors (i.e., Hamlin et al., 2007). However, due to physical and cognitive limitations, it is yet unclear whether young

infants are capable of acting on this understanding and behaving prosocially toward others. This study had two goals: 1) to replicate previous research demonstrating infants' social evaluation and preference for helpful over harmful others, and 2) to explore the use of new methodology using operant conditioning techniques to assess infants' capacity for prosocial behaviors. Methods: Infants (N = 48) 9-11 months of age were randomly assigned to experimental or control groups. There were two phases. In the first phase, in order to solicit social evaluation of behaviors, infants were shown a replication of the puppet show from Hamlin and colleagues (2007). A character tried and failed to move up a hill and infants saw both a helper (who pushed the character up the hill) and a hinderer (who pushed the character down the hill). Following the display, infants were instructed to choose between the helper and hinderer. In the second phase, infants were taught through operant conditioning to press a lever that manipulated the helper and hinderer puppets' behaviors (Figure 1). The infants were then provided the chance to both help and hinder the puppet in need through lever press responses. Frequency and timing of responses were recorded. Results: In the choice procedure, infants did not reliably select the helper or hinderer characters (44% chose the helper; $p = .82$), thus, not replicating previous research. However, in the operant conditioning procedure, infants in the experimental group who initially preferred the helper also helped the puppet in need more quickly ($F[1, 31] = 7.11, p = .013, \text{partial } \eta^2 = .21$; Figure 2) and frequently ($F[1, 31] = 17.35, p < .001, \text{partial } \eta^2 = .39$) than those who preferred the hinderer or those in the control group. However, the infants who initially preferred the hinderer did not hinder the puppet more than their peers ($F[1, 31] = .77, p = .40, \text{partial } \eta^2 = .03$). Additionally, all results from the control groups (controlling for color and movement preferences) were non-significant, suggesting that perceptual preferences did not significantly influence the results. Conclusions: The capacity to examine prosocial behaviors in early infancy allows researchers to better understand the developing moral system and its influences. In this study, infants who chose the helper also helped more than their peers who chose the hinderer or those in the control group. Infants who chose the hinderer did not hinder more, suggesting that the findings are not solely dependent on infant character choices and might represent rudimentary prosocial behaviors. These findings offer preliminary support for an exploratory and developmentally appropriate procedure to potentially detect the early emergence of prosocial behaviors in infancy.

P3-G-177 Smiling in Newborns: A Longitudinal Study from Birth to 4 Months

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Background: Smiling is a critical landmark in social development. While social smiling emerges by month 2, reflexive smiling is present at birth. Unlike reciprocal social smiling, reflexive smiling is observable in the absence of external stimulation, occurring most frequently during sleep. Despite the importance of smiling in social development, little is known about the manifestations of reflexive smiling and its developmental trajectory in relation to social smiling. For example, reports of the frequency of reflexive smiles in early infancy vary widely (Dondi, 2007), possibly due to the lack of longitudinal studies of reflexive smiling and the influence of behavioral state on smiling rates. The present study provides a densely-sampled prospective longitudinal investigation of reflexive smiling and its association with behavioral state in early infancy, setting the stage for future work examining the relationship between reflexive smiling and the emergence of social smiling. Objectives: (1) Measure change in frequency of reflexive smiling from birth to month 4; and (2) Evaluate the influence of sleep state on frequency of reflexive smiles. Methods: Participants were 7 healthy infants (4 male). Video recordings were collected from week 1 to month 4 (Figure 1). Reflexive smiles and behavioral state (Active Sleep, Quiet Sleep, Drowsy, Sleep-Wake Transition, Cry/Fuss, and Wake) were coded as in Dondi, 2007. Age was corrected for gestational weeks at birth. Frequency of reflexive smiling was defined as the number of smiles per minute observed during sleep. B-spline regression models were used to evaluate the frequency of reflexive smiling as a function of age. Linear mixed models were used to compare the percentage of time spent in each behavioral state and the frequency of smiles observed in each sleep state. Results: Aim 1: As expected, frequency of reflexive smiles declined with age ($F_{6,33}=4.36$, $p=.002$) (Figure 2a). Aim 2: Infants spent more time in active sleep compared to all other states (all p 's $<.05$), and spent more time in quiet sleep, compared to drowsy ($p=.005$) or sleep-wake transition states ($p<.001$). Frequency of reflexive smiles varied by sleep state, with reflexive smiles occurring more frequently during active sleep compared with quiet sleep ($p<.001$) and drowsy states ($p=.034$). Further, reflexive smiles occurred more frequently during drowsy and sleep-wake transition states, relative to quiet sleep ($p=.022$ and $p=.001$, respectively). See Figure 2b-c for trajectories of time in each state and the frequency of reflexive smiles during each sleep state. Conclusions: Frequency of reflexive smiles decreases over the first months of life, declining from a mean rate of .52 smiles per minute at birth to a rate of .06 smiles per minute at 90 days. Rate of reflexive smiling was influenced by behavioral state, with reflexive smiles occurring most frequently during active sleep. Immediate next steps include continued data collection in a larger sample to examine the influence of infant state on smiling rate across developmental time. Future research will examine the

relationship between developmental trajectories of reflexive smiling and the emergence of social smiling in these same infants, and in infants at-risk for autism spectrum disorder.

P3-G-178 Understanding of various similarity cues which lead to social preference

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The relationship between similarity and social preference is firmly established (e.g., Agnetta & Rochat, 2004; Sunnafrank, 1983). Infants prefer individuals who share similarities with them (e.g., Kinzler et al., 2007; Mahajan & Wynn, 2012; Liberman et al., 2014). Do they also form expectations about others' social interactions on the basis of similarity, and if so, which dimensions of similarity are important? The present research explores whether infants' expectations about the social preferences of third parties follow the patterns found in their own social preferences. In the study, we examined whether infants make sense of third party interactions based on shared Language, Preferences, and Behavior. Eight-to-12-month-olds were randomly assigned to one of these three conditions. In each condition infants saw Familiarization videos with a Target Actor and two other actors; Target and Similar-Actor exhibited a common trait (spoke the same foreign language; preferred the same object, or made the same physical motion) while Different-Actor exhibited a different foreign language, object preference, or motion. Infants' looking times to two test events were then measured: (i) the Target and Similar-Actor interacted positively, and (ii) the Target and Different-Actor interacted positively. Infants in the Language condition looked significantly longer at the Unexpected event, indicating that they differentiated between two foreign languages and that the fact of a shared/nonshared language influenced their expectations of whom the Target would interact with. Infants in the Preference condition looked significantly longer at the Expected event. Longer looking to expected events has been found in other studies assessing infants' understanding of social events (e.g., Kuhlmeier et al., 2003; Powell & Spelke, 2013), especially for stimuli infants find challenging to process. This suggests that for infants, shared preference is a weaker cue of friendship than is shared language. Infants in the Behavior condition did not discriminate between the Expected and Unexpected interactions, showing no tendency to infer friendship from similarity of action. These results confirm that shared language is a strong basis for generating social expectations during infancy. They also suggest that shared preference is sometimes used but is a weaker cue; and that shared motions are not a significant cue. These findings shed

light on early reasoning of third party interactions, and the roles that distinct types of interpersonal similarities play in this understanding.

P3-G-179 Kids and conflict: A transactional model of children's behavior problems, family conflict, and parenting stress over three years

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Children in homes with more family conflict and negative emotionality display more behavior problems and trouble with self-regulation (Harold et al., 2004; McCoy & Raver, 2011). Parents in homes with more family conflict may also experience more parenting stress and symptomatology (Fosco & Grych, 2013; Neece et al., 2012). However, it is unclear how children's own behavior problems may contribute to this stress and conflict in the home (Verhoeven et al., 2010), and how these constructs interact to influence each other over time in socioeconomically and ethnically diverse families of young children. The current longitudinal study examines children's behavioral problems, parenting stress, and family conflict at ages 1, 2, and 3 years, in order to explore potential transactional influences over time. 283 children and their families participated as part of the Early Head Start Family and Child Experiences Study (Baby FACES; Vogel & Boller, 2015). Behavioral problems were measured using the BITSEA (Briggs-Carter et al, 2004), parenting stress was measured using the PSI (Abidin, 1995), and family conflict was measured using the FES, family conflict subscale (Moos & Moos, 1994). Longitudinal weighting was used for a more accurate representation of the population. 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. Analyses were conducted using path model analysis in structural equation modeling with 95% confidence intervals constructed with bootstrapping in MPlus Version 7.2 (Muthén & Muthén, 2012). The fit indices for the overall model indicated good fit, CFI=.993, RMSEA=.020, SRMR=.030 (Figure 1, Table 1). More behavior problems at age 1 were associated with greater parenting stress and greater family conflict at age 2. Family conflict at age 2 was associated with greater parenting stress and more behavior problems at age 3. Family conflict at 2 years significantly mediated the relation between child behavior problems at 1 year and parenting stress at 3 (95% CI [.002, .058]). The results of the current study support a "child effects model" hypothesis, as the children's behavior problems at age 1 were associated with greater parenting stress and family conflict at age 2, which was then related to more

stress and conflict at age 3. Family conflict may play a particularly influential role, where it is not only children's behavior but also the way that conflict is handled in the home that impacts parent's stress. While previous studies have shown these areas to be interrelated, these results demonstrate longitudinally that children can have an impact on their parents and families beginning at a very young age. This sample's diversity suggests that these results may be more generalizable to a variety of low-income families. These findings also indicate that prevention and very early intervention programs could focus on children's behavior and development of self-regulation in the first year in order to reduce potential family conflict, parenting stress, and other potentially detrimental processes over time.

P3-G-180 Chinese Mothers' Sibling Status and their Children's Sibling Relationships: The Moderating Role of Supportive Coparenting

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Parents' experiences as siblings have received little attention from family psychologists. This study examined whether Chinese mothers' sibling status growing up with or without siblings played a role on the quality of their children's sibling relationships. It also tested whether the association between mothers' sibling status and children's sibling relationships was moderated by supportive coparenting. The goal was to provide preliminary evidence relevant to China's two-child policy. The sample comprised 167 two-child Chinese families. Mothers completed questionnaires assessing supportive coparenting and the quality of their children's sibling relationships. The results indicated that children whose mothers grew up with siblings had sibling relationships characterized by more positive involvement and less conflict and avoidance than their counterparts whose mothers who were only children. In addition, supportive coparenting was positively related to positive sibling involvement and in children of mothers without siblings negatively related to both sibling conflict and sibling avoidance. These findings enhance our understanding of how mothers' experiences as siblings may have a role in their children's sibling relationships.

P3-G-181 Associations between Maternal' Attachment Representations, Emotional Regulation and Responses to Toddlers' Expression of Emotion

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Parents' own experiences, capabilities, and beliefs shape the way they support their toddler's emerging emotional competencies. During infancy and early childhood, children develop the ability to regulate their own emotions and behaviors based on of their early experiences and what they are introduced to (Berger, Kofman, Livneh, & Henik, 2007). The purpose of this study was to examine how parents' difficulties in regulating their own emotions and holding negative beliefs about the role of emotions in young children's lives are related to their unsupportive responses to toddlers' expressions of negative emotions. We hypothesized that parental difficulties in managing their own emotions and negative beliefs about the value of emotions would be associated with their responsiveness to their toddlers' expressions of negative emotions. Unsupportive reactions may interfere with toddlers' ability to regulate and express emotions such as anger, sadness, and fear. A sample of 111 mothers (24% of parents had a high school education or less; 76% had some college or greater educational levels; mixed income) and their toddlers (Mage = 26.24 months, SD = 6.81; 54 girls) participated in a lab-based data collection session. Measures included self-reported attachment representations (Attachment Styles Questionnaire- ASQ; Van Oudenhoven, Hofstra, & Bakker, 2003), emotion regulation difficulties (Difficulties in Emotion Regulation Scale; Gratz & Roemner, 2004), and mothers' dismissing beliefs about toddlers' emotions (Emotion-Related Parenting Styles; Paterson, et al., 2012). Maternal responses to toddlers' expressions of anger, fear, and sadness were assessed via the Coping with My Toddlers' Negative Emotions (CTNES, Spinrad et al., 2004). Hierarchical linear regression indicated that a robust proportion of the variance in mothers' unsupportive (e.g., dismissing or punitive) responses to toddlers' expressions of anger, sadness and fear were associated with their dismissive attachment representations, $\beta = .27$, $p = .001$, difficulties in regulation their own emotions, $\beta = .28$, $p = .001$, and rejecting beliefs about children's emotions, $\beta = .40$, $p = .000$, $R^2 = .40$, $F(5, 106) = 15.98$, $p = .000$. Toddler age was also positively associated with mothers' unsupportive responses, $\beta = .19$, $p = .014$. Results indicate strong associations between mothers' own emotional experiences, including their attachment representations, difficulties in managing their own emotions and harsh beliefs about emotions, and their emotionally-unsupportive parenting. Such findings suggest that parenting education and support programs that utilize frameworks designed to attend to parents' mental health in support of more optimal parenting, such as the Infant Mental Health model, may be salient to parents with their own emotional struggles.

P3-G-182 Relations Between Community Stress and Emotional Processing in Infants

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Across a range of studies, both children and adults demonstrate a biased response to emotional stimuli--particularly threatening stimuli--in visual attention, detecting the presence of emotionally valenced or threatening stimuli more quickly than benign or neutral displays. These biases can be learned, and are particularly strong in individuals with specific phobias or clinical anxiety, suggesting that biases for emotionally valenced stimuli can be augmented by both trait-level individual differences and experience. Importantly, biases for threatening stimuli (i.e. angry faces) have been implicated in the development and maintenance of clinical anxiety, making this area important for continued research (see LoBue & Rakison, 2013, for a review). Living in poverty or in an environment with high levels of community stress is associated with a host of negative outcomes for both parents and children (e.g. Gutman et al., 2005). Yet, there is little or no research directly investigating the impact of neighborhood stress on individuals' ability to process emotionally valenced, or threatening information. As individuals living in a stressful community might experience more exposure to various kinds of threat when compared with individuals living in safer, more affluent neighborhoods, they might therefore learn to process threatening information differently. Processing patterns influenced by chronic stress or danger may place an individual at risk for poor socioemotional development. Here we investigated the impact of neighborhood and parental stress on emotional processing in 4-month-old infants. Data are being collected longitudinally from two sites, disparate for SES and neighborhood-based stress--rural State College, PA (N=27), and urban Newark, NJ (N=10) (data collection is ongoing). Emotional processing is measured in an infant visual search task, where infants are presented with various faces (neutral, happy, angry) one at a time, each appearing in one of the four quadrants of a screen. We use eye-tracking to measure infants' fixations. To quantify environmental stress, parents complete the Community Survey Questionnaire. Unsurprisingly, the two locations differ significantly on over 50% of the items on the Community Survey Questionnaire. Parents of infants in Newark report significantly higher levels of social disorder ($F(1,35)=9.47$, $p<.01$), violence ($F(1,35)=25.24$, $p<.001$), and delinquency ($F(1,35)=18.41$, $p<.001$) in their communities than parents of infants from State College. Most importantly, these factors are correlated with measures of infants'

attention to the emotional faces in the eye-tracking task, but only for participants from the Newark site, and only for certain emotions. Newark infants demonstrate a significant negative correlation between their parents' reports of violence, social disorder, and delinquency in their communities and infants' total fixation duration to the angry ($r = -.68$, $p = .03$) and neutral ($r = -.67$, $p = .03$) faces, but not to the happy faces ($r = -.10$, $p = .56$). While data collection is ongoing, these preliminary findings suggest that characteristics of a stressful community environment are related to infants' emotional processing as early as four months of age, and that these relationships might be specific to threatening (angry) or ambiguous (neutral) emotional signals. Future work will also focus on potential transmission mechanisms that link maternal perception of the environment and infant attention.

P3-G-183 Don't Hurt the Bunny: Toddlers? Selective Harm Avoidance

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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.

P3-G-184 Structure of Natural Parent Teaching Related to Toddlers' Learning

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Controversy exists in psychology and education literatures concerning the teaching strategies that benefit children's learning. Direct instruction (Klahr & Nigam, 2004), free play (e.g., Sim & Xu, 2017), and a combination of the two, e.g., collaboration (Sommerville & Hammond, 2007), have been found to benefit learning. It is yet unknown the types of structures children's first teachers, their parents, naturally employ while teaching their toddlers. The present study sought to understand which elements of natural parent teaching contribute to toddlers' learning of novel action sequences. In this study, 32 primary caregivers taught their 2-year-olds (22-26 months; mean age = 23.5 months, 17 males) to use novel multi-step toys. Out of a set of four toys, parents taught one of two puzzle-type toys and one of two block-building toys, each with multiple steps (see Figure 1). Parents were instructed to teach naturally, as they would at home, for up to five minutes per toy. An experimenter blind to the toys the child had been taught then tested toddlers' knowledge of the toy steps on the toys they had been taught ("taught toys") as

well as on two untaught, baseline toys ("control toys"). Fine-grained coding of the teaching structure was used as a predictor of children's test scores. Teaching structure was measured by coding which agent (parent or child) performed each toy step during teaching, and in what order. As a group, toddlers learned to perform the toy steps after teaching. Twenty-eight of the 32 children scored higher on the toys they were taught when compared with baseline control toys. While it might seem logical that children would perform better after being taught for longer amounts of time, this was in fact not the case; children instead seemed to learn from shorter durations of teaching ($r = -.524$, $p = .003$). However, the way in which the steps were balanced between parent and child was predictive of learning: Children who performed more steps (proportionally) than their parents during teaching had higher test scores ($r = .382$, $p = .041$; Figure 2). Additionally, teaching sessions where parents and children performed more collaborative steps, taking turns between parent and child, resulted in marginally higher test scores ($r = .355$, $p = .075$; Figure 2). Thus it appears that general characteristics of teaching, such as duration, are not predictive of learning while instead the way in which the interaction is structured (e.g., active learning or collaboration) might in fact benefit learning. Generally, these findings provide insight into how natural teaching occurs early in children's lives and how different features of teaching such as active experience and collaboration might help toddlers learn novel action sequences. Forthcoming results could have implications for our understanding teaching elements that are particularly beneficial for early learning.

P3-G-185 Transitioning Premature Infants to Direct Exclusive Breastfeeding

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Human milk is the preferred nutrition for premature infants. The American Academy of Pediatrics recommends exclusive breastfeeding for all infants for the first 6 months of life (AAP, 2012). Many mothers of premature infants express breastmilk for several weeks to provide human milk for their babies. However, less than 30% of these mothers are reported to actually feed their infants at the breast consistently when discharged from the NICU, and many abandon breastfeeding altogether (Pineda, 2011). This is partially due to the practice of the majority of neonatal intensive care units in the United States that require efficient bottle feeding as a criterion for discharge. The purpose of this study is to assess an intervention that supports breastfeeding in the NICU for infants born between 27 and 34 weeks gestation, and continues after discharge from the hospital. Enrollment is underway for 34 infants and mothers to be in the breastfeeding intervention. Short term

feeding and nutritional outcomes of the breast fed infants will be compared to a gestational age- matched control group, of 34 premature infants who transitioned from gavage to bottle feedings. Progress feeding at the breast will be assessed daily with the Premature Infant Breastfeeding Behavior Scale (Nyqvist et al., 1996). Mothers of the study infants will also report their level of confidence in caring for their premature infant, and their breastfeeding self-efficacy. Home follow-up visits will be provided weekly after discharge from the NICU as needed to support breastfeeding efforts, or until the mother stops breastfeeding. Data collection includes maternal questionnaires; direct observation of breastfeeding; infant patterns of growth; and maternal journaling of progress. Premature infants who are exclusively breastfed and premature infants who are primarily bottle fed will be compared for: time to reach full feeds by mouth, weight, length, and head circumference measures, and time from initiation of oral feeding to hospital discharge. The scores on the maternal confidence will be compared from initiation of feeding at the breast to full breastfeeding. Maternal breastfeeding self-efficacy will be measured at discharge. The duration of breastfeeding will be monitored and reported. It is expected that the patterns of growth will be similar between breastfed and bottle fed premature infants, and infants who are exclusively breastfed may be discharged sooner from the NICU.

