ABSTRACT BOOK

Day 1, Sunday, July 1st

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ICIS 2018 Abstract Book – Sunday 1st July

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

Contents

Symposium abstracts: Sunday 1st July

S1.1 Symposium: Maternal pathways of pre/perinatal stress effects on neurobehavioral development

S1.1i Preconception maternal stress predicts poor child cognitive and emotional outcomes

Danielle Swales[1], Elyssia Davis[1], Christine Guardino[2], Madeleine Shalowitz[3], Sharon Ramey[4], Christine Dunkel Schetter[5]

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Introduction: Maternal stress has been shown to have an adverse influence on child emotional and cognitive outcomes, however little is known regarding whether maternal stress prior to conception can shape child development. The present research explored whether preconception maternal experiences, specifically symptoms of traumatic stress, have a lingering impact on offspring outcomes. Hypotheses: We hypothesized that maternal posttraumatic stress (PTSD) symptoms, evaluated prior to conception, would predict poorer cognitive and emotional outcomes in children at 4 years of age. Study Population: The sample included 72 mother-child dyads. Novel to the current investigation, mothers were recruited prior to the conception of the study child and were followed prospectively until the child was 4 years old (M = 3.7 years, SD = 0.3). Methods: Maternal PTSD symptoms were self-reported prior to conception using the PTSD Checklist for DSM-IV (PCL-IV). Child cognitive outcomes were assessed using the Differential Ability Scales-II (DAS-II), a structured assessment of cognitive performance. The DAS-II yielded standardized scores of verbal ability (verbal index), nonverbal ability (nonverbal index), and spatial ability (spatial index), as well as general cognitive ability (GCA). Child emotional outcomes were assessed using the negative affect subscale of the Children's Behavior Questionnaire (CBQ), a maternal report measure of child temperament. Results: Linear regression models revealed that maternal preconception PTSD symptoms predicted lower general cognitive ability in childhood (β = -0.29, t = -2.52, p = 0.014, R2 = 0.083). Notably, of the three index scores that comprise general cognitive ability, only the verbal index was significantly predicted by preconception maternal PTSD symptoms (β = -0.36, t = -3.21, p = 0.002, R2 = 0.128). Maternal preconception PTSD symptoms additionally predicted poor child emotional outcomes, indexed by higher scores of negative affect on the CBQ (β = 0.67, t = 2.15, p = 0.035, R2 = 0.062). Conclusions: In this prospective study, mothers who reported greater symptoms of posttraumatic stress during the preconception period were more likely to

have preschool-aged children who showed evidence of poor cognitive performance, driven by a deficit in verbal ability, as well as a greater degree of emotional dysregulation, indexed by higher ratings of negative affect. These findings suggest that the pathways underlying the lasting transgenerational impact of trauma may begin in the preconception period.

S1.1ii Prenatal influences of fetal neurodevelopment: Parsing the complexity of in utero features and charting the early trajectory of alternations to neurodevelopment related to prenatal stress

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A wealth of research provides strong evidence that prenatal stress (PS) increases risk for negative developmental outcomes. This body of work assumes putative in utero alterations to fetal brain and CNS development due to PS exposure. Yet, precisely how PS may alter trajectories of fetal CNS development is not well understood. Parsing the complexity of PS features that may influence early neurodevelopment represents a significant challenge. This presentation aims to increase our understanding of prenatal influences on neurodevelopment by using a novel statistical approach (mixture modeling) to parse the heterogeneity of a comprehensive catalog of PS features, including maternal distress and lifestyle features (assessed via self-report), behavioral features (maternal attentional bias to threat indexed by an eye-tracking task) and biological features (total maternal HPA axis output during pregnancy indexed by maternal hair samples collected throughout pregnancy) in a community sample of pregnant women who were recruited prior to 15 gestational weeks. Maternal risk groups are associated with distinct trajectories of fetal development, measured via well-established fetal physiological indices of CNS development (heart rate, heart rate variability).

S1.1iii Complex effects of maternal stress and diet on neurodevelopment in nonhuman primates

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Introduction: Rhesus monkeys are an ideal model for studying the effects of maternal stress and diet on neurodevelopment as they have several developmental and social similarities to humans. Rhesus monkeys typically have singleton pregnancies that follow similar neurodevelopmental patterns as humans, resulting in complex gyrencephalic brains. Social groups are organized in strict social dominance hierarchies (thought to parallel SES in humans) that are maintained via random harassment of low ranking animals by higher ranking animals. Thus low social rank represents a chronic source of psychosocial stress that is present during the pre/perinatal periods. Stress such as this induces overeating of palatable foods and is a risk factor for obesity. Additionally, obesity can affect similar emotional regulation brain circuits as stress, and obesity is related to increased glucocorticoid release and inflammation. Hypotheses: Maternal stress (i.e. social subordination) will work synergistically with a high calorie diet to alter neurodevelopment of emotional regulatory circuits via increases in infant cortisol and inflammation. Study population: 41 female rhesus monkey infants assessed at 2 weeks (roughly analogous to 2 months of age in humans) and 6 months (roughly analogous to 2 years of age in humans) postpartum. Methods: Postnatally animals were assigned to either a choice condition (access to both low calorie standard diet and a highly palatable high calorie diet) or the low calorie only condition, balanced for rank (dominant vs. subordinate). This resulted in four experimental groups - dominant choice (DC), subordinate choice (SC), dominant low calorie only (DLC), and subordinate low calorie only (SLC). To assess stress, baseline sunrise and post-stress (the Human Intruder paradigm) plasma cortisol was measured at 6 months. Plasma C-reactive protein (CRP) was assessed as a measure of inflammation at both 2 weeks and 6 months. Total kilocalories consumed over the first 6 months of life was recorded using automated feeders (Research Diets). Structural and diffusion weighted magnetic resonance imaging (MRI) data were acquired at 2 weeks and 6 months under isoflurane anesthesia using imaging protocols optimized for developing rhesus monkeys. Statistical analyses included ANOVA and ANCOVA models where appropriate. Results: Animals in the choice condition consumed more calories than those in the low calorie condition regardless of rank. Higher baseline cortisol was observed in animals in the choice condition regardless of rank, however, SC subjects showed greater increases in cortisol in response to a stressor. Subordinate animals showed higher CRP levels than dominant animals, an effect driven by increased CRP in the SLC group. Neurodevelopmental differences between diet group (choice vs. low calorie only) were found in intracranial volume, temporal visual white matter, insular cortex, and the caudate with the choice group having larger volumes than the low calorie only group. Differences between dominant and subordinate animals were observed in the hippocampus and amygdala

(subordinates > dominants). These results suggest that stress early in life and diet interact to affect inflammation and stress physiology.

S1.2 Symposium: Everyday inputs and learning

S1.2i Infants' everyday object play and language inputs

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Object play presents opportune times for infants to learn words for the objects and actions of their attention. Lab-based studies of structured play reveal that mothers provide contingent language to describe and ask about objects under joint engagement. However, structured tasks are void of distractions: Infants have little to do than explore the objects in front of them, and mothers might feel compelled to talk. What is the nature of infant object engagement and language input during spontaneous interactions at home? In three studies, we examine infants' object engagements during home routines-the setting where learning actually occurs. We describe the frequencies and kinds of objects infants explore and the amount and semantics of language that mothers direct to infants. In Study 1 we asked whether 18-month-old infants' (N=16) engagements with objects consistently elicit verbal responses from mothers. We coded infant manual-visual attention and maternal speech to infants from 1-hour video-recordings of home routines. Time-locked codes yielded data on mothers' verbal responses to infant exploratory bouts (speech within 3-seconds of infant touch) and verbal initiations (i.e., speech outside the 3-second window). Infants averaged 111 exploratory bouts (range=41-279), distributing time between household objects and toys. Mothers only intermittently responded to infants' object exploration, and showed striking intra-individual variability in real-time contingency, sometimes ignoring what infants were doing, and other times providing dense contingent input (Figure 1). In Study 2 we delved into infant and mother object engagement to 13-month olds (N=40) during home routines, testing the degree to which visual and/or tactile object cues accompany "naming events". Mothers' speech was transcribed, and nouns on the MCDI spoken by > 25% of mothers (59 types and 3,219 tokens) were coded for infant and mother object gaze and/or touch/gesture 3 seconds before and after the naming event. Nearly all (92%) naming events referred to visually present objects, and 90% were accompanied by a manual or visual gaze by mother or infant. Infants looked at 68% of named objects and touched 45.6%; mothers looked at 82% and touched 53% of named objects. In Study 3 we tested whether language inputs to infants are reliably organized around infant "activity contexts". We coded the contextual cues that surround word use across 11,000 instances of concrete nouns and action verbs categorized into 20 semantic categories (e.g., animals, clothing, body parts, foods, intransitive verbs, transitive verbs). Infants' engagement in mealtime, grooming, literacy, object play, and

unstructured play (e.g., running around, climbing on furniture) was coded in temporal alignment with transcriptions of mothers' speech. The words mothers directed to infants reliably clustered around the objects and actions of infants' activities (e.g., body parts and clothing during dressing, foods during mealtime) (Figure 2). Infants spend much time engaged with objects at home. Mothers' responses to infant object engagement fluctuate between dense and sparse bouts of contingency. Nonetheless, visual and/or manual cues to word meaning accompany the majority of spontaneous naming events at home. Further, language input is context bound: Infants encounter words that match the activities of their everyday lives.

S1.2ii Quantity meets Quality: Examining a statistical solution of referential uncertainty in parent-child naturalistic interaction

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One challenge in early word learning is referential uncertainty. Many laboratory studies have focused on examining how human infants are able to infer the correct referent of an object from ambiguous contexts. Those experiments have been designed based on assumptions of referential uncertainty in the real world. However, little is known about exactly what degrees of uncertainty infants face with in their everyday lives. The two goals of the present study are 1) to quantify referential uncertainty in toy play -- one everyday context; and 2) to examine a statistical solution to referential uncertainty. 30 toddlers from 18-month to 21-month olds and their parents were asked to play with a set of 24 everyday toys in a lab space decorated as a toy room, as shown in Figure 1. Both toddlers and parents were fitted with head-mounted eye trackers that recorded their momentary gaze data in a free-flowing play session for about 10 minutes. From continuous gaze data, regions-of-interest (ROIs) on toy objects and the partner's face were coded frame-by-frame. Individual naming events in parent speech was identified and transcribed. In aggregate, parents generated 1287 naming instances, with a rate of 5.62 names per minute. The proportion of time infants attend to the named object within a naming instance was calculated as the quality measure of naming instance. To analyze quality and quantity of parent naming together, we divided naming instances into three groups based on quantity: low frequency words (only 1 or 2 twice in a session), medium frequency (3 to 5 times), and high frequency names (>5 times). We then calculated two versions of naming statistics in each frequency group: 1) based on individual naming instances; and 2) based on aggregated

naming instances of the same name. Figure (2) shows three major findings. First, there are dramatic differences in degrees of uncertainty among individual naming instances. In the three histograms based on individual naming instances, one third of instances are highly informative as infants looked at the target object within a whole naming moment. Another third of instances provided "misleading" information for learning as infants never looked at the target object within naming instances. The rest of instances are ambiguous as infants attended to more than one of the objects including the target. This variability reflects different assumptions that different researchers -and theories -- have made about referential uncertainty. Second, there is no difference among the distributions of naming instances in the three frequency categories, suggesting that more or fewer naming instances generated by parents don't improve nor deteriorate the quality of individual naming instances. Third, as shown in the second row of Figure 2, aggregated instances from high-frequency names show dramatic differences compared with the versions from low-frequency and medium-frequency names. Taken together, our results suggest that individual naming instances in naturalistic contexts contain different degrees of uncertainty. However, with the aggregation of multiple naming instances, the combination of quantity and quality offers a statistical solution to deal with different degrees of uncertainty in the real-world learning.

S1.2iii Everyday visual experience and the data for learning about visual objects

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Advances in wearable sensors and computing power provide a way to measure the everyday learning environments of infants and children with precision and at scale. They reveal unexpected regularities and structure in real-world learning environments that challenge traditional approaches. This talk will focus on findings from a large corpus of head camera images collected by infants from 1 month to 24 months as they went about their daily lives with the head cameras embedded in hats. The procedures used to collect and code images are available in Fausey, Jayaraman, & Smith (2016; see also Clerkin et al., 2017). The key methodological facts are that each infant contributed 4 to 6 hours of head camera video recorded at 30 frames per second and these were sampled at the rate of one image every 5 seconds. The number of sampled frames analyzed for all analyses reported below exceed 3000 per infant with 20 to 90 infants (depending on the specific analysis). Three general principles of the statistics of everyday experience emerge (see Figure 1). First, the regularities in the world are not stationary but change

systematically as the learner changes. For example, people are in the infant's first person views persistently and stably through the first two years of life. But the information presented by people changes dramatically with age. For infants younger than 3 months of age, when people are in view it is their faces in view; for infants older than 12 months, when people are in view, it is their hands that are in view. These hands are holding and instrumentally acting on objects in 80% of all hand present images. Second, during infancy sensory-motor development opens and closes gates on different learning tasks and orders them in a curriculum-like way. We zoom in on the infants aged between 6 and 15 months and show that sitting and crawling experiences of individual infants predicts the decline in views of people's faces and increased views of hands acting on objects. Third, infants' everyday experiences are characterized by massive and targeted experience about a very few things with extremely limited experience with most things. Very few people dominate infant views of faces; just 3 individuals account for over 80% of all faces seen in the first two years of life. Very few object categories account for the objects in people's hands and these correspond to the object names that infants normatively learn before 18 months. The world presents young learners with experiences in which they have the opportunity to learn a lot about a very few things but need to learn about many things (other faces, other object categories). We will consider how these properties of natural learning environments might simplify infants' learning tasks, enabling them to robustly learn and broadly generalize learning in many domains.

S1.2iv Learning to walk: Immense and varied input

Justine Hoch[1], Ori Ossmy[1], Danyang Han[1], Carli Heiman[2], Whitney Cole[3], Do Kyeong Lee[4], Karen Adolph[1]

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Walking is a creative act. No step is repeated in the same way. We walk uphill and downhill, over slippery floors and rugged terrain. We walk in all manner of footgear, while carrying loads, and while performing other tasks. How does anyone, let alone an infant, learn such a generative skill? We hypothesize that learning to walk requires vast amounts of varied input and a low penalty for error. Recent work suggests that the natural input for walking is immense--12- to 19-month-old infants average ~2400 steps/hour during free play with their caregivers in a lab playroom (Adolph, 2012). In Study 1, we replicated and extended these findings with a new group of 13- to 19-

month-old infants (N=82). Using video and an instrumented floor, we collected a detailed corpus of infants' natural walking. Across age, infants spent 45% (SD=13) of their time on the floor in motion, averaged 2899 steps/hour (SD=1024), and traveled 580 meters/hour (SD=205). Moreover, infant walking was highly varied. Many of infants' bouts (M=34%, SD=12) included only 1-3 steps, meaning that infants start and stop frequently. Most bouts (M=82%, SD=9) included omnidirectional steps (sideways, backward, and forward), and most paths (M=74%, SD=11) were curved. Infants spent M=46% (SD=20) of their time on elevated surfaces (e.g. stairs) and carried an object for M=33% (SD=19) of their walking bouts. Although infants fell frequently (M=12 falls/hour, SD=11.6), their falls were not serious and infants recovered within seconds (M=2.1, SD=1.9). A subset of infants studied in their homes (N=15) traversed M=11 surfaces/hour (SD=6), and amassed M=2638 steps/hour (SD = 943). In typical free-play paradigms, infants interact with toys, and their locomotion is highly correlated with that of their caregivers. Infant-caregiver time in motion, steps/hour, and area covered are highly correlated, $r_s>.48$, $ps<.01$. However, toys and caregivers are sometimes unavailable for play. In Study 2, we asked whether the availability of toys or a caregiver influences the quantity and quality of infant locomotion. 15-month-olds (N=40) played in view of a seated caregiver in a playroom where toys were available or absent. Across conditions, with the caregiver occupied, infants took twice as many steps/hour (M=4291, SD=1255) and traveled twice as far (M=625 meters/hour, SD=241) as infants whose caregivers were available for play. Moreover, infants took just as many steps/hour (toy: M=4379, SD=1154; no-toy: M=4092, SD=1145; $p=.82$), and traveled just as far (toy: M=627 meters/hour, SD=183; no-toy: M=632 meters/hour, SD=272; $p=.94$) when toys were absent. When toys were available, infants covered more of the playroom (toy: M=62%, SD=11; no-toy: M=49%, SD=22; $p<.01$) and spent less time within arms' reach of their caregivers (toy: M=17%, SD=15; no-toy: M=51%, SD=27; $p<.01$). Infants' everyday walking input is immense and varied. This diverse training set is spontaneously generated over the course of free play--even in the absence of a caregiver or toys. We hypothesize that through immense amounts of experience with varied body-environment relations accumulated over many weeks of practice, infants learn to walk with increasing proficiency and to select and modify locomotion appropriately in new situations.

S1.3 Symposium: Developing self-regulation in the transition to parenthood: the new fathers and mothers study

S1.3i Domain-specificity in the intergenerational transmission of executive functions

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While there are multivariate influences on the development of children's EF throughout the lifespan, substantial individual differences can be seen as early as when children are two years of age. Importantly, these individual differences are moderately stable throughout early childhood. Further, there is evidence that some amount of children's EF is transmitted from mothers, as there is modest stability in the relation between mom and children's EF from ages 2 to 4 (Cuevas et al., 2014). To date, no investigations have examined the intergenerational relation between mothers' and children's EF prior to the age of 2, and few investigations have examined the role of fathers' EF in the development of children's EF. As such, we were interested in the intergenerational transmission of EF from parents to 14-month-old toddlers. We investigated whether moms and dads' EF was related to toddler EF, and and whether the relation was domain-general or domain-specific (e.g., relation of parent inhibition to child inhibition rather than all facets of EF). To do this, we use a sample of N=435 children of first-time parents who were recruited prenatally from hospitals, clinics, and birthing classes in the US (N=114), the UK (N=197), and the Netherlands (N=124). When children were 14 months of age, children completed four EF tasks: the Prohibition Task (a measure of inhibition; Friedman et al., 2011), the Multi-Location Search Task (a measure of working memory; Diamond et al., 1997), the Delayed Response Task (a measure of inhibition and working memory; Diamond & Doar, 1989), and the Ball Run Task (a measure of planning and shifting). Factor scores for working memory and shifting were obtained, and latency to touch in seconds was used for inhibition. Factor structures and relations between the facets of EF are described in this symposium (Devine & Hughes, this symposium). At the same visit, both parents completed two measures of EF on laptop computers: Hearts and Flowers (a measure of inhibition; Diamond et al., 2007), and Tower of Hanoi (a measure of planning; Goel & Grafman, 1995). For parent inhibition, a difference score was calculated between reaction time on incongruent and congruent trials; for planning, total time before first move was used. Child inhibition, working memory, and shifting scores were simultaneously regressed on mom and dad inhibition and planning, as well as child gender and country. Child skills were uncorrelated with one another (all ps>.3). Dad inhibition and planning were unassociated with any child skills. Mom inhibition was

associated with child inhibition (β=0.15, p<.006), and mom planning was associated with child shifting (β=0.11, p=.043), but inhibition was unassociated with child shifting and planning was unassociated with child inhibition. No parent skills were associated with child working memory. These findings suggest some domain specificity in the intergenerational transmission of EF, and that intergenerational transmission may be limited to biological mothers. Further analyses will investigate longitudinal relations between parent EF and child EF at age 2, as well as mediators of the intergenerational transmission of EF.

S1.3ii Mental Health in the Transition to Parenthood

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Mental Health in the Transition to Parenthood Introduction: The transition to parenthood is a major life event that is associated with multiple new stressors and reduced couple satisfaction. We adopted an international design to investigate changes in wellbeing across this transition and early infancy, for both mothers and fathers. Hypotheses: Following previous studies we expected a universal drop in couple relationship quality following the birth of an infant (Mitnick, Heyman & Slep, 2009). We also expected problems of wellbeing to be more prevalent in mothers than in fathers. Reflecting contrasts in government support for new parents (e.g., paid parental leave) we hypothesized that expected between-country contrasts in wellbeing (NL > UK > USA) would widen over time. Study Population: The sample of 420 first-time parents was split between three sites (NUK = 195; NNL = 123; NUSA = 102). Samples for each site differed in mean age (mothers: MUK = 32.19; MNL = 26.42; MUSA = 34.00; fathers: MUK = 33.54; MNL = 29.32; NUSA = 35.67) but were similar in levels of education (84.1% of mothers and 76% of fathers have at least a bachelor's degree). Methods: At each wave, parents completed the 20-item Centre for Epidemiologic Studies Depression Scale (Radloff, 1977), the 6-item State-Trait Anxiety Inventory (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983), the 6-item Satisfaction with Life Scale (Diener, 1985) and the 16-item Couple Satisfaction Index (Funk & Rogge, 2007). Results: Couple and life satisfaction were correlated at each time point (mean r = .44). For all three sites (but especially the USA), average levels of both mothers' and fathers' reports of couple and life satisfaction showed a significant drop over the study time-points (36 weeks gestation, 4 and 14-months post-partum). Maternal trajectories for depressive symptoms showed a clear USA vs Europe contrast. Specifically, average depression

levels remained stable for Dutch and British mothers, but increased significantly between 4 and 14 months in American mothers (see Figure 1). Parallel analyses for fathers showed fewer depressive symptoms in expectant Dutch fathers than in either British or American expectant fathers. However, at 4-months there were no significant group differences and by 14-months the key finding was, as for mothers, a USA vs Europe contrast (i.e., American fathers reported higher levels of depression than either British or Dutch fathers, see Figure 2). The findings for parental anxiety were broadly similar: American mothers reported greater anxiety than either Dutch or British mothers and this gap widened over time; likewise American fathers reported more anxiety than either British or Dutch fathers at the 14-month time-point. Conclusions Viewed side by side, Figures 1 and 2 indicate striking between-country contrasts in wellbeing across the transition to parenthood coupled with interesting similarities in results for mothers and fathers. In January 2018, all three sites will have completed data-collection at 24 months and so we plan to extend our analyses to include this additional wave of results, applying analyses of actor and partner interdependence to investigate the interplay between changes in new mothers' and fathers' wellbeing.

S1.3iii Measuring and Predicting Individual Differences in Executive Function at 14 Months

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Children's ability to control their own thoughts and actions, or 'executive function' (EF), has been a topic of intense interest in the field of developmental science for the past two decades. The idea that there are developmental differences in the underlying structure of EF has been bolstered by studies of children aged between 2 and 6, which suggest that a single latent factor provides the best fitting model of EF in early childhood (Wiebe et al. 2008; Wiebe et al., 2011). Recent multi-measure small-scale studies of EF in infants suggest that, far from being a unified construct, there appears to be little cohesion among EF tasks in the second year of life (e.g., Miller & Marcovitch, 2015). The aim of our study was to examine early predictors of and correlations between a novel battery of EF tasks in a large sample of 14-month-old infants. 195 infants (108 boys) participated when they were 4 (M = 4.12 months, SD = 0.39) and 14 (M = 14.42 months, SD = 0.59) months old. At 4 months infants completed the sustained attention task (Cuevas & Bell, 2014). At 14 months infants completed a novel battery of four age-appropriate EF tasks based on standard paradigms: the Prohibition Task (a measure of

inhibition - Friedman et al., 2011), the Multi-Location Search Task (a measure of working memory - Diamond et al., 1997), the Delayed Response Task (a measure of inhibition and working memory - Diamond & Doar, 1989), and the Ball Run Task (a measure of shifting). Our results demonstrated that there was little cohesion among measures of EF at 14 months. Infants with longer looking times on the sustained attention task (an index of poor information processing) at 4 months showed poor performance on both the Multi-Location Search and Delayed Response Tasks at 14 months (even when verbal ability and temperament were taken into account). Our findings break new ground by examining the cohesion between indices of EF in the second year of life and demonstrating continuity between visual attention at 4 months and aspects of EF performance at 14 months.

S1.3iv Autonomy support and Warmth towards Toddlers in British and Dutch Mothers and Fathers: Similarities, Contrasts and Actor-Partner Interdependence

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Notable key gaps in research on parental autonomy support for infants concern: (i) parent / child correlates of individual differences in autonomy support; (ii) similarities / contrasts between mothers' and fathers' autonomy support; (iii) moderating effects of cultural context. To address these under-researched topics, we observed more than 300 British and Dutch infants at home in dyadic structured play with both mother and father at Time 1 (UK: N = 195; MAge = 14.42 months, SD = 0.59 months; NL: N = 123, MAge = 14.19 months, SD = 0.51 months) and Time 2 (UK: N = 180; MAge = 24.42 months, SD = 0.59 months; NL: N = 120, MAge = 24.31 months, SD = 0.61 months). Confirmatory factor analyses of 14-month data from the UK sample showed across-parent measurement invariance, enabling comparisons that revealed higher levels of autonomy support in mothers than in fathers. Variation in autonomy support was unrelated to either parental personality or child temperament, highlighting the potential importance of dyadic characteristics. Consistent with this view, fathers with sons displayed less autonomy support than fathers with daughters, whereas maternal autonomy support did not differ by child gender (see Figure 1). Across sites, coding of parental autonomy support for both time points will be complete in May 2018. Building on the above latent variable analyses we will examine whether the parent / child gender effects differ (a)

across sites (e.g., does the increased prevalence of co-parenting in the Netherlands lead to greater similarity between mothers' and fathers' levels of autonomy support?) or (b) over time (e.g., does the gap between mothers and fathers narrow as children develop and exert a stronger influence on the quality of parent-child interactions?). We will also use Actor Partner Interdependence Modelling (APIM) in order to examine: (c) temporal stability of autonomy support across the 10-month interval between time-points; (d) between-partner influences on changes in parental autonomy support over time; and (e) moderating effects of site (e.g., do expected contrasts in levels of co-parenting lead to greater between-partner inter-dependence for Dutch parents than for British parents?)

S1.4 Symposium: How to get the most out of infant data

S1.4i The Promises and Challenges of an Individual Differences Approach to Infant Research

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Much of the infant research literature focuses on broad patterns of behavior and knowledge, presuming that constructs of interest represent fairly-universal patterns of development that have stable, shared mechanisms. To this extent, the available data primarily speak to nomothetic patterns of development. This focus partially reflects traditional interests in the field, but is also driven by presumed "practical" considerations in infant research. That is, a large proportion of the literature presents (1) small samples drawn from (2) narrow populations that are then asked to complete (3) brief tasks with few trials and conditions. Yet, we know that infants differ in the timing, rate, and extent of both cognitive and socioemotional development. Understanding these differences will help us better understand variation within and across individuals, revealing more complex developmental mechanisms. In addition, an individual differences approach will allow us to better identify and intervene with children at risk. A well-powered individual difference study requires (1) larger samples chosen to reflect (2) heterogeneity across the constructs/mechanisms of interests that are then asked to complete (3) more complex paradigms designed to target conditions or processes that are tied to the variations of interest. This presentation will draw on two studies to illustrate how researchers can take on an individual differences approach to the study of infant development. In doing so, we focus on the illustrative example of temperament, attention to threat, and maternal characteristics. In addition, we will note two approaches to examining individual differences--first taking a variable-centered approach and then a person-centered approach. Both studies build on the argument that individual differences in attention may shape socioemotional development. Temperamentally extreme children preferentially attend to novelty and uncertainty as infants, show greater difficulty deploying attention when under stress as young children, and, by adolescence, preferentially attend to threat-cues. Although the literature presupposes that the link between attention and socioemotional functioning arises early in life, this proposition has had little direct empirical testing. We began to test the early emergence of the temperament-emotion-attention link in a large (N=260) cross-sectional study of infants between the ages of 4- and 24-months. The protocol included three eye-tracking tasks capturing associated components of attention to threat, questionnaires and laboratory observation of temperament, and maternal self-report.

We will note findings suggesting that attention to threat increases with age, is linked to increases in maternal anxiety, and is moderated by negative affect and effortful control. We will then present a latent profile analysis characterizing patterns of affect-biased attention across tasks. We found that negative affect increases with age, which in turn is associated with affect-biased attention, but only in conjunction with elevated maternal anxiety. The second study is an ongoing longitudinal study examining similar measures at 4, 8, 12, 18, and 24 months across three study locations. We will discuss the promises, and complexities, of implementing protocols designed to generate samples with the necessary power to detect variation across individuals and within individuals over time.

S1.4ii Maximizing data quality and quantity in eye tracking studies with infants

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Researchers face significant challenges when collecting data from infant subjects. Despite new technologies that make it possible for us to ask new questions, researchers continue to be plagued with difficulty recruiting sufficient samples to provide power to detect even modest effect sizes, collecting sufficient data from individual infants to provide powerful estimates of infants' performance, as well as problems with designing experiments, creating stimuli, training experimenters, and so on. In short, research with infants is expensive in terms of time and effort, and few researchers are in the position to waste any effort on failed experiments, testing extra subjects, or allowing inexperienced students to collect data. This presentation will focus on two issues. First, I will discuss the problem of sample size, and the importance of obtaining sufficient samples. Building on the work presented by Oakes (2017) on the effect of different sample sizes on observed results, I will present the results of simulations conducted on an "artificial" data set (i.e., one in which the distributions of the population are known). This will provide an additional understanding of how the sample size influences our ability to detect known effects. Second, I will discuss the importance of maximizing the amount of data obtained from each infant to include in our analyses. Historically, researchers have designed experiments in which infants provided only a small number of data points--for example, a novelty preference score after familiarization, dishabituation scores to one or more tests, or a preference for one type of stimulus over another. Eye tracking methods, however, can provide richer data sets. It is possible to collect data from infants over dozens of trials. On each trial, infants provide data 30 to 1000 times per second (depending on the system). These methods, therefore, help

address one issue in the study of infant development; the poverty of the data obtained from each subject. I will present simulations that demonstrate the effect of including in analyses different amounts of data from each subject. Demonstrating these two issues is not sufficient for helping to solve the problems researchers face when attempting to collect data from infants. Thus, in the final portion of this talk, I will describe methods we have used to successfully increase both the numbers of infants included in our analyses, and the amount of data each infant contributes to those analyses.

S1.4iii (Re)using video to document procedures, illustrate findings, grow sample sizes, and ask new questions

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Infancy research is plagued with many of the same issues faced by others areas of behavioral science-- efficiency of data collection, transparency of procedures, reproducibility of findings, and interpretation of results. Video can help. Video uniquely captures the richness and complexity of behavior and subtle details of the surrounding context. It records who did what and when and how they did it. It reveals: infants', caregivers', and experimenters' speech, gestures, emotional expressions, looking behaviors, postures, and movements; whether infants paid attention and experimenters adhered to the protocol; people's proximity to one another; the physical details of the testing space, and so on. As such, video is a remarkably informative source of raw data, beautifully suited for research reuse. And video is a tremendously powerful tool for documenting procedures, illustrating findings and phenomena, and constraining and enriching interpretations of research results. Researchers can exploit the possibilities of video to speed progress and facilitate knowledge about infant development by (re)using their own research videos as both data and documentation and by sharing videos with other researchers through repositories such as Databrary (databrary.org). Here, I use the example of infants in free play to show how video can be used as data and as documentation. To illustrate video reuse, I show how the same collection of videos (or subsets of the videos, or in combination with other datasets) was used: (1) to characterize essential features of infant walking; (2) as input to a robot simulation in a formal functional analysis of walking experience; (3) to test whether infants' locomotor exploration resembles patterns of exploration in non-human animals; (4) to analyze the frequency and severity of infants' falls; (5) to examine whether and how infants incorporate objects into their bouts of walking; (6) to determine whether infants

typically walk toward recognizable destinations; (7) and to analyze synchrony between infants' and mothers' movements. I also use the example of infants in free play to show how video can be used to document seemingly simple procedures (a locomotor experience interview; instructions to caregivers; layout of a lab playroom) and more technically challenging procedures (using a head-mounted eye tracker with infants; measuring infants' body dimensions). I show state-of-the-art, interactive protocols and coding manuals that exploit video clips as demonstrations and definitions of behaviors. The video clips used to illustrate research reuse also highlight the power of video to show research findings and surprising phenomena. Finally, I give a brief description of Databrary (databrary.org) and Datavyu (datavyu.org), two free, open-source tools for storing, managing, sharing, and coding research videos.

S1.4vi Using multiple converging measures in infant research: Lessons from the development of infants' responses to threat

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Collecting data from infants and young children is notoriously difficult, especially in the social domains. As a result, many studies rely on a single measure in a single age group to draw broad conclusions about the development of a phenomenon and even the mechanisms that drive it. Here we present data on infants' emotional responses to two categories of threatening stimuli--non-social threats (i.e., snakes and spiders) and social threats (i.e., strangers and threatening faces)--to demonstrate how a developmental approach using multiple converging measures can help us get the most out of our data and learn the most about an important phenomenon. Classic research using looking time tasks has shown that adults and children detect a variety of threatening stimuli very quickly. For example, several studies have demonstrated that adults and preschool-aged children detect non-social threats like snakes and spiders faster than flowers and mushrooms, and faster than a variety of nonthreatening animals like frogs, caterpillars, and cockroaches. Adults and children also detect social threats like angry and fearful faces faster than sad, happy, or neutral faces. In fact, in our own research, we have found that even 7- to 9-month-old infants turn more quickly to look at snakes versus flowers and angry faces versus happy faces (see LoBue & Rakison, 2013 for a review). Because of this remarkable consistency across studies, researchers have proposed that humans' responses to various threats are governed by an evolved fear module that is activated automatically in the presence of threat (Ohman & Mineka, 2001). However, most of

these studies only used a single measure (i.e., looking or latency to look) within a very narrow age range to characterize an important and possibly complex human behavior. Here, we use data from a large cross-sectional sample of infants (4--24mos; N=260), and a second longitudinal sample (4 and 8mos; N=50, data collection ongoing) to demonstrate how a developmental approach with multiple converging measures can provide us with a more complete story about the development of various threat responses. First, we use attentional measures that parallel the ones used with adults to demonstrate that the development of attentional biases for social versus non-social threats over the first two years of life follow different developmental trajectories. Next, we use behavioral data to show developmental differences in infants' responses to the approach of an actual social (i.e., live stranger) and non-social (electronic spider toy) threat in the lab. Specifically, while infants' negative responses to the approach of a stranger vary based on factors related to infant temperament ($r=-.29$, $p=.004$), this relationship does not hold for infants' responses to a large electronic spider. Similarly, while maternal anxiety is positively related to infants' emotional expression when approached by a stranger ($r=.25$, $p=.004$), it is not related to infants' responses to a spider. Altogether, this work illustrates how using a developmental approach with multiple converging measures can tell us more about the development of a phenomenon (i.e., humans' responses to threat) than any single measure can accomplish alone.

S1.5 Symposium: Building bridges across minds and brains: Using live paradigms to elucidate interpersonal neurocognitive processes in infancy

S1.5i Interpersonal neural synchrony between infants and adults during naturalistic social interaction

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Temporally contingent social interactions between adults and infants play a vital role in supporting early learning across multiple domains of language, cognition and socio-emotional development. It known that, in adults, effective communication involves the mutual alignment of brain activity, as well as the temporal alignment of behaviour (e.g. conversational turn-taking and mutual gaze). Yet little previous research has yet investigated whether infants' neural activity also shows contingency on an adult partner's neural activity, and whether gaze acts as a neural synchronisation cue during adult-infant communication. To assess this we used dual-EEG to assess whether direct gaze increases neural coupling between adults and infants during screen-based and live interactions. Typical 8-month-old infants either viewed videos of an adult (experiment 1) or interacted live with an adult (experiment 2) while the adult was singing nursery rhymes. Whilst interacting the adult either a) looked either directly at the screen, b) averted both head and eyes by 20°, or c) held head averted and eyes directly forward. Gaze-related changes in adult-infant neural network connectivity were measured using Partial Directed Coherence (PDC). Across both experiments, our results indicated that the adult had a significant (Granger)-causal influence on infants' neural activity, which was stronger during Direct and Direct-Oblique gaze relative to Indirect gaze. In experiment 1, unidirectional (Adult->Infant but not Infant->Adult) relations were observed. In experiment 2, bidirectional (Adult->Infant and Infant->Adult) relationships were observed. In further analyses we examined the three potential cues to interpersonal synchrony. First, we examine gaze behavior. Using time-windowed PDC analyses we examine how interpersonal synchrony changes relative to the starts, and ends, of different individual looks, including moments of mutual and non-mutual gaze. Second, we examine vocalisations. We report that infants vocalise more frequently during interactions that feature direct than averted gaze, and individual infants who vocalized longer also elicited stronger synchronisation from the adult. Third, we examined the effect of auditory ostensive cues (such as calling the infant's name) on interpersonal neural synchrony. We found that after infants' name was called, their

neural activity became significantly more synchronized to the adult relative to a baseline prior to name use.

S1.5ii Face-to-face and brain-to-brain: Effects of maternal attachment, caregiving, and sensitivity on mother-child neural synchrony

Trinh Quynh Nguyen[1], Ezgi Kayhan[2], Daniel Matthes[2], Pascal Vrticka[2], Stefanie Hoehl[3]

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Behavioral and affective attunement between caregiver and child are considered essential for attachment and emotion regulation. Behavioral synchrony between infant and caregiver in face-to-face interactions is closely associated with synchrony on the physiological level, e.g. coupling of heart rates (Feldman et al., 2011). Interpersonal coupling of brain activity, proposed to facilitate communication and temporal contingency between adults (Hasson et al., 2012), is only recently being addressed in developmental research. Here, we present a dual functional near-infrared spectroscopy (dual-fNIRS) study looking at the relationship between quality of mother-child interaction during a problem-solving task and brain-to-brain synchrony. Preschoolers and their mothers are tested simultaneously with dual-fNIRS. In the cooperation condition, mother and child are instructed to solve a tangram puzzle together where a template has to be recreated by arranging simple geometric shapes. In the individual condition, mother and child perform the same task alone with an opaque screen in between them. In a third condition mother and child are engaged in a free verbal conversation. Finally, a resting phase (closed eyes) serves as a baseline. Self-reports and behavioral data were collected to test our hypothesis that maternal attachment, caregiving, and sensitivity affect mother-child brain-to-brain synchrony, potentially mediated by child temperament: Parental Bonding Index, Experiences in Close Relationships, Parental Reflective Functioning, Parental Sensitivity Questionnaire, and Child Behaviour Checklist. In addition, the Parent-Child Interaction System (PARCHISY) is used to assess quality of the mother-child interaction during the collaborative task. Our preliminary sample consists of 33 mother-child dyads (14 boys and 19 girls). Children's mean age is 5;08 years (SD= 0;03 years; range=5;04-6;01 years). The mothers' age averages at 36.8 years (SD=4.26 years; range=28-46 years). 48% of mothers graduated from vocational school, the remaining mothers graduated with a university degree. Wavelet transform coherence (WTC) was used to assess the cross-correlation between the two fNIRS time series. For preliminary statistical analyses, WTC values were entered

as the dependent variable in a linear mixed effects model with condition (cooperation vs. individual; baseline corrected) and channel (16 per dyad) as fixed factors, a random intercept, and a AR(1) covariance structure. We found a main effect of condition due to increased coherence in frontal and temporal areas during the collaboration condition, $t(799)=2.60$, $p=0.009$. An exploratory post-hoc analysis on averaged coherence values in frontal vs. temporal areas furthermore showed that dyads with higher attachment anxiety in the mother had a stronger coherence increase in frontal areas, $t=2.05$, $p=0.04$. Finally, an increase in coherence was also observed when mother and child talked freely as compared to the resting phase, $t(799)=2,71$, $p=0.007$. Further analyses relating inter-brain coherence to differences in the quality of the parent-child interaction are underway. The study will be complemented with an investigation on mother-infant brain-to-brain synchrony depending on behavioral contingency during live interactions in 8-month-olds. Results will be discussed in the context of variables affecting the quality of parent-child interactions and the potential functional role of interbrain synchrony.

S1.5iii Infant brain responses to live face-to-face interaction with their mothers: Combining fNIRS with a modified still-face paradigm

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Previous studies suggest that depressed mothers show low maternal sensitivity in mother-child interaction. As a consequence, children of depressed mothers may have an increased risk of disturbed early social-emotional development and emergence of psychopathology later in life. To date, it is unclear how low maternal sensitivity, impacts the developing brain. Innovative, non-invasive imaging techniques, such as fNIRS, allow us to investigate neurobiological correlates of infant's social-emotional development within the context of early mother-child interaction. On a behavioral level, a number of studies have investigated parent-infant interaction employing the still-face paradigm (infant and parent engage in a face-to-face interaction episode (baseline); followed by a still-face episode, in which the parent ceases interaction and maintains a neutral facial expression; followed by a reunion episode, in which normal face-to-face interaction resumes) and found that the parent is an important co-regulator of infant's physiological and behavioral stress response and that the quality of early interaction may therefore shape children's social-emotional development. Yet, neurobiological correlates underlying parent-infant interaction and infant affect regulation during the

still-face paradigm have not been investigated. The main aim of the current study was to assess infants' brain responses to depressive and positive maternal cues (e.g. still-face vs. happy-face expressions) employing a modified still-face paradigm, which consisted of depressed vs. non-depressed live face-to-face mother-infant and stranger-infant interaction episodes, while infants undergo fNIRS imaging. We used a Hitachi ETG-4000 CW system with 22 channels spanning the frontal cortex to collect hemodynamic brain responses. Source-detector distances were app. 3 cm, and the system sampling frequency was 10 Hz. Infants tested were 6-to-8 months old. Here, first data of ten (6 females), typically developing infants, born full-term, with no known prenatal or perinatal complications, investigated at a mean age of 230.2±17.5 days are presented. Preliminary results show enhanced negative activation (indicated by a decrease in oxygenated hemoglobin) over the medial OFC during mother's still-face (CH20, $p<.05$) and the left posterior dlPFC during mother's happy-face (CH9, $p<.01$); brain regions also found to underlie maternal affect regulation in response to infant cues, such as crying. In a separate analysis, we compared infant fNIRS timecourse data collected during live vs. video stimulus presentation in age-similar samples to assess data quality and motion correction performance for live data. While we did not directly compare probe motion parameters between methods of stimulus presentation, we found no differences in data quality metrics indicating that live stimulus presentation did not differentially impact prevalence of motion artifacts or data quality in general. We also found first support that motion correction algorithms, such as wavelet filtering, are well suited for infant live data. The present work underscores that live design in infants can be done without increasing noise in the data as compared to a standard design. Live design constitutes a promising application of fNIRS, which promotes investigation of the developing brain in a naturalistic context, an advantage no other infant-friendly imaging technique can offer. Restrictions and implications will be discussed.

S1.5iv The Trajectory of Semantic Representation: from Encoding to Consolidation - an interplay of N400 & Alpha Desynchronization

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One pivotal component of early language acquisition is the ability to learn and remember what a word refers to in the complex scenes of our visual world (Quine, 1960). In the case of noun acquisition, infants first need to form an association between a typically socially-presented auditory representation of a word and a visual

representation of an object (Borgström, von Koss Torkildsen, & Lindgren, 2016). However, whether infants can form stable word-object associations that reflect referential semantic understanding of speech, rather than merely associations between objects and referents, is currently not fully understood. The literature suggests that preverbal infants may utilize multiple cues (social, linguistic, perceptual) when learning new words and that the social context may inform the learner about semantics (Ni Choisdealbha & Reid, 2014). The present study combines event-related brain potentials (ERP's) and event-related oscillations (ERO's) to investigate semantic representation of newly acquired nouns at two time points. During the learning phase, twenty 10- to 11-month-old infants experienced a 6-minute live social interaction in which an experimenter labeled two novel objects. On test trials, infants' retention for the newly acquired nouns and objects was investigated immediately after training and with a 24-hour delay. Following priming of familiar learning-phase labels via loudspeakers, one of the two objects appeared from behind an occluder on a computer screen. The word-object pairs were either congruent or incongruent. Results suggest that new information transforms to a more long-term representation over time. This was evident via the observed N400 ERP component for incongruent word-object pairs following the 24-hour delay (a significant Condition x Time interaction was found only for the right hemisphere on day 2, $F(3.4, 64.4) = 3.149$, $p = .026$, partial $\eta 2 = .142$. Analysis of a neural marker thought to index recruitment of knowledge, alpha band suppression for congruent word-object pairs over posterior channels (one-sample t-tests (with the test value = 0) revealed that only the congruent condition on day 2 reached significance from baseline, $t(19) = -2.655$, $p = .016$. Thus, both alpha and the N400 were only evident in the delayed retention test. Further, a correlation between the N400 and alpha suppression was found ($r = -0.454$, $p = .022$), suggesting that this specific alpha frequency recruits the knowledge system at 10-11 months. This implies that both correlates may index related cognitive mechanisms, namely the processing of semantics. In addition, we examined differences in attentional mechanisms between the immediate and delayed retention phases. As with the N400 component, the Nc negative central component (associated with allocation of attention) was greater for incongruous word-object pairs only 24-hours later, $F(1,19) = 4.713$, $p = .043$, partial $\eta 2 = .199$. Given these consistent findings, results strongly suggest infants can learn semantic information from social interaction rather than rely on associative learning as an underlying mechanism for social processing. This study highlights the importance of offline consolidation and proposes that semantic representation of newly acquired words in memory is most likely a function of time.

S1.6 Symposium: Grammar learning in infancy

S1.6i Marcus et al. (1999) revisited: which mechanism underlies infants' abstraction of ABA/ABB patterns?

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In this paper we present the results of our attempts to extend on, but also to replicate exactly the seminal study by Marcus et al. (1999). We will present the results of three experiments, starting with the extension and gradually returning to the pure replication attempt. In Experiment 1, we investigated whether infants were able to learn an XYX or XYY pattern and generalize them to different levels of abstractness: (a) familiar syllables in novel combinations, (b) familiar syllables previously heard only in Y position now heard in X position, and (c) completely novel syllables (as in Marcus et al.). In Experiment 2, we familiarized infants to the same patterns as in Experiment 1, but tested them only with novel syllables. In these first two experiments, we used a naturally-recorded, phonologically balanced set of phonemes as our stimuli. In Experiment 3, we reverted to a procedure and stimuli as similar as possible to the original Marcus et al. (1999) study. In all three studies, we were unable to replicate the result found in the original paper. Instead of looking more towards inconsistent test items, as in Marcus et al., infants in our experiments looked more towards patterns containing adjacent repetition (XYY in Experiments 1 and 2, and XXY in Experiment 3) independent of the pattern they were familiarized with. Bayesian sequential analyses, which allows us to better quantify and interpret the looking time data, provides strong evidence for this finding. This result indicates that while infants were able to discriminate the two test patterns, they did not do so on the basis of learning but probably on the basis of a general sensitivity to repetition, a perceptual primitive (Mehler et al. 2008). Indeed, Mehler et al. already suggest that the result in Marcus et al. (1999) might result from a repetition-based mechanism, rather than from a rule-learning mechanism. Our study confirms their suspicion. We conclude that learning of XYX/XYY type rules in infants might not be as reliable as previously thought, and we discuss the implications for this finding with respect to previously-proposed theories of the role of repetitions on learning.

S1.6ii Learning Repetition-Based Regularities at 6 Months

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The ability to extract regularities from linguistic input is essential for the acquisition of grammar. Infants have been shown to extract repetition-based regularities (e.g. ABB: "mubaba") at 8 months of age in behavioral studies (Marcus et al. 1999) and at birth in near-infrared spectroscopy (NIRS) studies (Gervain et al. 2008). While the presence of this ability is well established, the underlying mechanisms are under debate. Specifically, whether the mechanism is abstract or perceptual, language-specific or domain-general remain unclear. Its developmental trajectory is also unexplored. Here, we present two NIRS studies seeking to answer these questions. In the first study (Gervain, de la Cruz, Berent in preparation), we asked whether repetition-based rule extraction operates across linguistic modalities. We tested 6-month-old infants, never exposed to sign language, on sequences of two nonsense signs that were either identical (AA: Repetition Condition) or different (AB: No Repetition Condition). A native signer recorded the stimuli. They were presented in blocks (6 sequences per block, 7 blocks per condition). Infants' brain activity in the frontal, temporal and parietal areas was recorded, while they were watching the videos. The fronto-temporal areas in the right, and to a lesser extent, in the left hemisphere responded more to Repetition than to No Repetition (Figure1A, *<0.05), indicating that infants could extract the regularity. This result matches closely the repetition-advantage in newborns for similar patterns with speech sounds, suggesting that the representation of this regularity is common to different modalities of language. In the second study (Radulescu, Avrutin, Wijnen, Gervain, in preparation), we asked how variability in the speech input impacts rule extraction. High variability is argued to favor rule extraction and generalization, while low variability to trigger item-based learning (Endress & Bonatti 2007, Bouchon et al. 2015). We presented 6-month-olds with trisyllabic auditory sequences implementing a repetition (ABB: "fagege") or a random sequence (ABC: "fagera"), while they were watching a silent cartoon. We measured brain activation in the temporal, parietal and frontal areas. In half of the experiment (High Variability Condition [HV]; 3 ABB, 3 ABC blocks), infants were presented with highly variable ABB and ABC sequences build from a repertoire of 18 syllables, whereas in the other half (Low Variability Condition [LV], 3 ABB, 3 ABC blocks), sequences were created from only 9 syllables. For half of the infants, the HV was presented first, for the other half it was presented second. A 1-minute-long music block separated the two halves. Data collection is ongoing. Preliminary results show significant activation in most channels, but no difference between the HV and LV conditions, nor between the ABB and ABC patterns (Figure1B). If confirmed, these results may suggest a developmental shift in repetition-based rule extraction and/or infants' failure to extract a regularity when exposed to two different input sets. Taken together, these results are

the first to explore repetition-based rule extraction in 6-month-olds, and suggest that this ability is general across different language modalities, but may undergo developmental change at 6 months.

S1.6iii Developmental shift in non-adjacent dependency learning

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Grammatical dependencies between non-adjacent elements are important building blocks of language. For example, the sentence "The sister is singing" requires the listener to track grammatical relations between the auxiliary "is" and the verb suffix "-ing". Recent event-related potential (ERP) studies revealed that 4-month-old infants can learn these dependencies by merely listening to correct examples, while adults only learn under active task conditions (Friederici, Mueller, & Oberecker, 2011; Mueller, Friederici & Männel, 2012). Moreover, adults' ERP responses can be modulated by inhibiting the prefrontal cortex. We, therefore, propose that there is a developmental shift from infants' effortless learning of non-adjacent dependencies (NADs) to adults' effortful learning, potentially caused by prefrontal cortex development (Friederici, Mueller, Sehm & Ragert, 2013). We aim to specify at what age this developmental shift takes place by testing German-learning children between 24 and 36 months of age. We expose children to Italian sentences containing NADs between an auxiliary and a verb suffix (e.g. "La sorella sta cantando" (The sister is singing)). In addition, we expose the same children to tone sequences (1 tone replacing 1 syllable) containing NADs at the same position to investigate whether NAD learning is language-specific or domain-general. Infants are first familiarized with correct examples and then tested with correct and incorrect examples, containing a NAD violation, e.g. "*La sorella sta cantare" (*The sister is sing). Infants' discrimination of grammatically correct and incorrect test items (i.e. NAD violations) reveals whether they have learned the underlying rule and thus at what age the developmental shift from effortless to effortful NAD learning takes place. In a between-subjects design, we obtained data from electroencephalography (EEG) and near-infrared spectroscopy (NIRS). The comparison of these methods allows investigating the learning mechanisms as well as the brain areas involved in infants' NAD learning. First EEG data show that ERP responses of 36-month-old children are not

significantly different between grammatically correct and incorrect sentences or tone sequences, suggesting that 36-month-olds, similarly to adults, did not learn the underlying NADs from mere exposure. In contrast, preliminary NIRS data show an increased hemodynamic response to incorrect compared to grammatically correct sentences in 24-month-old children. This difference was only found for the linguistic, but not the non-linguistic material, and primarily present in the left temporal region. These data suggest that 24-month-olds are still able to automatically extract NADs from a novel language and do so by recruiting left temporal rather than frontal brain regions. Thus, we report a domain-specific developmental shift in NAD learning between the age of 24 and 36 months. While 24-month-olds still learned NADs from mere exposure in the linguistic domain, 36-month-olds, similarly to adults, did not learn under passive listening. The recruitment of temporal rather than frontal brain regions for the detection of NAD violations points to an associative learning mechanism in children, as opposed to more controlled learning in adults.

S1.6iv On the link between perception and cognition in auditory sequence learning

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The competent use of human language presupposes the ability to build and analyze complex patterns of sounds. It sounds almost trivial to assume that the detection of complex linguistic patterns is related to how well the underlying acoustic properties of the coding stimuli are processed. Yet, the exact relation between low-level auditory processes and higher-level sequence learning is not well understood. A link between auditory processes and linguistic abilities has, for example, been demonstrated in the domain of language impairments (Bishop, 2007), but joint investigations of auditory perception and on-line language learning tasks are rare. In a previous event-related potential (ERP) study in 3-month-old infants and adults, we could demonstrate that the learning of non-adjacent dependencies within tri-syllabic sequences depends on the quality of auditory processing, as measured in a pitch discrimination task (Mueller, Friederici, & Männel, 2012). We could further show that this relation also holds for preschool children (Mueller, Friederici, & Männel, in revision). These studies strongly suggest that higher-order sequence learning in speech is modulated by basic auditory perception. Yet, how exactly and which aspects of the auditory signal support sequence

learning remained unanswered. Also, it is unclear to which degree such a relationships holds across the speech and non-speech domains. After introducing the theoretical and empirical background of the relation between sequence learning and auditory perception, I will present an ERP study with 3-year-old children that aimed to test the generalizability of the proposed relation. In all of these studies, we used an oddball paradigm with three-syllable or tone sequences containing non-adjacent dependencies between the first and the last stimuli as standards. The standards were interspersed with violations of the non-adjacent dependency and with perceptual violations (of pitch or intensity). I will present ERPs in relation to the different types of deviants and, additionally, report on how the processing of perceptual deviants and non-adjacent dependency deviants are linked. The results shed light on how auditory processes might serve to guide learners' attention during auditory sequence learning and how this could be one of the stepping stones for the detection of syntactic regularities in language. References: Bishop, D. V. M. (2007). Using mismatch negativity to study central auditory processing in developmental language and literacy impairments: Where are we, and where should we be going? Psychological Bulletin, 133(4), 651-672. Mueller, J. L., Friederici, A. D., & Männel, C. (in revision). Developmental changes in automatic rule learning mechanisms across early childhood. Mueller, J. L., Friederici, A. D., & Männel, C. (2012). Auditory perception at the root of language learning. Proceedings of the National Academy of Sciences of the United States of America, 109(39), 15953-8.