P3-G-186 Young infants use physical size over numerical alliances to infer social dominance

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Beginning early in development, humans, like other animals, infer dominance on the basis of physical size (de Waal, 2007; Thomsen et al., 2011). Bigger individuals are considered more dominant than smaller individuals. Pun, Birch, and Baron (2016) recently argued that numerical alliances, rather than physical size, play a central role in establishing dominance, as evidenced by 6- to 12-month-olds' reliance on the number of group members when determining which individual should prevail in a competitive exchange. However, developmental research with preschoolers and adults demonstrated that size was weighted more heavily than numerical alliances in similar conditions (Lourenco, Bonny, & Schwartz, 2016). To address the apparent contradiction, we directly pitted size and number against each other as a strong test of which cue infants favor when judging social dominance. Adapting Pun et al.'s (2016) paradigm, 24 6- to 10-month-olds ($M = 8.1$ months, $SD = 1.52$) were familiarized to four identical small agents and two identical large

agents (Fig. 1). During familiarization, infants were shown a conflict in which one agent from each group attempted to cross the platform simultaneously. Immediately following familiarization, infants were presented with two test conditions: one in which the bigger agent (from the least numerous group) bowed down to allow the smaller agent (from the more numerous group) to cross (condition 1; Fig. 1), and one in which the smaller agent (from the more numerous group) bowed down to allow the bigger agent (from the least numerous group) to cross (condition 2; Fig. 1). If infants use size to infer dominance, then they should look longer to condition 1. However, if infants use numerical alliances to infer dominance, then they should look longer to condition 2. Looking time was calculated as a proportion of looking time to condition 1 as a function of total looking time to both conditions. An Analysis of Variance revealed that infants looked significantly longer during condition 1 ($M = .63$, $SE = .06$) than condition 2 ($M = .37$, $SE = .06$), $F(1, 23) = 6.72$, $p = .02$, $\eta^2 = 0.23$ (no effects of age or condition; $p_s > .3$). A non-parametric analysis confirmed that the majority of infants (17/24) showed this effect, $\chi^2(1, 24) = 4.17$, $p = .04$. These analyses suggest that infants relied on size to infer dominance in the competitive exchange. An alternative interpretation is that because the competitive exchange involved individual agents competing one-on-one, the numerical alliances were irrelevant and not referenced. However, preliminary analyses of infants' gaze patterns during familiarization and both conditions suggest that infants tracked the agents in relation to their respective groups and, thus, referenced their alliances (Fig. 1). Our results show that 6- to 10-month-olds favored physical size over numerical alliances when inferring social dominance. Although numerical information may be used when physical size is unavailable (ongoing data collection), our findings suggest a hierarchy of how these cues are weighted. As a salient perceptual cue correlated with strength, physical size may be an especially reliable cue to social dominance.

P3-G-187 Infants' Judgments about Dominance based on Vocal Pitch

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Several important social judgments we make about others are significantly biased by vocal sound cues. For example, men's judgments about dominance and women's perception of attractiveness are significantly affected by the low mean fundamental pitch (F0) of a person's voice (Hodges-Simeon et al, 2010). Furthermore, competing individuals have been shown to adjust their vocal pitch higher or lower to reflect a different dominance level (Puts, Gaulin, & Verdolini, 2006). If this sound bias is rooted in our evolutionary

history as some have suggested then we might see this sound bias reflected in the early stages of human development as well. To address this question the current study examined whether infants (aged 6.5 to 8.5 months) use the vocal pitch (i.e., F0) to infer the level of dominance a character should exhibit in a social conflict. In the first study, 16 infants were exposed to animations in which two same-sized bunny characters competed for the same swatch of space (similar to Mascaro & Csibra, 2012; see Figure 1). Throughout this competition the two characters produced sounds that contrasted with one another, a high- or low-pitched 'bi-bi'. We then measured infants' looking times in response to the high-pitched or low-pitched character 'winning' the dominance competition. We hypothesized that if infants disregard vocal pitch when judging social dominance then they would fail to discriminate these sound-behavior pairings. Instead we observed that infants significantly differentiated the congruent vs. incongruent test events, suggesting they use vocal pitch to inform their social judgment about the dominance of a character over its rivals. In a second study we asked whether this association between vocal pitch and dominance was mediated by a sensitivity to sound and the physical size of a character. For example, recent studies have demonstrated that 3-month-old infants relate a character's vocal pitch with its body size (Pietraszewski et al., 2017) and 10-month-olds expect a larger character to be more socially dominant over a smaller one (Thomsen, et al., 2011). Accordingly, it might be possible that infants' judgments of social dominance in our first study were mediated by their intuitions about physical size (even though no such size differences existed in our stimuli). To test this, we showed a separate group of 7-month-old infants a set of animations that included the same high- or low-pitched voices from the previous study that played while infants viewed two upright screens (see Figure 2). After several familiarizations to one or the other pitch (which varied across blocks), the screens were lowered to reveal either a large or small bunny character (and a mid-sized bunny that was shown as a reference point) as the source of voice because its mouth was moving. We found that infants did not significantly differentiate congruent from incongruent sound-size pairings using these same stimuli, suggesting that physical size is not directly mediating infants' judgments in our first experiment. Instead, we argue the possibility that infants might associate vocal pitch with the levels of social dominance they view in their environment.

P3-G-188 What is maternal responsiveness? The difference between maternal contingent responsiveness and maternal mirroring

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The measurement of maternal responsiveness to infant behavior in face-to-face interactions has many variations in the literature, which can obscure our understanding of the concept. Here we examined two concepts, maternal contingent responsiveness and maternal mirroring. They often are used interchangeably, yet the extent to which they are similar has not been examined. Both involve mothers' responses to infants' behavior that occur within a set time period, typically 1-3 seconds. However, they are coded differently. Contingent responsiveness is typically microcoded second-by-second and examines specific behaviors within a single modality. Scores for contingent behavior usually control for baseline frequencies of behaviors of interest, e.g., here maternal smiling contingency involves mothers' smiles that follow infants' smiles within one second, using limit of phi statistic that controls for baseline frequencies. Mirroring behaviors are judged to match or slightly exaggerate the infant's affect and intensity. Mirroring behaviors can be within the same modality as the infant's behavior (e.g., mother mirrors the infant's smile with her own smile), or in a different modality (e.g., mother mirrors the infant's surprised facial affect with a vocal gasp). Baseline frequencies are not controlled for due to the multitude of behaviors potentially involved. To examine the relation between maternal contingent responsiveness and mirroring behavior, both behaviors were coded in the same data set; both occurred within one second following infant behavior. Mothers and 5-month-old infants (N =31) engaged in a Still-Face Task. During periods of mutual gaze in the initial 2-minute interactive phase, mothers' contingent smiling responsiveness, contingent vocal responsiveness, and mirroring behavior were scored. Table1a shows the correlations among maternal vocal contingency, maternal mirroring, and maternal and infant vocalization durations. Table 1b shows the correlations among maternal smiling contingency, maternal mirroring, and maternal and infant smiling durations. Maternal smiling and vocal contingency were unrelated ($p = .15$). Maternal mirroring was unrelated to maternal smiling contingency but was marginally related to maternal vocal contingency. Infant vocalizing was related to maternal mirroring, and was marginally related to maternal vocal contingency; but infant smiling was unrelated to maternal mirroring or maternal smiling contingency. The data suggest that maternal vocal contingent responsiveness and mirroring behavior may be related. Indeed in separate studies, maternal mirroring at 5 months (Bigelow et al., 2017) and maternal vocal contingency, but not smiling contingency, at 3 months (Bigelow & Power, 2016) were related to infants' social bidding behavior. Infants may have more experience with mothers responding to their vocalizations than to their smiles. Infants vocalize from birth, whereas smiling emerges at two months. Infants also may find it easier to detect

responses to their vocalizations. Mothers' smiles tend to overlap with infant smiles, yet mothers tend to stop talking when infants vocalize and resume talking after infants' vocalizations have ended. Maternal contingent responsiveness and maternal mirroring are distinct means of responding to infants. Importantly, the data indicate that maternal responsiveness, whether as contingent responsiveness or mirroring, is distinct from maternal smiling or vocalizing per se.

P3-G-189 The Emergence of Infant Helping In the First Year of Life

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Research on the emergence of prosocial behavior focuses primarily on infants' aged 14 months and up (e.g., Hay & Cook, 2007; Warneken & Tomasello, 2007). However, an emerging body of research suggests that infants in the first year of life are capable of some forms of prosocial behavior (e.g., Dahl, 2015), and furthermore, that at least some of these behaviors may emerge before 8 months of age (e.g., Hamlin, Wynn & Bloom, 2010; Hammond et al., 2017; Saether & Sommerville, 2016). Even before they are capable of much locomotion, infants can assist others by engaging in cooperative bodily actions, such as adjusting ones body to facilitate dressing or feeding practices for the caregiver (Reddy et al., 2013). Also of interest is that in the context of daily care and self-care tasks, infants experience being helped, through individual social interactions styles may differ across caregivers. The proposed study builds on and extends recent work by [Reference omitted for review]. We will present data on the infant and parental behaviors relevant to the development of early prosocial behavior beginning at 3 months, with longitudinal data up to 7 months [anticipated by the time of ICIS 2018]. Early data from the 3 month period suggests that infants are learning to anticipate feeding tasks, but are not yet capable of much cooperation. However, the infant-parent dyads met with so far all engage in breast-feeding, rather than bottle-feeding. The current study explores both the earliest emergence of prosocial behaviour, and relations between emerging prosocial behavior and factors such as motor development and temperament, and social interaction characteristics such as mind-mindedness and sensitivity. Participants in this study, recruited in Canada, participate virtually (e.g., via Skype, Facetime etc) in a variety of structured observations and unstructured interactions (adapted from, e.g., Meins & Fernyhough, 2015, v. 2.2; Saether & Sommerville, 2016). Some examples include daily routine interactions such as dressing, prosocial behavioral tasks involving sharing or helping; activities to assess motor abilities, and the engagement of free play between

parents and their infants. Parents are also asked to complete online questionnaires regarding their infants' behaviors, including a motor development measure, the Early Motor Questionnaire (EMQ, Libertus Violi, 2016) and the Ages and Stages Questionnaire (ASQ; Briggs et al., 2012). Meetings with participants are scheduled approximately once a month for 10 to 15 minutes. Both concurrent and longitudinal relations and trends in early prosocial development will be presented and discussed.

P3-G-190 Young children pay forward others' kindness: Upstream reciprocity across task domains

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Adult research has demonstrated that help from a benefactor motivates not only direct reciprocity (repaying one's benefactor) but also upstream reciprocity (acting prosocially toward new individuals). This help-induced upstream reciprocity has been shown to increase cooperation within groups. Prior work using a distribution game found that 4-year-olds engaged in upstream reciprocity (Leimgruber et al., 2014). However, because the game involved the child receiving the same benefits that the child then distributed, it is unclear whether children's upstream reciprocity resulted from simply imitating the distributions that their benefactor had demonstrated rather than from true upstream reciprocity. 3- and 4-year-olds ($n=40$ per age group) played a purportedly difficult game in which they had to find a key hidden in one of four boxes. Before playing, children received a note from the child who had previously played the game (Sally). Half the children in each age group received a helpful note telling them which box the key was hidden in, and the other half received a positive but non-helpful note. Children then searched for and found the key, and used it to unlock a box containing five stickers. Then, while the experimenter was out of the room, children had the option of sharing stickers with a new child (not Sally). 4-year-olds who had received the helpful note were more likely to share stickers and shared more stickers with the new child than those who received the non-helpful note (Mann Whitney, $p=.008$). 3-year-olds did not share differently across conditions ($p > .05$). Thus, by 4 years of age, receiving help motivates upstream reciprocity, suggesting that something like an early sense of gratitude may serve to increase cooperation from early in development.

P3-G-191 Individual differences in oxytocin's influence on infant macaques' attention to threatening facial expressions

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Oxytocin is a neuropeptide tied to attachment and sociality, however, little is known about infants' naturally occurring levels of oxytocin and whether they are associated with social behavior. Macaques are an excellent animal model in which to study the developmental neurobiology of social behavior (Parr et al., 2016). The acute administration of oxytocin increases infant macaques' affiliative communication (Simpson et al., 2014) and social cognitive skills (Simpson et al., 2017). Interestingly, higher levels of endogenous oxytocin are positively associated with social attention (Simpson et al., 2014) and face recognition (Madrid et al., 2017). Further, neonates who imitate facial gestures, compared to non-imitators, appeared more positively influenced by exogenous oxytocin (Simpson et al., 2014). Here, we investigated the effects of aerosolized oxytocin on infant macaques' attention to conspecific facial expressions. In the first week of life, infants were classified as facial gesture imitators ($n=18$) and non-imitators ($n=26$). At 2-3 weeks of age we measured infants' baseline salivary oxytocin levels. At 4-weeks of age, in a double-blind experimental design, infants were nebulized with either saline (control) or oxytocin (Figure 1A) and then viewed three 10-second videos of animated adult macaques displaying a lipsmacking (positive, affiliative), a neutral still-face, and a threatening (negative) expression in a counter-balanced order, while we tracked their attention (Figure 1B-C). Infants' endogenous oxytocin levels were positively associated with their looking time to the eye region of the threat face ($r=0.643$, $p<0.01$), Figure 2A (blue). This association was eliminated when infants were administered oxytocin, Figure 2A (red). Imitators looked significantly more to the mouth region of the threat face than non-imitators ($t(24)=2.07$, $p=0.05$, $d=0.70$), Figure 2B (Saline). This effect was eliminated when infants were administered oxytocin, Figure 2B, and imitators looked more to the mouth in the saline compared to the oxytocin condition, $t(14)=5.009$, $p<0.01$, $d=1.03$. There were no effects of oxytocin for the lipsmacking or still-face expressions, $ps>.05$. Finally, neonatal imitators, compared to non-imitators, showed a trend of higher salivary oxytocin levels, $t(36)=2.01$, $p=0.052$, $d=.33$. Consistent with reports of anxiolytic effects of oxytocin (e.g., reducing salivary cortisol; Simpson et al., 2014), we found newborn monkeys' social behavior and physiology were positively associated with their attention to threatening, but not positive or neutral, facial expressions. Newborns with higher rates of neonatal imitation and higher salivary oxytocin--who may be more social and attend to more relevant features (Paukner et al., 2014)--looked longer to the eyes and mouth of a threatening expression compared

to their less imitative peers. These associations were reduced when infants were administered aerosolized oxytocin, suggesting that exogenous administered oxytocin may reduce attention towards faces, thus affecting face-processing mechanisms in these infants. Our finding that imitators display higher levels of oxytocin is consistent with studies in human newborns that report cerebrospinal oxytocin levels are positively associated with infant sociability (Clark et al., 2013). The present study highlights the importance of considering individual differences in reactivity to oxytocin and suggests that oxytocin may help assess neurodevelopment.

P3-G-192 The Patterns of Adaptive Behaviors in Children with High-Functioning and Low-Functioning Autism Spectrum Disorder

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Purposes: The aim of this study was to explore the profile of the adaptive behavior in children with autism spectrum disorder (ASD). Contributors including cognitive ability and symptom severity for the profiles were also examined. **Methods:** Children aged 2-5, including 72 High-Functioning Autism Spectrum Disorder (HFASD), 62 Low-Functioning Autism Spectrum Disorder (LFASD), and 41 Development Delay (DD), were included. ADOS and clinical impression (DSM-V) were assessed by the research team (one psychiatrist and one psychologist). Mullen Scale of Early Learning (MSEL) was used to measure cognitive function. Adaptive Behavior Assessment System-II (ABAS-II) which is based on Taiwanese norm was used. Three domains which were Conceptual (CON), Socialization (SOC), and Practical (PRA) were analyzed. **Results:** LFASD group had significant deficits compared to HFASD group in all adaptive domains. In CON, children with DD had significant deficits compare to children with HFASD, and there was no significant difference between children with LFASD and with DD. In SOC and PRA, there was no significant difference between children with HFASD and with DD, and children with LFASD had significant deficits compared to children with DD. Children with HFASD had a profile of adaptive behavior in which ?SOC = PRA < CON?. There was no significant discrepancy between adaptive behavior and DQ in children with HFASD. Children with LFASD had a profile of adaptive behavior in which ?SOC = PRA = CON?. Children with DD had a profile that indicate ?CON < SOC = PRA?. The children's DQ is significant lower than their adaptive behaviors in both children with LFASD and with DD. In children with HFASD, there was a significant negative relationship between SOC and ADOS social disability, but no other significant relationship was found between adaptive behavior and MA, DQ, and

ASD symptom severity. In children with LFASD, the relationship between adaptive behaviors and DQ was positive, and negative relationships were found between adaptive behaviors and ASD symptom severity. Conclusion: The results indicated that compared to children with DD, children with LFASD exhibited significantly greater deficits in adaptive behavior. The adaptive behavior in children with HFASD was higher than children with LFASD and with DD. The different adaptive patterns of HFASD and LFASD groups were contributed by cognitive ability.

P3-G-193 Maternal Reflective Functions, Maternal Behavior and Toddlers' Screen Time

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Prolonged exposure to screen media in early childhood has detrimental effects on children's health and well-being (Tomopoulos et al., 2010). Although the American Academy of Pediatrics (AAP) recommends that children under 18-months should not be exposed to screen media, many parents expose their toddlers to screens on a daily basis (Domingues-Montanari 2017). Thus, understanding parental behaviors surrounding media use is crucial for the development of prevention programs aimed to reduce toddler screen time and benefit child development (Coyne et al., 2017). Research suggests that distal familial such as ethnicity and parental education are related to children's extended media use (Anand & Krosnick, 2005). The current study aimed to identify potentially modifiable parental factors that may be related to toddlers' screen time. Specifically, we focused on the roles of maternal reflective functioning (RF; mother's capacity to understand her child as driven from internal mental states) and maternal provision of screens in reaction to child distress. We hypothesized that reduced maternal RF will be related to more frequent use of screen media to cope with children's distress which, in turn, will be related to children's elevated screen time. Participants were 103 mothers of 18-months old children. Maternal RF was assessed using the pre-mentalizing scale (i.e., difficulty entering child's subjective world and hostile attributions to the child's behavior) from the "Parental Reflective Functioning Questionnaire" (Luyten et al., 2009). Higher scores indicate lower maternal RF. Maternal provision of media use to cope with children's negative behavior was assessed through a modified version of the "Coping with Toddlers' Negative Emotion Scale" (Spinrad et al., 2007) in which mothers rated the likelihood of responding to scenarios of child distress with the provision of screen media (e.g., "If your child becomes fussy or upset during a car ride, how often would you let him/her watch or

play something on your phone/ tablet or portable DVD device"). A media use strategy score was calculated by averaging mothers' responses on all 4 scenarios. Toddler's average daily screen time was calculated using maternal report on average screen time in weekdays and during weekends. Mediation analysis was conducted using bootstrapping analyses (Preacher & Hayes, 2008), with 5,000 resamples and 95% CIs for the indirect effect, linking low maternal RF and screen time through media use strategy and controlling for income, maternal education and maternal screen time. The standardized coefficients for direct path among maternal RF, media use strategy and screen time are presented in Figure 1. Low maternal RF was related to more media use strategy (95% CI [.09, .47]), which in turn was related to more screen time (95% CI [.25, .60]). An indirect effect of low maternal RF on screen time was found through media use strategy (95% CI [.04, .25]). The total model explains 35% of the variance of children screen time. Maternal RF and use of screens to cope with toddler's distress might be detrimental in shaping toddler's screen time. Our findings can inform family-based interventions aiming to reduce toddlers' screen time. Future longitudinal research is needed to understand directionality and transactional processes between maternal behavior and child screen time.