S1.7 Symposium: Preventing obesity in infancy: updates on early interventions

S1.7i Maternal choice of study partner in a home-based obesity prevention trial aimed at infants and toddlers

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Introduction. While obesity prevention interventions targeting the first two years of life have increased dramatically over the last decade, critical gaps remain, including limited engagement of non-maternal caregivers. Nearly half of all infants and toddlers are in regular non-maternal care, most frequently by relatives, who are actively involved in feeding. Using baseline data from Mothers & Others: Family-based Obesity Prevention for Infants and Toddlers (Mothers & Others), the purpose of the current study is two-fold: (1) identify the types of caregivers mothers choose as their study partner; and, (2) determine associations between maternal choice of study partner and select sociodemographic characteristics. Methods. Data are from 430 baseline interviews of non-Hispanic black, pregnant women participating in Mothers & Others. The study began when women were 28 weeks' gestation (baseline), with a final assessment at 15 months postpartum. Six home visits were delivered by a trained peer educator at 30 and 34 weeks' gestation and 3, 6, 9, and 12 months postpartum. At the baseline visit, mothers were asked "Who is the person, other than a doctor or healthcare professional, that is most important to your decision-making about infant care or that will be involved in caring for the infant during the first few months after his/her birth?" Descriptive statistics were used to examine variable distributions. Caregivers were categorized into one of four groups: infant's father, infant's grandmother, other type of relative, or nonrelative. Separate bivariate logistic regression models were run for each type of caregiver and sociodemographic variable. Significance was set at $p<.05$. Results. Fifty-five percent of mothers chose the infant's father as their study partner, 27.5% chose the infant's grandmother, 11.5% chose another type of relative, most commonly the infant's aunt, and 6.4% chose a nonrelative, most commonly a friend. There were no significant differences in choice by treatment group. Characteristics associated with choosing the infant's father included older maternal age ($p<.001$), being married ($p<.001$), living with the father ($p<.001$), having some college education ($p<.001$) and a smaller household size ($p<.05$). Mothers who chose the infant's grandmother were younger ($p<.001$), had a larger household size ($p<.05$), and were less likely to be married ($p<.001$), to live with the infant's father ($p<.001$), or to have any college education ($p<.01$). Characteristics associated with choosing a relative other than the father or grandmother were presence

of depressive symptoms (p<.05), not living with the father (p<.001), and no college education (p<.05). Mothers who chose a nonrelative as a study partner were less likely to live with the infant's father (p<.001) and more likely to have lower levels of perceived social support from family (p<.001). Conclusion. There has been a growing emphasis in the literature on the importance of including fathers in early life obesity prevention efforts. Our data suggest this narrow focus on fathers may miss many infants, particularly those most at risk for obesity. Future early life obesity prevention interventions targeting the home environment should consider the varied circumstances and preferences of women with young children.

S1.7ii Effects of the INSIGHT trial on parenting, child behavior, and early childhood weight outcomes: A Randomized Clinical Trial

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Introduction: Infancy is a critical period of developmental plasticity with long-lasting metabolic and behavioral consequences. It is therefore not surprising that overweight and rapid weight gain during infancy increase risk for obesity as well as its co-morbidities across the lifecourse. Although modifiable factors promoting overweight and rapid growth have been identified, until recently, studies aimed at improving growth trajectories during early childhood have not been conducted. Yet, there is extensive evidence from the developmental psychology literature that sensitive and responsive care giving support intellectual, emotional, and social growth. Hypothesis: Grounded in the developmental literature on parenting sensitives, the central hypothesis of the Intervention Nurses Start Infants Growing on Healthy Trajectories (INSIGHT) trial is that responsive parenting (RP) promotes self-regulation and shared parent-child responsibility for feeding, reducing subsequent risk for overeating and overweight. Study Population: 316 first-time mothers and their full-term newborns were enrolled from one maternity. 297 dyads were randomly assigned to parenting or safety (control) groups. Methods: Two weeks after delivery, dyads were randomized to intervention or control. Research nurses conducted four home visits during the first year (age 3-4, 16, 28, and 40 weeks) and annual research center visits through 3 years. Both groups received intervention components framed around four behavioral states: Sleeping, Feeding, Alert and Calm, and Drowsy. INSIGHT's curriculum focused on RP in domains of infant feeding, sleep, interactive play, and emotion regulation. The control group received a home safety intervention. The primary outcomes were BMI z-scores at age 3

years, rapid weight gain, and the proportion of infants with BMI >85th and 95th percentiles. Other main outcome measures included parent feeding practices and infant sleep, dietary intake, emotional regulation, and physical activity. Results: Infants randomized to the RP group showed slower weight gain from birth to 6 months compared with the safety group (p=0.004); efficacy did not differ by feeding mode (i.e., whether infants were predominantly fed breastmilk or not). Infants in the RP group also had lower mean weight-for-length percentiles at 1 year than infants in the control group (57.5%; 95%CI, 52.56%-62.37%vs 64.4%; 95%CI, 59.94%-69.26%; P = .04) and were less likely to be overweight at 1 year of age (5.5%vs 12.7%; P = .047) and 2 years of age (11.4% vs. 20.8%; P=.04). In addition, INSIGHT infants slept longer at night, were more likely to meet the Academy of Pediatrics' no screen time recommendation prior to age 1, and consumed healthier diets, particularly among formula fed infants compared to control infants. Lastly, INSIGHT infants were less likely to use non-responsive feeding practices such as pressuring to finish the bottle and foods to soothe, and more likely to use structure based feeding practices. Conclusions and relevance: Parenting behavior and early life weight trajectories are modifiable with potential for long-term benefits related to weight status and its associated co-morbidities.

S1.7iii Two and 3.5-year post-intervention outcomes of the InFANT Program: a cluster-RCT to improve energy-balance behaviours in early childhood.

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Introduction: The rapid progression to overweight and obesity in around one quarter of children across the first five years of life, the establishment and entrenchment of predictive energy-balance behaviours, and parent's interest in their children's health provide robust rationale for early interventions. Very few RCTS have examined how we might effectively promote appropriate energy-balance behaviours at this time and few have examined intervention effects over time. Hypotheses: The InFANT Program tests the hypothesis that engaging parents in a low dose intervention focussed on achieving healthy diet, physical activity and reduced sedentary behaviours, within existing first-time parent groups across the first 18 months of life will improved children's energy balance behaviours across childhood Study population: Mother-child dyads (n=492) from Melbourne Australia Methods: The InFANT Program was a 6 session, 15- month obesity prevention and healthy lifestyle intervention delivered to first-time parents of

infants from approximately four months of age. The 492 families still enrolled in the InFANT Program at intervention conclusion (children aged approximately 18 months) were recontacted and >80% participated at each of the two follow ups. Outcomes 42 and 60 months of age (2 and 3.5 years post-intervention, respectively) assessed child body mass index, waist circumference, diet (3*24 hour recalls), physical activity (8 days of ActiGraph accelerometer data; parent reported active play) and sedentary time (8 days of ActiGraph accelerometer data and ActivPAL inclinometer data; parent reported screen time). Results: There was no effect of the intervention on zBMI or waist circumference z-score at either follow up. At two years post intervention, children who had received the intervention had significantly higher fruit, vegetable and water intake than their peers in the control condition, however, these effects were not evident at the 3.5 year follow up. At the 3.5-year follow up, intervention group children were reported to consume significantly less non-core drinks than those in the control group. At both follow-ups, sweet snack intake was significantly lower in children whose parents had received the intervention. Savoury snack intake was the only dietary variable where no effect of the intervention was evident. The intervention demonstrated no impact on children's physical activity. While television viewing was reported to be lower in the intervention compared to the control group by approximately 10 min at two year follow up and 13 min at the 3.5 year follow up after accounting for covariates, the between group differences were not statistically significant but likely to be meaningful at a population level. Conclusion: This study highlights that a low dose intervention targeting the genesis of early energy balance behaviours from infancy was successful in effecting sustained and positive dietary change for most dietary targets (with the exception of savoury snacks), 2 and 3.5 years post intervention conclusion (children aged 3.5 and 5 years). The reduction in effect between 2 and 3.5 years post intervention is likely to be influenced by children's growing autonomy and possibly reflects the need for interventions to continue across these early years. The finding of no significant differences in physical activity or sedentary time behoves our further consideration of how best to affect these important behaviours from early life

S1.7iv The NOURISH trial: preventing obesity using anticipatory guidance to promote positive feeding practices in very early childhood

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Introduction: Primary prevention of childhood overweight is a high priority. Capacity to self-regulate intake in response to hunger and satiety cues is innate in infants and critical to healthy weight status. This capacity may be overridden by social and emotional cues from parents, in particular, response to developmentally normal food refusal such as neophobia. Positive feeding practices that allow the young child to maintain control of the amount eaten in response to hunger and satiety cues may support intrinsic regulation of appetite and healthy growth. Hypotheses: A community-based intervention providing anticipatory guidance promoting positive feeding practices to first-time mothers will (i) foster healthy eating behaviours in young children, (ii) initiate and maintain positive feeding practices, and (iii) result in lower BMI z score up to 5 years of age. Study population: Mother-child dyads (n=698) from two Australian capital cities, Brisbane and Adelaide. Methods: All first-time mothers delivering healthy term infants were approached in postnatal wards of major maternity hospitals for assessment of eligibility and consent to later contact. When infants were approximately 4 months old mothers were re-contacted for full enrolment, baseline assessment and subsequent randomisation to intervention or control groups. The intervention comprised two education modules each of six fortnightly group sessions facilitated by a dietitian and psychologist. Module 1, at child age 4-7 months focused on introduction of solids and the importance of repeated exposure i.e. 'learning to like, liking to eat'. Module 2, at child age 13-16 months related to transition to family foods and positive responses to child feeding cues i.e. 'parent provide, child decide'. Both modules promoted authoritative parenting practices and feeding styles (high control and warmth); maternal recognition of and trust in child cues of hunger and satiety; and consistent, responsive use of developmentally-appropriate structure and limits. The control group had self-directed access to community child health services e.g. telephone helpline, individual weigh clinics. Outcomes were assessed at 2, 3.7 and 5 years (61% retention at 5 years). Weight and height were measured by study staff. Mothers self-reported feeding practices using validated questionnaires. Linear mixed models assessed group, time and time x group effects. Results: The NOURISH intervention led to improvements in child eating behaviour compared to usual care, up to 5 years of age (food responsiveness, 2.3 vs 2.4, p=.04; satiety responsiveness, 3.0 vs 2.9, p=.04). Mothers reported lower use of restriction, 3.2 vs 3.1, p=.003; pressure to eat, 2.0 vs 2.4, p=.001; instrumental feeding 1.9 vs 2.2, p=.001; and emotional feeding, 1.4 vs 1.6, p=.014. At each time point BMI z score was 16-17% lower in intervention children, with the overall group effect approaching significance (p = .06). Anticipatory guidance resulted in increased use of positive feeding practices with intervention effects sustained up to 3.5 years post-intervention. This presentation will conclude with preliminary

findings from the follow-up of NOURISH participants at age 7 and introduce the EPOCH meta-analysis. EPOCH (Early Prevention of Obesity in Childhood) has pooled data from four randomised controlled trials focussed on early feeding practices, from universities across Australasia.

S2.2 Symposium: The role of early experience in the development of auditory & audiovisual perception

S2.2i Cross-Modal Neuroplasticity in Deafness: Evidence from Children fitted with Cochlear Implants

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Congenital deafness prevents the normal growth and connectivity needed to form a normally functioning sensory system-- resulting in deficits in oral language and cognition in deaf children. Cochlear implants (CI) bypass peripheral cochlear damage, by directly stimulating the auditory nerve, making it possible to avoid many of the harmful effects of auditory deprivation. Children who receive CI's provide a platform to examine the characteristics of neuroplasticity in the central auditory system. An important aspect of compensatory plasticity that is evident in deafness is the re-organization and re-purposing of auditory cortex by other sensory modalities known as cross-modal plasticity. We examined cross-modal plasticity from the visual and somatosensory systems in deaf children fitted with CIs and related them to communication and cognitive outcomes. High-density 128 channel electroencephalographic (EEG) recordings to auditory, visual and somatosensory stimulation, tests of auditory-visual speech perception in noise and cognition were administered. Patients with cochlear implants showed activation of auditory cortical areas in response to visual and vibrotacticle stimulation, suggestive of cross-modal recruitment by the visual and somatosensory modalities. Children with cochlear implants who had greater difficulty understanding speech in noise via their cochlear implant showed greater evidence of cross-modal recruitment. Overall, our results show that compensation for degraded auditory input results in greater dependence on other modalities which serves to aid communication in real-world situations. Our results suggest that the alterations in neural circuitry that underlie compensatory cross-modal plasticity may be an important source of variability in outcomes for patients with CIs. Furthermore, by understanding neuroplasticity in deaf infants and children with cochlear implants we may be able to customize rehabilitation programs tailored to individual needs. Supported by the US National Institutes of Health.

S2.2ii New Insights into Critical Periods: Cross-modal Perception in Adults treated for Congenital Cataract

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Despite early treatment, children born with dense cataracts end up with many visual deficits. Here we consider whether cross-modal re-organization during the initial deprivation--as occurs in the congenitally blind--might contribute to the later deficits. Specifically, we examined audiovisual integration in adults treated for bilateral or unilateral congenital cataracts (n=13/group). Simultaneity judgments. Participants judged whether a flash and beep were simultaneous. Controls showed a typical gaussian curve peaking when the flash slightly preceded the sound; a shift attributed to plastic calibration for the slower travel time of sound. Bilateral patients were abnormal, with the vision-leading side of the curve being much wider. The curve for the unilateral patients had a normal peak but was wider than normal for both sound- and flash-leading sides (Chen et al., 2016), as is found in typically developing children. Fission illusion. Participants reported the number of flashes while ignoring accompanying beeps. Controls made errors, as expected, when there were 2 beeps/1 flash; fewer errors were made when visual stimulation was in the centre compared to the periphery. Unilateral patients had a similarly robust illusion and centre/periphery pattern. Bilateral patients had very little illusion in either centre or periphery, accurately reporting the number of flashes, regardless of the number of beeps. Thus, early visual input is necessary not only to set up the neural substrate for later visual development but also to allow normal audiovisual integration. When input is missing to both eyes near birth, auditory input establishes effective connections to putatively visual cortical areas (Collignon et al., 2015) and leads to enhanced auditory processing (de Heering et al., 2016), but at a cost to effective audiovisual integration. When the deprivation is unilateral, early input through just one eye may be sufficient to prevent that re-organization.

S2.2iii Short Periods of Perinatal Sensory Experience Change the Structure and Function of Auditory Cortex

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Background: Studies of deaf or blind subjects often report enhanced perceptual abilities in the remaining senses. Compared to hearing subjects, psychophysical studies have revealed specific superior visual abilities in the early-deaf as well as enhanced auditory functions in the early-blind. The neural substrate for these superior sensory abilities has

been identified to reside in the deprived cerebral cortices that have been reorganized by the remaining sensory modalities through cross-modal plasticity. Therefore, a causal link between supranormal visual performance and the visual activity in the reorganized auditory cortex has been demonstrated. Furthermore, it has been identified that the cartography of auditory cortex is altered following the loss of auditory input early in life. In total, perinatal deafness alters both the function and structure of the developing auditory cortex. The current investigation examines how exposure to brief periods of acoustic stimulation alters the developmental trajectory of auditory cortex. Objective: To determine how brief periods of acoustic experience early in life affects the structure and function of auditory cortex. Methods & Results: Compared to hearing animals, movement detection and localization of a flashed stimulus in the visual periphery are superior in congenitally deaf cats. These enhanced functions are localized to specific regions of deaf auditory cortex. For example, bilateral deactivation of posterior auditory field (PAF) results in the elimination of the superior visual localization capabilities of the deaf cats and results in performance similar to hearing cats. Furthermore, bilateral deactivation of the dorsal zone (DZ) of auditory cortex results in the elimination of the superior movement detection capabilities of the deaf cats and results in performance similar to hearing cats. To examine the role of acoustic experience in mediating these enhanced visual functions in the deaf, hearing animals were chemically deafened with ototoxic drugs at increasing ages postnatal. The animals had one to twelve weeks of acoustic exposure prior to the onset of deafness. In adulthood, the cats were trained and tested on the same visual tasks examined in the congenitally deaf cats. Overall, we found that following nine weeks of acoustic experience that no enhanced visual abilities could be identified. Furthermore, with only four weeks of acoustic exposure the enhanced motion detection ability was not evident. These reduced levels of enhanced visual functions were also correlated with changes in cortical cartography. As acoustic experience increased during development, the overall size of auditory cortex, and the size of individual auditory areas also expanded. Conclusion: These results demonstrate that enhanced visual performance in the deaf is caused by cross-modal reorganization of deaf auditory cortex and that increasingly longer periods of perinatal acoustic exposure result in reduced enhanced visual abilities and an increased size of auditory cortex.

S2.2iv The Role of Early Experience in Multisensory Processing and its Development in Human Infants

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Background: An infant's everyday world consists of objects and events which are often specified by a plethora of multisensory stimulus attributes. For example, infants often see and hear their social partners talking and inanimate objects moving and making sounds. To perceive the multisensory attributes of animate and inanimate objects as unitary and meaningful entities - rather than as collections of unrelated sensations - infants must be able to process and integrate their multisensory attributes into unitary wholes. Research shows that, at birth, infants only possess relatively primitive but, nonetheless, powerful multisensory processing abilities and thus that they can perceive relatively primitive forms of multisensory unity. As infants grow and acquire experience, however, their multisensory processing abilities gradually improve and become increasingly more sophisticated. How might early experience contribute to these developmental changes? Until recently, there were no answers to this question despite the fact that early experience is likely to play a major role in multisensory development because the infant nervous system is highly plastic and open to experience and because animal studies have shown that experience is fundamental in shaping multisensory neural circuits and functions. In recent studies, we have investigated the effects of early experience on multisensory processing and its development in human infants. I will present recent findings on this topic. Objective: To determine when and how early experience affects multisensory processing, its components, and its development. Methods & Results: Our studies investigate multisensory processing in typically developing infants and rely on indices of attention as measured with paired-preference, habituation/test, and eye tracking methods. I will begin by presenting evidence that the multisensory world of young infants is relatively undifferentiated because of sensory limitations and lack of experience. Then I will show that infants gradually shed their primitive multisensory processing mechanisms and suggest that this is due to perceptual learning/differentiation and perceptual narrowing. Finally, I will focus on the role of perceptual narrowing in multisensory processing and its development and present the results from recent studies in which we have compared processing of native vs. non-native inputs as a way to manipulate early experience. I will show that young infants are broadly tuned and, thus, that they perceive the multisensory unity of native and non-native multisensory inputs equally well but that older infants are more narrowly tuned and, thus, only detect the unity of native multisensory inputs. These findings will be illustrated with data from studies of infant matching of other-species faces and voices, matching of native and non-native auditory and visual speech, and discrimination of own and other-race faces. Finally, I will discuss recent findings showing that experience interacts with developmental changes in selective attention during the

first year of life and that these changes lead to marked, experience-dependent, developmental changes in selective attention to the audiovisual attributes of social partners. Conclusions: Multisensory processing undergoes major, experience-dependent, changes in infancy and these ultimately lead to the emergence of native-input multisensory expertise.

S2.3 Symposium: Complex trauma and domestic violence: effects on mother-infant relationships, playfulness and treatment adherence

S2.3i Infants Exposed to Complex Trauma And Domestic Violence. A closer look at the mother's experience of parenting.

Adella Nikitiades[1], Miriam Steele[1], Howard Steele[1], Paul Meisner[2], Karen Bonuck[3], Jessica DelNero[1], Anne Murphy[2]

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Dual exposure to domestic violence (DV) and other abuse and neglect (Hughes, Parkinson, & Vargo, 1989) for at-risk children can be one of the most high risk contexts that impact child development. This paper will present data from 87 mother-child dyads, 42 of whom have endorsed DV exposure for the child, and 45 that have reported significant trauma in the child's life but not exposure to domestic violence. This study hypothesized that DV exposure adds distinguishable difficulties to the complex trauma presentation of families who have suffered high levels of adversity. All families in this sample come from the Bronx, the poorest county in the US, and from a very diverse background. Families are referred for early intervention due to concern of the parent's ability to take care of their infant's needs. All families are faced with extreme adversity. T-Test analysis was performed to determine significant mean differences between the DV and Non-DV groups. The mothers whose children have been exposed to DV scored significantly higher on the Symptom Checklist 90-R (SCL-90-R, Derogatis, 1996) global severity scale and at 10 out of 12 of the sub-scales that measure psychopathology symptoms such as depression, anxiety, interpersonal sensitivity, hostility and obsessive - compulsive thinking. The mothers from the DV group reported experiencing parenting stress in significantly higher levels than the mothers for the non-DV group, with markedly significant elevations on the Parent-Child Dysfunctional Interaction scale and the Parental Distress scale of the Parenting Stress Index (PSI, Abidin, 1995). The mothers from the DV group reported significantly lower levels of self-esteem and perceived availability of confidants in a self report questionnaire measuring the levels of support that they experience in their environment (Interpersonal Support Evaluation List, ISEL, Cohen, & Hoberman,, 1983) The reported adverse events in the child's life were significantly higher than the non- DV group. 55% of the DV children had experienced 4 or more adverse childhood experiences, with most children having experienced separation of their caregivers (80%), 66% living with someone with mental illness, 53% household substance abuse and 33% living with someone that has been incarcerated (Adverse Childhood Experiences Questionnaire (Murphy, Dube, Steele & Steele,

2007)(Child Version). Per mother's report the levels of children's social-emotional problematic behaviors as described in the Ages and Stages Questionnaire (ASQ-SE-2, Social-Emotional, Second Edition, Brooks Publishing) were significantly higher than those of otherwise traumatized but not exposed to DV children. Children exposed to domestic violence are more likely to experience a wide range of adverse psychosocial and behavioral outcomes (Sousa et al., 2008; Sternberg, 2006). This study provides robust evidence for the added risk that dual exposure to DV and other trauma poses to children. Early intervention practices can benefit from considering the significantly higher levels of mental hardship and life stressors that the make up their developmental context.

S2.3ii Playfulness of Infants at Risk: The Effect of Exposure to Domestic Violence

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Play is a primary occupation of infants and children, and is integral to their development. Playfulness is the child's disposition toward play and is a seminal part of children's and infants' play. Playfulness has been found to be related to child development, wellbeing, and coping skills (Cornelli Sanderson, 2010). Buddy (1997) defined playfulness as consists of four dimensions: internal motivation; internal control; the freedom to suspend reality in play; and framing (the child's ability to communicate and interpret social cues). Children at risk of maltreatment, and specifically, children who are exposed to domestic violence (DV), have been found to play less, are less free during play, and show less playful behaviors than children in the general population (Osofsky, 1995; Valentino, Cicchetti, Toth, & Rogosch, 2006). However, the differences in playfulness levels of children at risk who have been exposed to DV and those who have not been exposed has not yet been examined. The presentation compares the playfulness level of 19 infants and toddlers at risk who were exposed to DV and 42 infants at risk who were not exposed to DV. Infants ages range between 6-46 months, 40% were females and the rest males. About one third (33.3%) of the infants were Hispanic-American, one third (33.3%) were be-racial, 31.5% were African-Americans, and the rest (1.9%) were white. All infants and toddlers were form high risk families. DV was measured using the Adverse Childhood Experience (ACE; Felitti et al., 1998), which was filled by the infants' mothers. Infant playfulness level was measured using a ten minutes' video-taped of mother-infant dyadic play interactions, that were analyzed using the Test of Playfulness (Bundy, 1997). A significant difference was found between playfulness

level of infants who were exposed to DV and infants who were not exposed to DV ($p < .5$). Surprisingly, infants at risk who were exposed to DV were found significantly more playful ($M = 1.48$, $SD = .47$) than infants at risk who were not exposed to DV ($M = 1.29$, $SD = .60$). Previous studies have shown that children that were exposed to DV show externalized behaviors and were found active when engaging in interactions with their mothers (Levendosky et al. 2006; Timmer, 2012). Playfulness has been identified to be a protective factor, which can help infants' and children cope with challenging situations (Saunders et al., 1999). The current study suggests that playfulness can be part of the behaviors set that infants who were exposed to DV use in order to interact effectively with their mothers. The study shades light on the complex phenomena of playfulness in children at risk and the effect of exposure to DV on children's playfulness.

S2.3iii Adherence in Parent-Child Psychotherapy: Implications of Childhood Adversity

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Adherence and attendance are essential in facilitating effective treatment in all areas of mental health, as they are directly related to treatment outcome. Unfortunately, attendance rates in psychotherapy are alarmingly low, with dropout and non-adherence being of particular concern in the area of family psychotherapy. Approximately two-thirds of children and parents in need of mental health services never receive treatment, and half of the families who receive treatment are non-adherent or dropout early. Moreover, rates of non-adherence are higher in groups who have been exposed to trauma or domestic violence. The literature pertaining to adherence in family therapies is limited, and far fewer studies have examined adherence in early childhood psychotherapy. In efforts to address this gap in the literature, the present study assessed rates of adherence and factors associated with attendance in families participating in early intervention treatment. The present study observed treatment adherence in a largely ethnic minority sample of parents and their children (0-3 years old) who completed treatment at the Center for Babies, Toddlers, and Families (CBTF) in the Bronx, New York. During intake, families were assigned to either the Group Attachment Based Intervention (GABI), a treatment developed to treat vulnerable parents and their children (Murphy et. al., 2015), or Systematic Training in Effective Parenting (STEP), a didactic training program for parents (Dinkmeyer & McKay). GABI is offered three times per week while STEP occurs once per week. Families participate in baseline, end of

treatment, and follow-up assessments at the Center for Attachment Research (CAR) and complete the Adverse Child Experiences Questionnaire (ACEs), a measure evaluating 10 categories of childhood trauma (Felitti et. al., 1998). Families who completed GABI attended between 1 and 45 sessions over the course of a 6-month treatment period (M=8.5), and between 0 and 46 sessions during follow-up period (M=10.2). While families who completed STEP attended between 1 and 12 sessions over the course of a 3-month treatment period (M=3.9). Follow-up sessions attended significantly correlated with child physical abuse ($r(32)=.42$, $p=.02$) as assessed using the ACE questionnaire, suggesting that families are more likely to continue treatment if their children have been exposed to violence. Household mental illness was also related to follow-up treatment attendance ($r(32)=.39$, $p=.03$). In addition, children who witnessed physical violence towards mother were more likely to attend follow-up sessions ($r(32)=.40$, $p=.02$). Alternatively, child protective scores were negatively related to attendance in follow-up period ($r(32)=.39$, $p=.02$), suggesting that parents who committed to treatment, felt more confident in their parenting abilities. Determining risk factors for non-adherence will allow for clinicians to better address potential barriers, and implement strategies to mitigate their impact before treatment begins. Gaining an understanding of attendance in parent-child psychotherapy is essential in improving treatment outcomes, and identifying those at heightened risk for dropout. Discussion will focus on the implications of childhood adversity and exposure to violence on treatment adherence.

S2.4 Symposium: The dyadic nature of learning: contingent parent responses influence infant attention and language

S2.4i Real-time effects of maternal responsiveness on infant's sustained attention

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Previous research suggests a strong link between the quality and history of parent-child interactions and language development. Tamis-LeMonda, Bornstein, & Baumwell (2001) showed that maternal responsiveness - the degree to which the parent is responsive to the cognitive and emotional state of the child - at 9- and 13-months predicted when children reached various milestones in early expressive language. The goal of the present study was to elucidate the mechanisms through which responsive behaviors from parents facilitate early word learning. To do this, we measured maternal responsiveness using standard approaches as well as the dynamic coupling of visual attention and action within the parent-infant dyad. The main hypothesis was that maternal responsiveness would be associated in the real-time extension of infant's sustained attention to the object of interest, which has been shown to promote early language learning (Ruff & Rothbart, 2001) 14- and 21-month-old infants and their parents (n=23) were fitted with head-mounted eye trackers that recorded momentary gaze data in a toy-play session with multiple toys. From continuous gaze data, regions-of-interest (ROIs) on toys and the partner's face were coded frame-by-frame. Holding behaviors (who and which toy) from both infants and parents were coded manually from the images captured by an overhead camera. Following Tamis-LeMonda's approach, we coded infant's activities (explore, play, bids/looking to parent, and vocalizations) and 6 types of maternal responsiveness (affirmations, imitations, descriptions, questions, play prompts, and exploratory prompts). As responses to children's exploration of objects and play were the most predictive in Tamis-LeMonda's study, they are the focus of the present study. On average, infants produced explore 6 times and play 3 times per minute during the experiment. Parents responded to 59.7% of explore actions, with a median lag of 1.55s, and 61.3% of play actions, with a median lag of 1.68s. Thus, parents respond promptly and frequently to their infants' behaviors during free play. Moreover, individuals' explore actions that received a response lasted longer (Mdn=3.55s) than the ones without a response (Mdn=2.18, $t = 8.26$, $p < .001$, using paired t-tests), suggesting that maternal responses extended infants' explore activities. However, we found no difference in play actions (Mdn=5.14s vs Mdn=3.95, n.s.). To further examine the effects of parental responses, we defined a 5-second temporal window after the onset of parent responses and measured the proportion of time that infants showed sustained attention

to the target object that they initially played with or explored. When parents responded to infants' explore actions, sustained attention to the target object was longer than the instances without parent responses (Mdn=54.7% vs. Mdn=43.0%, t = 3.76, p<0.01). Similarly, sustained attention following parental responses to infant play was greater than when there was no response (Mdn=57.5% vs. Mdn=44.9%, t = 2.48, p<.05). The reported findings are the first step to building bridges between macro-level descriptions and emerging micro-level analyses of dyadic interactions, demonstrating that maternal responsiveness relates to real-time changes in infant behavior.