P3-G-194 Parental warmth helps shy toddlers to be bold

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Shy toddlers experience fear and anxiety around new people and often withdrawal as a means of coping with their fear (Rubin, Coplan, & Bowker, 2009). However, with appropriate support, shy children do engage in adaptive social behaviors (Davis & Buss, 2013). The present study examined which aspects of parental support (behavioral prompts, affective warmth, or both) promote shy toddlers' social engagement. Forty-eight toddlers (18 boys; Mage = 22.89 months; range 21-24 months) pre-selected as temperamentally shy (i.e., ≥ 1 SD above the social fear subscale mean of the Toddler Behavior Assessment Questionnaire, Goldsmith et al., 1996) were observed in the laboratory with their parents (mostly mothers) as they completed a series of episodes. Data presented here are from the first 5 min of the laboratory visit, when a female examiner invited the child to play with attractive toys while another examiner talked with the parent, and a stranger approach episode, when a male examiner attempted to engage the toddler in play for 2 min while the parent was instructed to provide one of four types of support. In both episodes, toddlers were rated on a 5-point scale from 1 (none) to 5

(extreme) for the extent to which they showed wariness (i.e., avoidance of, withdrawal from, or discomfort with the examiner) and boldness (i.e., took initiative to engage with and be in proximity to the examiner). The four types of parental support were randomly assigned and included an encouragement condition, a warmth condition, an encouragement plus warmth condition, and a no support control condition. Parents assigned to provide encouragement were instructed to prompt specific behaviors (e.g., "I bet he likes Elmo, too. Show him Elmo"), parents assigned to provide warmth were asked to be affectively positive and express affection (e.g., "You're such a good boy/girl"), and parents assigned to the no support control condition were asked to look at a magazine and refrain from interacting with their toddler. Boys were less wary and more bold, $t(46) = -3.13$ and 2.16 , respectively, $ps < .05$, so analyses controlled for child gender. Children's observed wariness and boldness during the first 5 min of the visit were also included as a covariate to account for variations in initial shyness. Means and standard errors (controlling for child gender and initial wariness or boldness) are shown in Figure 1 and Figure 2, respectively. One-way analyses of variance (ANOVAs) indicated that observed toddler wariness did not differ by parenting condition, $F(3, 41) = 1.67$, $p = .19$, $\eta^2 = .11$, however observed boldness did differ by parenting condition, $F(3, 41) = 3.74$, $p = .04$, $\eta^2 = .19$. Pairwise comparisons with the Bonferroni correction indicated that shy toddlers took greater initiative to engage with the male stranger when parents provided warmth than when parents provided no support. These findings suggest that parents, who are important socializers in their toddlers' lives, can be taught simple strategies to promote social behaviors during their shy toddlers' everyday interactions with others. Parental warmth in particular may help shy toddlers to engage.

P3-G-195 Family routine consistency, maternal parenting style, and children's positive responsiveness to maternal autonomy support

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Parents may support children's emerging autonomy with consistent family routines. Consistent home environments scaffold children's self-initiative, internalization of conduct, and other goal-directed behaviors (Sirota, 2006; Grusec & Goodnow, 1994). Routines may facilitate children's repeated independent successes at home, thus reinforcing acceptance of parental autonomy support. Practicing autonomy within the structure of routines may be especially important for children of parents whose parenting styles may otherwise limit opportunities for such practice. An overreactive parenting style,

for example, is associated with higher assertion of control and less flexibility (Verschuere et al., 2006); these parents may provide fewer opportunities for their children to behave autonomously in daily life. In this study, we examined the extent to which routine consistency is associated with parenting style and children's real-time responsiveness to their mothers' bids for their autonomy. Children ($N = 96$; age 3) and their mothers participated in a dyadic clean-up task, and their behavior was coded on a second-by-second scale using an established coding system (Lunkenheimer, 2009). Maternal autonomy support was operationalized by teaching and proactive structure behaviors, and child autonomous behavior by on-task persistence. Children's dynamic responses to maternal autonomy support were calculated using hidden Markov modeling, and operationalized as the probability of the child moving from another behavior into autonomous behavior while the mother was offering autonomy support (Lunkenheimer et al., 2017). Mothers also completed the Changes to Children's Schedules questionnaire, which measured family routine consistency, and the Parenting Scale, which measured maternal overreactivity (Arnold et al., 1993). We conducted a linear regression analysis to test whether children's responsiveness to autonomy support varied as a function of routine consistency and maternal overreactivity. Our overall model was significant, $R^2 = .13$, $F(3, 93) = 4.83$, $p = .004$. An interaction between routine consistency and maternal overreactivity accounted for a significant portion of the variance in children's responsiveness to maternal autonomy support, $b = 0.15$, $t(93) = 2.19$, $p = .03$. A simple slope post-hoc analysis revealed a moderation effect: Routine consistency was not of significant importance for children's autonomous behavior when mothers scored low on overreactivity (one SD below the mean, $b = -0.01$, $t(93) = .07$, $p = .91$), but was significant with mean-level overreactivity, $b = .12$, $t(93) = 2.13$, $p = .04$. The relation strengthened with higher overreactivity (one SD above the mean, $b = .26$, $t(93) = 2.78$, $p = .01$). Our results suggest that maternal overreactivity moderates the relationship between routine consistency and children's responsiveness to autonomy support, such that dyads with the highest levels of maternal overreactivity may benefit most from routine consistency. Thus, routines may act as a buffer in the context of overreactive parenting, though future research should examine directional associations between these variables. Indeed, family routines are regulated, in that their maintenance is driven by family factors, and regulating, in that their presence helps maintain cohesion within the family unit (MacPhee et al., 2015). As children's autonomous behavior may be promoted by family routines, it may also reinforce the consistency of such routines.

P3-G-196 Does maternal autonomy support in infancy matter for child sleep in the preschool years?

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There is a great deal of evidence showing that adequate sleep is necessary for multiple aspects of infant and child development (see Chaput et al., 2016 for review). Hence, it is important to study the environmental factors that could promote optimal sleep among children. A growing body of literature suggests that the quality of mother-infant relationships is an important factor to consider in this regard (Tikotzky, 2017). One potentially relevant aspect of mother-infant relationships is autonomy support, which assesses the degree to which parents gradually encourage their infant's growing autonomy, and thus, potentially, promote the self-regulatory skills that are essential to attain and maintain sleep. Maternal autonomy support during mother-infant interactions has been found predictive of infant sleep assessed with mother-completed sleep diaries (Bordeleau et al., 2012). However, parental sleep diaries are subject to parental bias, whereas actigraphy, an objective measure of sleep assessing motor activity levels, is increasingly recognized as a more reliable method (Sadeh, 2015). Consequently, the aim of this study was to examine the longitudinal associations between maternal autonomy support in infancy and child sleep at preschool age, using actigraphy. The sample consisted of 58 mother-child dyads (32 boys). Maternal autonomy support was assessed in infancy ($M = 15.5$ months) during three mother-infant joint problem-solving tasks, including two puzzles and a block tower task. These videotaped interactions were later coded for maternal autonomy support following Whipple et al.'s (2010) coding system. Autonomy support scores were averaged across the three tasks and inter-rater reliability was excellent, $ICC = .97$. Nearly three years later ($M = 4.1$ years), child sleep was assessed with an actigraph (Mini-Mitter® Actiwatch Actigraph, Respironics), a watch-like monitor that was worn by the child on his or her non-dominant wrist for three consecutive nights. Validated algorithms (Sitnick et al., 2008) were used to derive two sleep parameters from the motor activity counts (averaged across the three nights): nighttime sleep duration and sleep efficiency (ratio of sleep to total time in bed, an index of sleep quality). Multiple hierarchical regressions were carried out to assess the unique effects of autonomy support on sleep duration and sleep efficiency while controlling for family socioeconomic status (SES), a known correlate of child sleep (El-Sheikh et al., 2013). Above and beyond SES, maternal autonomy support significantly predicted sleep duration ($\beta = .28$, $p = .039$), suggesting that higher maternal autonomy support in infancy is associated with longer child sleep duration nearly three years later. However, no significant result emerged with

sleep efficiency ($p > .05$). Findings suggest that greater maternal autonomy support as displayed during mother-infant interactions predicts longer sleep duration, but not higher efficiency, at preschool age. Considering that child sleep duration plays an important role in several developmental outcomes from infancy to adulthood, these results provide further support for the importance of considering the quality of early mother-infant relationships in child sleep studies.

P3-G-197 Beyond Prosocial: The Development of Distinct Forms of Prosocial Behavior

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Empirical studies of prosocial behavior in infancy have focused on a range of different behaviors, including: instrumental helping (e.g., Warneken & Tomasello, 2006), emotional helping and comforting (e.g., Zahn-Waxler, Radke-Yarrow, Wagner, & Chapman, 1992), sympathy (e.g., Vaish, Carpenter, & Tomasello, 2009), altruism (e.g., Svetlova, Nichols, & Brownell, 2010) and sharing (e.g., Schmidt & Sommerville, 2011). However, very little research has examined how different forms of helping emerge and are utilized during the second year of life. To address this gap, this study examined 16- 19- and 24-month-old infants' deployment of 3 distinct forms of helping behavior: emotional helping, instrumental helping, and soliciting help from a third-party. We analyzed a corpus of videos (Walle, Reschke, Camras, & Campos, 2017) in which 16-, 19-, and 24-month-old infants ($N = 142$) responded to an experimenter's emotional communication (joy, sadness, fear, anger, or disgust) toward a toy or object. All infants had previously been coded as demonstrating prosocial responding. Unique to the present investigation, each infant's prosocial response was further delineated to determine the presence of 3 distinct forms of helping behavior: Emotional Helping = attempts to help or comfort the victim emotionally (Dunfield et al., 2011; Roth-Hanania et al., 2011) ; Instrumental Helping = attempts to address a physical/objective need (Eisenberg et al., 1999; Fabes et al., 1994); and Soliciting Help = attempts to involve the caregiver or experimenter in remedying the situation (Zahn-Waxler et al., 1992). Codes were not mutually exclusive. We hypothesized that (1) infant helping behaviors would differ across age groups, with emotional helping and soliciting help more prevalent in older infants; and (2) infants would be more likely to respond with emotional and instrumental helping in response to sadness, whereas soliciting help from another would be more prevalent in response to anger and fear. Each prosocial behavior was analyzed using separate linear mixed

models with a binomial distribution and a logit link. Restricted maximum likelihood (REML) was used for all models. Each model included emotion as a within-subjects factor and age as a between-subjects factor, as well as an Age Emotion interaction. Paradigm was also included in each model as a within-subjects factor to control for differences across contexts. Significant effects and interactions were followed by planned comparisons, with interaction terms explored by age group for each emotion. Analyses revealed that infants' emotional helping varied as a function of age, $F(2, 126) = 16.63$, $p < .001$, $\eta^2 = .21$, and emotion, $F(4, 126) = 26.70$, $p < .001$, $\eta^2 = .46$. The Age Emotion interaction was also significant, $F(8, 126) = 11.00$, $p < .001$, $\eta^2 = .41$. Descriptive statistics and pairwise comparisons of the main effects of age and emotion are presented in Table 1. This study indicates that distinct forms of infant helping behaviors emerge gradually in the second year of life and are differentially deployed across discrete emotion contexts. Potential cognitive and socialization factors that may account for the observed patterns will be discussed.

H: Emotional Development

P3-H-198 Perinatal loss as a risk factor for paternal involvement with subsequent infants

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In Quebec (Canada), almost 23 000 families experience a perinatal loss every year (from pregnancy to 1 year postpartum; CHUM, 2017). Because the majority of women will become pregnant in the year following the loss, the consequences of perinatal losses on family functioning with subsequent children should be examined (Lamb, 2002). Currently, their long-term consequences are not well documented, especially in fathers. The loss of an expected child can be devastating for both women and men and the risk of post-loss mental health complications can affect their ability to care for their subsequent children (Al-Maharma, et al., 2016; Bennett, Litz, Lee & Maguen, 2005; Pantke & Slade, 2006). Fathers' involvement with subsequent children has never been investigated in relation to perinatal loss. As father involvement is highly important for child development, a better understanding of the factors that might promote or hinder it is crucial (Lamb, 2010). Therefore, the goal of this study was to examine the impact of perinatal loss on fathers' involvement with their subsequent infants. This project is part of a longitudinal study involving 104 families living in Quebec (Canada) and visited at their home when the infants were 6 months. Parents were asked if they ever experienced perinatal losses before the

birth of their infant (including miscarriage, stillbirth, or neonatal death) and how many times. A total of 32% of fathers reported at least one perinatal loss. The frequency of fathers' involvement in infant care and play activities was assessed with the «Who Does What » questionnaire (Beitel & Parke, 1998). Even though there was no difference in self-reported involvement between fathers who did not report a perinatal loss and fathers who did, the latter were perceived by their partners as less frequently involved in infant care but not in play activities (see Figure 1). Moreover, the number of perinatal losses was negatively associated with paternal involvement in infant care as evaluated by the fathers themselves ($r = -.24$, $p = .03$) and by the mothers ($r = -.24$, $p = .02$; see Table 1). These results suggest that experiencing perinatal loss before the birth of a child is a risk factor for lessened paternal involvement in infant care. Given the high number of men that will experience perinatal loss (Armstrong, 2001), the lack of interventions designed for men after such loss (de Montigny et al., 2010) should be remediated.

P3-H-199 Evaluating Interrelationships between Pregnancy Anxiety, Maternal Prenatal Attachment and Infant Negative Emotionality

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Although prior findings related to effects of prenatal depression and anxiety on infant temperament have been equivocal, the construct of pregnancy-specific anxiety has emerged as an important predictor of infant and child outcomes. Little is known, however, about psychosocial factors that may inform interrelationships between pregnancy-specific anxiety and infant temperament. The present study explored longitudinal relationships between prenatal anxiety, pregnancy-specific anxiety, maternal prenatal attachment styles, and early development of infant negative emotionality. Maternal attachment variables were represented via three indicators: level of anxious attachment within romantic relationships, level of avoidant attachment within romantic relationships, and attachment to the fetus. At Time 1, eligible participants ($N = 142$) completed online questionnaires during their third trimester of pregnancy, which assessed symptoms of prenatal depression (Edinburgh Postnatal Depression Scale; Cox et al., 1987), state anxiety (State Trait Anxiety Inventory; Spielberger et al., 1989), and pregnancy-specific anxiety (Pregnancy Related Anxieties Questionnaire - Revised; Huizink, 2000), as well as attachment to romantic partners (Experiences in Close Relationships-Revised; Fraley et al., 2000) and attachment to the fetus (Prenatal Attachment Inventory-Revised; Pallant et al., 2014). During the early postpartum period (Mean = 9.95 weeks, $SD = 1.61$), participants

were invited to complete a follow-up set of online questionnaires about birth outcomes, their postpartum mental health status, and infant temperament (measured via the Infant Behavior Questionnaire-Revised, Short Form; IBQ-R; Gartstein & Rothbart, 2003; Putnam et al., 2014). All attachment styles were examined independently and as moderators of the relationship between pregnancy-specific anxiety and infant negative emotionality, using hierarchical multiple regression. The centered means of the symptom scale predictors (e.g., mean centered PRAQ-R score) were used to reduce multicollinearity. Prenatal depression scores and demographic factors that were significantly related to any predictor variable or infant negative emotionality were entered first. The second step of each regression model included prenatal state anxiety, pregnancy-specific anxiety, and the indicator(s) of prenatally-measured attachment style (i.e., anxious, avoidant, or maternal-fetal attachment). For the regression models that examined moderating effects, interactions between pregnancy-specific anxiety and maternal attachment styles were explored in step three. Finally, effects of prenatal anxiety and attachment style on infant negative emotionality after controlling for postpartum symptoms were explored in the final step. Contrary to expectations, pregnancy-specific anxiety did not predict infant negative emotionality in any of the regression models, nor were there any significant moderating effects of attachment (Tables 1 and 2). Although both prenatal state anxiety and maternal anxious romantic attachment significantly predicted infant negative emotionality, effects were no longer significant after controlling for postpartum state anxiety. In the final model exploring simultaneous effects of all attachment styles, the only significant prenatal predictor of infant negative emotionality was maternal attachment to the fetus, which was positively associated with infant negative emotionality (Table 2).

P3-H-200 Infant Effects on Experimenter Behavior

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Beginning in the late 1960's (e.g., Bell, 1968), a considerable literature has emerged documenting the impact of children's characteristics on their own care and biopsychosocial outcomes. Yet, surprisingly little research has focused on the impact of the child on the experimental setting. It is well known in the infant literature that infant emotional states contribute to their own attrition, and even cognitive performance (e.g., Fagen et al., 1991). Less well known is the extent that infant characteristics contribute to experimenter social engagement. In the present investigation, we explored whether two experimenters responded to infants differently as a function of infant temperament. Sixty-

five infants (37 girls) visited the lab at $M = 15.38$ months ($SD = 1.99$). Mothers completed the Infant Behavior Questionnaire - Revised (IBQ-R) and a demographic assessment. Temperament measures derived from the IBQ-R were reduced to three overarching superdimensions (negative affectivity, effortful control, and surgency) from 14 subdimensions. Infants participated in a Brooks and Meltzoff (2005) type gaze-following procedure. On Trial 1, either of two experimenters sitting directly across from the infant established eye-contact by calling the child's name, said "Look!", then turned their head to look at a target object on the infant's left for 8 seconds. On Trial 2, experimenters followed the same procedure but looked to the infant's right. Trial 3 was the same as Trial 1. On Trials 4-6, experimenters followed a right-left-right pattern, with the exception that an Elmo videotape played on a monitor behind and above the experimenter as soon as the experimenter looked at the target object. Trials 4-6 were designed to test gaze-following under conditions of distraction. The two experimenters did not differ statistically from one another in looking to the target object on any trial (see Table 1; t 's ≤ 1.60 , p 's $\geq .12$); although, due to procedural requirements looking time for both experimenters differed as a function of distraction condition [$F(1, 57) = 98.53$, $p = .000$; see Table 1]. Nevertheless, during a procedural fidelity check, and despite both experimenters being blind to children's temperamental status, we found that experimenter looking time to the target objects in the control condition was correlated with both effortful control and surgency (see Table 2). These correlations were carried primarily by the subdimensions of duration of orientation and perceptual sensitivity, respectively. Evaluating the correlations separately by experimenter showed that both experimenters appeared to be susceptible to infant temperament. These results raise the possibility that even highly trained experimenters, blind to child temperament status, may be responsive to child characteristics when implementing experimental protocols. Obviously, in the present case, when experimenters remained visually engaged with target objects for longer periods of time for certain children, those children had greater opportunity to demonstrate gaze-following. In principle, children high in effortful control and surgency could demonstrate longer gaze-following not as a direct effect of their temperament, but as an indirect effect of their temperament mediated through an experimenter. Future experimental researchers may wish to include temperament instruments as standard protocol to test for experimenter fidelity.