S2.4ii Temporal and statistical characteristics of dyadic interactions that facilitate communicative development

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How do infants learn from other people? The microstructure of interaction between infants and caregivers is characterized by statistical regularities in the form and timing of adult responsiveness. Manipulations of responsiveness using biological and robotic interaction partners reveal that social reactions to prelinguistic vocalizing facilitate rapid developmental advances in speech and language (e.g. Goldstein & Schwade, 2008). To examine the mechanisms by which social responsiveness facilitate vocal learning, we examined the effects of immature vocalizations on the structure of caregiver speech in two studies. In Study 1, we examined changes in naturalistic infant-directed (ID) speech in response to babbling. Parents were observed in free play with their 9-month-old infants. ID speech was transcribed and each utterance was categorized as contingent (within 2 sec of an infant vocalization) or non-contingent. The structure of parental contingent and non-contingent ID speech was compared, with unique number of words produced as a measure of lexical diversity. Maturity of infants' vocal repertoires was assessed by calculating the proportion of infant vocalizations containing consonant-vowel transitions. Parents simplified their ID speech in response to infants' babbling compared to their non-contingent ID speech. Contingent parental speech was significantly less lexically diverse than non-contingent speech, p< .001. Contingent speech also had a significantly shorter mean utterance length than non-contingent speech, p< .001. We analyzed the relation between parents' speech complexity and infant vocal development. The lexical diversity of parents' contingent speech predicted infant vocal maturity, r(28) = .41, p=.02. Noncontingent speech did not predict infant vocal development. Our findings suggest that infants' babbling may function to elicit

changes in the structure of parents' ID speech which may facilitate infant communicative development. In Study 2, we assessed the influence of specific acoustic parameters of babbling on mothers' speech. We developed a playback paradigm, in which mothers of 9-month-old infants responded to audio-visual examples of unfamiliar 9-month-old infants' vocalizations. Prerecorded examples of infant vocalizations varied systematically in maturity (infraphonological category, Oller, 2000) and vocalization directedness. Vocalization directedness was manipulated by depicting the infant vocalizing while holding and looking at an object (object-directed) or while vocalizing into space (undirected). Mothers responded to vocalization clips by speaking their response to the infant. Playback paradigm validity was established by comparing mothers' responses to prerecorded infant stimuli to response patterns when interacting with their own infants. Mothers gave significantly more sensitive responses to infants' object-directed vocalizations and more narrative responses to infants' undirected vocalizations, ps< .05 (Figure 1). Mothers were also more likely to respond to more developmentally-advanced fully-resonant vocalizations than to less advanced quasi-resonant vocalizations. Thus, the context of infant vocalizations and vocalization maturity influence the likelihood of maternal response. Taken together, these studies show that immature vocalizations create learning opportunities by catalyzing social responses that contain simplified, learnable information.

S2.4iii Parental Responsiveness during Prelinguistic Vocal Development: Variability and Association with Language Outcomes

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The current study explored infants' prelinguistic vocalizations, how parents responded to vocalizations, and if certain responses were associated with language outcomes. We observed ten infants once per month from 8-12 months with their mothers and fathers separately during 30 minutes of free play, seven infants comprise the current sample. Infant vocalizations were coded as vowel-like or a consonant-vowel. Parents' responses were coded as sensitive or redirective and further classified as verbal or behavioral actions. Verbal responses were coded as specific speech acts. Parents did not differ in overall responsiveness (Mmother = .76, SD = .10 and Mfather = .67, SD = .17). However, there was a main effect of response style $F(1, 6) = 83.243$, $p<.001$, $\eta p2= .933$ and a main effect of response type $F(2, 12) = 5.174$, $p=.024$, $\eta p2= .463$; sensitive responses (SV) were more frequent than redirective responses (RV) (Msensitive=.20, SD=.04 vs.

Mredirective=.04, SD=.01, p<.001). In addition, verbal responses were more frequent than combined verbal-behavioral responses (Mverbal=.16, SD=.04 vs. Mverbal-behavioral=.10, SD=.04, p=.028). There was also an interaction between response style and response type F(2, 12) = 28.961, p<.001, ηp2= .828; sensitive verbal responses were more frequent than sensitive behavioral responses (MSV = .30, SD = .09 vs. MSB=.12, SD = .06), t(6)=3.204, p=.018, and SVB (MSVB = .16, SD = .07), t(6)=3.990, p=.007. The most frequent speech acts by parents were questioning, naming, imitating and descriptives, but speech acts varied to infants' V or CV vocalizations. A repeated measures ANOVA with proportion of speech act type in response to V as the dependent variable found a main effect of speech acts F(9, 54) = 11.586, p<.001, ηp2= .659. Specifically, play vocalizations were more frequent than prohibitions, affirmations, naming, and exclamations (all p's<.04); whereas, a repeated measures ANOVA with proportion of speech act type in response to CV as the dependent variable found a main effect of speech acts F(9, 54) = 8.375, p<.001, ηp2= .583. Specifically, imitations were more frequent than naming (p=.037), directives were more frequent than prohibitions, p=.035, and questions were more frequent than exclamations, p=.050. Lastly, there was a significant interaction effect of type of vocalization and speech act F(1,6) = 27.437, p=.002, ηp2= .821. Parents produced imitations more in response to CV than V, p=.003. Mother's overall responsiveness and infants' increase in comprehension from 8-12 months was positively associated (r =.757, p<.05); whereas, father's sensitive responsiveness correlated with an increase in productive vocabulary between 8-12 months (r =.774, p <.05). We are currently exploring the relationship between sensitive and redirective responses and change in vocal structure, and between specific speech acts and language outcomes.

S2.4iv Adult Responses to Infant Prelinguistic Vocalizations are Associated with Infant Vocabulary: A Home Observation Study

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Previous research has shown that naturalistic infant-caregiver dyadic interactions are positively associated with infant vocabulary size (Warlaumont et al., 2014). However, examining the relation of specific pragmatic types of caregiver responses with the quality of infant vocalizations has previously been restricted to lab settings (Gros-Louis et al., 2014). This study used LENA recording devices to capture infants' home language environments and examine how qualitative differences in adult responding to infant

vocalizations related to infant receptive and productive vocabulary. Twenty-three 12-month-old infants and their caregivers contributed daylong home audio recordings and caregivers completed the MCDI (Fenson et al., 1994) to assess infant vocabulary. The 6 most voluble 5-minute samples (30 minutes total) over the full day were hand coded for infant vocalizations and infant-directed speech. Infant speech-related vocalizations were identified and further coded as either canonical (i.e. containing at least one mature, speech-like syllable) or non-canonical. Infant-directed adult speech was identified and classified into different pragmatic types. Multiple regressions examined the relation between adult imitating, recasting, expanding, and naming, and infant canonical and non-canonical vocalizations with caregiver-reported infant receptive and productive vocabulary sizes. Models included the total infant directed speech and infant non-canonical vocalizations to control for caregiver input and infants who are more voluble, respectively. An interaction between adults' naming and infants' canonical vocalizations indicated that the combination of the two was positively associated with infants' receptive vocabulary, b=1.66, p=.02. Specifically, infants with high levels of canonical vocalizations and adult naming had larger receptive vocabularies (see Figure 1). Similarly, an interaction between adult responses that incorporated sounds the infant had just produced (i.e., imitations, recasts, and expansions) and infant canonical vocalizations was positively associated with productive vocabulary, b=0.47, p=.001. Infants with high levels of canonical vocalizations and adult responding that incorporated sounds like the infants had just produced had larger productive vocabularies (see Figure 2). Analysis of trigram codes indicated that instances of adult naming bound by canonical vocalizations predicted receptive vocabulary, b=31.32, p=.05 and adult recasts bound by canonical vocalizations predicted productive vocabulary, b=3.81, p=.02. Thus, adult responses initiated and responded to by infant speech-like vocalizations were associated with vocabulary. These findings provide specific insights into the types of infant-adult vocal exchanges most related to early vocabulary development and insight on how the home language environment is co-constructed by infants and caregivers.

S2.5 Symposium: Can we close the gaps in research on nonadjacent dependency learning?

S2.5i Input in the lab causes 15-month-olds to learn an English non-adjacent dependency

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Non-adjacent dependencies between two constituents in a sentence are ubiquitous, but surprisingly little is known about how children acquire such dependencies in natural language. Artificial language learning studies with infants (11.5-12 months in [1], 12, 15, and 17 months in [2]) have tested this question by presenting a series of word strings (e.g. pel-kicey-rud, pel-taspu- rud, etc.) that contain a non-adjacent dependency like aXb, where X is a variable (e.g. kicey, taspu) and a and b are co-occurring constants (pel-rud). These studies found that in order to learn an aXb dependency, infants require exposure to input with 18 to 24 variations in the X slot. However, it is unknown whether or to what extent the mechanisms of statistical learning identified in artificial language learning paradigms extend to learning of a natural language, especially given that in naturalistic input the target dependency does not occur in isolation but is rather embedded in sentences. The present study replicates the finding that 15-month-olds do not yet know the is-V-ing dependency [3], and goes on to show that they can learn this dependency in the lab, generalizing across verbs. This result suggests that results from artificial language learning can be informative about the role of input in natural language acquisition.

S2.5ii Individual Differences in Infants' Nonadjacent Dependency Learning

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There is considerable controversy over whether infants' ability to learn statistical regularities is relevant to learning grammar. English-learning infants are sensitive to simple nonadjacent dependencies (NADs) in their native language by 18 months (e.g, distinguishing between "Everybody is baking" and "Everybody can baking"). Work with artificial languages suggests that invariant statistical regularities between nonadjacent words promotes learning: By 15 months, infants exposed to strings of the form "pel X rud" and "vot X jic" learn that "pel" predicts "rud" (but not "jic") when many unique Xs

can occur. However, the extent to which performance on artificial-language learning tasks is relevant to native language development has been extensively debated. We tested whether infants' (N = 48) performance on the artificial-language task is meaningful by asking whether it predicts sensitivity to native-language NADs, and whether it is in turn predicted by language input. At 15 months we tested infants' ability to learn novel NADs, and at 18 months we tested their discrimination between grammatical and ungrammatical native-language NADs, both using the Head-Turn Preference Procedure (HTPP). We obtained recordings of infants' language environment at 12 months and coded how much infant-directed speech (IDS) they heard. We also obtained parent-report measures of lexical development to aid interpreting performance on the HTTP tasks. Sex differences in NAD learning have been previously reported (Lany & Gómez, 2008; & Mueller et al, 2012). Here we found sex differences in how NAD-learning at 15 months was related to the other measures. For females, stronger novelty preferences on the native-language NAD task at 18 months were predicted by receptive vocabulary size, suggesting that novelty preferences reflect greater sensitivity to native language NADs. Critically, females who displayed greater familiarity preferences on the novel NAD-learning task at 15 months showed stronger novelty preferences at 18 months. They were also likely to have larger receptive vocabularies, and to have heard more IDS at 12 months. Thus, females' performance on the novel NAD-learning task was related to key measures of language development and to language input. Males' performance on the native-language NAD task at 18 months was unrelated to any of the other measures (Table 1). Performance on the LDD-learning task at 15 months was related to expressive vocabulary size, but not to the native-language NAD task or IDS. Thus, the males' results provide more modest evidence that performance on the NAD-learning task reflects factors relevant to native language development. Note also that the direction-of-preference associated with stronger language skills was different for males and females. In sum, we found evidence that infants' ability to learn NADs in an artificial language is relevant to their native-language development, but that females and males may be learning NADs differently. Determining why their NAD-learning manifests differently holds promise for understanding how environmental and cognitive factors interact to support language learning.

S2.5iv A rhythm model of learning non-adjacent dependencies

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The statistical learning literature has repeatedly shown that learners are capable of extracting adjacent statistics from continuous language streams, with few exceptions. In contrast, findings concerning non-adjacent dependency learning are less clear and more nuanced. We present three experiments and showed successful learning of non-adjacent dependencies under conditions that are contrary to both accounts. Furthermore, we argue that these results can be explained by our recently proposed statistical learning model that exploits temporal regularities in the input to constraint learning, which readily accounts for these results. In the model, we propose a conceptual shift in thinking about statistical learning with a rhythm detection model that expects temporal regularities in the input. The model detects and makes use of temporal regularities so that the incoming sequence can be bracketed into subsequences. The model estimates two parameters--rhythmic interval and phase--which it then uses to divide the continuous speech stream into subsequences of equal intervals. It can be mathematically shown that correctly obtaining the parameters results in segmenting the continuous stream into subsequences that contain linguistic dependencies, as long as the dependencies are repeating at fixed timing intervals. This model captures not only the learning of non-adjacent dependencies, but also adjacent dependencies (in studies such as in Saffran, Newport & Aslin, 1996), providing a unifying theory of dependency learning. We speculate that past failures to may have been because the stimuli were presented at a suboptimal rate for identifying rhythmicity (i.e., outside natural speech rates of 3-7 syllables per second) or measures used were not sensitive measures of grammaticality. We propose that using rhythm as a first hypothesis to infer the latent structure of a language limits the amount of linguistic computations that need to be performed, and provides a domain for statistical learning to operate over.

S2.6 Symposium: Does looking lead to learning? Individual and contextual differences in visual attention

S2.6i Attentional processes, imitation and learning from 2-D media at 12- and 16-months of age

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Introduction: Imitation is a strong learning mechanism already during the first years of life. Early imitation has also been linked to early memory development (e.g. Jones & Herbert, 2006) and a considerable body of research has examined various factors influencing how children learn and form memories through imitation. However, less attention has been paid to events occurring at encoding that may explain individual differences. Here we examine how infants' distribution of visual attention while watching videos of imitation tasks relates to imitation of the observed action. It was hypothesized that high imitators would show a lower face-to-action ratio during action presentation. Method: The current eye-tracking study examined 12- (n= 48) and 16-month-old infants (n = 29) watching four 40-45s videos, each portraying an adult demonstrating a single action on an object (e.g. Meltzoff, 1985) or a multiple-action task (Barr et al, 1996). Each action was presented three times before infants were offered the object (counterbalanced order across infants). Infants' behavior was coded for imitation of the actions presented in the video and infants were grouped into high and low imitators by a median split. Eye-tracking data was analyzed by creating areas of interest for the face of the presenter and the area where the action occurred. The dependent variable was face-to-action ratio calculated by visit duration in the face area divided by visit duration in face and action area. The ratio was calculated for each of the four actions and averaged across tasks. Results: A repeated measures ANOVA showed a significant increase in face-to-action ratio for each additional presentation (12-m: $F(1.6,54.3) = 19.3$, $p < .001$, $\eta p2 = .36$, and 16-m: $F(2,48) = 41.4$, $p < .001$, $\eta p2 = .63$). Contrary to our hypothesis, high imitators at 16 month reoriented towards the face more than low imitators during the third demonstration, as indicated by a significant interaction between high vs low imitators and face-to-action ratio at 16 months, $F(2,48) = 3.7$, $p = .03$, $\eta p2 = .14$. There was a trend towards a negative correlation between a sum score for single action tasks and the multiple action task at 12 months, $r(40) = -.28$, $p = .08$, hence we also defined high and low imitators based on the multiple action task only. High imitators of the multiple action task at 12 months support our hypothesis as they reoriented towards the face less frequently than did low imitators, $F(1.7,60.4) = 6.0$, $p < .01$, $\eta p2 = .14$, for the third presentation. Conclusion: Infants' distributions of visual

attention seem to differ between high and low imitators. Whereas infants initially focus more on the action compared to the face, infants look more at the face for each additional presentation. High imitators at 16 months focus more on the face at the last action presentation. High imitators of the multiple action at 12 months however stay focused on the actions presented and do not switch back to the face. The different findings for 12- and 16-month-olds may signify developmental changes in attentional processes and have implications for learning from 2-D media in infancy.

S2.6ii The constraints of sensorimotor coordination on the distribution of visual attention

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 Infants select objects for visual attention by directing their gaze, and they often do so in very crowded and cluttered environments. Visual clutter can be reduced by using manual actions to bring objects closer to the head and eyes, providing optimal moments for learning and exploration. The alignment of manual actions and gaze, a type of sensorimotor coordination, is therefore hypothesized to be an important ability for controlling and distributing attention. However, little is known about how sensorimotor coordination impacts attention in environments with many possible objects to select. Here, we present a study investigating the extent to which sensorimotor coordination constrains the distribution of visual attention in cluttered environments.   Twenty-five infants (M=19.4 months, SD=2.17 months) and their parents participated in a 10-minute naturalistic toy play session. Each play session was unconstrained and included 24 toys that were pilot-tested to be interesting and engaging. Video and head-mounted eye-tracking were used to collect manual actions and eye gaze, respectively. Manual actions on and gaze to objects by infants were recorded and coded. Sensorimotor coordination was derived by measuring the proportion of frames that included manual action and gaze on the same toy. A median split was conducted on the proportion of time in sensorimotor coordination to partition infants into either the 'low' sensorimotor ability group or the 'high' sensorimotor ability group. There was no difference in age between the two groups (p=.49) and the high group (M=0.38, SD=0.07) had a higher proportion of sensorimotor coordination relative to the low group (M=0.24, SD=0.04), ps<.001.   Overall, the high group (M=0.74, SD=0.10) had a higher proportion of toy looks relative to the low group (M=0.61, SD=0.18), p<.001. Importantly, the proportion of toy looks outside of

sensorimotor coordination did not differ across the two groups (p>.1) suggesting that the difference in the amount of toy looks across the two groups was not influenced by an overall higher propensity of toy looks for the high group. To determine differences in the distributions of visual attention across the two groups, ranked-order cumulative functions of toy-specific look proportions were submitted to growth curve analyses (see Figure 1B). There were no differences in the shapes of the cumulative functions of toy looks outside of bouts of sensorimotor coordination (intercept, linear, and quadratic coefficients: ps>.1). However, there were differences in the shapes of the cumulative functions of toy looks inside bouts of sensorimotor coordination (intercept, linear, and quadratic coefficients: ps<.001), suggesting that the 'low' group had a more constrained distribution of visual attention to the toy set relative to the 'high' group.   Our findings indicate that individual differences in sensorimotor coordination impact the extent to which infants distribute their visual attention in a cluttered environment. Infants with low sensorimotor coordination had overall lower proportions of visual attention to toys and their distributions of visual attention to the set of toys were more constrained relative to infants with high sensorimotor coordination. Overall, these results highlight sensorimotor coordination as a critical pathway for visual attention.

S2.6iii Selective attention and learning from interactive and noninteractive video: An eye movement study

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Introduction: Toddlers learn more from interactive than noninteractive screen media (e.g., Lauricella et al., 2010; Troseth et al., 2006). For instance, compared to toddlers who viewed noninteractive video, 24-month-olds learned more from touchscreen applications that required a specific touch response to target information (e.g., location of an object that was labeled; Choi & Kirkorian, 2016; Kirkorian et al., 2016). The purpose here was to determine whether such interactive applications support learning by directing attention to target information on the screen. Method: Toddlers (24-36 months, N = 88) completed an object-retrieval task using an analogous video and felt board. During training, the experimenter demonstrated the correspondence between the two displays. During each of four test trials, children watched a bear hide on video and then searched for a bear sticker behind the corresponding location on the felt board. To see the bear hide, toddlers either touched the bear (relevant), touched a star

(irrelevant), or watched without touching (noninteractive). Two-thirds of the children (N = 58) wore a Positive Science head-mounted eye tracker. Of particular interest were the proportion of fixations that were "off-target" (i.e., on the video but not on the bear or hiding spot) during hiding events. Hypotheses: We predicted that, relative to noninteractive video, relevant interactivity would decrease off-target fixation and thus improve object retrieval, whereas irrelevant interactivity would increase off-target fixation and thus decrease object retrieval. Results: Across all children, the probability of successful object retrieval decreased as off-task fixations increased, $t(152) = -2.07$, $p = .040$. However, this did not explain condition effects: Compared to noninteractive video, relevant interactivity (i.e., touching the bear) resulted in less off-target fixation during hiding events, $t(52) = -2.06$, $p = .044$. However, this did not lead to an overall increase in object retrieval ($p > .250$). There was a marginally significant Relevant*Age interaction such that relevant interactivity slightly increased performance among older children but slightly decreased performance among younger children, $t(81) = 2.00$, $p = .050$. Irrelevant interactivity (i.e., touching a star) had no effect on off-target fixation ($p > .250$), and it increased object retrieval performance, particularly on later search trials, $t(258) = 2.76$, $p = .006$. See Figure 1 for modeled object retrieval as a function of off-task fixation, age, and condition. Conclusion: Results suggest that the benefit of interactive media cannot be explained by increased selective attention to target information: Although relevant interactivity did lead to more attention to the target during hiding events, it did not lead to an overall increase in object retrieval across all children. On the other hand, irrelevant interactivity did not reduce attention to the target, and it actually increased (rather than decreased) object-retrieval performance. It seems that, as with television (e.g., Lorch, Anderson, & Levin, 1979), selective attention to interactive media is a proxy for (but not the sole indicator of) learning. Data collection is currently underway for a follow-up study to test the same hypotheses and establish generalizability using a word-learning task.

S2.6iv Empty looks or paying attention? Exploring infants' visual behavior during encoding of an elicited imitation task

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Introduction: The use of screens for stimulus presentation has become a powerful tool for researchers. When combined with the recent advent of eye-tracking methodology, stimulus presentation on screens allows researchers to examine ongoing visual behavior,

potentially providing insights concerning the micro-structures of cognition (Aslin, 2007, 2012). Along this line, there has recently been an increased interest in the relation between looking time during encoding and subsequent memory performance in imitation tasks demonstrated on a screen. Hitherto the results have been inconclusive: one line of research finding a link between looking time and performance (e.g., Taylor & Herbert, 2013), another line finding no relation (e.g., Kirkorian, 2012). The existing studies may, however, have been restricted by using small samples, limited looking time measures, and short retention intervals. In the present study we examined the relation between visual behavior (looking time and pupil dilation) during the encoding process by means of eye-tracking technology in 20-month-old infants participating in an elicited imitation task and their subsequent memory performance - both immediately after demonstration as well as after two weeks. Hypotheses: Overall we expected to find positive correlations between visual behavior during encoding and the infants' performance on the two imitation tests. In addition, we expected that dilation of the infants' pupils (indicative of arousal and cognitive engagement) during the third and final action of each prop would be positively correlated with the infants' performance on the two memory tests. Participants: A total of ninety healthy and full-term 20 month-olds (Mage= 20.19 months, SD = .15, 43 girls) were tested and divided into two groups: a test group (n=68) and a baseline group (n=22). Methods: The infants in the test group visited the laboratory twice. Three different three-step props were used: A spinner, a shaker, and a jumping jack. At the first visit the infants watched the demonstration of each prop (presented twice) on a TV-screen while being eye-tracked. Immediately after the demonstration, they were asked to re-enact the modeled sequence. At the second visit, two weeks later, the test was repeated. The infants in the baseline condition were only tested once and provided us with a measure of what the infants would do spontaneously with the props without an initial demonstration. Results: The results from the imitation tests followed the typical pattern obtained in imitation studies testing this age range. The infants (a) learned from the demonstrations, and (b) remembered the demonstrated actions across the two-week delay, but (c) also showed some forgetting (see Fig. 1). In contrast to our predictions, simple looking time (assessed as fixation duration) did not correlate consistently with subsequent memory measures. In some cases, looking time correlated negatively with imitation scores. In contrast, positive correlations were found between pupil dilation and some of the memory measures, suggesting that pupil dilation may be a more sensitive measure in the present context compared to looking time measures.

S2.7 Symposium: Precursors of logical concepts at work: does logical reasoning support exploration and learning in preverbal infants?

S2.7i Negation and infants' representation of the relation of difference

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Human cognition is unique in its ability to represent abstract concepts such as electron or freedom and combine them to create novel concepts: free electron. The relational concept same and different constitute a good case study to address the origins of these capacities. Indeed, they are abstract as they can be generalized to novel, never experienced stimuli, and different is likely to be a complex representation resulting from the combination of negation and a representation of same (i.e., different means not same; Clark, 1974). In 4 experiments, we used pupillometry (Hochmann & Papeo, 2014) to assess 11-month-olds' ability to represent the structures of syllable sequences defined by the relations same and different. Infants heard sequences of syllables while watching one cartoon character jumping on the screen of an eyetracker. Forty-eight different syllables were used with every participant, so that infants needed to learn an abstract structure rather than specific sequences. In Experiment 1 (N=16), pupil dilation was observed in response to deviant AAAB sequences (e.g., ba-ba-ba-di) in the midst of standard AAAA sequences (e.g., ku-ku-ku-ku), peaking around 1500 ms (cluster mass permutation test P=.04). Thus, infants learned the AAAA structure, expecting the last syllable to be the same as the preceding ones. In Experiment 2 (N=16), no difference was observed between the responses to standard AAAB and deviant AAAA sequences. This suggests that infants failed to distinguish AAAB and AAAA. This failure may be due to the difficulty to represent both the sequence of three same syllables AAA and the final different syllable. In the last two experiments, we made it harder or impossible to represent the exact number of same syllables, so that infants would focus on the final different syllables. In Experiment 3 (N=16), the number of same syllables in standard trials varied before the final different syllable (AAB, AAAB or AAAAB), while deviant trials consisted in four identical syllables (AAAA). A cluster mass permutation test found significantly larger pupil dilation for deviant trials between 2967 and 3233 ms (P=03). In Experiment 4 (N = 16), five same syllables (a number that 11-month-olds cannot represent precisely) preceded the final different syllable in standard trials (AAAAAB). Deviant trials consisted in six identical syllables (AAAAAA). A cluster mass permutation test found significantly larger pupil dilation for deviant trials between 1717 and 2233 ms

(P=.05). Infants thus appear able to represent a structure defined by the relation same (Experiment 1) or different (Experiments 3-4). In Experiments 3-4, after hearing a number of identical syllables, e.g., ba ba ba, infants expected the final syllable to be anything but the preceding syllable ba. This computation is equivalent to negation combining with the representation of the syllable ba; i.e., infants expect the last syllable to be not ba. These results suggest that the cognitive foundations of abstraction and combination are in place by the end of the first year of life.

S2.7ii Infants reveal the identity of a hidden speaker with reasoning by exclusion

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It is not unusual for infants to interact with multiple speakers. Interacting with multiple speakers, however, may be challenging: speech may not only overlap but sometimes even its source may be hardly identifiable. Identifying correctly the source of communicative intent is a precondition for successful communicative interactions. Here we study, whether infants are able to infer the identity of the speaker via reasoning by exclusion, when direct evidence is not available. In Experiment 1 10 and 12-month-olds infants were presented with video-edited scenes with two identically looking protagonists. Initially each character is partially occluded, preventing the visibility of their mouth. During the presentation of the stimuli infants hear human speech from the loudspeakers, but not having access to any direct cues of its source (e.g. visible mouth movements) the identity of the addresser remains ambiguous. Immediately afterwards, one of the occluders slides down revealing that that the mouth of one character is not moving. In one condition this event is accompanied by speech. Using this information, infants may infer by exclusion that the source of the voice has to be the partially occluded face. This condition was contrasted with a scenario, where instead of human speech we play a melody. In this case, the visual information available is not indicative of the source of the melody: as a consequence this remains ambiguous. If infants succeed in disambiguating by exclusion the source of the speech in the speech condition they should fixate more the character with the occluded mouth, than in the melody condition. The analysis of their eye movements revealed an orientation of attention consistent with our predictions, but only in the older age group. This experiment, however, remained inconclusive regarding the nature of the cognitive processes responsible for the results. Halberda (2006) suggested a specific oculomotor marker diagnostic of an inference by exclusion in word learning. In these studies, adults and

preschoolers were asked to identify the referent of new labels while being presented with a familiar and a new object. Whenever a new label was presented, if their participants started the identification of the referent from a new item, their eye moved to the familiar item then back, identifying eye movements mimicking the steps of the inference. Building on this finding, we test the presence of a similar scanning path diagnostic of a logical inference in our speaker disambiguation paradigm. Experiment 2 implemented a gaze-contingent paradigm: half of the trials were initiated with fixations on the visible non-speaking face (that is the to be eliminated alternative) while the other half from the target, semi-occluded face. While our sample is still incomplete the preliminary results suggest that the two conditions elicit differential scanning paths.

S2.7iii Precursors of logical reasoning in goal-directed action understanding: does reasoning by exclusion support infants' processing of other agents' preferences?

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Disjunction is a basic logical representation that frames hypotheses as a set of exhaustive alternatives and that grounds the logical rule disjunctive syllogism (either A or B; not A; therefore, B) for the generation of expectations by trimming a space of hypotheses. The external, linguistic counterpart of the concept of disjunction ("OR" in English) is produced relatively late in development, around the age of 3 years, and disjunctive reasoning has been shown to be extremely hard to study in the absence of overt linguistic behavior (Mody, 2016). As a case study for the presence of disjunctive inferences in preverbal infants we ask whether they can disambiguate the choice of an agent by eliminating competing hypotheses regarding her goal. In a violation of expectation paradigm, 14-month-olds were familiarized with video-animations depicting a hand that repeatedly reached for one of two objects. Presented with this type of events, infants typically form the expectation that the hand will reach again for the preferred object (Woodward, 1998). Afterward, infants were tested with new situations where the identity of the preferred object was ambiguous and required an inference by elimination. First, the two objects were invisibly displaced with the help of two occluders, disrupting in this way the spatial tracking of the target. Then, we revealed the location of the non-preferred object. From this point, infants could infer the identity of the concealed preferred object using an inference by exclusion. Finally, the hand entered the scene and reached for one of the objects, half of the time the non-preferred object, the other half the concealed object. In Experiment 1 (N=24), the scenes with a

choice of the non-preferred object triggered longer looks than the scenes with a choice of the concealed object. This result suggests that infants inferred the identity of the concealed object deductively and used this information to evaluate the consistency of the observed actions with the previously learned preference. In Experiment 2 (N=24), in the test we replaced the non-preferred object with a new one, to exclude that infants surprise was driven by a negative attitude toward the non-preferred object cued by the reaching action. Infants' looking time pattern replicated the results of Experiment 1. In Experiment 3 (N=24), no competitor was presented during the familiarization, to rule out a bias to attribute preference for unknown objects. Now the results documented in the previous experiments flipped: infants reacted with longer looking time at the choice compatible with the actions presented in the familiarization. Finally, in Experiment 4 (N=24), infants were familiarized with scenes where the hand chose an object which identity was ambiguous and required an inference by elimination. Afterward, we test the successful encoding of the preference by showing a reaching action for one of two fully visible objects, either the preferred one or a new competitor. Again infants looked longer when the hand chose the competitor. Together these results suggest that preverbal infants can use a disjunctive inference both for detecting violations of previously established preferences and for encoding new preferences when an agent's choice is perceptually ambiguous. Our findings thus indicate that a precursor of logical reasoning is in place at the beginning of the second year of life and can assist infants' understanding of their social environment.

S3.2 Symposium: ManyBabies: collaborative research in developmental science as a productive response to the "replication crisis"

S3.2i ManyBabies 1: A Multi-Lab Study of the Infant-Directed Speech Preference

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[1]on behalf of the ManyBabies1 Group

The preference of infants for infant-directed speech (IDS) is a well-known phenomenon supported by research spanning decades (e.g., Cooper & Aslin, 1994; Fernald, 1985; Newman & Hussain, 2006; meta analysis by Dunst, Gorman & Hamby, 2012), and is therefore ideally suited for a first large-scale replication study of infant perception, designed to measure variability in this phenomenon across labs, methods, and countries. IDS and ADS (adult-directed speech) stimuli were created using a laboratory-based elicitation task in which mothers of 4-8 month old infants described objects separately to their infant and to an experimenter in North American English. In the paradigm currently being tested, infants hear 8 test trials each of IDS and ADS and their looking time to a paired uninformative visual stimulus is measured. Preference for IDS will be analyzed using both meta-analytic and mixed effects regression approaches. To date, over 60 laboratories have formally pre-registered their contribution. Of these, about half are North American, another quarter are from other English dialects, and the remaining quarter non-English samples. Laboratories will collect data using the Headturn Preference Procedure, the Single-Screen method, or an eyetracker. Data are being collected across 4 age groups: 3-6, 6-9, 9-12, and/or 12-15 months, with a minimum of N = 16 per group. Our total infant sample size is projected to be over 2,000. Our findings will allow us to report on a) the effect size of preference for IDS within a North American sample, b) the extent to which this varies across language communities and with age, and c) the influence of different methodologies on reported effect size. We are excited to share what we believe to be the largest ever experimental study of infancy with the ICIS community.

S3.2ii Bilingual infants' preference for infant-directed speech: ManyBabies 1B

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From the earliest months of life, infants prefer listening to infant-directed speech (IDS) over adult-directed speech (ADS). Yet, IDS differs in form and prevalence across

languages, individuals, and cultures. Infants growing up bilingual are useful in understanding experiential influences on infants' attention to IDS, as bilingual infants are exposed to IDS in two languages. ManyBabies 1 Bilingual is a large-scale, multi-lab, pre-registered attempt to understand how bilingualism affects infants' preference for IDS versus ADS. In all labs, we are using looking time measures to index infants' preference for North American English IDS versus ADS. Both within and across sites, infants vary widely in their experience with North American IDS. Thus, our multi-site approach will give us precision in estimating the overall effect size of bilingual infants' preference for IDS in comparison to monolingual infants, while allowing us to disentangle how experience with specific languages moderates this preference. We are in the process of collecting data from two age groups: 6-9 and 12-15 month-olds, whose responses will be compared to those from monolingual infants from the same communities collected in our companion project, ManyBabies 1. Currently, 17 labs from 8 countries have registered to collect data, yielding a projected sample size of 192 bilingual 6-9 month-olds, and 192 bilingual 12-15 month-olds. Our results will reveal experiential moderators of infants' preference for IDS, and will provide a model for how bilingualism researchers can collaborate to better understand this varied, difficult to recruit, and under-studied population.

S3.2iii ManyBabies 2: A multi-lab study of Infant Theory of Mind

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Traditionally, research with explicit verbal task suggests that Theory of Mind (ToM) develops slowly and in protracted form before children acquire a concept of belief around age 4. In the last 15 years, however, ToM research has been revolutionized by new studies with implicit tasks using violation of expectation (VoE), anticipatory looking (AL) and interactive measures. Findings from these studies suggest that even infants can master ToM tasks once they are suitably simplified. These findings have been the basis for far-reaching theoretical claims arguing for an early onset of ToM abilities. However, such conclusions have been controversial and recent attempts to replicate and validate these new implicit paradigms have produced mixed findings. Against this background, ManyBabies 2 is a concerted multi-lab initiative testing the replicability and validity of implicit ToM tasks in children and adults more systematically. The long-term plan is to have three waves of multi-lab studies corresponding to the main research paradigms (VoE/AL/interactive). All studies will be conceptual replications of the original tasks. The

ManyBabies 2 consortium, which includes authors from the original studies, will develop optimal study designs. The first wave will start with AL measures. In a typical AL False Belief task, subjects watch a video of an agent who pursues some goal and at some point forms a (false) belief. Implicit ToM reveals itself in spontaneous anticipatory looking to where the agent will act according to her false belief. Different conditions will be employed with the aim to (1) replicate original findings and, if replicable, (2) test the task's construct validity. Participants will be 24-36-month-olds and adults. After having agreed on critical conditions, the ManyBabies 2 consortium is currently working on developing the stimuli for the study. The main aim of this presentation is to solicit feedback and encourage further participation.

S3.3 Symposium: Threat perception from infancy to the preschool period: behavioral and neuroimaging perspectives

S3.3i Developmental Change in Attention Biases for Social and Non-Social Threats in Infancy

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The ability to recognize and detect threatening stimuli has been of interest to researchers for decades. Countless studies have shown that humans detect threatening stimuli more rapidly than benign control displays. The adult literature often alludes to evolutionary processes to explain these findings, suggesting that individuals who quickly detected threatening stimuli would have been more likely to survive to reproduce, and thus rapid threat detection is the result of dedicated brain circuitry that is activated automatically in the presence of threat cues. This classic account assumes that biases for threat are normative, present early in development, and stable across individuals. Although this widely cited argument is broadly accepted, recent developmental work suggests that it is incomplete. Indeed, attention biases for threat can be learned, they can change over the course of development, and may reflect a broad spectrum of individual differences. Further, a growing literature has implicated biased attention to threat as a potential mechanism in the development of various anxiety-related behaviors. However, limited data on the topic in infancy has limited our ability to characterize the development trajectory of attention biases for threat and their downstream effects on behavior. Here, we present data from a large cross-sectional sample of infants (4--24mos; N=260), and a second longitudinal sample of infants (4 and 8mos; N=50, data collection ongoing) on three new eye-tracking tasks designed to investigate attention bias, attention vigilance, and disengagement from social (angry faces) and non-social (snakes) threats. In an age-appropriate version of the classic adult dot-probe task, we presented infants with two images side by side, followed by a probe that appeared in place of one of the two images. In an overlap task, we presented infants with a threatening or non-threatening image in the center of the screen, followed by a checkerboard probe that appeared simultaneously to the right or left. Finally, in a vigilance task, we presented infants with a center fixation point followed by a threatening or non-threatening image in one of the four corners of the screen. We found that in the dot-probe task, infants more often first fixated snakes than frogs, and they were faster to fixate probes that appeared in place of snakes. Importantly, there were no significant developmental differences across our wide age range. In contrast, there were significant age-related changes in infants' responses to face stimuli across

the first two years of life, with a general increase in looking time to faces before the probe and an increase in latency to fixate the probe after seeing angry faces. Additional data from the overlap and vigilance tasks suggests that attention to social threats is also sensitive to individual differences in infant temperament and effortful control, as well as differences in maternal anxiety. Altogether, this work suggests that while attention biases for non-social threats emerge early and are relatively stable across infancy, attention biases for social threats undergo significant developmental change in the first two years of life and are sensitive to a variety of individual differences and environmental risk factors.

S3.3ii Infant Profiles of Attention to Threat: Individual and Parental Mechanisms

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Individual differences in attention may shape socioemotional development. Temperamentally extreme children preferentially attend to novelty and uncertainty as infants, show greater difficulty deploying attention when under stress as young children, and, by adolescence, preferentially attend to threat-cues. Reflexive perceptions of ambiguity, novelty, and threat drive individual differences in affect-biased attention, which in turn, and may help explain how and why individuals show idiosyncratic responses to the social environment. The literature presupposes that the link between attention and socioemotional functioning arises early in life, although this proposition has had little direct empirical testing. In addition, much of the infant and clinical literature has taken a variable-centered approach to the relations between attention and socioemotional functioning. A person-centered approach may help identify unique profiles in the environment and better understand phenotypic-level individual differences. We will present a large-scale study (N=260) examining the link between temperamental negative affect and attention to faces in the first two years of life. Infants (145 males, Agemean=11.27mos, Agerange=4.0-24.9mos) completed a battery of eye-tracking tasks that tap core attention mechanisms: attention bias to threat (Baby Dot-Probe), attention vigilance (Visual Detection Task) and the ability to disengage from threat (Overlap Task). Negative affect scores were based on behavior in the laboratory (i.e., Lab TAB) and with maternal report (i.e., IBQ or TBAQ). Mothers also reported on their own levels of anxiety (i.e., BAI). A latent profile analysis based on the eye-tracking tasks produced a two-class solution. Infants in group 2 tended to dwell on emotion faces longer than infants in group 1 and were faster to find and fixate on intermittent

stimuli when they appeared. This "checking" pattern is in line with previous work suggesting that attention to intermittent stimuli is associated with the later emergence of Behavioral Inhibition and social discomfort. As such, all analyses were performed within one formal statistical model using continuous scores predicting the probability of membership in group 2 (Probabilitymean=0.61, Probabilityrange=0.00 to 1.00). Increases in probability can be interpreted as increases in affect-biased attention. We assessed a moderated mediation model, examining how maternal anxiety moderates the age-related emergence of negative affect and affect-biased attention (PROCESS Model 59). The initial model found no significant relations between age, negative affect, and affect biased attention. However, infants showed greater negative affect with age if the mother reported high levels of anxiety, t=2.30, p=0.02, while there was no significant relation at median or low levels of anxiety. A Johnson-Neyman analysis noted that the interaction was significant for BAI scores greater than 7.56 (raw score). Second, increases in negative affect were associated with greater affect-biased attention, but only the highest levels of maternal anxiety. The interaction was significant for BAI scores greater than 13.48 (raw score). Finally, the central mediation analysis found that the indirect effect of age on affect-biased attention through negative was significant, ab=0.004, 95% CI=0.00 to 0.01, only at high levels of maternal anxiety.

S3.3iii Individual differences in the response to fearful faces at 7 months predicts helping behavior at 14 months of age

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The tendency of humans to engage in altruism varies greatly across individuals. In children and adults, responsiveness to others in distress has been linked to altruistic tendencies, with increased sensitivity to and recognition accuracy of fearful faces linked to greater helping behavior. The ability to detect and discriminate between emotional expressions emerges early in infancy, and by 14 months, infants display instrumental helping of others in need. Given the early emergence of these vital social proficiencies, it may be that responsiveness to fear in others is associated with future prosocial behavior at its earliest stage. It is unknown whether this link exists, and if so, what brain processes in response to fear may be linked to variability in prosocial behavior. The current study tested this link early in development by examining whether emotional responsiveness at 7 months of age predicts helping behavior at 14 months of age in a large group of infants (N = 64). Using eyetracking and functional near-infrared spectroscopy (fNIRS),

our analysis revealed that helping behavior in toddlerhood was selectively predicted by infants' responsiveness to fearful faces, but not happy or angry faces. Specifically, infants' enhanced duration of the first look at fearful eyes and reduced attentional bias to look at fearful faces at 7 months predicted greater prosocial behavior at 14 months of age. Infants' reduced attentional bias to fearful faces was linked to reduced recruitment of the left dorsolateral prefrontal cortex (dlPFC) during fearful face processing, which also predicted greater prosocial behavior at 14 months of age. This suggests that, from early in ontogeny, variability in helping behavior is rooted in our responsiveness to seeing others in distress and brain processes implicated in cognitive control. These findings are in line with adult research and critically advance our understanding of the ontogenetic origins of altruism by highlighting the importance of responding to fear in others.

S3.3iv Individual Differences in Event-Related Potentials to Emotional Faces from Infancy to 3-years: Developmental Stability and Relation with Risk Factors for Anxiety

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Neural responses to angry and/or fearful faces may track individual differences in threat processing prior to the development of anxiety, perhaps as early as infancy when sensitivity to emotional faces emerges. It is unknown whether early individual differences in neural responses to emotional faces are developmentally stable or relate to risk for anxiety. In this longitudinal study, we examined whether individual differences in event-related potentials (ERPs) to emotional faces are stable from infancy to 3 years of age, and whether they relate to internalizing symptoms at 3 years. Data collection and analysis are underway; preliminary results are summarized below. We assessed child ERPs to happy, angry, and fearful faces in infancy (5, 7, or 12 months) and at 3 years. At both timepoints, mothers reported on their children's temperament (IBQ-R; ECBQ) and on their own anxiety symptoms (STAI-Trait). At 3 years, mothers reported on their children's emotional/behavioral problems (ITSEA), including internalizing symptoms. To examine the developmental stability of ERP responses, we considered participants who provided valid ERPs in infancy and at 3 years (N=20). Amplitudes were z-scored by age and emotion. Preliminary results suggest weak/moderate stability in the N170/N290,

P400, and NC (Pearson's rs ~ 0.25; Figure 1A). We next sought to identify predictors of child internalizing symptoms at 3 years. Female gender ($p=0.005$) and higher infant negative affectivity ($p<0.001$) predicted greater child internalizing symptoms (N=338), controlling for infant orienting/regulation ($p=0.132$) and maternal anxiety ($p=0.618$). We further examined whether N170, P400, and NC amplitudes at 3 years (N=61) related to gender and concurrent negative affectivity and internalizing symptoms. Males had smaller NC to angry faces ($\beta=1.24$, $p=0.049$) and marginally larger NC to happy faces ($\beta=-1.00$, $p=0.060$). Negative affectivity was marginally associated with larger N170 to angry faces ($\beta=-0.20$, $p=0.051$). Controlling for gender ($\beta=-1.02$, $p=0.593$), negative affectivity ($\beta=11.40$, $p<0.001$), and N170 to angry faces ($\beta=0.49$, $p=0.627$), larger NC to happy faces was marginally related to internalizing symptoms ($\beta=-1.82$, $p=0.066$). Finally, we examined whether infant ERPs related to gender, infant negative affectivity, and internalizing symptoms at 3 years (N=61). Males had larger NC to angry ($\beta=-0.75$, $p=0.031$) and marginally smaller NC to happy faces ($\beta=0.59$, $p=0.069$). There was no relation between infant ERPs and negative affectivity. After controlling for gender ($\beta=1.03$, $p=0.587$) and infant negative affectivity ($\beta=1.71$, $p=0.239$), larger NC to angry ($\beta=-2.81$, $p=0.022$) and smaller NC to happy faces ($\beta=2.49$, $p=0.082$) were significantly and marginally related to internalizing symptoms, respectively (Figure 1B). In conclusion, individual differences in NC amplitudes to angry and happy faces in infancy related to internalizing symptoms at 3 years, an early indicator of potential anxiety difficulties. There was limited evidence that NC amplitudes at 3 years related to concurrent internalizing symptoms, perhaps due to developmental changes in emotional processing, differences in relations between NC amplitudes in infancy versus 3 years to negative affectivity, and/or methodological limitations. Fig.1 A. Correlation of individual differences in ERPs between infancy and 3 years (N=20). B. Partial regression plot of relations between infant NC and internalizing symptoms at 3 years (N=61).

S3.4 Symposium: Infants' understanding about social interactions, relations, and social structures

S3.4i Music, Synchrony and Prosocial Behaviour in Infants

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Infants show attentional and emotional responses to music, and caregivers sing to infants and engage them in musical experiences. In these interactions, infants and caregivers often engage in synchronous movement. Moving in synchrony has social consequences for adults: after synchronous movement, adults trust and like each other more, and cooperate more than after asynchronous movement. Because the regularity of musical rhythms enables prediction of when the next beat will occur, music is an ideal stimulus to promote synchronous movement between people. In a series of studies (Trainor & Cirelli, 2015; Cirelli, Trehub & Trainor, under review) we asked whether synchronous movement between an infant and an adult would increase the infant's helpfulness to that adult. Methods. 14-month-old infants were held in an infant carrier facing outward and bounced by an assistant to Twist and Shout. The infant faced an experimenter who either bounced in sync with the infant or out of sync (i.e., at a different tempo). After 3 minutes of bouncing, infants were given 30-sec opportunities to help the experimenter by, for example, picking up an object needed for a task that the experimenter "accidentally" dropped. Results. Infant helping rates were significantly higher after synchronous than asynchronous bouncing (Cirelli, Einarson & Trainor, 2014). A second study showed increased helpfulness after synchronous bouncing was targeted at the bouncing partner, and did not generalize to a neutral stranger (Cirelli, Wan & Trainor, 2014). A third study showed, however, that increased helpfulness after synchronous bouncing transferred to someone shown to be a friend of the synchronous bouncer (Cirelli, et al., 2016). Interestingly, music itself is not necessary; synchronous bouncing without music also led to increased helpfulness (Cirelli et al., 2017). Furthermore, infants use synchronous movement to interpret third party relationships, showing surprise when two adults who moved out of sync demonstrated friendly behaviour (Cirelli et al., in press). Conclusions Synchronous movement is a cue infants use to decide who to befriend as they learn to navigate their social world. References Cirelli, LK, Einarson, KM, & Trainor, LJ (2014). Interpersonal synchrony increases prosocial behavior in infants. Developmental Science, 17, 1003-11. Cirelli, LK, Trehub, SE, & Trainor, LJ (under review). Rhythm and melody as social signals for infants. Cirelli, LK, Wan, SJ, Johanis, RC, & Trainor, LJ (in press). Infants' use of interpersonal asynchrony as a signal for third-party affiliation. Music & Science. Cirelli, LK, Wan, SJ, Spinelli, C, &

Trainor, LJ (2017). Effects of interpersonal movement synchrony on infant helping behaviors: Is music necessary? Music Perception, 34, 319-326. Cirelli, LK, Wan, SJ, & Trainor, LJ (2014). Fourteen-month-old infants use interpersonal synchrony as a cue to direct helpfulness. Philosophical Transactions Royal British Society B: Biology, 369, 20130400. Cirelli, LK, Wan, SJ, & Trainor, LJ (2016). Social effects of movement synchrony: increased infant helpfulness only transfers to affiliates of synchronously moving partners. Infancy, DOI: 10.1111/infa.12140. Trainor, LJ, & Cirelli, LK (2015). Rhythm and interpersonal synchrony in early social development. Annals New York Academy of Sciences, 1337, 45-52.

S3.4ii How synchronous motion affects infants' social perception

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Recent research is beginning to reveal the social significance of synchronous motion early in life. Infants tend to like (Tunçgenç, Cohen, & Fawcett, 2015) and help (Cirelli, Einarson, & Trainor, 2014) those who have moved in synchrony with them. However, there has been little research on infants' interpretations of others' synchronous movements. In this series of studies, we examine how others' synchronous motion influences infants' social perceptions. One previous eye tracking study suggested that 15-month-olds expected those who moved in rhythmic synchrony to also affiliate (Fawcett & Tunçgenç, 2017). Infants first saw three animals engage in rhythmic swaying or bouncing motions with the center animal always moving synchronously with one other animal and non-synchronously with the other. Then, they saw the center one state "you are my best friend". Infants tended to look at the animal who had been in synchrony with the center one after the statement, indicating that they associate the synchronous animal with the positive statement. Now we are testing whether infants also expect affiliation between those who engage in non-rhythmic synchrony and whether they adjust their gaze behavior based on the valence of the center animal's statement to determine whether infants gaze is based on an inference of affiliation or just an association. Specifically, infants first view a motion familiarization with two individuals playing in synchrony and a third playing out of synchrony. Then, the target individual states either "I like you" or "I don't like you". We expect that infants will look more to the previously synchronous individual after the "I like you" statement and more

to the non-synchronous individual after the "I don't like you" statement. In another study we examine whether moving in synchrony affected 18-month-olds' perception of others' likelihood of cooperation. Infants watched an initial motion familiarization in which two actors waved or tapped rhythmically with their actions varying in interpersonal synchrony (completely, partially, or not at all synchronous, between-subjects). Next, the actors engaged in a series of block-moving actions that were ambiguous as to whether they were based on collaborative or individual goals (see Fawcett & Gredebäck, 2013, 2015). We expected that greater synchrony would lead to greater expectation of cooperation between the actors, however, we found that infants tended to expect the actors to collaborate overall and these expectations did not differ across conditions. This suggests that synchronous motion does not increase expectations of collaboration between observed individuals. It is possible that any positive social engagement between individuals is sufficient to lead infants to believe they will later collaborate. Together the results suggest that synchrony may not always have the same role in infants' third-person perceptions as it does in their first-person interactions during the second year of life.

S3.4iii How does a prosocial or antisocial act change interactions between two agents?

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We interact with others constantly. What factors can change patterns of social interactions? Young children tend to gravitate towards peers who behave prosocially, e.g., help others, but avoid peers who behave antisocially, e.g., hit others (e.g., Asher & McDonald, 2009; Parker & Asher, 1987). Even infants are able to distinguish between prosocial and antisocial agents, and expect others to approach or help a prosocial agent but not an antisocial agent (e.g., Hamlin et al., 2007, 2011; Kuhlmeier et al., 2003; Premack & Premack, 1997). We therefore examined how antisocial (Experiment 1) or prosocial (Experiment 2) acts would change patterns of interactions between two agents in infants' understanding about social interactions, using violation-of-expectation looking-times tasks. In Experiment 1, 13-month-old infants (n = 48) first watched two puppets (depicting boys or girls), Agent1 and Agent2, interact in a positive manner. They clapped hands or hopped in synchrony and then turned to face each other and wiggled as if laughing. Infants expected them to continue interacting positively, even after they saw Agent2 hit a new puppet, Agent3, with Agent1 absent. If Agent1 also saw

Agent2's transgression, infants expected Agent1 to change his or her interaction with Agent2 by ignoring Agent2, consistent with previous reports that infants accept "punishment" of antisocial agents (e.g., Hamlin et al., 2011). Infants therefore seemed to consider Agent1's perspectives when predicting his or her actions. If Agent2 hit Agent3 by accident, infants accepted that Agent1 could interact or not interact with Agent2, suggesting that they also considered Agent2's intentions when interpreting the agents' interactions. In Experiment 2, Agent1 and Agent2 initially did not interact. Agent2 clapped hands or hopped, turned to face Agent 1 and wiggled as if laughing, as in Experiment 1. Agent1, however, stood motionlessly, ignoring Agent2. Next, Agent3 walked in but fell down on the floor. Agent2 went to comfort him/her. Interestingly, infants (n = 32) seemed to expect Agent1 to continue ignoring Agent2, regardless of whether or not Agent1 witnessed Agent2's prosocial act toward Agent3. Ongoing research is examining whether Agent2's prosocial act toward Agent1, not Agent3, would change the two agents' ensuing encounters so that Agents 1 and 2 would interact positively with each other. Taken together, the present study demonstrate that infants use their perspective-taking abilities and social evaluation skills to make sense of agents' interactions. Furthermore, the results make clear that an interaction partner's prosocial or antisocial acts feature differently in infants' expectations. An antisocial act, even toward a third party, is expected to change the two agents' initially positive interactions, while a prosocial act towards a third party does not appear to cause any change - the two agents who do not interact in their previous encounters are expected to continue doing so.

S3.4iv Adults and infants expect social dominance to be derived from alliance relationships

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In many human and animal societies, individuals do not become dominant just because of their own personal characteristics (e.g., their physical strength). They can also "derive" their dominance status from alliance relationships, for instance when an individual dominates other people by virtue of being allied with someone outranking them. Derived dominance plays a crucial role in shaping social structures, in rank inheritance, or in determining power relationships between groups. Furthermore, some species of non-human primates appear to be sensitive to derived dominance (Bergman et al., 2003), thus suggesting that inferences based upon the interplay between alliances and

social dominance relationships may have ancient evolutionary roots. Yet, the role of expectations about derived dominance in humans' social reasoning has not been investigated directly. We address this issue in two studies. In Study 1 (N = 60), a paired-associates learning paradigm confirms that adults draw inferences consistent with dominance being derived. These inferences cannot be the product of a simple compression heuristic since adults no longer draw the same inferences for social structures of identical complexity in which affiliation relationships are replaced with enmity relationships. In Study 2 (N = 32), we probe the ontogeny of these inferences with a looking time paradigm. In the Experimental condition, we familiarize 14-month-olds to 2D animations showing that (i) one agent is dominant over another one, and that (ii) the dominant and the subordinate agent each have a different ally. During the test trials, infants look significantly longer when the subordinate's ally prevails over the dominant's ally than when the opposite happens ($t(15) = -3.00$, $p = .009$). This pattern of looking time is disrupted in a Control condition in which participants no longer receive interpretable information about agents' alliances. These results suggest that infants infer unknown social relationships in accordance with expectations about derived dominance. Our data reveals that systematic expectations about the way alliances and social dominance interact guide the discovery of social structures from infancy onward. They indicate that infants possess expectations about the stratified nature of social structures.