P3-H-201 Temperament and the "developmental niche": Contributions of bedtime routine across 14 cultures

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Cross-cultural comparisons provide an opportunity to explore contextual factors that cannot be manipulated experimentally. In the study of temperament, research addressing differences in culturally-influenced daily context, such as sleep routines, can identify elements shaping developmental trajectories. Sleep is crucial to wellbeing across the lifespan and linked to temperament in early childhood (Scher, Tirosh, & Lavie, 1998). Parental bedtime routine practices vary considerably between cultures, and can help explain cross-cultural variability in temperament (e.g., Super et al., 1996); yet, such models have not been empirically tested. Multilevel modeling was used to explain cross-cultural differences in temperament measured using the Early Childhood Behavior Questionnaire (ECBQ; Putnam, Gartstein, & Rothbart, 2006), with three factors: surgency/extraversion (SUR), negative emotionality (NE), and effortful control (EC), and 18 fine-grained dimensions. Active (e.g., walking around, going for a car ride) and gentle (cuddling or reading stories) sleep techniques were assessed via parent-report on the Daily Activities Questionnaire (DAQ; Gartstein & Putnam, in press) among 14 countries: US, Brazil, Spain, Mexico, Italy, Russia, Finland, Romania, Belgium, the Netherlands, China, South Korea, Turkey, and Chile (N= 865), and examined as predictors of temperament. Child age and gender were included as covariates, and parenting techniques were considered as both culture-level (i.e., as culture averages) and individual-level (i.e., group-mean centered) variables. Significant effects for cultural means indicate that average frequency of use for a specific technique (i.e., either active or gentle) within a culture predicts individual differences in temperament. In contrast, significant group-mean centered effects indicate that the degree to which an individual varies in comparison to the cultural average reliably accounts for variance in temperament. Both within- and between- cultures differences in use of gentle or active techniques accounted for significant variance in all three temperament factors and several fine-grained dimensions. Interestingly, use of active techniques was more frequently associated with NE and its associated subscales, with the exception of the motor activity (an SUR subscale) and attention shifting (an EC subscale). In contrast, gentle techniques were significantly associated with SUR, EC, and many of their associated subscales, as well as various subscales of NE. Results support the importance of parenting practices and sleep routines in early development across

cultures. Culture-level differences in active and gentle techniques accounted for significant between-culture differences in temperament variables (e.g., NE was lower in cultures with higher average gentle technique use), and the degree to which caregivers deviated from the average bedtime practices of their culture accounted for significant within-culture variance (e.g., more frequent use of active techniques relative to the culture-mean predicted higher NE). This study demonstrates utility of the multilevel modeling approach in cross-cultural developmental research, which provides more accurate significance testing relative to traditional techniques (e.g., ANOVA) due to more precise standard error estimates, and allows for both within- and between groups effects, testing of more complex theories concerning universal and unique developmental trajectories.

P3-H-202 ABC Intervention for High-Risk Infants:Examining Effects on Maternal Depression in the Context of Community-Based Implementation

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Maternal sensitivity plays a central role in shaping children's development across a number of domains, and may be disrupted by maternal depression. According to the Center for Disease Control, approximately 1 in 9 women experience postpartum depression following the birth of their child. High-risk mothers (e.g., poor, homeless, history of adverse childhood experiences), in particular, are at heightened risk for maternal depression (Sidor, et al., 2011). Maternal depression may interfere with sensitive parenting through multiple mechanisms, including blunted neural responses to infant cues (Rutherford et al., 2016), negative cognitions about infant crying (Leerkes et al., 2015), and reduced emotion regulation capacities (Haga et al., 2012). Thus, it is critical to identify effective intervention approaches that reduce maternal depression, enhance maternal sensitivity, or potentially both. Intervention approaches studied thus far for depressed mothers have taken a number of approaches including home-based dyadic interaction training/coaching (e.g., Kersten-Alvarez et al., 2010), support groups (e.g., Fleming et al., 1992), and individual psychotherapy (e.g., Murray et al., 2003). A meta-analysis of 10 studies reporting on 13 interventions for depressed mothers demonstrated a small to medium effect size of interventions on improved maternal sensitivity (Kersten-Alvarez et al., 2011). However, few studies of mother-infant interventions have reported on intervention effectiveness at modifying maternal depression. Attachment and Biobehavioral Catch-up (ABC; Dozier et al., 2013) is a 10-session home-based intervention

that aims to increase nurturance to distress, increase following the lead, and decrease frightening behaviors. In previous efficacy studies, ABC has been shown to reduce insecure and disorganized attachment (Bernard et al., 2012) and normalize diurnal cortisol rhythms among infants (Bernard et al., 2015), relative to a control intervention. In the context of an effectiveness trial of the ABC intervention in the community, the current study examined the effect of ABC on reducing maternal depression. Participants included 98 parents (primarily minority mothers living in poverty in a high-risk urban community) and their infants (Mean age = 11.92 months). Upon enrollment, dyads were randomly assigned to receive ABC immediately or be placed on a 3-month waitlist. At baseline and follow-up, mothers completed the Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977). At baseline, there were no group differences in maternal depression, $t(96) = .87$, $p = .39$. A mixed-model ANOVA with time (pre/post) as a within-subjects factor and group (ABC/Waitlist) as a between-subjects factor revealed a significant interaction in predicting maternal depression, $F(1,96) = 4.43$, $p = .038$ (See Figure 1). Parents in the ABC condition showed a decline in depression, $t(47) = -1.98$, $p = .054$, whereas parents in the waitlist condition showed no change, $t(49) = 1.05$, $p = .30$. Findings demonstrate that ABC reduced depressive symptoms among high-risk mothers of infants, extending evidence about ABC's effectiveness from outcomes of child well-being to outcomes of maternal well-being. Future research should examine whether these changes in maternal depression mediate pathways towards key outcomes of interest, such as parent sensitivity and infant attachment.

P3-H-203 Parent Emotion Regulation Difficulty, Unsupportive Responses, Temperament, and Attachment Behaviors: A Moderated Mediation Model

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Emotion socialization practices, such as parental responses to toddlers' emotions (Eisenberg, Cumberland, & Spinrad, 1998), are often studied in relation to the development of children's emotion-regulation abilities. However, parents' responses to toddlers' emotions, particularly reactions to expressions of negative emotions, are also associated with the quality of the parent-child relationship (Berlin & Cassidy, 2003). Little work has examined parents' own emotion-regulation difficulties as related to their responses to their toddlers' emotions. Parents who have difficulty accepting their own feelings may find it harder to respond supportively to toddlers' emotions. In turn, toddlers who receive little support for their emotions may show compromised attachment-related

behaviors, indicating that the parent is not perceived as a consistent emotional resource and the child does not seek support from familiar adults. This may be especially salient for children whose temperamental reactivity renders them particularly sensitive to both positive and negative rearing experiences (Belsky, Bakermans-Kranenberg, & van Ijzendoorn, 2007). Using a differential susceptibility framework, the purpose of the study was to examine whether parental reactions to toddlers' negative emotions (Coping with Toddlers' Negative Emotions Scale; Spinrad, Eisenberg, Kupfer, Gaertner, & Michalik, 2004) mediated the relationship between parent-reported non-acceptance of their own emotions (Difficulties with Emotion Regulation; Gratz & Roemer, 2004) and toddlers' attachment behaviors (Attachment Relationships scale; LeBuffle & Naglieri, 1999), and whether these relationships were contingent upon child temperament (Early Childhood Behavior Questionnaire - Negative Affect; Putnam et al., 2006). The sample included 97 toddlers (Mage = 26.14 mo, SD = 6.90) and their mothers. Using Hayes' PROCESS model, we estimated the coefficients of a moderated mediation model wherein the indirect effect of parents' non-acceptance on attachment behaviors through unsupportive reactions was presumed to be moderated by child negative affect (Fig. 1). Maternal non-acceptance was significantly related to unsupportive responses, $a_1 = .37$, $CI[.18, .55]$. Controlling for parent-child dysfunctional interaction, the effect of unsupportive responses on toddlers' attachment behaviors depended on child temperament $b_3 = -5.15$, $CI[-9.27, -1.03]$. Bootstrapping procedures provided evidence of significant moderated mediation $iM = -1.88$, $CI[-4.20, -.43]$. Results indicate that parents' unsupportive reactions to toddlers' negative emotions predicted toddlers' attachment-related behaviors but only for children with a highly reactive temperament $b = -1.16$, $CI[-2.61, -.32]$. While parents' lack of acceptance of their own emotions increased their tendency toward unsupportive reactions to their toddlers' emotions, this relationship did not impact attachment behaviors for non-reactive children. Consistent with differential susceptibility, reactive children showed the highest risk in unsupportive contexts but also the greatest benefit in the absence of unsupportive responses (Fig. 2). Findings emphasize unsupportive responses as an important pathway through which parental emotion-regulation difficulties impact attachment behaviors thought to foster resilience. Findings also highlight the need to consider variations in susceptibility when examining how and for whom emotion socialization efforts impact parent-child relationship.

P3-H-204 The unique and interactive effects of prenatal exposure to maternal emotion dysregulation and acute stress on infant reactivity

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Introduction: Prenatal exposure to maternal emotion dysregulation can disrupt brain development and autonomic and immune system functioning (Monk, Spicer, & Champagne, 2012). Plasticity allows the developing fetal stress response system to adjust in structure and/or function in response to prenatal cues (Ellis, Bianchi, Giskevicius, & Frankenhuis, 2017). Although several research groups have examined effects of chronic stress on child social and emotional development, such as prenatal exposure to maternal depression, very little is known about how maternal chronic and acute stress interact to affect the infant stress response system. Gaining a better understanding of how these prenatal stressors interact to shape infant development will help us identify which children are most vulnerable to effects of acute stressors. In this study, we examine the main and interactive effects of prenatal acute and chronic stress exposure on infant stress reactivity. Hypotheses: Infants who were exposed to higher levels of prenatal chronic stress and a higher number of acute stressors will exhibit greater autonomic reactivity to a social stressor, the still-face (SF) paradigm. The effect of prenatal maternal chronic stress on an infant's physiology during the SF will depend on prenatal exposure to maternal acute stress. Study population: Participants (N = 31) are mothers and their 7-month-old infants recruited from a longitudinal study of prenatal exposure to maternal emotion dysregulation. Pregnant women are recruited from OB/GYN clinics and community centers serving pregnant women and are 10.3% Hispanic or Latino, 7.7% American Indian or Alaskan native, 15.4% Asian or Pacific Islander, 64% White, and 2.6% Black/African American. Infants are 55% Male, 45% Female. Average maternal age = 28.78 years. Method: Chronic stress was operationalized as maternal emotion dysregulation as measured by the Difficulties in Emotion Regulation Scale (DERS) during the third trimester of pregnancy. This measure assesses the mothers' ability to modulate emotional arousal, as well as being aware of, understanding, and accepting emotions (Gratz & Roemer, 2004). Acute stress exposure was measured during the third trimester using the UCLA Life Stress Inventory, which provides an index of discrete stress exposures over the previous 6 months (Hammen, Kim, Eberhart, & Brennan, 2009). Mother-infant dyads returned to the lab at 7 months to complete the SF paradigm (Tronick, Als, Adamson, Wise, & Brazelton, 1978). Physiological Monitoring: Infant heart rate and respiratory sinus arrhythmia (RSA) were collected during the SF paradigm using Mindware 3.1.5. Results: There were no significant main effects of prenatal maternal emotion dysregulation or prenatal episodic stress on infant HR or RSA during the SF episode (p 's > .38). Maternal emotion dysregulation and acute stress were also not significantly correlated ($r = .06$, $p = .75$). A significant interaction between maternal emotion dysregulation and episodic stress on infant HR (but not RSA) during the SF episode emerged. There were no significant

differences in HR among infants whose mothers were less dysregulated, regardless of the number of episodic stressors they experienced (Figure 1). However, the highest infant HRs emerged for infants whose mothers were more dysregulated and who experienced more chronic stress.

P3-H-205 Maternal Singing: Arousal Consequences for Mother and Infant

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Mothers around the world sing to their infants while providing care. Infant-directed (ID) song is typically higher in fundamental frequency, slower, more temporally regular, and more emotionally expressive than adult-directed (AD) song (Nakata & Trehub, 2011; Trainor et al., 1997). In general, ID song is readily identified as a lullaby or playsong. These song styles differ in acoustic properties and in their functional roles. Mothers sing lullabies with the goal of soothing infants or promoting sleep, and they sing playsongs to stimulate and engage their infants (Trehub & Trainor, 1998). There is little information, however, about the arousal consequences of these divergent singing styles for infant or mother. The present study included 20 mothers and their 8- to 11-month-old infants. Infants sat in a highchair, and mothers sat facing them. Mothers sang "Twinkle Twinkle Little Star" 16 or more times, singing it alternately in a soothing manner (i.e., like a lullaby) and in a playful manner (i.e., like a playsong). Between each sung performance, mothers talked and played with infants for 30 s. Maternal and infant arousal was assessed by measuring skin conductance (SC) with wireless sensors attached to the infant's foot and to the mother's fingertips (BioNomadix Wireless EDA Transmitters). For purposes of analysis, we used the normalized mean SC for the first and last 8 s of each sung performance. Mothers exhibited higher arousal levels when singing in a playful manner than in a soothing manner ($p < .001$), but in both cases their arousal decreased from the first to the last 8 s of their rendition ($p < .001$). During lullaby performances, infants ($p = .019$) as well as mothers ($p < .001$) exhibited decreases in arousal from the first to the last 8 s. Coordinated mother-infant arousal was not evident during playsongs but infants were more visually attentive to mother during playsong than during lullaby performances ($p = .030$). These findings highlight variations in arousal and attention in response to maternal song style, with lullabies having calming effects on mothers and infants (decreased arousal), and playsongs increasing maternal but not infant arousal but effectively capturing infant attention.

P3-H-207 Sociability Moderates Associations Between Shyness and Toddlers' Inhibitory Control.

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Early shyness has been linked to children's inhibitory behaviors, most commonly under the premise that shy children may show greater inhibitory control because they tend to be compliant (Rudasill & Konold, 2008). Interestingly, research has suggested that the association between shyness and children's behaviors may differ according to subtypes of shyness, specifically children who show shy-sociable tendencies versus those who show shy-unsociable behaviors (Asendorpf, 1990; Rubin & Coplan, 2004). In this regard, Cheek and Buss (1981) posited that considering sociability in relation to shyness may render explanation why shy people are not all alike since sociability may moderate the relation between shyness and various outcomes (Bruch, Gorsky, Collins, & Berger, 1989). We posit that similar differences in associations between shyness and children's inhibitory control will be evident based on elements of sociability and shyness. Further, a unique aspect of the current work is the focus on toddlers, in contrast to the bulk of the literature on shyness/sociability which has focused on adults and adolescents. Children begin to develop inhibitory control in toddlerhood (Carlson, 2005). Inhibitory control is closely associated with emotion regulation (Carlson & Wang, 2007) and social competence (Rhoades, Greenberg, & Domitrovich, 2009), both of which are important developmental areas emerging during early childhood. As previous studies found different social-emotional development outcomes between shy-sociable and shy-unsociable individuals (Asendorpf, 1990; Bruch et al., 1986; Rubin & Coplan, 2004), these two types of shy children may vary in their inhibitory control. Therefore, in this study, we examine whether sociability moderates the association between shyness and inhibitory control. A total of 107 toddlers (M age=26.14 months, SD age=6.90) were observed during a standard Gift Delay Task and inhibitory control was coded on a 5-point scale describing the child's inhibitory behavior toward the gift (0, Pulled gift from the bag, to 4, Did not touch or peek into the bag). The Early Childhood Behavior Questionnaire (ECBQ; Putnam, Gartstein, & Rothbart, 2006) was administered to parents to determine toddler's shyness and sociability. Hierarchical multiple regression analysis was conducted to test whether there is an interaction effect between shyness and sociability on inhibitory control. Results indicated a significant interaction effect between shyness and sociability predicting inhibitory control. Simple slope tests indicated that only the slope of high sociability was

significant ($b = -.52, p < .01$). For children with low sociability, inhibitory control did not differ across their level of shyness. However, children who were higher in both shyness and sociability, showed lower inhibitory control compared with children who were lower in shyness and higher in sociability. Their poorer inhibitory control may be due to their anxious behavior as previous studies found that shy-sociable individuals exhibited more anxious behavior, which is originated from an approach-avoidance conflict, a combination of feelings of inhibition and desire to interact. (Asendorpf & Meier, 1993; Cheek & Buss, 1981). Further, children who were lower in shyness and higher in sociability showed higher inhibitory control. Our results suggest that sociability may be an important factor to consider in the relation between shyness and social-emotional outcomes.

P3-H-208 Moderators Influencing the Association between Maternal Depression and Preschool Social Inhibition

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Early child social inhibition predicts later negative adjustment outcomes such as anxiety and peer difficulties (Rubin, Coplan & Bowker, 2009). Studies suggest that maternal depression plays a role in child socioemotional outcomes (Goodman et al., 2011). However, this association is likely indirect and influenced by parent-child interactions and individual characteristics. Possible moderators include child temperament and harsh parenting. Fearful temperament and maternal anxiety are related to later social withdrawal (Kiel & Buss, 2011, 2013), though the relation with maternal depression is unknown. Additionally, studies demonstrate that parenting behaviors influence the association between maternal psychopathology and children's outcomes (e.g., Gartstein & Fagot, 2003). The present study aims to examine the roles that fearful temperament and parenting behaviors play as moderators of the association between maternal depression and child social inhibition. Based on prior literature, we hypothesized that harsh parenting and fearful temperament would predict more social inhibition for children with more depressed mothers. The current study is part of a larger longitudinal study. We assessed fearful temperament at 24-months using observations of behavior from the toddler-version of the Lab-TAB (Buss & Goldsmith, 2000); a greater sensitivity of fear across high- and low-threat tasks reflected higher fearful temperament (Buss et al., 2017). Parents also completed questionnaires on their parenting practices at 24-months. We created a composite for harsh parenting by standardizing and averaging parent responses to the verbal hostility, non-reasonable punishment, and corporal punishment subscales of the

Parenting Practices Questionnaire (Robinson et al., 1995). At 60 months, parents self-reported internalizing symptoms using the Center for Epidemiologic Studies Depression Scale (Radloff, 1977) and General Anxiety Disorder Questionnaire (Newman et al., 2002). Teachers reported children's outcomes using the McArthur Health Behavior Questionnaire (Armstrong et al., 2003), and we measured solitary play from a laboratory observation of free play with peers using the Play Observation Scale (Rubin, 2001). We found a significant interaction between maternal depression and fear sensitivity when controlling for maternal anxiety to predict teacher-reported social inhibition on the HBQ ($\beta = 0.04$, $t(39) = 3.27$, $p = 0.002$). Maternal depression was positively associated with social inhibition in a classroom context for children lower in fear sensitivity. Controlling for maternal anxiety, there was also a significant interaction between maternal depression and harsh parenting on children's solitary passive play behaviors in the laboratory ($\beta = -1.08$, $t(56) = -3.07$, $p = 0.003$) (Figure 1). These findings are surprising given prior literature demonstrating that harsh parenting and fearful temperament are related to increased social inhibition. Our composite of harsh parenting may be a reflection of parental control. For children with depressed mothers, low fear sensitivity and having less parental control may be risk factors for developing social inhibition symptoms. Temperamentally fearful children may be less sensitive to the effects of maternal depression and could become socially inhibited regardless of maternal symptoms, whereas, for other children, maternal depression and parental control may be another pathway for developing social inhibition.