S3.5 Symposium: Representations of support from infancy to childhood: reasoning, categorization, and language

S3.5i Teaching Infants a New Support Rule via Explanation-Based Learning

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Infants acquire a large number of physical rules that identify relevant features for predicting the outcomes of support, occlusion, containment, and other physical events. These rules are general and strikingly similar across infants. Yet for any given rule, (a) each infant observes a unique and relatively small set of events from which to extract the rule, and (b) each event includes numerous potential features. How, then, do infants acquire these rules? Explanation-based learning (EBL) has been proposed as one of the processes that enable infants to efficiently acquire and revise their physical rules. The EBL process has three main steps. The first is triggering: When infants encounter outcomes they cannot explain based on their current rules, the EBL process is triggered. The second step is explanation construction and generalization: Infants bring to bear their physical-domain knowledge to construct a plausible explanation for the outcomes they observed. Though rarely correct from a physicist's perspective, this explanation still provides a rudimentary causal analysis that specifies which features of the events contributed to their outcomes--other features are implicitly omitted. As such, the explanation is easily generalized, resulting in a candidate rule that incorporates only the relevant features specified in the explanation. The final step in the EBL process is empirical confirmation: Once a rule has been hypothesized, it must be evaluated against further empirical evidence, which serves to either confirm or reject it. If the candidate rule proves accurate in predicting outcomes for a few additional exemplars, it is adopted and integrated into infants' physical-domain knowledge. The EBL account not only describes how infants acquire and revise their physical rules: It also suggests how infants might be "taught" a rule they have not yet acquired, via exposure to EBL-designed observations. To evaluate this suggestion, we conducted three experiments (n = 260) focused on simple support events in which an asymmetrical object was released with half of its bottom surface resting on a base. We attempted to teach 12-month-olds (Experiment 1) and 11-month-olds (Experiments 2 and 3) to replace their current support rule (proportion-of-contact: an object is stable when half or more of its bottom surface is supported) with a more sophisticated rule (proportional-distribution: an object is stable when half or more of the entire object is supported). In each experiment, infants first saw either (a) appropriate teaching events that were designed to facilitate EBL or (b) inappropriate teaching events that were designed to disrupt one of the three

critical steps in EBL (triggering, explanation construction and generalization, or empirical confirmation). Next, all infants saw expected and unexpected test displays involving a novel asymmetrical object and a novel base. When shown appropriate teaching events, infants detected the violation in the unexpected display, suggesting that they had learned the proportional-distribution rule. When shown inappropriate teaching events, however, infants failed to learn the rule. Together, these results provide strong evidence that EBL is one of the learning mechanisms that contribute to infants' acquisition and revision of their physical rules, including their support rules.

S3.5ii A core concept of support for infant cognition and language learning

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Configurations of support include configurations of 'support from below' (cup on a table), as well as configurations involving mechanical support, such as adhesion (stamp on envelope) and embedding (star on shirt). Mature language users show a "division of labor" in the encoding of support, with basic locative expressions ("BE on" in English) frequently used to encode 'support from below' and lexical verbs (e.g., "stick") used to encode cases of mechanical support (Landau et al., 2016). Given this complexity of the semantic space, how do children acquire the language of support? Two studies tested the hypothesis that 'support from below' (henceforth, SFB) is privileged in infants' conceptual representations of support, and that these pre-verbal representations serve as the basis for children's use of support terms in early language productions. In Study 1, using the Preferential Looking Paradigm, 6- and 12-month-olds were familiarized to two different SFB events and then presented with a different SFB event vs. a 'support via the side' event. Infants looked longer at the 'support via the side' event suggesting that infants categorized SFB during familiarization and represented it as distinct from 'support via the side' during test. In Study 2, an examination of spontaneous productions of children younger than 4 years from the CHILDES corpora revealed that children used "on" to refer to SFB more than other types of mechanical support. They also used the verb phrase BE on more to refer to SFB than mechanical support. This suggests that SFB may be privileged in mapping to "on" in early child language, and that children show a distinction in how they map "BE on" to different support configurations even in the earliest stages of language production. Together, these findings suggest that a concept of SFB may serve as a possible core representation of

support, which is then privileged in the mapping to basic locative expressions in languages ("BE on", in English).

S3.5iii Preschoolers' Spatial Reasoning: Is Support More Challenging than Containment?

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Containment and support are among the first spatial relations that infants categorize (e.g., Casasola et al., 2003; Park & Casasola, 2015) and label (e.g., Choi & Bowerman, 1991); yet, there may be a difference in conceptual structure between these two relations. Infants find categorizing support more challenging than containment (Casasola & Cohen, 2002); the spatial term "on" is understood later than "in" (e.g., Brown 1973, Clark, 1973); and children's and adults' descriptions of these events suggest conceptual differences underlying their linguistic organization (Johannes, Wilson, & Landau, 2016; Landau, Johannes, Skordos, & Papafragou, 2016). In two studies examining the spatial reasoning of Korean 3-year-old children, we provide additional evidence that containment remains a more conceptually accessible concept than support. In Study 1, we tested 3-year-olds' (n = 30) transfer of support, containment, or above relations from a target image to a response option (e.g., from an apple on a book to a doll on a folded blanket) in a modified Spatial Analogies Test (Huttenlocher & Levine, 1990). Using line drawings of realistic objects, we presented children with a target image (i.e., a figure object in a containment, support, or above relation to a ground object), and asked them to choose which of three response options best matched the target. Children completed four items with each relation for a total of 12 items. Children were not above chance when the target relation was support (M = 1.60, SD = 0.89), t (29) = 1.64, p = .113, but were above chance with containment (M = 2.17, SD = 0.91), t (29) = 5.00, p < .001, and interestingly, below chance with above (M = 0.90, SD = .89), t (29) = 2.68, p < .05. That is, children only successfully transferred containment. A repeated-measures ANOVA with spatial relation type as the within-subject factor yielded a significant effect of spatial relation, F (2, 58) = 16.22, p < .001, p2 = .36. Children transferred significantly more containment than support items (p < .05), and more support than above items (p = .002). In Study 2, another group of Korean 3-year-old children (n = 20) were tested with line drawings of abstract geometric shapes rather than realistic objects. Children again performed above chance only with containment (M = 1.85, SD = 0.88), t (19) = 2.64, p < .05 (support: M = 1.40, SD = 0.94, t

< 1, ns; above: M = 1.05, SD = 0.95, t (19) = 1.34, p = .196). A repeated-measures ANOVA yielded a significant effect of spatial relation, F (2, 38) = 4.04, p = .03, p2 = .18. Children scored higher with containment than above relations, p < .05; there was no difference between support and the other relations. Overall, the present results support theoretical views that support is a more challenging spatial concept than containment. Even into the preschool years, children show greater ease at generalizing containment than support, extending results of infant categorization and early language development to preschool spatial reasoning.

S3.6 Symposium: Connecting self and other in infancy through neural representations of the body

S3.6i Infant Brain Responses to Felt Touch of Self and Observed Touch of Another Person: An MEG Study

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There is growing interest in the ways that the human body, both one´s own and that of others, is represented in the infant brain. We used magnetoencephalography (MEG) brain-imaging to test 32-week-old infants. Experiment 1 evaluated infants´ neural responses to their body being touched. Experiment 2 assessed infant neural reactions to seeing someone else´s body being touched. In Exp. 1, 14 infants received tactile stimulation to the hand, and 14 infants received tactile stimulation to the foot. Tactile stimuli were computer-controlled silent, punctate taps, time-locked to the MEG record (Fig. 1A). In line with adult studies, we hypothesized that tactile stimulation to the hand and foot would activate the contralateral primary somatosensory (S1) cortex in the infant brain. We also hypothesized that hand touch would activate more lateral portions of S1 than foot touch, reflecting the somatotopic (homuncular) organization of the neural body map. We used advanced infant MEG techniques, including procedures that allowed continuous tracking and correction of infants´ head position. As predicted, the neural responses were primarily contralateral. The grand average waveforms exhibited two large deflections: An earlier peak around 100 ms and a later peak around 250 ms. Consistent with the prediction of somatotopic organization in the infant brain, ECD modeling showed that the source of the early hand response was significantly more lateral than the source of the early foot response, difference = 19 mm, p = .024. For the later responses the source of the hand response was also more lateral, difference = 20 mm, p = .0018. In Exp. 2 we explored infant neural responses to visually perceiving another person´s body being touched. A new group of 32-week-olds watched video clips of an adult´s body being touched (Fig. 1B). Three key findings emerged. First, there was significant activation in infant somatosensory cortex and other parietal areas that overlap with similar regions activated in Exp. 1. Second, fewer infants showed activation in somatosensory areas in response to observed touch (Exp. 2) than to felt touch (Exp. 1). This is compatible with adult studies estimating that somatosensory responses to observed touch of another person are approximately 10 times weaker than to felt touch of the self. Third, we found significant activation in the extrastriate body area (EBA) and fusiform body area (FBA), as well as in the temporoparietal junction (TPJ), an area involved in self-other distinction.

Discussion focuses on two points: (a) the value of using infant MEG-brain imaging for providing information about source localization and spatiotemporal neural networks in infancy, and (b) the potential for this work to shed light on infant social cognition, including action imitation, which may build on neural representations that map equivalences between the bodies of self and other. This work suggests future avenues for combining infant brain and behavior to investigate fundamental issues in infant social-cognitive development.

S3.6ii Using Somatosensory Mismatch Negativity as a Window into Body Representations in Infancy

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Although the tactile receptor surface (the skin) forms a continuous sheet, tactile perception is non-linear. In adults, tactile body perception is modulated by: (a) perceptual-cognitive representations of body parts (e.g., the differentiation of the hand from the forearm--which is part of the 'body scheme'), and (b) neural representations in primary somatosensory cortex (the organization of the neural homunculus). Very little is known about how these factors influence tactile body processing in infants. The mismatch negativity (MMN) response is a well-documented ERP component associated with automatic involuntary novelty detection. The MMN shows greater amplitude to larger stimulus deviance. The auditory MMN is a robust neuroscience measure in audition and speech perception. In the tactile domain, a somatosensory mismatch negativity (sMMN) response has been studied in adults, but not infants. Here we use the sMMN to investigate both neural representations ('homuncular distances') and categorical boundaries between body parts (body scheme) in 6- to 7- month-olds. In Exp. 1, 27 infants participated in a 20 min EEG recording. sMMN responses were elicited using an oddball paradigm with 2 pairs of contrasts: face vs. neck and face vs. hand. These contrasts were selected based on a discontinuity in the cortical representation of the body. Although the face and the neck are spatially close on the actual body surface, they are relatively far apart in the primary somatosensory cortex. The opposite is true for the face and hand (adjacent in the brain's homunculus but separated in the 3D body). What system best accounts for the amplitude of the sMMN response--distance in the neural homunculus or distance on the 3D body of the infant? Fig. 1A shows that the sMMN response elicited by the face/neck oddball pair was significantly larger than the face/hand contrast ($p < 0.01$). This raises

the idea that infant sMMN responses may be sensitive to distances in unde"rlying neural body representations, which is similar to related neuroscience work we did with adults. For Exp. 2, 11 infants were presented with stimuli to test whether young infants have formed category boundaries between different body parts. Infants were presented with two pairs of tactile oddball stimuli with equal physical distances, either within the forearm or across the wrist boundary. Fig. 1B shows that the sMMN amplitude elicited by stimuli across the body-part boundary was significantly greater than within the body part ($p < 0.05$), suggesting a categorical segmentation of the infant body into parts. We are reporting two novel findings: (a) sMMN can be used to test body representation in young infants, and (b) sMMN amplitude is modulated by both neural representations in the cortex ('homuncular distances') and categorical representations of body parts (perceived 'body scheme'). This new infant technique promises to be useful in studying the development and re-organization of body representations across age in infancy.

S3.6iii Neural Body Maps for Lips, Hands, and Feet in 60-Day-Old Infants

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An increased understanding of neural representations of the body promises to inform theories of social-cognitive development, but there are still large gaps in our understanding the scope and nature of neural body maps in early infancy. Previous work shows a somatotopic pattern of response to tactile stimulation in 7-month-olds (Saby, Meltzoff, & Marshall, 2015). The novelty of the current experiment is that we tested significantly younger infants and explored the neural representation of the oral region. The neural representation of lips is important for three reasons: (a) infants experience intrauterine lip stimulation, (b) lip control is essential for survival (sucking), and (c) lips may be overrepresented in the infant brain, based on adaptations for speech and facial expressions. During EEG recording, 14 infants (Mean age = 52 days; 8 female) were presented with light tactile taps using a hand-held wand. When the wand made contact with the skin, an event trigger was recorded and synchronized with the EEG record. Using a within-subjects design, three different body parts were touched during the experimental session: left hand, left foot, and the midline upper lip. Each body part received a total of 50 taps (two blocks of 25 taps each). The order of the six blocks was randomized across participants. Video recordings were used to eliminate trials in which the infant moved. Somatosensory evoked potentials (SEPs) were computed for

a 600 ms window following tactile stimulation onset relative to a 100 ms prestimulus baseline. As predicted, the tactile stimulation elicited a large positive response in the 50-150 ms time window at central electrode sites (C5, C3, Cz, C4, C6, Pz). Mean amplitudes of the responses during this time window were analyzed. As predicted, a 3 (Body part) x 6 (Electrode) repeated-measures ANOVA revealed a significant interaction between the body part stimulated and the topography of the SEP response ($F[10, 160] = 6.75$, $p < .001$). Follow-up contrasts and scalp maps (Fig. 1) indicated that simulation of the upper lip generated a strong bilateral response at electrodes C5 and C6 (bilateral activity was predicted because the touch was midline). A strong contralateral response was observed at electrode C4 for stimulation of the left hand. Tactile stimulation to the left foot elicited a mild response predominately at the midline electrode Pz. The topographic pattern of the infant neural responses strongly resembles the somatotopic neural organization found in adults and older infants: Lips were most lateral, foot most medial, and hand in between. This comports with the classical Penfield homunculus. This study is the first to report brain responses to the touch of infant lips. Future work on the neural representation of lips may open avenues for exploring speech articulation and early social-emotional development, because infant lip processing (tactile, proprioceptive, and motor) is important for articulation, smiling, and other facial expressions.

S3.7 Symposium: Rigor and reproducibility in infant temperament research: person-centered approaches to characterize infant behavior

S3.7i Temperament profiles among infants with prenatal substance exposure: Neonatal origins and implications for neurobehavioral development.

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Individual differences in childhood temperament can be traced back to organized patterns of reactivity and regulation in infancy. The composition of temperament is known to be multifaceted and comprised of multiple interacting traits. Less clear are the ways in which a newborn's unique constellation of neurobehavioral traits function together to affect temperamental proclivities during the first year of life. Elucidating the neurobehavioral origins of infant temperament may shed light onto how constitutionally-based temperament traits develop in infancy. The aim of the present study was to examine the structure of infant temperament, and test whether newborn neurobehavior predicted individual differences in temperament profile membership. Data were collected in four U.S. cities (Detroit, MI; Memphis, TN; Miami, FL; and Providence, RI) as part of the Maternal Lifestyle Study (MLS) (N=1388), the largest prospective study of prenatal cocaine exposure. A total of 658 neonates were classified as cocaine exposed. A non-exposed comparison group of newborns (n = 730) were matched on race, sex, and gestational age. At 1-month postnatal, trained personnel administered the NICU Newborn Neurobehavioral Scale (NNNS; Lester & Tronick, 2001), a standardized protocol for assessing neonatal neurobehavioral organization and motor development. This study utilized data from the following NNNS scales: Arousal, Attention, Excitability, Handling, Lethargy, Quality of Movement, Regulation, and Stress/Abstinence. Mothers reported on infant temperament at 4-months of age using the Infant Behavioral Questionnaire (IBQ; Rothbart, 1981). Temperament data were available for 1085 infants. We first examined the structure of temperament using Latent Class Analysis (LCA). Results indicated that temperamental proclivities among infants who were prenatally exposed to substances were best characterized by a four-profile solution (Figure 1). Specifically, we identified a high positive affect, well-regulated profile (41.7%, n = 452), which included infants with average levels of activity, high smiling and laughter, low negative affect, and above-average levels of soothability and orienting; a moderately low reactive, moderately dysregulated profile (36.1%; n = 392), which included infants with below-average levels of positive reactivity, negative reactivity, and regulation; a negative reactive, dysregulated profile (13.2%, n = 143), which included infants with mean levels of activity, high smiling and laughter, low negative affect, and

above-mean levels of regulation; and a reactive, well-regulated profile (9.0%, n = 98) that included infants with above-average levels of positive reactivity, negative reactivity, and regulation. Findings support the use of LCA for classifying children's temperamental proclivities in the first months of life. Follow up analysis will examine whether patterns of newborn neurobehavior predict infant temperament. Two NNNS factors corresponding to "Reactivity" and "Inattention" have been identified based on exploratory and confirmatory factor analysis conducted on random halves of the sample. NNNS factors will be utilized in a subsequent path analysis model to predict the probability of temperament profile membership. Discussion will focus on how person-centered approaches can advance our understanding of normative and aberrant neurobehavioral development among children who were prenatally exposed to substances.

S3.7ii Culture, temperament, and problem behavior development in a Mexican American sample

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Mexican American (MA) children represent one of the most prominent subgroups in the US (US Census Bureau, 2010), and are known to experience disproportionate risk for behavioral problems. Nonetheless, surprisingly little is known about the child characteristics that might exacerbate or mitigate risk for problem behavior development in MA samples. In fact, although some studies have identified child characteristics thought to confer risk for problem behavior development (see Rothbart, 2012), these studies have tended to comprise predominantly middle socioeconomic status, White families and may not generalize to MA samples. For example, cross-cultural studies of temperament have demonstrated that different characteristics may be more desirable in different cultural contexts (e.g., Super et al., 2008), and also that different characteristics confer risk for problem behavior development across cultures (e.g., Gartstein et al., 2013). The current study is among the first to consider whether (1) certain temperament types may be more prominent among families who are more enculturated in Mexican or Anglo-American culture, and (2) whether Mexican or Anglo-American cultural orientation may moderate associations between those same temperament types and subsequent problem behavior development. Data were collected from 322 MA mothers and their infants during prenatal, 9-month, and 12-month interviews. Family

demographics and maternal reports of Anglo and Mexican orientation were obtained prenatally between 23-40 weeks gestation, and again at 9 months postpartum. Maternal reports of infant temperament were obtained at 12 months, and behavioral symptoms at 36 months. Latent Class Analyses (LCA) were performed to identify the number and nature of classes of temperament profiles, and a structural equation model using maximum likelihood with robust standard errors was used to consider whether mothers' enculturation in Mexican or acculturation in Anglo values was predictive of posterior probabilities of class membership in each of the identified classes. Results of LCA indicated that a four-class solution fit the data best (see Table 1). These profiles corresponded to behavior styles reflecting: High positive affect, Well-Regulated (38%), Moderately Low Reactive, Mean Regulated (35%), General Reactive, Moderately Dysregulated (16%), and Negative Reactive, Dysregulated (11%) (See Figure 1). Posterior probabilities of class membership were obtained from LCA, and latent variables reflecting mothers' Anglo or Mexican orientation across infancy were created. Results of the structural equation model (see Figure 2) indicated that model fit was adequate ($\chi 2$ (37) = 181.08, $p < .001$. RMSEA < .001, CFI = .90, SRMR = .05), and that Mexican orientation was associated with a lower probability of class membership in the General Reactive, Moderately Dysregulated profile. Subsequent analyses will consider the associations between each of the temperament profiles and children's behavioral symptoms at age 3, and whether mothers' Anglo or Mexican orientation may moderate those associations. Advancing research about the nature and role of temperament in Mexican American samples may contribute importantly to understanding about the developmental processes underlying competence and problem behavior development for a population experiencing substantial growth yet disproportionate risk for mental health disparities.

S3.7iii Person-centered analysis of infant temperament: Leveraging existing data.

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Temperament domains outlined on the basis of the Rothbart's psychobiological model have been examined primarily through a variable-centered/dimensional approach, with

overarching factors typically prioritized over fine-grained scales. There is renewed interest in person-centered approaches to understanding the structure of temperament. However, questions concerning temperament types are not frequently framed in a developmental context, especially during infancy. In addition, the most common person-centered techniques, Cluster Analysis (CA) and Latent Profile Analysis (LPA), have not been compared with respect to temperament types derived in early childhood. In the current study, we set out to identify temperament types for younger and older infants, comparing LPA and CA, to address this gap in research. Multiple data sets (N=1,356) were utilized. Infants were between 3 and 12 months of age (Mean=7.85; SD=3.00), and equally distributed across gender (Girls: n=672; Boys: n=677). Mothers rated infant temperament using the Infant Behavior Questionnaire-Revised (Gartstein & Rothbart, 2003), with the 14 subscales considered in this study. LPA and CA were performed separately for younger and older infants, due to rapid development in the first year of life. Results supported 3-profile/cluster solutions as optimal for younger, and a 5-profile/cluster for the older infants, indicating considerable differences between early/mid and late infancy. For younger infants, profiles included Low Reactive/Regulated, Average Positive/Difficult to Calm, and High Positive/Regulated. Profiles for older infants were as follows: Low Positive/Orienting, Fearless, Low Soothable/Cuddly, High Active/Fearful, and High Positive/Regulated. Clusters for younger infants consisted of: Average Positive/Difficult to Calm, High Positive/Regulated, and Low Reactive/Regulated, and for older infants included: High Active/Fearful, High Positive/Regulated, Low Soothable/Cuddly, Average/Sad, and Fearless/Inattentive. LPA and CA solutions were characterized by linear combinations of fine-grained scales best discriminating among profiles/clusters with Discriminant Function Analysis (DFA). Falling Reactivity and Cuddliness emerged as uniquely contributing to distinctions between types derived via CA and LPA for younger and older infants. DFA supported the importance of positive affectivity related dimensions (e.g., Approach) to type distinctions as well, albeit often in the context of joint effects. Direct comparisons between LPA and CA solutions were also performed. Chi-square tests comparing the distribution of cases assigned to matched types resulting from the LPA vs. CA classification of younger ($2=60.49$; $p<.001$) and older ($2=60.81$; $p<.001$) subsamples were significant, indicating some children were classified differently. Notably, a greater consistency in classification across LPA and CA techniques was observed for older infants. DFA results demonstrated parallels between best-differentiating scales for younger and older infants, yet LPA and CA solutions suggested potentially key differences in types that coalesce in early/mid versus late infancy. Notably, fear-related distinctions gain prominence across both approaches at the end of

the first year of life, consistent with developmental expectations based on the temperament theory and empirical research. Overall, both person-centered techniques point to the importance of surgency/positive affectivity and regulation.

S4.2 Symposium: Let's get social! Infants' sensitivity to social information in the first postnatal year of life

S4.2i Infants' gaze following behavior in response to schematic eyes - an interactive eye tracking paradigm

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The ability to follow another person's gaze is an important prerequisite for joint attention and is related to later language abilities (Brooks & Meltzoff, 2005). Infants follow the joint head and gaze direction of other people already at 3 months of age (D'Entremont, Hains, & Muir, 1997). But following a shifted gaze within a straight face occurs not before the end of the first postnatal year of life (Lempers, 1979). The orientation of the straight head may conflict with the shifted gaze orientation. Accordingly, when this conflict is removed in showing only isolated schematic eyes without the context of a face, infants are sensitive to the gaze orientation already at 4 months of age (Fawcett, Wesevich, & Gredebäck, 2016; Michel, Pauen, & Hoehl, 2017). Here, we examined whether infants overtly follow isolated eye movements in the absence of a face. We investigated if infants' sensitivity to eyes is influenced by the specific black and white contrast of eyes and how reward influences gaze following behavior. In an eye tracking paradigm, we presented 4-month-olds with schematic eyes with a natural contrast (black dots on a white background in Experiment 1) or a reversed contrast (white dots on a black background in Experiment 2). In each trial, gaze shifted to the side thereby cueing one comic mouse while looking away from another one. Based on infants' looking times, we assessed infants' preference for the cued mouse as a measure of gaze following. In an initial baseline phase, infants' spontaneous gaze following behavior was assessed. In a subsequent training phase, we rewarded infants for performing following behavior. Whenever the infant looked at the cued mouse, this mouse started wiggling in an interesting way. Final test phase was identical to baseline. We expected 4-month-old infants to follow the cue in Experiment 1, but not in Experiment 2. If infants learn through reward that it pays off to follow the orientation of the cue, we expect infants to enhance their gaze following behavior from baseline to test in both experiments. The final sample consisted of 20 4-month-olds (8 female, average age: 4 months 22 days,) in Experiment 1 and of 21 4-month-olds (10 female, average age: 4 months 24 days) in Experiment 2. Infants in Experiment 1 spontaneously followed the orientation of the black dots, $t(19)=2.098$, $p<.05$, but did no longer show a preference for the cued mouse in test, $p = 0.117$. In Experiment 2, infants followed the

cue neither in baseline nor in test, ps >0.243. At 4 months of age, infants follow eye-like stimuli without the context of a face but not an equal motion by a cue with reversed colors. Infants stopped following the eye-like cue during test which may be explained by a general loss of interest in the repetitive stimuli. We did not find any effect of reward learning. The guiding effect of social cues goes beyond the pure motion of a stimulus and seems to be based on low-level features like the color.

S4.2ii Investigating young infants' attentional preference for social interactions

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From early on, humans preferentially attend to social stimuli. Already infants orient their attention toward faces (Goren, Sarty, & Wu, 1975), bodies (Frank, Vul, & Saxe, 2012), and voices (DeCasper & Spence, 1986). In the current study, we investigated whether infants' attentional bias toward social signals also applies to social interactions. Based on prior studies documenting a qualitative change in social engagement beginning at around 9 months ("9-month revolution" in Tomasello, 1999), we particularly examined whether a potential preference for social interactions is stronger in infants older than 9 months compared to infants younger than 9 months of age. Infants from two age groups participated in the currently ongoing study: one group consisting of infants between 7 and 8.5 months of age (n = 10; data collection currently ongoing; 4 females; mean age = 232.9 days, SD = 12.62 days) and one group consisting of infants between 9.5 and 11 months of age (n = 20; 10 females; mean age = 315.5 days; SD = 10.23 days). To investigate infants' attentional preference, we simultaneously presented them with two kinds of videos. In one video, two agents turned toward one another and engaged in social interaction (leaning their heads towards one another, playing an interactive clapping game, or touching their hands). In the second video, the same two actors performed the identical movements as in the other video, but individually turned away from one another (non-interactive control). Each infant was presented with 12 experimental trials. We measured their looking time toward the two videos by using eye-tracking. We hypothesized that if infants preferentially attend to social interactions, they should look more than chance level (50 %) of their total looking time at the social stimuli. This pattern should be stronger in the older compared to the younger sample, if a preference for social interactions increases after 9 months of age. Results suggest that infants older than 9 months prefer to look at social interactions, t(19) = 2.95, p = .004; d

= 0.66, whereas no such pattern was found in the younger age group , t(9) = -0.78, p = .87 (preliminary result). Our findings indicate a decisive developmental change in the preference for social information between 7 and 11 months of age. Infants' attention patterns concerning social interactions will be discussed in relation to their active social interaction behavior, which we additionally investigated during a 5-minute parent-child free play session (coding currently ongoing).

S4.2iii Agency cues and 11-month-olds' and adults' anticipation of action goals

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The ability to predict the action goals of others is crucial for humans. However, the processes involved when infants observe actions of different agents is not yet fully understood. Experience-based accounts suggest that infants' processing and goal prediction for observed actions is closely tied to their own motor experience. Therefore, infants should not be able to predict the goal of novel actions or the action goal of a novel agent. In contrast, cue-based accounts propose that infants identify goal-directedness based on the availability of certain agency cues, such as self-propelled movement, equifinality of goal-achievement or the production of a salient action effect. Hence, infants should be able to predict the goal of a novel action or the goal of a novel agent when agency cues are available. We investigated the impact of agency cues on 11-month-olds' (n=72) and adults' (n=72) goal anticipation during observation of a grasping action by a mechanical claw. In Experiment 1, we measured predictive gaze shifts via eye tracking in two conditions (n=18 per age group per condition): In the agency condition, a claw was presented with biological motion (self propelled movement), approached a toy from different angles (equifinality of goal achievement), and lifted up the toy upon contact with an accompanying sound (salient action effect). In the mechanical condition, the claw moved mechanically, approached the toy only from one angle, and contacted the toy without lifting it up. In Experiment 2, two additional conditions were tested: An agency condition without a sound during the action effect and a mechanical condition with an aligned amount of movement when compared to the agency condition. Our results confirmed the hypotheses of the cue-based account, in that the 11-month-olds shifted their gaze to the goal object significantly faster in the agency conditions than in the mechanical conditions across both experiments. Furthermore, infants exhibited predictive gaze shifts in the agency conditions and reactive gaze shifts in the mechanical conditions. Also as expected, the

adults were predictive in all four conditions, but contrary to our hypotheses, in Experiment 2, they shifted their gaze to the goal object significantly faster in the agency-soundless condition than in the motion-controlled mechanical condition. Therefore, our study provides evidence that the presence of agency cues has a significant impact on infants' predictive gaze shifts, whereas adults do not need agency cues for their goal predictions. In two additional studies, we also extended our findings and investigated the specific impact of the presence of a salient action effect on action prediction in infants: First, we examined how an action effect, compared to equifinality of goal-achievement combined with biological movement, fosters 11-month-olds' action prediction when observing a grasping action by a mechanical claw. Second, we investigated the impact of a salient action effect on action prediction for 7.5- and 11.5-month-olds when observing a human grasping action. Taken together, these studies provide new insights into the influence of agency cues on early action processing.

S4.2iv Why do infants attend to infant-directed speech?

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Several studies suggest that infants prefer listening to infant-directed speech (IDS) relative to adult-directed speech (ADS) (e.g. Segal & Newman, 2015). However, the reasons underlying this preference are still unclear (Golinkoff, Can, Soderstrom, & Hirsh-Pasek, 2015). We tested infants' preference for listening to IDS; the functional relevance of IDS and individual differences in the physical characteristics of IDS produced by the infants' caregivers across development, i.e., at 6- and 13-months of age. This allowed us to examine the relationship between these features of IDS in language processing and how this relationship changes across development. First, mothers were recorded telling a familiar story in ADS and, on a different day, in IDS. Second, a preferential-listening task recorded the amount of time infants' spent listening to the same stimuli in IDS and ADS. Third, in an eye-tracking experiment, we measured the speed and accuracy with which infants followed the gaze of an actor speaking IDS or ADS (cf.,Senju & Csibra, 2008). Results show a preference for IDS over ADS and an improved gaze following behavior of an actor speaking IDS at 6 months. Thirteen-month-olds did not show a preference for IDS in both the gaze following and preferential listening task. Neither did we find changes in the quality of IDS across development. Correlations between the mothers' speech and infants' preference showed at 6 months an increased preference to listen to speech in general (IDS and ADS), if the mothers IDS minimum pitch was high, r

= .5, p = .013. Different results were found in 13-month-olds. At this age, the higher the minimum pitch in maternal IDS, the less the infant preferred to listen to IDS, r = -.46, p = .018. No correlations were found between the mothers' speech and the gaze following behavior of the infants. Correlations between the preference of the infant and her gaze following behavior were found only at 6 months. During ADS presentation, infants who showed a preference for ADS looked less to the target during the gaze following task, r = -.40, p = .038 and more to the model, r = .47, p = .014, indicating the more the infant prefers to listen to ADS, the less she follows the gaze of a person speaking ADS, but the more she looks back to the person speaking. Against the background of correlations between infants' preference for listening to IDS and their gaze following behavior and the maternal input, we interpret these results as indicating a more active role for the infant in early language development. The more infants show a preference for a particular kind of input, the more they respond to such input. At the same time, we highlight the functional relevance of IDS early on, with infants following the gaze of someone speaking IDS faster, and looking instead at the person speaking ADS. IDS may signal the availability of more information about their environment while ADS may merely direct infants' attention to the speaker.

S4.3 Symposium: Looking for language: how hearing and deaf infants navigate the visual world to learn language

S4.3i Referential cues support novel sign learning in young deaf children

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The social and referential cues that accompany early language input are key to helping young children map new words to their referents (e.g. Baldwin, 1993; Booth, McGregor, & Rohlfing, 2008). For hearing children, the association between language and its referents is made through simultaneous and multi-modal perception; language input is perceived through the auditory mode, while objects and referential cues are typically perceived through the visual mode. In contrast, deaf children acquiring a sign language such as American Sign Language (ASL) perceive both linguistic and non-linguistic information through the visual mode. Thus, in order to integrate language input with attention to objects in their environment, deaf children must learn how to optimally alternate visual attention between their conversational partners and the surrounding visual world (Lieberman et al., 2014). Currently, little is known about the temporal dynamics of word learning in deaf children under these unique perceptual conditions. In the current study, we use an eye-tracking paradigm to investigate how young deaf children use social and referential cues to learn novel signed words. We measure whether and how deaf children (ages 18-60 mo) rapidly learn novel object-sign label associations while varying the timing of referential cues (gaze shifts and points) with respect to the signed label. Participants saw novel signs and novel objects along with a gaze/point cue that occurred either before or after the signed label, or not at all. Novel object trials were interleaved with familiar object trials. We subsequently assessed novel sign recognition in test trials where previously labeled novel objects were paired and one was labeled. Given the exploratory and novel nature of this paradigm in ASL, we first conducted this study with a group of hearing adults (n=24) who were L2 learners of ASL. During the initial object labeling phase, adults spent significantly more time looking at the target and directed more fixations to the target in the Sign-Point condition than the other two conditions ($p = .009$). In the test phase, adults recognized the labeled novel objects equally well in all conditions. Preliminary analysis with deaf child participants suggest both similarities and differences from adult looking patterns. In the learning phase, children had more fixations on the novel object in the Point-Sign condition than the No Cue condition ($p = .03$). In the test phase, children were highly variable in their ability to map the novel label to the novel object. This study is a first

step in exploring deaf children's ability to use referential cues to guide looking behavior and learn new words when all input occurs in the visual modality.

S4.3ii Touch and speech input to hearing-impaired children

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Differences in the quality of the input as exemplified by caregiver interaction style above and beyond the speech stream may aid or hinder language acquisition (e.g., Hirsh-Pasek et al., 2015; Tamis-LeMonda et al., 2001; Tamis-LeMonda et al., 2014). Such differences in interaction style may be particularly salient to hearing-impaired (HI) children learning spoken language since their vocabulary development lags behind age-matched normal-hearing peers (NH-AM) and is highly variable (e.g., Vohr et al., 2011). Further, caregivers who have a hearing mismatch with their children may be less able to adjust their feedback to their infant, particularly with respect to speech cues (e.g., Kondaurova et al., 2016; Meadow-Orlans, 1997). We examined whether caregivers of HI children provided speech and touch cues in a way distinct from caregivers of NH-AM children and whether alignment of cues showed sensitivity to hearing status. Participants were 24 dyads: 12 HI children and 12 age- and gender-matched NH-AM peers and their normal-hearing mothers. Each dyad spent 6 minutes engaged in free play with three objects (a ball, a toy cat, and a toy dog) with no relevant knowledge about the aim of the experiment. Audio- and video-recordings were subsequently micro-coded for touches and words (cat, dog, ball) and scripts calculated the alignment of touches and words as well as the frequency of both. Results revealed that while caregivers of HI and NH-AM children produce words with the same frequency, touches are more frequent to HI children (Figure 1). However, the patterns in which touch was used, in terms of its location on children's bodies and its type (with or without a toy), were the same across the two groups. Further, caregivers of HI children produce more toy labels aligned with touches, and produce more touch events that are aligned with utterances compared with caregivers of NH-AM children. In sum, results reveal that caregivers' use of multimodal cues was sensitive to hearing status. The more frequent use of touch with children with HI as opposed to their NH-AM peers, suggests that caregivers may be attempting to compensate for their children's sensory deficit by using a sense modality that is harder to ignore or miss - touches can be felt and seen. The greater alignment of touches with speech in caregivers of HI children may indicate that they are attempting to use touch to draw children's attention to speech. Ongoing analyses examine responses to touches,

words, and words aligned with touches to explore whether children look more at the caregiver's face or her touch location and whether this differs across the two groups of children (HI, NH-AM). These analyses will allow us to examine whether children are able to capitalize on differences in learning opportunities. If they are, we predict that HI children may attend more to the caregiver's face during multimodal events to gather articulatory cues while NH-AM infants may attend more to the touch location.

S4.3iii An information-seeking account of eye movements during spoken and signed language comprehension

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Language comprehension in grounded contexts involves integrating visual and linguistic information. But when the visual signal also contains information about language - as in the case of sign language processing - this creates a tradeoff where the listener must decide what kind of information to gather and at what time. How do young signers choose where to look? Here, we propose an information seeking account: that signers modulate the timing of eye movements away from a language source to gather higher value information about the linguistic signal compared to children learning spoken language. To test our account, we compared eye movements of children learning ASL (16-53 mos, n=30) to three groups of children learning English (n=83; ~27 in each dataset; 24-36 mos) using parallel real-time language comprehension tasks. Children's eye movements were recorded as they processed familiar sentences ("Where's the ball?") while looking at a simplified visual world with three fixation targets (center stimulus, target, and distracter; see Figure 1). We analyzed the Accuracy and Reaction Time (RT) of children's first shifts away from the center stimulus after the start of the target noun. We also used two model-based analyses: an exponentially weighted moving average (EWMA) method to quantify the proportion of shifts driven by language and a drift diffusion model (DDM) to quantify differences in the underlying decision processes leading to behavioral differences. We focused on two parameters: boundary separation, which indexes the amount of evidence gathered (higher values suggest more cautious responding) and drift rate, which indexes the efficiency of evidence accumulation (higher values suggest more efficient processing). ASL learners generated slower RTs compared to English learners (β = -0.97, $p < .001$). However, ASL learners' gaze shifts were more accurate (β = -0.78, $p < .001$), even compared to English-learners in the Face task (β = -0.62, $p = 0.001$). ASL-learners also generated more language-

driven shifts and less random early shifting (EWMA results Figure 2B). Finally, the DDM analysis showed that ASL learners had a higher boundary separation (ASL = 1.77 [1.64, 1.9]; Face = 1.35 [1.21, 1.49]), but similar drift rates. This suggests that ASL learners' were more accurate because they accumulated more evidence before generating a response and not because they processed language more efficiently. Together, the behavioral analyses and the modeling results suggest that young ASL learners are sensitive to the higher value of eye movements in a visual language. This behavior is reasonable since the potential for missing important linguistic information is high if signers shift away from a language source. These results also suggest that as the value of fixating on a location to gather information about language increases, eye movements to the rest of the visual world become less useful and occur less often. Our ongoing work explores how this information seeking account can explain the dynamics of spoken language learners' eye movements as they process speech in noisy environments where the value of visual information increases relative to the less reliable acoustic signal.

S4.3iv Where should I look? How hearing infants allocate their visual attention when Speakers, Signers, and Gesturers communicate with their hands.

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Listening to language promotes core cognitive capacities in infants. For example, by just 3 months, spoken language boosts object categorization (Ferry, Hespos & Waxman, 2010). This task requires infants to coordinate information from two sensory modalities: audition (language) and vision (a set of objects). But not all languages are spoken. Infants acquiring sign language also must coordinate two sources of information (the objects and linguistic signal) both of which are presented visually. How do infants accomplish this? Past work has shown that even hearing infants, with no prior exposure to sign language, distinguish sign language from more general communicative gestures (Krentz & Corina, 2008). In the current study, we go one step further, asking how infants allocate visual attention to objects when information about these objects is also presented in the visual modality. Four to six-month-old infants (N=96) participated in a visual object categorization task during which information about these objects was conveyed in the visual (sign language; pointing) or in the auditory (spoken language) modality. Infants viewed 8 distinct objects from the same category (e.g., dinosaurs) one at a time on a large projector. Each exemplar was accompanied by a video of a woman who pointed to and looked at the object. In the Look and Point Condition, she offered

no additional linguistic information. In the Language conditions, she also named each object, using either spoken or sign language. All three conditions included the same looking and pointing social cues. This permitted us to tease apart the effect of sign language, per se, from a more general advantage conferred by observing social and pedagogical cues in the manual modality. In all conditions, infants' visual attention to either the woman or the object was coded offline. We report three main findings. First, all infants spent more time looking at the woman (M=78%) than the object (M=22%) (β=.63, p<.01). However, this difference was especially pronounced in the Spoken Language condition with infants devoting a significantly greater proportion of looking time to the woman (M = 92%) compared to the Sign and Looking & Point Conditions (M=79%, 77% respectively), (β =.13, p<.01). This suggests that by 3-6 months, infants have a difficult time dividing their visual attention between objects and a speaking communicative partner. Second, infants' preference to look at the woman (versus the object) persisted when she was actively communicating (β =.70, p<.01) as well as when she had stopped communicating and was inert (β= .36, p<.01). Third, and most provocative, infants in the Sign Language Condition were more likely than those in Spoken and Look & Point Conditions to disengage from the woman and devote visual attention to the object when the woman was inert (β=.17, p<.01). Together, these results indicate that hearing infants adapt flexible looking strategies to accommodate variations in the modality in which information is conveyed. These results advance our understanding of how infants allocate attention across diverse communicative contexts.

S4.4 Symposium: New directions in infant emotion perception

S4.4i Developmental changes in emotion categorization: The influence of verbal labels

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Although there is an extensive literature on infants' ability to discriminate between different emotional expressions, less is known about infants' ability to form emotion categories. One aim of the current research was to determine whether infants would form a superordinate category of negative valence across perceptually similar emotional expressions (Study 1). Further, in the object categorization literature, it has been reported that verbal labels can prompt infants to form either one superordinate category or two narrow categories, depending on how the labels are paired with the stimuli. Thus, a second aim was to explore how verbal labels influence emotion categorization (Studies 2 and 3). In Study 1, 10-, 14-, and 18-month-olds (n=24 per age) were habituated to pictures of an adult expressing anger and disgust. Four test trials were then presented in a counterbalanced order. If infants formed a superordinate category of negative valence, there should be no significant difference in their looking time to the Negative Familiar trial (familiar person-familiar emotion) relative to the Negative Novel Face (new person-familiar emotion) and Negative Novel Emotion trials (familiar person-sadness). However, infants should look significantly longer at the Positive Novel Emotion trial (familiar person-happiness). Results indicated that (a) 10-month-olds formed a category of person identity; (b) 14-month-olds formed a narrow category of negative valence that included sadness but excluded a new person expressing anger or disgust, and (c) 18-month-olds formed discrete emotion categories. In Study 2, 10- and 18-month olds (n=32 per age) heard one novel label ("toma") during each habituation event. In Study 3, 14-month-olds (n=32) heard one novel label for the anger habituation trials (e.g., "toma") and another novel label (e.g., "modi") for the disgust habituation trials. Results indicated that the label in Study 2 helped infants to form a narrow category of negative valence that included the novel emotion of sadness but excluded a new person expressing disgust or anger. In Study 3, the provision of different labels for each emotion encouraged infants to form discrete emotion categories. These results indicate that emotion categorization changes between 10 and 18 months of age. Further, these findings extend to infancy what is currently known about the constructive role of language in emotion categorization for older, verbal children and adults.

S4.4ii Emotional Expressions Reinstate Recognition of Other-Race Faces in Infants Following Perceptual Narrowing

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Perceptual narrowing occurs for face race: younger but not older infants differentiate other-race faces. Given the adaptive advantages of preserving sensitivity to infrequent stimuli (e.g., learning foreign languages, responding to diverse face types without bias), researchers are examining variables that reduce narrowing. Because angry and happy expressions have been shown to enhance face processing, we investigated whether they would reinstate recognition of other-race faces following narrowing. In Experiment 1, a paired-comparison task measuring looking time (familiarization with one face, preference test with familiar vs. novel face) demonstrated narrowing for Caucasian infants viewing neutral Asian faces: 3-month-olds discriminated between them; 6-month-olds did not. Experiment 2 followed the method of Experiment 1, but was conducted with Caucasian 6-month-olds presented with angry or happy Asian faces during both familiarization and preference test, and the faces were discriminated. Experiments 3 and 4 yielded comparable results (i.e., narrowing with neutral faces, reinstatement of sensitivity with emotional faces) for Caucasian 6- and 9-month-olds presented with African faces. Infant looking time during familiarization did not differ for neutral and emotional faces from either race, indicating that the expressions did not yield more salient stimuli. Also, equivalent pairwise similarity ratings obtained from Caucasian adults for the neutral and emotional Asian and African faces indicated that the expressions did not create more discriminable stimuli. Without support for the lower-level accounts, we are intrigued by the possibility that the infants processed the communicative intent of the expressions. Because angry faces pose threat and happy faces invite affiliation, expression may create motivation to individuate. The data suggest early perceptual-social linkage in face representation, and imply that such linkage can arise via a social-to-perceptual pathway.

S4.4iii Epigenetic modification of the oxytocin receptor gene impacts infants' brain responses to emotional facial expressions

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

brain function during infancy and points to the right IFC as a brain region sensitive to endogenous variability in the oxytocin system.

S4.4iv The Development of Body Emotion Processing in Infancy

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Emotion processing is a critical component of social functioning. While faces are a significant source of emotion information, bodies may be even more informative than faces under certain circumstances. Yet, while a considerable amount of research has examined the development of emotion processing from faces, very little research has been directed at body emotion processing in infancy. We will discuss studies that address this topic. Infants progress from discrimination to recognition of emotions in faces during the first year of life. It is unknown whether the perception of emotions from bodies develops in a similar manner. To address this issue, we first sought to determine whether infants' ability to discriminate between emotions manifests as specialized scanning patterns. Six- to 7-month-olds' look location and duration to fearful, happy, angry, and sad body expressions were recorded using an eye-tracker. Infants systematically attended to bodies based on the emotion represented. For example, they looked significantly less at the trunk region of happy stimuli compared to angry, sad, and fearful bodies. Next, we tested infants' emotion recognition by presenting them with happy and angry body videos and voices to examine their ability to match emotion information across modalities. Five-month-olds looked longer at the matching body when they were presented upright but not when they were inverted. In contrast, 3.5-month-olds failed to match even with upright videos. Thus, 5-month-olds, but not 3.5-month-olds, exhibited evidence of recognition of emotions from bodies by demonstrating intermodal matching. In a subsequent experiment, younger infants did discriminate between body emotion videos but failed to exhibit an inversion effect, suggesting that discrimination may be based on low-level stimulus features. These results document a developmental change from discrimination based on non-emotional information at 3.5 months to recognition of body emotions at 5 months. This pattern of development is similar to face emotion knowledge development and suggests that both the face and body emotion perception systems develop rapidly during the first half year of life. Another index of emotion identity knowledge is the ability to react functionally to the emotional content of stimuli. For example, prior research suggests that adults attend to negative emotions differently than to other emotions. We examined whether body

emotions similarly affect infants' attention. We tested 5- and 9-month-olds on an attention overlap task in which a checkerboard was presented in the middle of a screen followed by an emotional body video in the periphery. Infants were significantly faster to reach the body stimulus when the display was fearful than when it was happy or neutral, indicating that fearful bodies engage infants' attention faster than happy and neutral bodies. We are currently examining the nature of the information in these videos that systematically affect infants' attention. These studies document infants' ability to process socially relevant emotion information from bodies. Although much remains unknown, our findings suggest that the development of body emotion processing parallels facial emotion processing in infancy, and indicates an early ability to utilize a variety of sources of socially-relevant information in a coherent manner.

S4.5 Symposium: Co-development of motor and cognitive abilities in infancy: dynamic systems approach

S4.5i From Postural Control and Object Exploration to Means-End Problem Solving: A Dynamic Developmental Cascade

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Introduction. Early delays in postural control and perceptual-motor abilities may negatively impact the development of infants' reaching skills and object exploration (Dusing & Harbourne, 2010; Hopkins & Rönnqvist, 2002; Soska & Adolph, 2014), which can result in diminished opportunities to explore the environment and learn, thus placing infants at risk for delays in cognitive development (Brooks & Meltzoff, 2005; Lobo & Galloway, 2013; Mundy & Newell, 2007). The current longitudinal study provided a comprehensive picture of one such "motor to cognitive" developmental cascade not previously documented. We hypothesized that: 1) infants born preterm would show delays in non-object oriented (NOO) exploration, object-oriented (OO) exploration, and means-end problem solving (MEPS); 2) infants' NOO exploratory behaviors would relate to their OO exploratory behaviors; 2) infants' intensity and variability of OO exploration would relate to their MEPS success. Methods. The study included 24 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). Infants' NOO and OO exploratory behaviors were assessed at 3, 4, 6, 9, 12, 18, and 24 months. NOO exploratory behaviors are defined here as behaviors infants engage in when not directly interacting with portable objects. OO exploratory behaviors were recorded during infants' semistructured exploration of 7 infant toys. Infants' MEPS was tested at 6, 9, 12, 18, and 24 months in a task requiring rotation of a turntable to attain a distant toy. NOO exploration behaviors were related to infants' OO exploration, and OO exploration was related to MEPS using the Hierarchical Linear Modeling (HLM; Raudenbush et al., 2004). Results. Compared to full-term peers, preterm infants showed poorer postural control (less antigravity head lifting), midline behavior (less holding the head and both hands in midline), hand-to-mouth and visual-motor behaviors, and lower intensity and variability of NOO exploratory behaviors. Preterm infants also demonstrated delays in OO exploratory behaviors (less holding and manipulating objects, lower OO exploration variability) compared to their full-term peers. Preterm infants showed less MEPS goal-directedness and trial success (Table 1). Infants' NOO exploratory behaviors (e.g., looking at the hand(s), holding the hands in midline, touching the body with the hands, NOO exploration intensity, NOO exploration variability) significantly related to the

corresponding OO behaviors (e.g., looking at the object in the hand(s), holding the object in midline, touching the body with the object, OO exploration intensity, OO exploration variability). Furthermore, the intensity and variability of OO exploration was positively related to MEPS trial success (Table 2). Discussion. Early NOO and OO exploratory behaviors are closely related and information gathered via OO informs early cognition, so impairments in early NOO exploration might negatively impact OO exploration, which might delay the development of MEPS skills, thus increasing risk for future cognitive delays. These results suggest a dynamic relation between the development of motor and cognitive abilities in infancy, and highlight motor behaviors that could be targeted through early intervention to facilitate infants' future cognitive development.

S4.5ii From Faces to Objects: Crawling Experience Modifies Patterns of Infant Attention

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Infants develop as a dynamic system in which changes in motor abilities afford new experiences in cognitive abilities. Crawling provides infants with autonomy, allowing them to pursue objects without help from a caregiver (Campos, Anderson, Barbu-Roth, Hubbard, Hertenstein & Witherington, 2000). One potential cascading effect of crawling is the infant's ability to allocate attention more to objects than to faces, a shift that occurs around the same age that infants begin to crawl (Fausey, Jayaraman & Smith, 2015), but for which there is no established empirical link.This hypothesis was tested in a laboratory experiment in which infants were required to disengage attention from the experimenter's face and follow the cue to attend to an object attended by the experimenter. We included two conditions of cues (Figure 1): In the Weak cue condition, the experimenter directed head and eyes to the object but did not touch the object. In the Strong cue condition, the experimenter directed head, eyes and hands to the object. The expectation was that all infants will show competence in the task by following the Strong cue, but that in the Weak and more ambiguous cue condition, only infants with more crawling experience -and thus increased goal-directed actions in relation to objects (Zachry & Mitchell, 2012; Campos et al., 2000)- will follow the cue. This study addresses dynamic links between motor and cognitive development, and proposes a candidate mechanism for the infants' transition from seeing faces to objects and hands during their first year of life. Method. 9-month-old infants (n=25) participated and were

classified as early or late crawlers based on a median split on the onset of crawling (Median=8.10mo, SD=1.08mo). The task consisted of 12 trials: During six Weak cue trials, the experimenter presented two objects, turned her head and looked at one object (the target). During six Strong cue trials the experimenter turned her head, looked at the target, picked it up and held it. Infant eye-gaze was coded as directed to the target or to the experimenter's face. The measure, Delta prop, was computed as proportion of time in which the infant looked at target minus at the face. Results. During the Weak cue trials, infants with less crawling experience spent on average an equal proportion of time looking at the face and target (Delta prop = -0.04, SE=0.08), while infants with more crawling experience spent on average more time looking at target than the face (Delta prop=0.18, SE=0.06). During Strong cue trials, both early and late crawlers allocated attention predominantly to the target. The mean Delta prop was 0.73 (SE=0.05) for late crawlers and 0.78 (SE=0.04) for early crawlers. Discussion. Crawling experience predicted infants' attention to objects and faces. Future studies should test crawling as a control parameter that gates the developmental timing of triadic attention to objects in social contexts. Furthermore, given that performance on gaze-following tasks predicts future language development (Brooks & Meltzoff, 2008), future research might explore the pathway from crawling to joint attention to early word learning.

S4.5iii Duration of object visual encoding on precision reaching in 9-month-old infants

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Infants appear to reach for objects in their vicinity the best they can, using fast movements seemingly lacking a priori planning. Their ultimate goal seems to be making contact with the target as quickly as possible. It is unclear how much object related information infants process during those quick reaching moments and how it contributes to planning the reach. Research on incidental memory has shown that in the first year of life infants need at least 2s of object exposure to process and remember object information. Can prolonged visual exposure to an object prior to reaching influence encoding of the target and precision reaching in infants? To address this question, we performed two studies with 9-month-old infants. In study 1, the object was presented directly within infant reach, thus, infants in this study could immediately reach for the object to grab it. In study 2, infants were presented the object out of reach for 5s,

such that they were enticed to look at the object longer before they were allowed to reach for it. In both studies, looking behavior on the target object was recorded with a remote eye-tracker and the area of first hand contact with the object was coded. Infants in study 1 did not display a particular look-and-reach strategy. As expected, they aimed for the object as soon as it appeared, and many times they reached for the object before even looking at it. Infants in study 2 engaged in a more extended process of visual exploration of the object, which led to the visual selection of a specific area of the object. This selected area matched the object area infants touched first. This look-and-reach matching did not occur systematically in infants in study 1, and if it occurred, it seemed to be more a chance event than the product of a deliberate movement plan. These findings suggest that the duration of visual encoding of the target prior to reaching may be a critical factor in the process of action selection in infancy.

S4.5iv Using Dynamic Systems Thinking for Characterizing the Relation of Sensorimotor to Language Development: Models and Metaphors

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Dynamic systems are internally coherent but change over time via the interaction of their components. These interactions enhance & constrain each other to give rise to emergent complex properties. Dynamic systems are good models of processes of change and development because they don't need a guidance plan. For many psychological phenomena (language, cognition, sensorimotor abilities, social & emotional functioning), it is difficult to assign numerical values to their states during development. Thus, dynamic systems theory can be applied only metaphorically. This symposium's presentations, reveal how this metaphor can stimulate research projects that reveal how sensorimotor and cognitive development may produce emergent properties in both. A dynamic systems approach can reveal how infant sensorimotor engagement with the social & physical environment permits the self-organization of neuromotor experiences that can serve as the basis for the development of complex psychological abilities, even when the structure of individual experience appears to be insufficient for development. Any psychological phenomenon that displays the properties of self-organization, attractor states, threshold phenomena, bifurcations, chaos, discontinuities, and self-similarity during development are appropriate for the metaphoric use of dynamic systems theory. I discuss some aspects of sensorimotor development that reveal these properties as the infant engages with the social and

physical environment. Then, these properties will be related to comparable properties in early language as a means of constructing a dynamic system account of early language development. This metaphoric technique can be applied to other forms of cognitive development thereby removing the need for constructs of innate or core abilities. With a dynamic systems metaphor, early sensorimotor development can serve as the foundation for the development of later social, cognitive, and emotional traits and abilities.