P3-H-209 Early Withdrawn Behaviors in Toddlers Predicts Later Depressive Mood in Pre-Adolescents

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The aim of the study was to examine the early risk factors, including withdrawn behaviors in infancy, for adolescent depressive symptoms. Previous research indicated children who are more fearful, withdrawn, and inhibited in early ages are more likely to exhibit depressive symptoms as they enter early adolescence (Caspi, Henry, McGee, Moffitt, & Silva, 1995). However, not all individuals with early depressive symptoms and withdrawn behaviors develop depressive symptomatology. Effortful control (EC), a temperamental trait that describes one's ability to manage one's attention and behavior, has been found to moderate the severity of depression (Rothbart, Ellis, Rueda, & Posner, 2003). Low levels of EC are linked to the development psychopathology among children (Dennis, Brotman, Huang, & Gouley, 2007). While accumulating research indicates the connections between

early temperament, EC, and psychopathology, the findings of the associations between EC and depression symptomatology are inconsistent. Therefore, we test this moderation model of effortful control. We hypothesized that early depressive/withdrawn behaviors in toddlers would predict later depressive mood when children have lower effortful control, but not when children have high effortful control. Data were drawn from a longitudinal study of temperament and social development. Participants were 124, 2-year-old toddlers (54% female, 92% Caucasian, 57% total annual income above 60,000) and their caregivers followed through to the age of 12. At age 2, parents completed the Infant-Toddler Social & Emotional Assessment (ITSEA) which measured early symptomology. We followed up with a sample of 61 participants and the caregivers and participants completed additional measurements at age 5 and 12 years old. Effortful control was measured at age 5 via parent-report using the Children's Behavior Questionnaire (CBQ). When the participants were reaching adolescent at the age of 12, they completed the Early Adolescent Temperament Questionnaire (EATQ), which measured the depression symptomatology. The preliminary results indicated the depression/withdrawn scale on the ITSEA at age 2 significantly correlated with the depressive mood at age 12 years on the EATQ ($r = .397^{**}$). Withdrawn behaviors at age 2 predicted the depression symptomatology at age 12. We then ran moderation analyses using EC to determine whether the early effortful control can protect the children from developing depression in adolescence. Although the overall interaction model was not significant, a Process model probing different levels of effortful control revealed significant effects at low ($\beta: 21.67$ $p: .003$) and moderate ($\beta: 16.52$ $p: .013$) levels of effortful control, but not at high levels of effortful control ($\beta: 11.38$ $p: .288$). This indicates that the effects of early withdrawn behaviors on later depressive mood are not present when children have higher effortful control, suggesting that effortful control may serve as a protector from developing depressive symptoms.

P3-H-210 Early Predictors of Callousness and Unemotional Traits: The Role of Child and Parent Temperament

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Callous and unemotional (CU) traits are identifiable by patterns of persistent lack of empathy, disregard for others, and a generally deficient affect. These traits are associated with increased risk of severe and violent antisocial behavior, and endorsement of the CU specifier for Conduct Disorder in the Diagnostic and Statistical Manual-5th Edition (DSM-5; American Psychiatric Association, 2013) is considered to be a negative prognostic

indicator. Frick (2014) noted children with CU traits have difficulty regulating their emotions, and described their behavior as distinct from other antisocial youth and more similar to characteristics of adult psychopathology. Despite emerging research, an adequate understanding of early childhood etiology of CU traits is currently lacking. The present study addresses this gap in research, considering parent and infant, as well as toddler temperament, as predictors of CU, controlling for concurrent child behavior problems. Based on the existing literature, a child temperament profile marked by fearlessness, sensation-seeking tendencies, and low affiliativeness, was expected to confer risk for CU. A similar pattern of effects was anticipated for parental temperament, although the latter has not been previously empirically examined in this context. Data from a larger project were utilized. Specifically, maternal responses to the Infant Behavior Questionnaire-Revised (IBQ-R; Gartstein & Rothbart, 2003) and the Adult Temperament Questionnaire (ATQ; Evans & Rothbart, 2012) were obtained at 4 months, with parent-report of temperament collected again at 2 years of age, using the Early Childhood Behavior Questionnaire (ECBQ; Putnam, Rothbart, & Gartstein, 2006), at the same time that general behavior problem and CU trait information was obtained (N=85). The Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2000) was used to provide an indicator of total behavior problems, considered as a covariate, as well as to derive an indicator of CU traits (Trentacosta et al., 2016), based on three items ($\alpha = 0.65$). Parental and toddler temperament factors were also considered as predictors of CU, to determine which dimensions made unique contributions. Although the IBQ-R indicators were not significantly correlated with CU, a number of associations were noted for ATQ scores (Table 1). CU was positively correlated with maternal effortful control and extroversion, and negatively correlated with ATQ negative affectivity. At the subscale level, CU was positively correlated with inhibition and high intensity pleasure. Associations in the negative direction were noted for maternal discomfort and frustration. CU was significantly negatively correlated with the negative emotionality factor of the ECBQ, as well as fear and shyness subscales. CU was also significantly positively correlated with activity level, high intensity pleasure, and positive anticipation subscales. Hierarchical multiple regression was performed to identify unique significant associations between parental and toddler temperament and CU traits. Only toddler positive affectivity significantly predicted CU ($\beta = .178, p < .038$) with other temperament factors in the equation. These findings suggest CU traits are associated with toddler, but not infant temperament correlates, as well as parental temperament attributes. The latter links may be important to understanding the intergenerational transmission of risks for conduct disorder and adult psychopathy.

P3-H-211 Infant Anxiety and Depression at 24- and 36-months: Infant and Maternal Characteristics and Social Support

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Anxiety is an adaptive response to stressful situations that can be found in all age groups including infants. Infants may experience anxiety when separating from parents, when experiencing a new or unusual situation or loud noises. These anxieties are adaptive and found in most typically developing infants, but in some situations, infants can experience high levels of anxiety and as a result develop Anxiety Disorder later in life. Although Anxiety Disorders have been well described for older children and adults, researchers only recently have started to focus on Anxiety Disorders in toddlers and preschoolers but not many focus on infants. As a result, little is understood about predictors and correlates of Infant Anxiety/Depression (IAD) during the first three years of life. The main purpose of this study therefore is to examine child and maternal characteristics as risk and protective factors for IAD in 24- and 36-month-old infants. Using data from the National Institute of Child Health and Human Development Early Child Care study, the current study tested the effects of multiple child characteristics and maternal characteristics on IAD at 24 and 36 months longitudinally. Specifically, the current study examined indirect effects of maternal depression, parenting stress, social support measured at 6-, 15-, 24-, and 36-months, and maternal personality and infant difficult temperament measured at 6-months on IAD. Maternal negativity was observed and measured at 24-months during dyadic play, with higher score indicating higher level of maternal negativity. Finally, IAD was reported by mother at 24- and 36-months using the Child Behavior Check-List for Ages 2-3, with higher score indicating higher level of anxiety/depression. Path analyses were conducted to assess the direct and indirect impact of maternal and child characteristics on IAD separately at 24- and 36-months. See Figures 1 and 2. The findings of this study show that Infant Anxiety and Depression at 24-months was predicted directly by maternal depression and parenting stress at 15-months, and maternal agreeableness and infant difficult temperament. Infant AD at 24-months was predicted indirectly by difficult temperament, social support (6-mos.) and maternal agreeableness through maternal depression and parenting stress. Infant Anxiety and Depression at 36-months was predicted directly by maternal depression and Infant AD at 24-mos and parenting stress at 6-months, and infant difficult temperament. Infant AD at 36-months was predicted indirectly by difficult temperament via IAD at 24-months; maternal depression at 6-months via maternal depression and IAD at 24-months; parenting stress via IAD 24-months. These findings suggest that infant difficult temperament early in infancy is a

precursor to the development of IAD at both 24- and 36-months. High levels of maternal depression and parenting stress in infancy are red flags for the development of IAD in the first three years of life. Finally, maternal social support, even when provided early in infancy can still serve to reduce the development of IAD by reducing mothers' depression and parenting stress. These findings suggest the need for alleviating maternal depression and parenting stress early in infancy in order to prevent the development of anxiety disorder.

P3-H-212 Unpredictability in Parent-Child Interactions and Children's Externalizing Problems

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Child behavior problems are associated with negative outcomes such as an increased risk for conduct, adjustment problems, and poorer mental health (Choe, Olson, & Sameroff, 2013; Sterba, Prinstein, & Cox, 2007). Maladaptive parent-child interaction patterns are one key contributor to children's behavior problems. For example, research has shown that higher rigidity in parent-child interactions, defined as fewer transitions between dyadic behavioral or affective states, predicts children's higher behavior problems (e.g. Hollenstein, 2005; Lunkenheimer et al., 2011). Such research suggests that the dynamics of parent-child interactions matter. However, very little is known about how unpredictability in parent-child interactions, or disorganized interaction patterns that reflect an equal probability of transitioning into any one of many dyadic states, influences children's behavior problems. When dyadic behavioral patterns are disorganized it may be difficult for dyad members to predict one another's behaviors (Dishion et al., 2004), which may lead to dysregulation in one's own behavior. Dyadic unpredictability may reinforce children's already dysregulated behaviors leading in turn to behavioral problems. The current study investigates the relations between dyadic unpredictability and children's externalizing and internalizing behavior problems. Sixty-five mother-child dyads participated in a 3-wave study. Data from time 1 (T1) and time 2 (T2) were analyzed. At T1 and T2 children were on average 2.58 years old ($SD_{age} = .15$ years) and 3.15 years old ($SD_{age} = 0.10$ years), respectively. At T1 and T2 mothers completed questionnaires about their children's behaviors. At T2 dyads completed the Parent-Child Challenge Task (PCCT; Lunkenheimer et al., 2016). Dyads completed several puzzles above the child's cognitive ability level that necessitated parental verbal guidance. The PCCT was coded offline for parent and child behaviors using an established coding system. State Space

Grids were used to plot coded behaviors on a 5 X 4 grid and calculate a corresponding entropy value that represents unpredictability, $\text{Entropy} = \text{Sum of } P \cdot \ln(1/P) = \sum (P_i \cdot \ln(1/P_i))$. Regression analysis revealed the overall model examining the relation between dyadic unpredictability and externalizing, controlling for previous levels of externalizing, was significant ($F(2,65) = 25.49, p < 0.001, \text{Adj. R-sq} = 0.42$). A significant positive relationship between dyadic unpredictability and externalizing was revealed, such that higher levels of unpredictability were related to higher levels of child externalizing even after controlling for previous levels of externalizing ($b = 0.18, t(65) = 2.15, p = 0.04$). This same relation was not found for internalizing. Although the overall internalizing model was significant ($F(2,63) = 31.33, p < 0.001, \text{Adj. R-sq} = 0.48$), there was no significant relation between dyadic unpredictability and child internalizing ($b = .007, t(63) = 0.24, p = 0.81$). Given that young children are gaining the foundational skills for self-regulation from parent-child interactions, these results suggest that unpredictable interaction patterns influence children's externalizing but not internalizing, behaviors. This influence may be due to disorganized patterns contributing to children's dysregulated behaviors. Future work should focus on examining child and parent characteristics that may affect dyadic unpredictability and child behavior problems.

P3-H-213 Affect Presentation and Parenting Experiences in Infancy Predict Later Internalizing Behaviors

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Affect representations during infancy are associated with internalizing behaviors in children (Dougherty, Klein, Durbin, Hayden, & Olino, 2010). However, few studies have examined the roles of early sensitive and negative-intrusive parenting practices as potentially shaping such associations and how these constructs simultaneously predict internalizing behaviors. Early caregiving experiences play a critical role in the development of emotion and affect (Côté et al., 2009) and ultimately thus may indirectly affect the onset of internalizing behaviors. The current study examined how positive and negative affect at 15 months were associated with internalizing behaviors at 58 months, as well as such associations were moderated by sensitive and negative-intrusive parenting at 24 months. Given research indicating that parenting influences differ across ethnic groups, we examined whether the effects differ for African American versus European American children. Data come from a representative sample of children living in low-income, rural U.S. communities. The sample ($N = 1,255$) was 41% African American and 46% female. At

15 and 24 months, positive and negative affect and sensitive and negative-intrusive parenting behaviors were measured using observational assessments during a parent-child interaction task. At 58 months, internalizing behaviors were measured using the Strengths and Difficulties Questionnaire based on parental reports. Analyses consisted of a series of hierarchical multiple regression models including child gender, race, maternal income ratio, and state of residence as covariates. Two models were tested, one for positive parenting and other for negative parenting. Significant interactions terms from these analyses were probed using tests of simple slopes. Results indicated that sensitive parenting in infancy predicted lower levels of internalizing behaviors for all children ($b = -.03$, $b = -.07$, $t(708) = -2.08$ $p = .03$). Although it was hypothesized that associations among affect and parenting dimensions would be found among all children, results indicated that the nature of these associations were moderated by race. For European American children, lower levels of negative affect were associated with greater internalizing behaviors in the presence of low positive parenting ($b = -.05$, $b = -.16$, $t(386) = -2.13$ $p = .03$). For African American children, more negative-intrusive parenting was associated with higher levels of internalizing behaviors ($b = .05$, $b = -.13$, $t(323) = 2.37$ $p = .01$). The present study highlights association between child affect and parenting experiences in infancy as predictors of emerging internalizing psychopathology during middle childhood. First, it extends the general finding that sensitive parenting plays a protective role with respect to the early emergence of internalizing behaviors across ethnic groups. Second, it provides evidence that negative-intrusive parenting predicts internalizing behaviors in African American children. Finally, it suggests that infants low in negative affect may be at risk of developing internalizing behaviors in the presence of insensitive parenting. These findings raise important questions regarding different levels of vulnerability to environmental influences among European American and African American children. Understanding sociocultural differences in the developmental significance of infant affect and early parenting behaviors may inform preventive interventions.

P3-H-214 Parenting prevention intervention in mothers of pre-term infants

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Children born pre-term are at-risk for poor self-regulation, emotional difficulties and behavior problems (Feldman, 2009; Linhares, Gaspardo & Klein, 2012). Moreover, the developmental regulation process depends of the quality of mother-child interactions.

The parental practices of the mother may interact with the biological risk of prematurity, moderating it through buffer or exacerbate the negative impact of risk. Therefore, preventive intervention programs can support mothers to develop positive parental practices and act as co-regulators of the emotional and behavior responses of children. The ACT Program - Raising Safe Kids, (Silva, 2009, American Psychological Association), is an universal preventive intervention, performed in eight group sessions, aiming to improve parental skills and promote positive parental practices. The aim of this study was investigate the effects of the ACT Program on the parental practices of mothers of pre-term infants of 1-3 years of age, and on child behavior outcomes. The sample comprised 18 Brazilian young adult mothers, who participated in the intervention ACT, and another 18 child's family caregivers (predominantly, the fathers), who participated only answering the child behavior questionnaire. The mothers answered the ACT Questionnaire (Silva, 2009) and the Parenting and Family Adjustment Scale (PAFAS) (Sanders et al., 2013), for parental practices assessment. The mothers and another informant caregivers answered the Strengths and Difficulties Questionnaire (SDQ) (Goodman, 1997), for child behavior assessment. All evaluations were performed at pre- and post- ACT intervention. The statistical descriptive and within-group comparison (Wilcoxon test) analysis were performed ($p \leq 0.05$). The results showed that Communication ($p \leq 0.05$) and Emotional/Behavioral Regulation ($p \leq 0.001$) scores, assessed by the ACT scale, and the Parenting Practices ($p \leq 0.0001$), Parental Adjustment ($p \leq 0.012$) and Parent-child Relationship ($p \leq 0.019$) scores, evaluated by PAFAS, improved in the post-intervention in comparison to the pre-intervention. In SDQ evaluation both mothers and another caregivers reported few behavioral problems in the children in the pre-and post- intervention moment; thus, there was no statistically significant differences within moments. Despite this, there was an increase in the percentage of the normal classification, both in the perception of the mothers (67% to 78%) and the other family member (67% to 88%). In conclusion, the ACT Program was effective for modifying parental practices of mothers of children born preterm, acting as a protective factor against the negative impact of premature childbirth on child development.

P3-H-215 Longitudinal Predictors of Parental Involvement in Early Infancy: The Role of Parent Personality and Infant Anger and Fear

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Parenting is a complex construct that is generally assessed in two broad categories: quality (i.e., sensitivity, responsiveness) and quantity (i.e., involvement). Parental involvement has found to be influenced by both parent and child factors (Mehall et al., 2009). Parent factors, such as employment status and parental competence, have been found to directly influence parental involvement (McBride & Mills, 1993; Pleck, 1997). Infant temperament has been found to indirectly predict parental involvement (Mehall et al., 2009). However, the association between parent personality and infant temperament as predictors of parental involvement has not been examined by previous research. There are also differences in amount and type of parental involvement between mothers and fathers. Mothers are more involved than fathers; father involvement increases as infants age (Gaertner et al., 2007). Mothers are involved in more care activities, whereas fathers are more involved in play activities (Marsiglio et al., 2000). However, research examining differential predictors of parental involvement in mothers versus fathers is lacking. The current study aimed to address these gaps in research by examining whether infant temperament moderated the association between parent personality and parental involvement across infancy in mother-infant versus father-infant dyads. Participants in this longitudinal study included families (mother, father, and infant) at 4 ($n = 49$), 6 ($n = 41$), and 8 ($n = 35$) months of age. Parents separately completed questionnaire packets, which included the assessments of infant temperament (Infant Behavior Questionnaire - Revised; Rothbart & Bates, 2003), parent personality (Behavioral Activation System/Behavioral Inhibition System Questionnaire; Carver & White, 1994), and parental involvement (What I Did with my Baby Checklist; Lickenbrock & Braungart-Rieker, 2015). Hierarchical multiple regression models revealed different results for mothers and fathers. For mothers, infant anger at 4 months was found to moderate the association between maternal BIS at 4 months and involvement at 8 months ($B = .26$, $SE = .10$, $p < .05$). Follow-up simple slope analyses were used to test all interactions at one standard deviation above and below the mean (Aiken & West, 1994). Figure 1 shows that for infants higher in anger, as maternal BIS increased, maternal involvement increased as well ($B = .24$, $SE = .07$, $t = 3.60$, $p < .01$). Regression models for fathers revealed two significant interactions, (Figure 2). Infant anger at 4 months was found to moderate the association between paternal BIS and involvement at 8 months ($B = .20$, $SE = .09$, $p < .05$). For infants lower in anger, as paternal BIS increased, paternal involvement decreased ($B = -.25$, $SE = .09$, $t = 3.60$, $p < .01$). Additionally, father models revealed that infant fear at 4 months moderated the association between paternal BIS and involvement at 8 months ($B = -.22$, $SE = .09$, $p < .05$). For infants higher in fear, as paternal BIS increased, involvement decreased ($B = -.25$, $SE = .08$, $t = -3.14$, $p < .01$). Overall, results from this study show that there are differential predictors of involvement for mothers and fathers in early infancy.

P3-H-216 Intra-Infant Variability in Negativity and Toddler Effortful Control

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Temperament refers to interindividual differences in the intraindividual processes of reactivity and regulation (Kagan, 1994; Derryberry & Rothbart, 1997). During early life, infants with negatively reactive temperaments may be experienced as difficult to care for, potentially straining caregiver capacity and creating risk for suboptimal social-emotional development (Bridgett et al., 2009). Alternately, temperamentally negative infants may elicit increased caregiver support and gain increased opportunities to practice social-emotional skills with caregivers (Paulussen-Hoogeboom et al., 2007). The present study explores whether variability in fussing and crying at 4 months predicts a key regulatory competency, effortful control, at 18 months. Participants were 106 infant-mother dyads who were primarily white and middle class. When infants were 4 months old, mothers completed daily diaries recording infant state (asleep, awake/content, awake/fussy, awake/crying, and feeding) every 5 minutes for 3 days (Barr et al., 1988; James et al., 1993). Fussing and crying proportion scores were calculated for each hour, resulting in a total of 15,264 datapoints (106 dyads x 24 hours x 3 days x 2 variables). Intra-infant variability in fussing and crying were operationalized as the individual-level mean squares of successive differences (iMSSD), a measure that captures both overall dispersion and successive mean changes across time. Higher iMSSD indicated more frequent negativity bouts and/or greater variability in bout duration. When toddlers were 18 months old, effortful control was measured in the laboratory via the "Don't Touch" procedure, which requires the toddler to delay playing with an attractive toy until receiving permission from an experimenter (Kochanska & Knaack, 2003). Outcomes were dichotomized so that only toddlers who waited the entire delay period were considered to have "passed." Logistic regressions tested whether intra-infant variability in fussing and crying predicted toddler effortful control during the "Don't Touch" procedure. Results indicated that intra-infant variability in fussing evinced a linear relationship with effortful control; each unit increase in intra-infant fussing variability was associated with a 40.32 higher log odds of passing the delay procedure. A quadratic association was not found. In addition, intra-individual variability in crying was not related to toddler effortful control at all. These findings are in keeping with previous work demonstrating positive associations between temperamental difficultness and positive social-emotional outcomes among low-risk, middle class families (Paulussen, Hoogeboom et al., 2007).

P3-H-217 Associations between maternal physiology and maternal sensitivity vary with infant reactivity across fear and anger contexts

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Previous research demonstrates that maternal sensitivity during infant distress tasks is predicted by the interaction of mothers' physiological reactivity (skin conductance; SCL) and regulation (RSA withdrawal), with greater reactivity related to more sensitive cognitions and subsequent responses only for mothers who display greater regulation (e.g. Leerkes, Su, Calkins, & O'Brien, 2016). However, this pattern may depend on other salient characteristics. First, mothers' interpretation of infant needs and corresponding physiological responses may vary across situational contexts (see Porges, 2007). Situations that elicit infant fear may motivate maternal fight-or-flight responses, and thus an SCL increase paired with RSA withdrawal may better support sensitive soothing and protection. Alternatively, mothers may view anger-inducing situations as safer and more goal-oriented, and thus SCL increase paired with RSA augmentation may instead facilitate sensitive social engagement and problem-solving. Secondly, these patterns of physiological responses may be more strongly tied to sensitivity to infants who display relatively more negative emotional reactivity and thus indicate greater emotional needs. Based on these expectations, the current study examined maternal sensitivity during interactive tasks eliciting infant fear and anger as predicted by the interaction of infant negative affect, maternal SCL change, and maternal RSA change. Mothers and their 1-year-old infants (N = 189, 49% Caucasian) participated in two interactive tasks designed to elicit infant fear (novel character approach) and infant anger (toy removal). Infant negative affect was coded continuously throughout each task. Mothers' SCL and RSA were assessed during each task and change scores were calculated relative to a baseline assessment. Lastly, maternal sensitivity was rated from videos based on the appropriateness of maternal behavior to infants' affect. Multiple regression models predicting maternal sensitivity were run separately for the fear and anger task, based on infant negative affect, mother RSA change (higher scores indicated greater withdrawal), mother SCL change (higher scores indicated greater increase), and all 2- and 3-way interaction(s), controlling for mother race and education. Consistent with hypotheses, a significant 3-way interaction emerged for each task, and indicated that the RSA-by-SCL interaction was significant only when infants displayed relatively higher negative affect

(NA). In the fear task, among mothers of infants who displayed higher NA, greater SCL increase was related to greater sensitivity in mothers with higher RSA withdrawal ($B = .13$, $p < .001$), but not lower ($B = -.04$, $p = .28$; Figure 1). However, in the anger task, among mothers of infants who displayed higher NA, greater SCL increase was related to greater sensitivity in mothers with lower RSA withdrawal ($B = .04$, $p = .02$), but not higher ($B = -.02$, $p = .32$; Figure 2). These results have important implications for our understanding of the physiological bases of maternal sensitivity. First, maternal physiological responses may be more strongly tied to sensitivity with infants who display relatively greater negative emotional reactivity. Secondly, mothers may have different motivational responses to different types of infant emotion, and as such, maternal sensitivity may be supported by different patterns of maternal physiological responses in different interactive contexts.

P3-H-218 Emotion regulation behaviors in 6- and 12-month-old full-term and VLBW preterm infants: Implications for adaptive self-regulation

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The development of adaptive emotion regulation strategies predicts social and emotional competence. Failure to develop these abilities is associated with socioemotional, behavioral, and academic problems, and ultimately risk of psychopathology. In early development, parents and infants operate jointly to regulate emotions, allowing infants to develop adaptive independent regulation strategies. Prematurity, particularly when associated with low birth weight, may be disruptive to dyadic regulation, and to the development of independent regulation. Although the developmental transition from dyadic to independent strategies is well-documented, there is a dearth of research on how the development of these strategies differs in full-term and preterm infants. We examined dyadic and independent emotion regulation behavior in full-term and very-low-birthweight preterm (VLBW/PT) infant-mother dyads. Mothers and their full-term ($>2750\text{g}/6\text{lbs}$; 38-41 weeks gestation; $n=40$) and VLBW/PT ($800\text{-}1500\text{g}/1\text{lb}12\text{oz-}3\text{lbs}$; <32 weeks gestation; $n=40$) infants participated at 6 and 12 months. At 6 months, dyads participated in the Still-Face procedure, consisting of two normal interaction periods and a still-face interaction (mothers maintain a neutral expression and do not interact with their infants; Tronick et al., 1978). At 12 months, dyads participated in two free-play interactions, a puzzle task, and an interference task (mothers complete a questionnaire while child plays nearby). Emotion regulation behaviors were coded using a systematic,

observational coding system adapted from the Infant Regulatory Scoring System (Tronick & Gianino, 1996). Mother-infant interactions were coded on a second-by-second basis to capture the following infant behaviors: Dyadic (cooperative play, joint attention, attention-seeking), Self-comforting (self-directed vocalizations, mouthing, exploratory), Escape (ignoring or increasing distance from mother), and at 12-months, Independent play (individual and parallel play). A series of 2 x 4 (Group x Period) mixed ANOVAs were conducted. At 6-months, infants exhibited more self-comforting during the still-face period, and more dyadic and less escape behavior during the reunion-normal period. Across interaction periods, VLBW/PT infants engaged in similar amounts of dyadic and escape behavior, however full-term infants exhibited more self-comforting behavior than VLBW/PT infants. At 12-months, infants exhibited more self-comforting and independent play during the interference task, and more dyadic behavior during the puzzle task. Across tasks, full-term and VLBW/PT infants engaged in similar amounts of dyadic behavior. Full-term infants exhibited more self-comforting behavior while VLBW/PT infants exhibited more independent play. There was an interaction effect in escape, such that full-term infants exhibited more escape behavior in the free-play and interference tasks, but VLBW/PT infants exhibited more escape behavior in the puzzle task. These findings suggest the early emergence of independent regulation in full-term infants, whereas VLBW/PT infants may continue to rely on strategies that have an external source of regulation, be it toys or their mother's presence. Consistent with past studies, our findings indicate that VLBW/PT infants display less sophisticated emotion regulation capabilities. These results have implications for the differential development of independent self-regulation behaviors in full-term and preterm infants.

P3-H-219 Caregiver interference in relation to infants' vocal expressions: Context and maternal perceptions of infant's temperament matter

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The Laboratory-Temperament Assessment Battery (Lab-TAB) behaviorally assesses temperament-linked individual differences and consists of a series of short episodes designed to elicit fear, joy, or frustration (Buss, 2011). For example, one episode consists of a puppet show, where the puppets are friendly and engaging towards the child, which is generally considered pleasant. A different episode consists of a mechanical spider moving into the room with the infant is seated on mom's lap. Infants' reactions during such contrasting episodes provide valuable information about their temperament profiles.

For instance, some infants show fearful responses to non-threatening episodes and extreme fear during the spider episode, whereas others may happily approach novel or scary stimuli. Equally relevant to infants' responses during these episodes is the fact that mothers are always present, and their behavior likely influences the infant's emotional expressions. In addition, caregivers behave differently as a function of child's temperament (Kiel & Buss, 2012). We examined caregiver interference in relation to infants' negative and positive vocalizations during different Lab-Tab episodes. Fifty six infants-to-date (34 boys) between 15 and 24 months ($M=19$, $SD=3$) who completed all Lab-TAB episodes and the Toddler Behavior Assessment Questionnaire (TBAQ) were included in the analyses. The TBAQ captured mothers' perceptions of their child's temperament, particularly infant's social fear. From videotaped observations Coders rated infant's vocal distress, positive vocalizations, and caregiver interference in 10-second epochs. With the exception of caregiver interference - which was coded once in each episode - behavioral codes were averaged across the duration of the episode. Preliminary linear regression models for each Lab-TAB episode revealed significant associations for the Spider episode only (Fig. 1). Caregiver behavior was significantly related to infant's vocal distress, $\beta = 1.23$, $t(48) = 2.34$, $p < .05$, but also significantly interacted with TBAQ scores to predict vocal distress. During this episode, mothers of high socially fearful infants were more likely to interfere even when the infant was not exhibiting vocal distress, $\beta = -.27$, $t(48) = -2.0$, $p < .05$. There were no associations between caregiver behavior and vocal expressions for the Puppet episode. These results are in line with previous findings that mothers of temperamentally fearful infants may be more protective and intrusive if they anticipate their children's fearful responses (Kiel & Buss, 2011). Furthermore, these results highlight the effects of context on caregiver behavior, which may not be equally intrusive across different situations. However, we do not know how infants' emotional expressions might change across the timeseries of different Lab-TAB episodes, and whether these individual trajectories are differentially associated with caregiver interference. With the full sample, rather than creating averages across episodes we will conduct timeseries analysis to examine the dynamics of infants' emotional expressions across the episode's timeseries using a person-specific approach (Molenaar, 2017), and test whether caregiver interference mitigates or exacerbates children's emotional expressions. We hypothesize that emotional expressions will differ in their micro-trajectories depending on infant's temperament, as will the effects of caregiver interference.

P3-H-220 Maternal sensitivity towards maltreated infants: A look at maternal unresolved attachment state of mind and childhood trauma

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Very few studies have been conducted on young maltreated children aged 0 to 3. It is well established that maternal childhood trauma, current parenting stress, and psychopathology are good predictors of parenting difficulties leading to child maltreatment (e.g. Pereira et al., 2012). However, to our knowledge, maternal states of mind with respect to attachment, have never been examined in relation to sensitivity of maltreating parents. To better inform attachment based-intervention with maltreating parents, this study examined the distinct and combined contributions of severe maternal past trauma and current unresolved maternal attachment state of mind to maternal sensitivity. The sample is composed of 69 mothers ($M = 27.07$, $SD = 6.22$) and their maltreated children (55.1% boys) aged 0 to 3 ($M = 12.57$, $SD = 12.85$). At the time of assessment, all mothers had been reported to Child Protective Services (CPS) for child abuse and/or neglect and all were undergoing a parental capacity assessment (see table 1). Mothers were administered the Childhood Trauma Questionnaire (Bernstein & Fink, 1998), to assess their childhood history of maltreatment, and the Adult Attachment Projective (West & Pettem, 1997) to evaluate for the presence of an unresolved attachment state of mind according to the standard 4-schemes classification system. The short version of the Maternal Behavioral Q-Sort (MBQS; Pederson & Moran, 1995; Tarabulsky et al., 2009), yielding scores between -1 and 1, was completed by an independent observer, using a 10-minute, filmed, mother-child free-play task. Results of a two-way analysis of variance revealed a significant effect for attachment unresolved state of mind ($F(1,65) = 5.134$), indicating that mothers with unresolved attachment had lower sensitive interactions with their children ($M = 0.15$, $SD = 0.35$) in comparison to mothers with a resolved states of attachment ($M = 0.32$, $SD = 0.36$). No significant effect was found for childhood trauma, nor for the interaction term testing for the cumulative effect of childhood trauma and unresolved attachment ($F(1,65) = .71$ and 1.20 , respectively, see table 2 for means and standard deviations). This study suggests that a history of childhood maltreatment is not a significant predictor of later maternal insensitivity in maltreating mothers. Rather, this study underscores the importance of maternal unresolved attachment state of mind as a better predictor for maternal insensitivity. In conclusion, this study suggests that one way to improve sensitivity and responsiveness levels of maltreating parents towards their child, is to help them with the reinterpretation and

resolution of their past attachment experiences with their own attachment figures. A clinical focus on past trauma seems not to be necessary.

P3-H-221 Attachment in infants with Visual Impairment: applicability and findings of the Strange Situation Paradigm

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Studies with diverse populations enrich attachment theory by documenting both universal and idiosyncratic aspects of attachment. Given the effects of attachment in children's socio-emotional outcomes, such studies are necessary to investigate the impact of children's sensory impairments on attachment development. Yet very little attachment research has focused on infants with visual impairment (VI), a population in which infant-caregiver emotional exchanges through visual means are reduced or absent. To conduct attachment research in VI infants, we must first investigate methodological questions that arise from the fact that current paradigms were designed for typically sighted children. Do paradigms, such as the Strange Situation Paradigm (SSP), trigger attachment behavior in VI infants? Do VI children evidence their attachment in ways that are classifiable by existing coding protocols? Thus, our first aim was to investigate the applicability of the SSP, with added instructions to compensate for degraded visual input (table 1), in 20 VI infants (with no additional disabilities and who were receiving developmental counseling). Our results provide evidence that the SSP, with added instructions to maximize infants' perception of the procedure's relevant information, can successfully trigger VI infants' attachment behavior, and that attachment patterns in this population of children can be reliably coded. All but 1 of the 27 collected SSPs were deemed classifiable by a certified and experienced SSP coder. Our second aim was to report the distribution of attachment patterns in VI infants. Several documented factors put at risk attachment development in VI infants. Caregivers may fail to perceive and respond to VI infants' signals in ways that promote social exchange. VI infants show some pre-attachment and attachment behaviors with less consistency and strength than sighted peers do. We thus wondered if we would find an increased prevalence of insecurity in our sample of VI infants, compared to reports in sighted peers. We did not have a strong prediction on this point because VI infants do demonstrate some attachment behaviors more consistently and at earlier ages

when they have haptic/olfactory/auditory input from adults. In addition, the way these behaviors manifest in these infants is less through their facial expressions and more through their vocal and motor actions. If caregivers are aware of the optimal conditions to emotionally engage with their VI infants, and of the idiosyncratic ways their infants signal attachment, caregivers will be more likely to perceive and respond to their VI infants' signals. If so, a higher representation of insecurity may not be an unavoidable outcome in this population of children. Indeed, across the ages tested (fractional age range = 0.9-2.33), most VI infants' attachment patterns were classified as secure (table 2) and organized. In summary, the present investigation provides evidence that the SSP, with added instructions to increase VI infants' perception of critical events (i.e., separation and reunion from caregiver), is applicable to this population of children. Findings also suggest that, VI infants with no additional disabilities and whose caregivers receive developmental counseling, do not necessarily show a higher prevalence of attachment insecurity, compared to sighted peers.

P3-H-222 Infant temperament, and parents' anxiety are related to infant processing of emotional faces

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Introduction: Cognitive theories of anxiety assign a causal role to attention biases towards threat in the development of anxiety disorders (Van Bockstaele et al., 2014). A causal bidirectional link between anxiety and attention biases towards threat has been reported in child and adult populations (Bar-Haim et al., 2007; Dudeney et al., 2015). Anxiety in parents was also recently shown to be related to stronger attentional biases towards threat in infant offspring (Morales et al., 2017). However, we have not yet tested direct links between parents' and offsprings' attention biases towards threat in early development. The current study for the first time explored the direct links between infants' and parents' attention and pupillary arousal to dynamic emotional (vs. neutral) facial expressions. The relationship between parents' anxiety and attention biases towards threat in infants was also investigated, alone and in interaction with infants' negative temperament. Hypotheses: We hypothesized that (a) more anxiety in parents and more negative temperament in infants would be linked to stronger attention biases and stronger pupillary responses to threat in infants and (b) there will be a positive relation between parents' and infants' attention biases to threat and pupillary responses. Study Population: The sample consisted of 225 infants (74 6-month-olds, Mage = 6.09, SD =

0.51, 83 12-month-olds, $Mage = 12.08$, $SD = 0.60$, 68 18-month-olds, $Mage = 17.90$, $SD = 0.65$) and 224 parents from the community sample. Methods: Infants' and parents' pupil responses and dwell times to angry, fearful, happy, and sad (versus neutral) faces were measured with an eye-tracker. Mothers' and fathers' anxiety, and infants' negative temperament were measured with parent-report questionnaires. Results: Parents, but not infants, showed stronger pupillary responses to emotional (vs. neutral) expressions. Infants looked longer at fearful and happy faces, while parents looked longer at negative versus neutral faces. The direct positive link between parent-infant pupil responses was only significant in the 18-month-old group. More negative temperament in infants predicted stronger pupillary responses to angry and happy (vs. neutral) expressions. Maternal and paternal anxiety jointly predicted less interest to fearful and sad (vs. neutral) expressions in infants. Conclusions: The current findings reveal differences in infants' and parents' emotion processing, and show that similarities between parents' and infants' pupillary responses only become observable when infants are 18 months old. The findings provide additional support for the idea that infant temperament and parental anxiety dynamically shape infants' emotion processing.

P3-H-223 Maternal Depressive Symptoms and Infant Sleep: The Role of Maternal Physiological Response to Infant Distress

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Links between environmental risk factors and infant sleep have been established (Sadeh, Tikotzky, & Scher, 2010), including the well-documented association between maternal depressive symptoms (MDS) and infant sleep problems. As such, identifying protective factors that can buffer the negative effect of MDS on infant sleep has important applied implications. Based on recent theoretical models (Bridgett 2015; Deater-Deckard, 2014) and empirical evidence (Groh et al., 2017; Leerkes 2016) that highlight the role of maternal self-regulatory abilities in children's developmental outcomes, the current study examined physiological aspects of maternal self-regulation that can moderate the link between MDS and infants' sleep. One physiological measure that has been associated with self-regulation is respiratory sinus arrhythmia (RSA), which indexes parasympathetic control of the heart via the vagus nerve (Porges, 2007). RSA withdrawal (RSAW), or the decrease in RSA (from baseline) that occurs during challenging contexts, is thought to support behaviors indicative of active coping. It has been argued that a high degree of

maternal RSAW within challenging caregiving contexts is an indicator of mothers' physiological self-regulation that facilitates the organization of an effective caregiving response (Mills-Koonce et al., 2007). Thus, in the current study we examined whether maternal heightened RSAW in response to infant distress can buffer the negative effect of MDS on infant sleep. Eighty-four infants and their mothers were assessed at age 6 months. MDS were reported using the Center for Epidemiological Studies Depression Scale (CES-D; Radloff, 1977). Mothers' cardiac activity was recorded at rest and during the Face-to-Face-Still-Face (SFP) paradigm and estimates of maternal RSAW were calculated by subtracting the average RSA during the reunion episode of the SFP from the average RSA during baseline. High scores indicate greater RSA withdrawal. Infant sleep was measured via actigraphy (Actiwatch-2) for 7 consecutive days. Two sleep outcomes were derived: night time sleep duration and sleep consolidation (i.e., ratio of nighttime sleep to 24-hour sleep). MDS and maternal RSAR were both not significantly related to infant sleep duration and consolidation. However, there was a significant interaction between MDS and maternal RSAW in predicting infant sleep consolidation ($\beta = .76$, $p < .001$) explaining 36% of the variance in infant sleep consolidation. As depicted in Figure 1, post hoc analysis indicated that the link between MDS and infant sleep consolidation was significant only when mothers had low degrees of RSAW ($B = -.06$, $SE = .01$, $p < .001$), but not when mothers had high degrees of RSAW ($B = .00$, $SE = .01$, $p = .60$). The interaction between MDS and maternal RSAW did not predict infant sleep duration. Mothers with efficient physiological regulatory capacities may be better able to modulate their negative emotions during challenging caregiving contexts, preventing the negative effect of depressive symptoms on parenting behaviors and consecutive infant sleep problems. Further research is needed in order to elucidate the behavioral mechanisms that may explain the protective role of maternal RSAW in the context of infant sleep.

P3-H-224 Touching Base: Maternal Touch During the Reunion Phase of the Still-Face Paradigm and Relationship to Concurrent Trauma Symptoms

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Introduction: Touch is key to caregiver-infant bonding in the postnatal period (Feldman et al., 2010). Observations from rat models further suggest that touch may be one of multiple "hidden regulators" at work in mother-infant dyads (Hofer, 2006). In a role that is perhaps inseparable from its regulatory function, touch also forms part of the early communication system (Hertenstein, 2002). Caregiver touch (deliberately or not)

communicates a range of emotions to the infant, with consequences for the infant's emotional arousal (Hertenstein, 2002). Previous studies have examined maternal depression and touch in the context of the Still Face Paradigm (SF). Peláez-Noguera and colleagues (1996) found that infants of depressed mothers demonstrated more positive affect when the mother's neutral face was accompanied by touch; the same did not hold for infants of nondepressed mothers. Mantis et al. (2018) coded touch behaviors of depressed and nondepressed mothers during both the reunion phase and pre-SF interaction. Higher levels of depressive symptoms predicted less engagement in touch behaviors during the reunion phase and less playful/stimulating touch overall. With few if any exceptions, studies of maternal touch during the SF have yet to examine maternal trauma symptoms as a predictor of touch behaviors. The present study examines whether maternal trauma symptoms predict the extent to which mothers touch their infants in the SF reunion phase; the correlation between trauma symptoms and the proportion of reunion time spent in specific categories of touch (e.g., affectionate, stimulatory) is also examined. Finally, the role of maternal touch in predicting infant stress recovery (as indexed by respiratory sinus arrhythmia) will be investigated. Method: The sample for the present study represents a subset of a cohort of $N = 105$ low-SES infant-mother dyads studied prospectively across the pre- to postnatal transition. At the time of enrollment, participants were living below the US federal poverty level. Data for the present investigation comes from the 5-month post partum assessment, in which mother-infant dyads participated in the Still-Face Paradigm (SF). Mothers completed the Trauma Symptom Checklist-40 during this same visit (TSC-40; Briere & Runtz, 1989). The TSC-40 includes 40 items divided into six subscales, which correspond to classes of trauma symptoms. Maternal touch behaviours during the SF reunion phase were micro-coded offline using research software (Noldus, Wageningen, the Netherlands). The software equips coders (blinded to maternal TSC scores) to view video in .01-second frames. Maternal touch categories were those devised by Feldman and colleagues, and included affectionate, stimulatory, functional, and proprioceptive touch, and touch to the infant's extremities (Feldman and Eidelman, 2007). Results and Discussion: Total TSC scores ranged from 2 to 54 ($M = 10.84$, $SD = 6.34$). Mothers spent between 0.22 and 28.04 percent of the reunion phase engaged in infant-directed touch ($M = 10.84$, $SD = 6.34$). TSC scores were negatively correlated with the percentage of the reunion phase spent in touch ($r = -.37$, $p = .012$); women reporting higher total TSC scores engaged in proportionally less time touching during reunion. Analyses are underway to determine if TSC scores predict differential proportions of time spent in categories of touch. Further analyses will determine if TSC scores interact with touch to predict RSA changes.

P3-H-225 Infants' Attentional and Emotional Reactions to others? Emotional Faces: the role of Parental Empathy

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Already in their first year of life, children are able to communicate their emotions while engaging in social interactions with different social partners. The ability to coordinate eye gaze with facial expressions represents a fundamental step into the development of a mature socio-emotional functioning, essential for regulating daily relationships, and inevitably social life. Whereas research has abundantly showed the importance of parental mentalization abilities during early parent-child interactions, surprisingly little is known about the role of parental empathic dispositions for children's socio-emotional development. The present study investigated how both maternal and paternal empathic abilities to feel and understand the causes of others' emotional experiences relate to infants' attentional and emotional reactions to different emotional faces, already in the first year of life. Participants were 115 parents (Nmothers = 109, Nfathers = 93) and their infants (N6month = 51, N12month = 64). Parents' empathy was assessed with the Interpersonal Reactivity Index (IRI; Davis, 1983). Two subscales that assess affective aspects of empathy (empathic concern and personal distress) and one subscale that assesses the cognitive aspect of empathy (perspective taking) were analyzed for the present study. Infants' attentional and emotional reactions were observed during an experimental procedure in which each parent-infant couple was presented with five different dynamic emotional faces (neutral, happy, fearful, sad, angry) on a computer screen. Attentional (i.e., infants' gaze to the video and to the parent) and emotional (i.e., positive, neutral and negative facial expressions) reactions during the triadic contexts were systematically coded at the micro-level. Preliminary Spearman's nonparametric correlations analyses were first conducted between infants' visual attention behaviors and parents' scores on the questionnaire measures. Results highlighted a positive relation between maternal personal distress and children's visual attention to the fearful videos, $r = .19$, $p = .045$. In addition, results show also a positive relation between maternal empathic concern and children's attention to the parent during the neutral videos, $r = .25$, $p = .008$. Secondly, associations between infants' emotional reactions and parents' empathic dispositions pointed out: a) positive relations between maternal perspective taking and infants use of positive facial expressions during the neutral videos, $r = .28$, $p = .023$; b) positive relations between maternal empathic concern and children's use of positive facial expressions during angry videos; c) negative relations between infants' neutral emotional responses to angry emotional videos and maternal perspective taking

and empathic concern, $r = -.25$, $p = .009$ and $r = -.22$, $p = .021$, respectively; d) negative relations between maternal empathic concern and infants' neutral emotional response to sad emotional videos, $r = -.22$, $p = .025$; e) negative relations between maternal prospective taking and infants' neutral responses to neutral videos, $r = -.28$, $p = .017$. Although preliminary, findings support the idea that infants' attentional and emotional reactions to emotional situations already in the first year of life are related to parents' affective and cognitive dispositional empathy. Crucially, the patterns of these associations seem to consistently differ between mothers and fathers.

P3-H-226 Salivary Alpha-Amylase Response to High and Low Levels of Infant Crying

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Title: Salivary Alpha-Amylase Response to High and Low Levels of Infant Crying **Authors:** Rachel Level, Sophie Arnold, Hayley Beach, Ana Isabel Torruella Suárez and Debra Zeifman

i Autonomic Nervous System (ANS) dysregulation has been suggested as a factor contributing to caregivers' aggressive or neglectful response to infant crying. In recent studies, salivary alpha-amylase (sAA) has been used as a biomarker of ANS arousal, and both physiological hyper-arousal and hypo-arousal have been linked to potentially harmful response patterns. In addition to caregiver's physiological response profiles, infant temperament and specifically excessive crying is known to contribute to hostile responses. Infants are at greatest risk for abuse and Shaken Baby Syndrome near the developmental peak of crying, and infants whose cries are perceived to be excessive are at elevated risk. The present study aimed to measure women's ANS reactivity in response to high and low levels of infant crying during a 10-minute caregiving interaction employing a realistic infant simulator. In Study 1, $N = 35$ nulliparous women were randomly assigned to care for an infant simulator programmed to be either "difficult" (crying frequently) or "easy" (crying infrequently) for 10 minutes. Salivary alpha-amylase was assayed 3 times: at baseline, immediately following the 10-minute simulation, and after a 10-minute recovery period. In addition, women were asked to rate their own subjective stress and emotional reactions to the infant simulator. Although women in both experimental conditions displayed similar post-simulation increases in sAA, there was a statistically significant difference in sAA between the "easy" and "difficult" conditions following the recovery period. A repeated-measures ANOVA with experimental phase (baseline, post-simulation, recovery) as a within-subject factor and experimental condition

(high, low demand) as a between subject factor yielded a significant main effect of phase on sAA, $F(2, 32) = 8.16, p = .001$, and a significant interaction between phase and condition, $F(2, 32) = 3.48, p = .043$. Women exposed to a "difficult" infant took significantly longer than those exposed to an "easy" infant to recover from the stress of caring for a frequently crying infant (see Figure 1). In Study 2, $N = 19$ mothers were run through the same 10-minute caregiving simulation. In contrast to non-mothers, mothers exhibited similar sAA response and recovery profiles in response to caring for a "difficult" and "easy" infant. Mothers also reported being less stressed by the simulation and experiencing less anger and irritation than non-mothers. The results suggests that both infant temperament and caregiver experience may play a part in determining women's responses to caring for infants. One limitation of the present research is women's age and parental status were confounded in our sample; mothers in Study 2 were older, on average, than non-mothers in Study 1. Future studies should recruit women who are similar in age but have varying levels of childcare experience in order to isolate the effects of age and previous experience. Additional research employing larger sample sizes, a greater number of physiological indices, and economically diverse and at-risk populations is needed.

P3-H-227 Patterns of Maternal Threat Bias Moderate the Association between Household Chaos and Infant Regulation.

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Household chaos, a measure of the level of routine, organization, and noise in a home, has extensive behavioral correlates in members of a household, including aspects of infant negative emotionality (Bridgett, Burt, Laake, & Oddi, 2012) and increased problem behaviors and less effective discipline from a parent during childhood (Dumas, Nissley, Nordstrom, Smith, Prinz, & Levine, 2005). Moreover, Finegood, Raver, DeJoseph, and Blair (2017) have found that parental report of chaos in the home environment is predicted by an interaction between parental anxiety and a negative attentional bias, specifically in a low-income sample. Here, we asked whether maternal report of home chaos at 4 months concurrently predicted infant regulation, and whether this relation was moderated by variation in threat bias of the caregiver. Infants (to date $n = 35$) were part of a larger ongoing longitudinal study assessing attention and temperament at 4, 8, 12, 18, and 24 months of age. At the 4-month time point, parents completed the CHAOS scale (Matheny, Wachs, Ludwig, & Phillips, 1995) to measure household chaos, and the IBQ-R (Gartstein

& Rothbard, 2003), to assess temperamental regulation, including subscales assessing low intensity pleasure, cuddliness, duration of orienting, and soothability. The primary caregiver also completed a dot probe task with trials including angry vs. neutral faces, happy vs. neutral faces, and neutral vs. neutral faces. Eye movements were recorded during the task. Using the eye tracking data, an emotion bias score for both angry and happy faces was created by subtracting the net dwell time of the neutral face from the net dwell time of the paired emotional face. The score of interest was the angry bias score, reflecting a visual bias to threat. A moderated regression indicated a significant interaction between caregiver report of home chaos and caregiver threat bias in predicting caregiver report of infant regulation ($\beta = 0.001$, $t(31) = 3.76$, $p < 0.001$). Examination of the Johnson-Neyman interaction plot (Figure 1) shows that for caregivers with a threat bias score of greater than 14.353 above the mean, home chaos is positively associated with infant regulation. However, for caregivers demonstrating avoidance to threat, with a threat bias score of less than 17.345 units below the mean, home chaos is negatively associated with infant regulation. Prior work suggests home chaos predicts generally negative behavioral outcomes. However, these data suggest a potential protective effect of higher maternal attention bias to threat for infant's regulatory abilities in a chaotic home. Conversely, attention avoidance, which has been associated with anxiety in individuals exposed to trauma, may be linked to greater risk. Future directions will examine regulation at 8 months of age, to see if these relations at 4 months predict regulation patterns at 8 months.

P3-H-228 Early signs of maternal and paternal role-reversed caregiving: Relations with toddler emotional regulation

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Parental role reversal, defined as caregiving during which the parent looks to their child to meet the parent's emotional needs, has been shown to predict poorer self-regulation, externalizing problems, and poor childhood peer interactions (Macfie, Houts, McElwain, & Cox, 2005; Sroufe & Jacobvitz, 1989). Compared to hostile/harsh forms of insensitive parent-child interactions, role reversal between young children and parents has been understudied. As of yet, it is unclear how early it is possible to observe signs of role-reversed parenting, and whether these early observations of role-reversed parenting predict early problems in children's emotion regulation. Moreover, most studies of parental predictors of children's early emotional development have only examined

mother-child interactions as a predictor of children's later emotion regulation. However, young children are part of a family system, experiencing caregiving from both parents. Thus, the purpose of the present study was to examine early signs of both mothers' and fathers' role-reversed caregiving when their infants were 8 months old as predictors of their later emotion regulation at age 24 months. We hypothesized that role-reversal in both parents' caregiving at 8 months would predict poorer emotion regulation in infants at 24 months, but that these effects would be qualified by a significant interaction between mothers' and fathers' role-reversed caregiving, such that their toddlers' adaptive emotion regulation would be lowest when both parents showed high role-reversal, and highest when both showed low role-reversal. Data from 119 mothers and fathers were collected from a larger longitudinal study that focused on parenting dynamics. Role reversal was assessed at eight months during separate mother-infant and father-infant interactions that included play, feeding, and a clothes change. These videotaped interactions were later coded for instances of parental role reversal using a 9-item rating scale that assessed the extent to which the parent seemed to become upset or hurt when baby did not show affection, and saw baby as an extension of the parent rather than an autonomous person. Toddler emotion regulation was assessed through two tasks that have been successfully used to assess toddler emotion regulation by inducing frustration (Hazen et al., 2010). Adaptive emotion regulation was scored high when toddlers exhibited a developmentally appropriate range of emotions to the tasks, whereas low scores were given to toddlers who became too distressed to complete the tasks, or demonstrated flat affect regardless of success or failure. Results demonstrated that, after controlling for infant temperament, the interaction of mothers' and fathers' role-reversal caregiving at 8 months predicted poorer toddler emotion regulation at 24 months (see Table 1). As expected, emotion regulation was highest when both parents had low role-reversal ratings, but unexpectedly, it was lowest when one parent was high in role-reversal and the other was low. These results underscore the importance of understanding mothers and fathers as a caregiving team from a family systems theory perspective. They also have important implications for early parenting interventions and education.

P3-H-229 Infants' Discrimination of Bimodal Emotion Depends on Valence

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Infant-directed registers are emotion communication, conveying feelings and intentions that facilitate and modulate attention and language learning. Many studies have

examined bimodal emotion discrimination during infancy but not the relative salience of different modalities in emotion discrimination. This study examined how 7- to 15-month-old infants discriminate changes in visual emotion, auditory emotion, and visual+auditory emotion after being habituated to a bimodal emotion display. The study involved a between subject condition of emotion type during habituation: half the infants were habituated to a fear display whereas the other half were habituated to a happy display. Thus, emotion discrimination could be assessed both in terms of the modality of change and the emotion valence. Twenty-three infants were habituated to an audiovisual display of emotion (happy or fear) then received four test trials: (1) neither source of information was changed (familiar), (2) auditory information was changed (A), (3) visual information was changed (V), or (4) both auditory+visual were changed (AV). The primary dependent measure was infant-controlled look duration during test trials. A mixed ANOVA on looking duration with condition (Happy, Fear) as the between subject factor and trial (Familiar, A, V, AV) as the within subject factor resulted in no main effect of trial ($F(3,63)=1.61$, $p=.20$, $\eta^2=.07$), a significant main effect of condition ($F(1,21)=5.55$, $p=.03$, $\eta^2=.21$), and no significant condition \times trial interaction ($F(3,63)=1.26$, $p=.26$, $\eta^2=.06$). Given the small sample, we examined whether the ratio of attention on change test trials to the familiar test trial was different across condition. For Happy, infants looked more on V trials (fear face; $t(11)=2.75$, $p=.02$), but not on A trials (fear voice; $t(11)=1.44$, $p=.18$). Look duration on AV trials was marginally significant (fear voice, fear face; $t(11)=2.02$, $p=.07$). In contrast, infants did not look longer on A, V, or AV trials in Fear (all $ps > .40$). Comparing attention on like test trials across conditions, only AV trials were different ($t(21) = 2.23$, $p=.04$); look duration on Happy AV trials was significantly longer than on Fear AV trials. These findings show that (1) infants' attention is elevated seeing/hearing positive emotions which is consistent with infants' ongoing preference for IDS; and (2) infants' discrimination of a change in emotion was easiest when going from a happy to fear face, but not the reverse, and not going from a happy to fear voice. It is possible that being familiarized to a bimodal fear expression increased infants' arousal such that they could not accurately attend to changes in emotion valence in any modality (i.e., low attention to all changes in the fear condition). This is also evident in infants' high level of attention to the AV change only in the Happy condition. These results will be discussed in terms of the interaction between multimodal sensitivity and attention/arousal processes during infancy.

I: Translational Science

P3-I-231 Maternal Irregular Sleep Patterns and Parenting Quality during Infants' First Six Months

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Literature addressing sleep dysregulation and compromised daytime functioning is well-established. Late bedtimes have been associated with depression (Levandovski et al., 2011) and poor physical health (Fabbian et al., 2016); short sleep durations have been linked with cognitive dysfunction (Banks & Dinges, 2007); and variability in sleep duration has been predictive of poorer well-being (Lemola et al., 2013). Few studies, however, have examined linkages between sleep dysregulation and quality of mothering with infants. There is, we believe, good reason to do so. Impairment of cognitive and emotional functioning resulting from dysregulated sleep may compromise parents' ability to provide sensitive, appropriately responsive parenting with infants. This hypothesis was examined in the present study. Because sleep is multidimensional, we included multiple indicators of sleep patterning to enable a fuller understanding of maternal sleep patterns' links to parenting quality. Data from an NICHD-funded study focusing on parenting, sleep, and infant development were used. Mothers reported their daily bedtimes and wake times across 7 consecutive days when infants were 1, 3 and 6 months. Maternal sleep duration was calculated as the difference between wake time and bedtime. Each mothers' bedtime and sleep duration was averaged across the 7 days at each age point, and variability in sleep duration across the 7 days for each mother was also calculated. At each age point, maternal emotional availability (EA) was scored from videorecordings during one night of infant bedtime and from one daytime videorecording of mother-infant free play and feeding, using the Emotional Availability Scales (Biringen et al., 1998). EA coders were blind to maternal sleep patterns and were highly reliable in their scoring. As the correlations in Table 1 indicate, later bedtimes and greater variability in sleep duration were significantly associated with lower bedtime EA at 3 and 6 months ($ps < .05$), but were not related to daytime feeding or interaction EA. The correlation between average sleep duration and EA at infants' bedtime was only significant at 6 months (Table 1). Stepwise multiple regression analyses were then conducted to predict maternal bedtime EA from average bedtime, average sleep duration and variability in sleep duration at 3 and 6 months separately. At 3 months, variability in sleep duration significantly predicted maternal bedtime EA at step 1, but average bedtime and average sleep duration did not enter into the model at step 2. At 6 months, variability in sleep duration was significantly predictive of bedtime EA at step 1. At step 2, both variability in sleep duration and average bedtime significantly predicted bedtime EA, but the average sleep duration did not enter into the model. These results are among the first to demonstrate that maternal irregular sleep patterns, especially variability in sleep duration and late bedtimes, are predictive of

poorer parenting quality with infants at bedtime. Parent sleep regulation and sleep hygiene have typically not been primary foci in parenting interventions, but the present findings suggest that they should be, and perhaps particularly so during the transition to parenthood, when parental sleep is highly likely to be disrupted.

P3-I-232 Mothers of Overweight Infants: What, Me Worry?

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Obesity rates for infants under age 2 years, while not as alarming as for preschoolers, are nevertheless worthy of concern. Indeed, using CDC growth charts and a criterion of greater than or equal to the 95th percentile, it is estimated that 8.1% US infants are already obese, with rates for girls higher than for boys (Ogden et al., 2014). It is well established that parents of preschoolers are not very accurate in assessing their children as being overweight (Carnell et al, 2005); however, little is known as to whether parents of infants give any thought to this, or are even less concerned than parents of young children. In the present study, the responses of mothers of normal weight infants were compared to those of infants already deemed to be obese to determine if the latter group displayed higher concerns related their infants' weight status. As part of a longitudinal investigation on the precursors of child obesity, low-income mothers were recruited at a WIC center. The 91 mothers who participated in this phase of the study were either black or Latina, and all reported having formula-fed their infants from birth. Mother-infant dyads were visited at home when their babies were 24-months-old, with the infants weighed and measured and the mother responding to an orally-administered questionnaire. The survey instrument included 12 items culled from the Infant Feeding Practices Questionnaire (IFPQ; Baughcum et al, 2001) and from the Child Feeding Questionnaire (CFQ; Birch et al., 2001). Items were scored on a 1-5 scale, with 5 being high on the characteristic. Using their weights and heights to calculate BMI, 67 of the infants were classified as being of normal weight (less than the 85th BMI percentile for age and sex), while 24 of the infants (~18%) were shown to be at or above the 95th percentile, classifying them as obese. To examine differences between mothers of the obese (OB) versus non-overweight (NO) infants, t-tests were conducted on the survey items. Significant differences were detected for mothers': » concern that infant is underweight: NO= 2.60, OB= 1.92, $t = 2.059$, $p < .05$; » perceived responsibility: NO= 3.85, OB= 4.67, $t = -2.052$, $p < .05$; » food monitoring: NO= 4.01, OB= 4.72, $t = -.215$, $p < .05$. However, differences were not shown for items such as mothers': » awareness of infant's hunger cues: NO= 4.32, OB= 4.58; » perception that

infant is overweight: NO= 1.75, OB= 1.83; » concern that infant is overweight: NO= 2.09, OB= 2.42; » concern that infant is overeating: NO= 1.79, OB= 1.52; pushing the infant to eat more: NO= 2.10, OB= 1.80. Despite their infants meeting the criterion for obesity, these mothers displayed little concern for their infants being excessively overweight. Recalling that the sample was comprised of Latina and black mothers, it is possible that these mothers may actually favor fatter babies. That is, while not making a conscious effort to overfeed their infants, the view that "a chubby baby is a healthy baby" as a cultural norm (Kaufman & Karpati, 2007) may partially explain their responses that reflect their lack of concern.

P3-I-233 Trajectory of Fidelity After Introducing a New Model of Intervention

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Introduction: Attachment and Biobehavioral Catch-up (ABC) is an evidenced-based parenting intervention that improves attachment and self-regulation in high-risk infants and toddlers. ABC is implemented by parent coaches who make in the moment comments about intervention-relevant parenting behaviors: sensitivity, nurturance, and delight. The fidelity of these comments is tracked through supervision during a parent coach's first year of training. Parent coaches are expected to reach specific milestones to become certified. After reaching certification levels in the infant model of ABC, coaches have the opportunity to train in the toddler model, which introduces a new behavior target addressing dysregulation. This study examined the trajectory of parent coach commenting rates from infant certification to the toddler intervention. It was expected that there would be an initial drop in the trajectory of their commenting at the start of the toddler intervention, as coaches may struggle with commenting about child dysregulation, with a rate that then returns to or surpasses certification level once the parent coach had the opportunity to master the new behavior target. Methods: Once beginning training in the toddler model, parent coaches met with supervisors weekly via video conferencing. Prior to meeting, supervisors and coaches independently coded a 5-minute video clip from a recent session. During supervision, the coach is provided with feedback on commenting and coding. The data included in this study were from a sample of 10 parent coaches' infant certification levels, their first opportunity to comment on dysregulation (beginning of toddler training), and their final supervision. Two cohorts of parent coaches trained in the toddler model will be available by ICIS. The first cohort is presented below. Results: The average rate of comments per minute at time of infant-

certification was 1.55. As expected, there was a significant decrease at the start of the toddler intervention with an average rate of 1.16 ($t(9) = 6.328, p < .001$). The average rate significantly increased to 2.14 at the final supervision ($t(9) = 9.263, p < .001$). Analyses of the average content level of comments and percentage of missed opportunities will also be presented. Conclusions: These preliminary findings support the hypothesis that further supervision for parent coaches training in the expansion of a parenting intervention is necessary. This will better prepare the coach to make frequent and well-structured ITM comments. These findings also suggest that the additional supervision effectively helps coaches master the new target.

P3-I-234 Dyadic interactions in children exhibiting the broader autism phenotype: Is BAP distinguishable from typical development?

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Objectives: In families raising a child with an autism spectrum disorder (ASD), infant siblings are at elevated risk for ASD and other developmental concerns including subclinical ASD features, often called the Broader Autism Phenotype (BAP). Typically the BAP is indexed using standardized developmental assessments; however, BAP difficulties are often social in nature. The present study aims to expand our developmental understanding of the BAP within a social context. Specifically, this study compares children exhibiting elements of the BAP to their typically developing peers on (1) standardized measures (replicating previous studies), and (2) during dyadic play interactions during the first two years of life. **Methods:** As part of a prospective study, dyads were recruited from families with at least one older child with ASD (high-risk group, $n = 36$), and families with no history of ASD (low-risk group, $n = 38$). During laboratory visits at 12, 15, 18, and 24 months of age infants completed a series of standardized assessments and a mother-child play session. Dyadic play interactions were micro-analytically coded for gaze, positive affect, and vocalizations to create theory-driven composites to index dyadic synchrony and responsiveness. Videos were also coded with an existing rating scheme for joint engagement and child responsiveness. Between 24 and 36 months, children completed an outcome visit and, following previously established criteria, children were assigned to BAP ($n = 22$) and TYP ($n = 52$) groups. **Results:** A series of ANCOVAs were conducted, with terms for infant sex and maternal education as covariates, and revealed significant group differences on select standardized measures and dyadic constructs. Specifically, group comparisons revealed differences between the BAP and TYP outcome

groups by 24 months of age in the domains of receptive, $F(1, 65) = 14.70$, $p < .001$, partial $\eta^2 = .18$, and expressive language, $F(1, 68) = 6.77$, $p = .01$, partial $\eta^2 = .09$, socialization, $F(1, 68) = 4.22$, $p = .04$, partial $\eta^2 = .06$, and parent-rated communication, $F(1, 68) = 5.71$, $p = .02$, partial $\eta^2 = .08$. By 15 months of age the BAP group exhibited fewer responses to their mothers, $F(1, 27) = 5.27$, $p = .03$, partial $\eta^2 = .16$, spent less overall time engaged with their mothers, $F(1, 27) = 12.02$, $p = .002$, partial $\eta^2 = .31$, engaged in less supported joint engagement, $F(1, 27) = 17.00$, $p < .001$, partial $\eta^2 = .39$, and engaged in less coordinated joint engagement, $F(1, 27) = 9.30$, $p = .005$, partial $\eta^2 = .26$. However, these results were not consistent across visits (illustrated in Figures 1 and 2). Discussion: Overall, this study provides preliminary support for exploring the importance of dyadic exchanges in the BAP, which may inform later developmental outcomes and early intervention efforts. By examining group differences across four time points, the current study demonstrates that distinct patterns exist between BAP and TYP groups. Recognizing the increasing demand for elevated-risk interventions, these findings highlight several social constructs through which interventions may promote optimal development in children developing at risk.

P3-I-235 Single Time-Point Neonatal Cytokines Fail to Predict Neurodevelopmental Outcomes in Preterm Infants

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Background: Preterm birth is associated with neurodevelopmental impairments in cognition (Aarnoudse-Moens, Weisglas-Kuperus, van Goudoever, & Oosterlaan, 2009), motor performance (Charkaluk, Truffert, Fily, Ancel, & Pierrat, 2010), behavioral and sensory functioning (Cabral, da Silva, Martinez, & Tudella, 2016), and language development (Aarnoudse-Moens et al., 2009). Impairments in brain development and subsequent neurodevelopmental outcomes may be mediated by high levels of systemic neonatal inflammation. While some investigators have found associations between high neonatal cytokine levels and neurodevelopmental impairment (Kinjo et al., 2011; Leviton et al., 2016), others have been unable to replicate this finding (Blok et al., 2011). Purpose: The purpose of this analysis was to further test the hypothesis that early measures of neonatal cytokines are predictive of short-term neurodevelopment in very preterm infants. Method: Data from a randomized control trial funded by the NIH were analyzed using multiple linear regression models for each log-transformed cytokine and Huber-White sandwich variance estimators. Blood was collected within the first 2 weeks of life

for the quantification of interleukin (IL)-6, tumor necrosis factor (TNF)- α , granulocyte colony stimulating factor (GCSF), IL-8, monocyte chemoattractant protein (MCP)-1, IL-10, granulocyte macrophage colony stimulating factor (GMCSF), IL-8, and IL-1 receptor antagonist (IL-1ra); specific cytokines were selected based on theoretical importance. Neurodevelopment was assessed at the time of discharge from the neonatal intensive care unit (NICU) using the attention/orientation (AO) and motor development and vigor (MDV) subscales of the Neurobehavioral Assessment of the Preterm Infant (NAPI) and at 6 months corrected age using the Bayley Scales of Infant Development (BSID). Results: Only IL-1ra was associated with AO ($\beta = -6.14$, $p = .019$), controlling for infant sex and post-menstrual age at the time of neurodevelopmental assessment. IL-1ra did not predict scores for MDV or any subscales of the BSID. There were no significant findings for any other cytokines. Conclusion: Though IL-1ra levels were predictive of poorer AO in this sample, the predictive validity of IL-1ra for other outcome measures was inconsistent. There were no significant associations between neurodevelopment and the other measured cytokines, suggesting that single time-point, neonatal cytokines may not be predictive of short-term neurodevelopment in preterm infants. Further research is needed to determine whether persistently high levels of cytokines better predict outcomes. Cytokine trends over the first few critical weeks of life may be more important than single time-point measures, but reports of cytokine trends in very preterm infants are rare. In the age of precision health, the ability to describe sustained inflammation and its association with demographic and clinical variables is critical to optimize outcomes.

P3-I-236 Restricted and Repetitive Behaviors in Infants and Toddlers with Autism Spectrum Disorder: Piloting a New Instrument

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Objective: The overall goal of the study is to pilot a newly developed instrument measuring restrictive and repetitive behaviors (RRBs) in very young children with autism spectrum disorder (ASD). This symptom domain has been neglected compared to social-communication; yet, since the age of ASD diagnosis has been extended downward to 24 months and younger, it is important to understand these behaviors more thoroughly. For example, do infants and toddlers show the same forms of RRBs as older children, are there developmentally younger versions, or is there discontinuity from RRBs shown in infancy to older children? These issues also have clinical implications, since reduced recognition

and inadequate characterization of RRBs in infants and toddlers has led to fewer early diagnoses using the reconstructed DSM-5 criteria (Barton et al., 2013; McPartland et al., 2012). Recently RRBS have been investigated in young children using the Repetitive Behavior Scale-Revised and the Repetitive Behavior Questionnaire (e.g., Honey et al., 2012). However, it is problematic to extend RRB frameworks initially created for older individuals to infants and toddlers. Others have reported on early RRBs using the ADOS2 and ADOS-T (Harrop et al., 2015) but in this instrument the RRB categories and exemplars are overly narrow and do not allow for what children may show in other settings and at home. This study addressed these concerns by piloting the Infant-Toddler Restricted and Repetitive Behavior Inventory (IRRBI), which includes a large set of behaviors observed and reported across settings for the youngest children diagnosed with ASD. The study objectives were to 1) Examine IRRBI item endorsement through coding psychological evaluation reports; 2) Examine the same from IRRBIs applied during clinical evaluations at a specialty clinic; and 3) Examine the relationship between other clinical measures and the IRRBI scores. Methods: Instruments. An exhaustive list of RRBs was developed to create the Infant-Toddler RRB Inventory (IRBBI). Item categories, based on previous research using factor analysis and other construct validity strategies include: Repetitive Behavior (Motor and Visual Stereotypies, Repetitive Play), Insistence on Sameness, Restricted Interests/Areas of Unusual Ability, and Sensory Behaviors. Procedures: 100 evaluation reports of children diagnosed with ASD, aged 16 - 36 months, were coded using the IRRBI. 70 IRRBIs were filled out during clinical evaluations. For both sets of data, scores from the Vineland Adaptive Behavior Scales, Childhood Autism Rating Scale-2, and ADOS-T and Module 1 were also recorded. Results: For both methods, the types of items endorsed the most frequently were Sensory Behaviors (Tactile, Auditory and Vestibular, respectively). The second most frequently endorsed scale was the Visual Interest Items, with the Creates Visual Interest with Objects highest. The next most frequently endorsed scales were: Repetitive Play, Motor Stereotypies, and Restricted Interests. Of significance was that these relative endorsement frequencies were the same for both data collection methods (coding reports vs. clinical contacts). Conclusion. The IRRBI, a measure of repetitive behaviors for infants and toddlers with ASD, shows promise as an improved method for documenting these types of symptoms in very young children.

P3-I-237 REARING Coding System (RCS): Validation of a competence coding system for Group Attachment Based Intervention (GABI©) Clinicians

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Clinician competence in children's mental health is an often neglected, vital aspect of the dissemination of evidence-based practices (EBPs). The rapid dissemination of EBPs has focused attention on monitoring implementation quality and is traditionally; assessed through adherence measures. However, the findings on adherence to manual based treatments are inconsistent, with some studies finding that greater adherence to manualized treatments is related to poorer outcomes. Clinician competence, however, better predicts positive outcomes than adherence alone, and reflects the sense of appropriateness in utilizing therapeutic action. Competence can reflect both the science (i.e., dissemination of evidence based treatments and interventions), as well as the art of psychotherapy, in its ability to capture the flexibility within the treatment model and the clinician's adaptability to different patients and treatment settings. This presentation discusses a clinician competency-based coding system from an attachment perspective, developed for the Group Attachment Based Intervention (GABI ©), an intervention aimed at improving the parent-child attachment relationship in high-risk families with children 0-3 years of age. Based on review of over 100 clinical videos, a competency coding system was developed to measure clinician effectiveness and competence in the GABI model. Using defined anchors and examples, 10 minute video clips of clinicians were rated on a scale of 1-5, where higher scores indicated greater clinician competency on each core feature of therapeutic action in the intervention, defined by the REARING model (Reflective functioning, Emotional attunement, Affect regulation, Reticence, Intergenerational patterns of attachment, Nurturance, and Group context.) Results of this study provide support for the usefulness of the REARING Coding System (RCS) in determining the efficacy of clinicians disseminating an attachment-based intervention for infants, toddlers, and their families. The measure is flexible enough to be applied to a range of treatment providers and clinicians, ranging from psychology externs to experienced PhD level clinicians. The measure has also exhibited robust inter-rater reliability (ICC= .824, $p < .01$ amongst 3 independent raters), and internal consistency ($\alpha = .976$), exemplifying its validity for measuring clinician competence. This presentation will discuss the development of the RCS and the current use of this as both a fidelity measure for dissemination but also an important tool for supervision and training. Additionally, the RCS is currently being used with the dissemination of GABI in supervision and consultation with new clinicians implementing the intervention for the first time. The presentation will conclude with a discussion of applying such measures across a range of early intervention, attachment based, and parent-child interventions.

P3-I-238 Do Interventions at Birth Interfere With Intended Breastfeeding Duration?

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Breastfeeding is inextricably and intricately tied to sensitive caretaking practices during the immediate postpartum period, as it is well-documented that breastfeeding provides a plethora of physical and psychological advantages to mother-infant pairs (Britton, Britton, & Gronwaldt, 2006; Jansen, de Weerth, & Riksen-Walraven, 2008). To increase maternal plans to breastfeed, initiation rates of breastfeeding in the perinatal period as well as duration of breastfeeding across the postpartum period it is necessary to understand the barriers to accomplishing the mother's goals associated with her feeding choice. In particular, the purpose here was to examine the impact of birthing experiences on breastfeeding accomplishments based on maternal feeding plans as well as breastfeeding duration postnatally. The question we had was whether vaginal/cesarean section delivery and birthing interventions (e.g., induction and pain medications, etc.) shapes the mother's prenatal breastfeeding plans as well as the actual breastfeeding duration across the postnatal period. Thirty-one mothers (M age = 31.84, SD= 7.07), who expressed a desire to breastfeed, were queried prenatally and postnatally as to their plans and their actual practice in feeding their infant. Mothers were asked within two-weeks after birth as to their delivery experience, including delivery-type and birthing assistance methods were utilized. All mothers were assessed again at 6-weeks postpartum and at 3-months postpartum. During the last visit, a feeding interaction was recorded. Mothers who had discontinued breastfeeding at any of the assessment periods (or began using a mixed feeding method) were asked a number of questions about current feeding method and when they had changed feeding method as well as the rationale for moving from breastfeeding to formula feeding. As expected, ANOVAs showed there were no differences in breastfeeding plans (prenatal plans) in mothers who delivered their baby vaginally versus by c-section as both groups planned approximately 12 months of breastfeeding (M=12.05, SD=6.09). In addition, there was no reduction of breastfeeding duration found between women who did give birth vaginally compared to mothers who delivered by c-section (M=71.26 days, SD=34.01). However, there were reductions in planning and duration of breastfeeding between mothers who had birthing interventions, with those mothers who had c-sections and one intervention and those with a vaginal delivery and more than one intervention differing in breastfeeding patterns, Wilks λ , = .56, F = 4.57, p < .05. Notably attenuation of planned-breastfeeding was predicted (R squared = .27, p =.01) by the number of birthing interventions over and above delivery type, see Figure 1. While Hobbs and colleagues (Hobbs, Mannion, McDonald, Brockway,

& Tough, 2016) recently reported that planned c-sections are associated with early breastfeeding cessation, our study showed that it was only in combination with birthing interventions that breastfeeding was negatively impacted. This bolsters findings by other researchers that highlight the importance of countering the negative effects of birthing interventions with additional encouragements to breastfeed (Zuppa Alighieri, Riccardi, Cavani, Lafisco et al., 2014). Thus it is imperative to educate mothers about how birthing interventions may interfere in the care routines of mothering and specifically their breastfeeding experiences.

P3-I-239 Early Nighttime Parental Interventions and Infant Sleep Regulation Across the First Year

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An important "task" of parenting involves the socialization of self-regulated behavior, which has direct implications for children's functioning in the wider world (Pears et al., 2015). One early manifestation of self-regulation, sleep regulation, is also influenced by parenting (Sadeh et al., 2010), although the particular parenting behaviors that promote vs. impede self-regulated infant sleep, and their developmental timing, is poorly understood. The present study examined early parenting behavior with infants during the night and its predictive relation to infant sleep regulation in the first year. As such, the present study addressed the broader question of what constitutes competent nighttime parenting with infants, in terms of the capacity to promote infant self-regulated sleep. Video recorded data from four occasions (1, 3, 6, and 9 months of age) were used to examine two types of interventions parents commonly used with infants during the night. We were particularly interested in nighttime parenting during the first three months, during which infant sleep rapidly consolidates (Henderson et al., 2011). "Infant-initiated" interventions were identified by a parental behavior (e.g., talking to/touching the infant) in direct response to infant distress. "Parent-initiated" interventions, by contrast, were identified by behavior directed to a non-distressed infant (e.g., to a sleeping infant or an awake nondistressed infant). Parent-initiated interventions appeared to be motivated by a parent's desire to be near to or interact with the infant. Infant arousal state were also scored from videos. From questionnaire information provided by parents, solitary sleeping infants were identified as those who consistently slept in a separate room beginning before 6 months of age and continuing thereafter. Cosleeping infants were identified as those who consistently slept in the parents' room across the first nine

months. Inter-rater reliability on all observational data was high. Growth curve modeling ($N = 107$) revealed several findings: (1) Infant night waking declined across the first 9 months, as expected. (2) Night waking among infants in cosleeping arrangements decreased more slowly than night waking in solitary sleeping infants. (3) Controlling for infant-initiated interventions, solitary sleeping infants who experienced more parent-initiated interventions showed a slower decline in night wakings than solitary sleepers with fewer parent initiated interventions. By contrast, parent-initiated interventions were not associated with sleep trajectories among co-sleeping infants. (4) Controlling for parent-initiated intervention, higher levels of infant-initiated interventions during the first three months predicted steeper decreases in infant night wakings, even after accounting for overall amounts of infant distress. That early parent responding to infant nighttime distress appeared to promote infant sleep across the first year is consistent with earlier work showing that parent-infant distress-relief sequences predicted less infant distress and more secure attachment (Bell & Ainsworth, 1972; Higley & Dozier, 2009). By contrast, nighttime parental interventions to non-distressed infants predicted less well-regulated infant sleep across the first year. These findings contribute to a clearer understanding of what constitutes competent nighttime parenting, defined in terms of the ability to promote infant sleep regulation across the first year.