S4.6 Symposium: Using innovative methods to understand children's curiosity-driven learning

S4.6i Investigating children's word and action preferences using gaze contingency

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For young children, multimodal information seems to be omnipresent in their surroundings: For example, communication with young children not only includes the linguistic modality in form of speech but also movements like the hopping of the rabbit. This multimodal input has been shown to support language learning (Gogate, Bahrick, & Watson, 2000; Werker, Cohen, Lloyd, Casalola, & Stager, 1998). According to dynamic approaches, multimodal input can help the child to learn from the environment but also provides the possibility for the child to alter their own learning experience through selective attention (Gogate, Walker-Andrews, & Bahrick, 2001; Hirsh-Pasek, Golinkoff, & Hollich, 2000). This interactive scenario can be influenced by the child's curiosity and preferences, which, in turn, will shape the child's learning behaviour. In the current study, we investigated children's preferences for either actions or words, and their learning behaviour based on their preference. 2- to 3-year-olds (N = 40) participated in a novel gaze-contingent paradigm that allowed them to choose between words and actions for two novel objects. Thus, the child could shape his or her learning experience based on the preference for one of the two modalities. In the following test phase, the two objects were presented side-by-side on screen in silence for 2.5 s (baseline phase). Then, the objects disappeared when in a prime phase, infants either hear the label for one of the objects (word-object trial) or see a hand performing one of the actions (action-object trial). Then, the objects reappeared on-screen for a further 2.5 s (test phase) to examine whether participants looked at the correct target object upon hearing the label. Generalized linear mixed models and growth curve models show that children's preferences are highly individual and interact with their learning behaviour. That is, children who preferred verbal input also learned these words, whereas children preferring actions rather showed successful action recognition. Still, word recognition appeared to be stronger than action recognition. In addition, we will present data from adults (data collection is on-going) to compare potentially similar learning mechanisms. Thus, children's curiosity seems to drive their learning experience: In our study, their interest in one modality fosters learning in this modality and possibly neglects learning in the other modality due to the child's self-chosen, individual amount of exposure. This directly relates to children's curiosity-driven learning when interest guides information acquisition and thereby guides learning. In multimodal environments, children's

preferences might help to structure the complex input into chunks that are compatible with the child's cognitive capacities in that moment. In addition, gaze-contingent eye-tracking paradigms allow us to recognise children as active learners, which will help us to step deeper into our understanding of children's learning behaviour in a complex world.

S4.6ii New evidence for systematicity in infants' curiosity-driven learning

Han Ke[1], Gert Westermann[1], Katherine Twomey[2]

[1]Lancaster University, [2]Manchester University

Decades of research demonstrate that infants' learning is sensitive to task features. However, what level of complexity best supports learning is unclear. Moreover, infancy studies typically employ carefully-designed experiments with complexity determined a priori. Whether infants systematically generate a particular level of difficulty during everyday, curiosity-driven exploration is therefore unknown. Twomey & Westermann's (2017) model of visual curiosity-driven learning predicted that infants will generate intermediate task complexity (cf. Kidd, Piantadosi & Aslin, 2012) but to date this prediction has not been tested. In the current work, we explored the possibility that infants will systematically prefer intermediate task complexity when allowed to freely explore a set of 3D objects. To test this hypothesis in a naturalistic environment, we developed a shape priming paradigm using 3D-printed toy-like stimuli and head-mounted eyetracking. Twelve- (N=18), 18- (N=18) and 24-month-old (N=18) infants were tested. Stimuli were sets of 3D-printed stimuli. Stimulus edges differed in a continuum from corners to rounded. Differences between exemplars were manipulated such that each object was perceptually distinct from every other object, but differences between successive stimuli in the continuum were controlled. Infants were presented with a single 'prime' object from a set for free exploration, followed by the full remaining set. Infants' first touches and subsequent exploratory sequences were coded offline. Data show that regardless of age group infants show an identical pattern of object selection, first selecting exemplars of greatest perceptual difference from the prime(see Figure 2). Cluster analysis demonstrated that overall infants exhibited 2 or 3 exploratory styles, generating either high-intermediate or low-intermediate complexity sequences. Overall, this study offers new evidence that infants as young as 12 months actively impose structure on their learning environment outside the constrained lab environment.

S4.6iii Attentional Dynamics in Complex Learning Environments: Insights from computational modeling and empirical work

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Understanding how attention is allocated efficiently requires understanding how the attentional system interacts with complex real-world environments and the learners' existing knowledge. By creating a model that formalizes the dynamic relationship between attention and learning, we were able to generate testable predictions about how attentional switching should operate in order to maximize learning in complex learning environments. The computational model describes the looking behavior of an ideal learner in an environment containing multiple objects, each of which contains a set amount of information that can be learned. The model is based on only a few parameters: the shape of the learning curve that the learner follows as they attend to an object, the speed that their memory decays for objects they are not attending to, the cost of disengaging and reengaging attention when switching between items, and the amount of information about each object that the learner starts with at the first time-point. Based on these basic parameters, the learner makes a decision about which object will provide the greatest information gain at each time-point, and begins attending to, and learning from, that object. Interesting, nonintuitive switching patterns emerge from these simple constraints. For example, the results predict that if a learner is optimizing potential information gain, they might start with a slow switching rate as they gather initial information about each object, but that that rate would then increase over time as they work to maintain what they have learned. In order to test these behavioral predictions, we utilized multiple behavioral paradigms, including a gaze-contingent eye-tracking task assessing visual switching rate over time in infants and adults, a touchscreen game investigating preference for information rate in children, and a listening task assessing curiosity and information-gathering preferences in adults.

S4.6iv How do infants sample novel object-label associations?

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Infants play an active role in selecting and soliciting information about properties of novel objects (Begus & Southgate, 2012; Stahl & Feigenson, 2015). Yet we still know little about the strategies infants use to seek out novel information. In learning novel words, for instance, will infants seek out an object's label if they know it less well? In the current work, I will discuss ongoing work to develop gaze-contingent eye-tracking methods that allow infants to more actively control their learning environment. In the first set of studies, we asked whether 20-month-old infants differentially sample information about novel word-object associations when given active control over what material they can learn. We first exposed infants to object-label pairs in a skewed distribution: while all objects occurred equally often, some were labeled more frequently than others. Next, in the Sampling Phase of the experiment, we used a gaze-contingent eye-tracking methodology in which infants controlled which object-label pairings they heard next. On each trial, two objects were presented and subsequently obscured from view by screens. Once infants fixated one of the object locations, the screen rose to reveal the object, which was subsequently labeled. In Study 1 ($n = 25$), we found that the likelihood of infants' sampling an object increased with the relative informativeness (based on the relative frequency of the infant's previous exposure to each object-label pairing) of the object-label pair (logistic mixed-effects model, $z = 5.15$, $p < .001$; see Figure). Moreover, we found that infants were more accurate at identifying object-label pairings in a picture-pointing task when they were chosen more frequently during the Sampling Phase ($z = 1.94$, $p = .05$). We subsequently replicated the finding that infants differentially sample object-label information dependent on their previous exposure to the object-label pairing with a new sample of 20-month-old infants ($n = 28$; $z = 3.42$, $p < .001$; see Figure). We will also report the results of a separate study (data collection ongoing), in which we test 18-month-old infants' exploratory behavior in a gaze-contingent design in which they can continuously sample object-label associations. In the study, we first manipulate infants' uncertainty about a set of object-label associations by labeling half of the objects consistently (e.g., the object is always labeled "tursa") and half of the objects inconsistently (i.e., the object is given a different label each time it occurs). Next, we ask whether infants will seek out label-object associations with higher uncertainty in a continuous gaze-contingent Sampling Phase. In this design, a set of objects appears on the screen. Once the infant fixates one of the objects, it is continuously labeled until the infant looks away. Then, the infant has the opportunity to fixate a new object and hear its label. Thus, infants are given the opportunity to continuously explore a set of object-label associations, offering a potentially more sensitive measure of infants' information-seeking under uncertainty. Overall, we will

discuss the possibilities provided by gaze-contingent eye-tracking methods to study infants' exploratory behavior and information-seeking preferences.

S4.7 Symposium: Singing from the start: song acquisition in infancy

S4.7i Infant Vocal Imitations Of Music: A Case Study

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Infant vocal development is described as a trajectory in which infants gradually acquire the capacity to produce the speech sounds they hear around them. Less is known about vocal development of music, and it is not clear whether infants also respond to the music sounds produced around them in terms of their own vocal music production. We investigated infant singing by identifying and analyzing vocal imitation of music produced by James, a 15-month-old infant. James wore a recording device that captured the sounds he heard and produced during an entire day at home with family. Through extensive listening of the 16-hour audio file we identified instances in which he imitated music he had heard earlier that day. We analyzed his vocal imitations and the music models that he imitated in a variety of ways. To corroborate our analyses, we completed a study with 65 adults who were asked to match the infant's vocalizations to excerpts of the models and foils. The results of the following four imitations will be discussed during the presentation: (1) James imitated the exact pitches of the first two measures of "Happy Birthday", a tune he had heard played by an electronic toy repeatedly 10 hours earlier. (2) James imitated the playsong "Rain, Rain" sung to him by the mother 6 hours earlier. The father recognized his singing of the song and engaged him in a turn-taking interaction. In each imitative response, the infant incorporated speech sounds of the father's words and transposed the song to match his father's singing while preserving fundamental music components of the tune. (3) and (4) While playing by himself, James imitated music intervals produced by his siblings in the background. The private nature of these two imitations suggests that singing is not restricted to social contexts and may pass unnoticed even to attentive adults. The results of the study show that James imitated music features of the models, such as pitches, intervals, melodic contour, and rhythms, as well as speech sounds from the lyrics. The findings indicate the infant's ability to accurately represent music melodies, recall these representations without prompting or reinforcement, and, importantly, express these representations vocally in such a way that adults can identify them. That James sang familiar music despite a limited amount of exposure to singing (i.e., 14 minutes) suggests that he was responsive to the music produced for him and around him and actively learning about music from such experiences.

S4.7ii Infant Soundscapes: Differences in the Music Environments of Infants from the United States and Tanzania

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There is extensive research showing the profound and long-lasting effects that the quantity and quality of exposure to speech has on the development of infants' language skills (e.g., Hurtado et al, 2008). Research on infant musical environment is not as plentiful and is based almost exclusively on parental questionnaires and interviews (e.g., Barrett, 2009). Previous findings using daylong recordings of infants and their families show that caregivers overestimate the duration and frequency of musical episodes (Costa-Giomi & Sun, 2016). Most research on music exposure in infancy has been conducted with infants and families representative of Western cultures and childrearing practices. Because diverse social and cultural contexts have not been adequately represented and assessed, it is unclear whether infants of different backgrounds share similar musical experiences. Infants (n=12 American, n=20 Tanzanian) wore a portable recording device (LENA) during an entire day that captured all sounds produced near them as well as their own vocal production continuously for up to 16 hours. The sound files were analyzed through repeated listening to identify relevant music indicators. The analysis of home music environments suggests that there is considerable variation in the characteristics of the music interactions in which infants participate, even across families of similar SES and cultural background. Overall, the initial results suggest that cross-cultural differences in caregiving behavior may provide infants with different types of musical experiences. For example, American mothers reported singing frequently to their infants, yet, behavioral data showed that they did so for very short periods of time. Tanzanian mothers, on the other hand, rarely reported singing to the infants but the behavioral data showed that indeed they did so. American infants were immersed in digital sounds produced by toys and electronic devices, something that was more rare in Tanzanian homes. But Tanzanian infants were exposed to a larger variety of sounds produced by people around then and immersed in more social interactions with other children than were American infants. Such experiences are likely to shape the way in which the infants learn music and become active participants in their own musical culture.

S4.7iii Song Acquisition Birth to Three

Gwendolyn McGraw[1]

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Although tuneful singing is regarded as an early manifestation of musicality, little is known about the developmental profile of children who sing tunefully from infancy onwards. Here, I explored the emergence of tuneful singing in infancy, co-occurring developments in speech acquisition, and ongoing singing development to age 3/4. Overview. Exploratory research. Subjects: n = 48. Mixed methods: semi-structured interviews, longitudinal observations, and questionnaires. Qualitative analyses. Research questions. (1) What conditions are associated with acquisition of tuneful singing early in life? (2) At what age do child singers begin to sing tunefully? (2) How does the earliest tuneful singing compare to concurrent expressive speech? (3) How does tuneful singing development unfold birth to age three? (4) Is there evidence that informal 'training' and 'practice' play a role in early singing and subsequent development? Selected results. Parents self-reported 40 minutes daily singing (average, to age 2). Experience-dependent (multisensory) learning was evident from infancy onwards. Some Ss tunefully sang song fragments prior to age one, while others first sang recognizable songs 14-24 months of age. Overview of development follows: 1. Infancy: Socially grounded learning, with significant, ongoing exposure to parental singing: innate pitch-matching ability maintained during sensory and sensorimotor periods. Babies segment pattern-laden songs that scaffold all vocal learning (Francois et al., 2017). Some sing simple, vowel-based melodic patterns (i.e., organized tonal sequences) that are longer than concurrent emergent speech. 2. Adults guide singing 'practice' through age 2, when discrete-pitch matching is solidified. Toddlers sing whole songs tunefully in octave+ range. 3. Age 2-3. Children increasingly sing known songs independently during play. 4. Age 3 onward. Described as 'singing constantly,' children learn new songs on their own, with media playing important role. Huge amount of informal tuneful singing practice. Rapid temporal processing, acute auditory perception (especially for facets of human vocal signal), and robust melodic memory were observed. Discussion. Early singing acquisition was intertwined with speech acquisition, and was associated with two indicators of accelerated vocal learning: accelerated acquisition of speech and more adult-like speech clarity as compared to developmental norms. Moreover, more adult-like auditory acuity, temporal processing, and melodic memory suggested that children's self-initiated pitch-accurate singing 'practice' was associated with important changes to neural substrate during early childhood. Thus, parents' consistent commitment to singing acquisition was critical for song acquisition in infancy -- and was later associated with a cascade of

complex, inter-related auditory, vocal-motor, perceptual, and cognitive abilities/behaviors. Conclusion. For these children, facility with a 'tonal language in music' was effortlessly acquired by age 2 during the same time frame that their native language was learned. Song acquisition was socially-mediated, and was associated with increasingly complex musical behaviors across development. Results indicate a synergistic interplay between 'nature and nurture,' coupled with an early, optimal period for singing acquisition.

Flash talk abstracts: Sunday 1st July

S1.8 Flash talk session 1: The interrelation of motor, cognitive, and social development

S1.8i Infants' use of pointing gestures is related to their perception of others' points

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By at least 12 months infants are sensitive to the intentions and goals that drive both their own and others' actions (Meltzoff 1988, 1995; Brooks & Meltzoff, 2002; Woodward, 1998). Such action understanding is linked to important social cognitive advances, and in particular to communicative development (e.g., Brooks & Meltzoff, 2008). Indeed, infants likely apply the same process for understanding the referential and intentional nature of actions to understanding gestures and even words (e.g., Capirci et al., 2005; Woodward 2004). Resonant activation of the motor system during observation of actions has been implicated as a neural correlate for action understanding (Rizzolatti & Fabbri-Destro, 2008), and there is a small but growing body of research linking resonant motor activity and the understanding of communicative acts, including both gestures and speech in adults (Moreno et al., 2013, 2015; Schippers et al., 2009). Further, there is a growing body of evidence that experience with actions is related to action understanding (Cannon et al., 2012; Sommerville & Woodward, 2005b), and experience is also correlated with increased activation of the sensorimotor system during action observation (e.g., Cannon et al., 2014; Orgs et al., 2008; van Elk et al., 2008). What is not yet known is whether this resonant motor activity is related to experience with or understanding of communicative gestures in infancy. In the current study we examined motor activity during observation of communicative pointing gestures in 30 12-month-old infants, and then looked at relations between infants' motor activity and their experience with pointing. We used the mu rhythm (6-9 Hz) as measured via electroencephalogram (EEG), which is a well-established index of motor cortex activation, as the measure of motor activity (over central (C3, C4) electrode clusters). Increased motor activity is indicated by a decrease in mu rhythm power (or desynchronization). Infant pointing production was measured via parents reporting whether their child produced points often, sometimes, or never. We also measured infants' tendency to appropriately follow pointing gestures via an experimenter-implemented social communication task. Across the whole sample, we found only moderate to non-significant mu rhythm desynchronization when the infants

observed pointing gestures (Fig. 1). However, when we divided the infants according to their pointing experience, we found that infants who were reported as pointing 'often' showed significant desynchronization during pointing observation, whereas their peers who were reported as pointing 'sometimes' or 'never' did not (Fig 2). Further, infants who were reported as 'often' pointers were more likely to follow pointing gestures, as compared to their 'sometimes' or 'never' pointing peers, suggesting a stronger understanding of the gestures ($t = -2.175$, $p=0.036$). These findings provide further evidence for the link between experience and the understanding of actions, and extend this body of work to the perception and production of communicative gestures.

S1.8ii The Role of Motor Experience on Social Learning in Infants and Young Children

Lauren Howard[1], Amanda Woodward[2]

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Previous research has shown that both human children (Stahl & Feigenson, 2014; Howard, Riggins, & Woodward, under review) and nonhuman primates (Howard et al., 2017, Howard, Festa, & Lonsdorf, under review) are more likely to remember information that is presented in a social (vs non-social) context. What is still not well understood is exactly why this "social memory bias" exists. One possibility is that observing the actions of a person recruits one's own motor system (e.g., Filippi et al., 2016), allowing for more multimodal encoding and therefore increased event memory. In the current series of studies, we explored the role of motor experience on social memory in both infants (9-month olds) and preschool children (36-month-olds). In each study, participants watched videos that either included a person (social condition) or did not include a person (non-social condition). Participants also varied with regards to whether they received motor training prior to watching the videos. Regardless of condition, each video showcased a construction sequence whereby smaller pieces were assembled to create a larger object, and subsequent memory for this sequence was assessed. In Study 1, 9-month-old infants ($N=60$) were familiarized to videos of a person (social condition) or a mechanical claw (non-social condition) building a simple object. At test, infants in the social condition showed a significant novelty preference (looking to the new vs. old tower, $p<.01$) while those who viewed the claw building the object did not ($p= .13$, see Figure 1), suggesting better memory for the event in a social vs. non-social context. In a third condition (training condition), infants were given motor training prior to watching the videos. In this condition, infants watched an experimenter use the claw to grab an object before passing

the object across the table for the infant to grasp (see Figure 2). Results show that, similar to the social condition, infants in this training condition showed a significant novelty preference (p =.02, See Figure 2), suggesting that previous experience aligning motor movements with the claw improved infant memory for the non-social event. In Study 2, 36-month-old children (N=48) watched a video that either included a person building an object (social condition) or the same sequence without a person present (non-social condition). Additionally, participants received either motor experience (motor training condition) or matched non-motor experience (control training condition) prior to watching the videos. As with Study 1, children were more likely to remember the social vs. non-social event, even though attention to the videos was equivalent across conditions. However, children who were given motor experience prior to watching the non-social videos later remembered significantly more than children in the control training/non-social condition (p=.04) and as much of the event as children in either of the social conditions (ps>.21). Taken together, the results of these studies show that social events are powerful for structuring memory early in life. Our findings also highlight the role that self-generated motor experience can have on later event encoding. Specifically, activating self-generated motor plans, even when observing non-social events, seems to increase recall for sequences in much the same way as observing social events. Therefore, it's possible that one of the reasons social events produce such robust memories is direc

S1.8iii Sensory processing in 10-month-olds have predicted their visual attention engagement during parent-infant interactions at 14 month

Alicja Radkowska[1], Sonia Ramotowska[1], Anna Malinowska[1], Przemyslaw Tomalski[1]

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Sensory processing difficulties are ubiquitous in toddlers and children diagnosed with Autism Spectrum Disorders (ASD), a characteristic reflected in the latest diagnostic criteria of DSM-5 (American Psychiatric Association, 2013) and thought to be related to atypical top-down modulation of sensory input (e.g. Pellicano, 2013). Research on sensory profiles of toddlers with ASD indicates that they are more often hipo- and hypersensitive and display more sensory avoidance and less sensory-seeking behaviors (Ben-Sasson et al., 2007). Some aspects of parent-child interactions (PCI) may signal early atypicalities of development, for example in infants who are later diagnosed with ASD (Wan et al., 2012). The sensory atypicalities in these children are thought to influence their behavior during social interactions (Hilton, Graver, & LaVesser, 2007; Matsushima & Kato, 2013) and their social play skills (Kuhaneck & Britner, 2013). However, the research to date used

questionnaire measures only in older children. In this study, we investigated whether infants' sensory processing characteristics at 10 months were related to infants' and dyadic gaze behavior during PCI at 14 months. We hypothesized that sensory difficulties are related to reduced attention to parent and diminished time of dyadic attention. We also performed supplemental analysis of differences in sensory processing between infants at high familial risk of ASD (HR) and low risk (LR) controls at 10 months. The analyses of the relation between infant sensory profiles at 10 months and infants' and dyadic visual attention during PCI at 14 months included 29 participants (18 HR and 11 LR infants). Infant sensory processing profile was measured with the parent report Infant-Toddler Sensory Profile (Dunn, 2002) at 10 months. We analyzed 6 minutes of free-play, recorded in the laboratory. The analyses included visual attention of the infant (looking at the partner of interaction only, at the partner manipulating an object and looking at objects) and dyadic attention (mutual gaze and parallel attention) using an existing coding scheme (Niedźwiecka, Ramotowska, Tomalski, in press). Our hypothesis has been confirmed. There was a significant negative correlation between the scores in Sensation Seeking and the duration of looking at parent during PCI: $r = -0.37$, $p = 0.05$. Additionally, scores in Low Registration were negatively related to looking at parent: $r = -0.37$, $p < 0.05$ and to mutual gaze, $r = -0.49$, $p < 0.01$. Supplemental analysis indicated significant differences in Sensation Seeking between HR and LR group at 10 months, with HR infants scoring significantly higher ($t(34) = -3.51$; $p < 0.01$), suggesting less sensation seeking behaviors among HR; and no group differences with regard to Low Registration at 10 months ($t(34) = -1.05$; ns). Our results showed that more hyposensitive infants at 10 months looked more at parents and spent more time in mutual gaze at 14 months. Additionally, infants less prone to sensation seeking at 10 months looked less at parent at 14 months. The small group sizes didn't allow for within group analysis. The quality of PCI has a fundamental role in infant cognitive development (Tamis-LeMonda, Cabrera & Lamb, 2004). Obtained results point to potential significance of individual differences in infants' sensory patterns for their participation in it. Additionally, our results suggest that lower Sensation Seeking might be a distinctive feature of HR siblings.

S1.8iv Awareness of a Conflict Confers a Competitive Advantage

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Detecting dominance relationships provides a clear fitness advantage, because it helps individuals assess their potential risk of injury before engaging in a competition. A critical

cue for predicting these relationships among non-human primates is the number of allies an individual has (Wilson & Wrangham, 2003). Paralleling these findings, preverbal human infants use numerical group size to infer social dominance between competitors (Pun, Birch & Baron, 2016). Specifically, infants inferred that an agent with more group members (even when such group members never demonstrated actual support) would be socially dominant. However, it is unclear what infants actually understand about the functional role group members play in affording a dominance advantage to a group member. In two experiments we examined whether group members need to be aware of a conflict between their own and other group members to confer a competitive advantage. In Study 1, we reasoned that in order for social allies to be potentially helpful, allies must be privy to and aware of the conflict occurring. Therefore, we hypothesized that alliance members' visual access to the conflict would influence infants' expectations of social dominance. More specifically, when numerical group size is equated (3 vs 3), infants should be more surprised (and therefore look longer) when the agent from the group that cannot see the conflict prevails (unexpected outcome) (See Figure 1). As predicted, a paired-samples t-test comparing the mean looking time (s) revealed that infants (N = 48) ages 6-12 mo looked significantly longer at the unexpected outcome trial (mean = 15.43 s) compared to the expected outcome trial (mean = 11.90 s), $t(47) = 2.52$, $p = 0.015$, $d = 0.38$. This suggests that infants expect agents who have allies that have witnessed the conflict to be socially dominant. However, to rule out the possibility that infants use overall numerical group size (which is independent of the group members' visual knowledge of the conflict) to infer which agent is socially dominant, we conducted an experiment which depicted the actions and goals of two identically sized novel agents (Study 2). However, each competing agent belonged to a group that differed in numerical size and color (3 vs 2). And, importantly, each of the non-competing agents' eyes were obscured by a barrier (See Figure 2). In contrast to previous findings outlined by Pun et al., (2016) in which an agent from a numerically larger group (that is privy to the conflict) was considered to be socially dominant, when alliance members' visual access to the conflict was obscured, infants revealed no expectation that an agent from either group (either the numerically larger or smaller one) would prevail $t(47) = -1.06$, $p = 0.29$. Indeed, these results are consistent with conflict strategies employed by non-human primates, whereby the capacity for alliance members to assist in a conflict (such as being aware that a conflict is present), determines whether one will engage with opposing group members (Wilson & Wrangham, 2003).

S1.8v Independent Walking and Superior Social-Communication Skills in 12-month-old Infants at High-Risk for Autism

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Objective: Achievement of early motor milestones in infancy affords new opportunities for social interaction and communication. Specifically, the onset of independent walking significantly enhances the quality of parent-infant interactions and brings about more sophisticated social-communication skills. Research has shown that both motor and social deficits are observed in infants who later develop autism spectrum disorder (ASD). Research thus far has not identified delays in walking in infants at-risk for ASD, but it is possible walking may facilitate social-communication development for this high-risk group. To assess whether independent walking is associated with superior social-communication skills, the current study utilized a standardized assessment designed to elicit social-communication and symbolic play skills from infants while they are in a seated position (Communication and Symbolic Behavior Scales; CSBS). Evaluating infants while in the same sitting posture allows all participants equal visual and motoric access to proximal and distal objects, events, and people, regardless of walking ability. The current study examined associations between motor and social-communication skills in 12-month-old infant siblings of children with ASD who are at heightened risk for developmental delays (N=86) and low-risk, typically developing infants (N=113). Methods: Participants were classified into one of three groups based on walking ability: walkers (walks independently), standers (stands independently), or pre-walkers (does not yet stand or walk independently). Social-communication and cognitive skills were assessed with two standardized measures (CSBS and Mullen Scales of Early Learning) and compared across the three walking groups. Results: There were no differences in the proportion of pre-walkers, standers, and walkers between high-risk and low-risk groups ($X^2(2)=0.86, p=0.651$). Age-adjusted, two-factor ANOVA demonstrated significant walking status by risk interactions for Communication Rate ($p=0.042$), Word Use ($p=0.015$), Object Use ($p=0.048$), Gestures Use ($p=0.010$), and Action Schemes ($p=0.040$). Age-adjusted one-factor ANOVAs for these variables, run separately for high-risk and low-risk groups, identified significant differences in the frequency of requesting and protesting ($p=0.009$), use of proximal ($p=0.012$) and distal ($p=0.008$) gestures, word use ($p=0.006$), and symbolic play ($p<0.001$) for high-risk infants. Pairwise comparisons showed that, generally, pre-walkers scored significantly lower than walkers in all domains. In contrast, social-communication and play skills did not differ for low-risk infants with different walking abilities. A significantly higher proportion of high-risk pre-walkers scored in the concern

range on the CSBS (p=0.030), but this association was not significant for low-risk infants. Finally, walking status was not associated with cognitive abilities (F(2,139)=0.29,p=0.746) or fine motor skills (F(2,136)=0.14,p=0.865), measured with the Mullen, for all infants. Conclusions: High-risk walkers showed superior social-communication, but commensurate cognitive skills, compared to high-risk pre-walkers. In contrast, social-communication and cognitive skills were largely comparable for low-risk infants, regardless of walking status. Motor development and its impact on reorganization of the infant social and interactive experience should be considered in light of early identification and intervention efforts for ASD.

S1.8vi The Role of Walking in Language Acquisition: New findings from China

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In recent years, much work has focused on the role of motoric activity as an organizer of psychological development (Anderson et al, 2013). Like crawling, walking has shown promise as being a similar organizer of multiple cognitive, social and perceptual changes. Recently, a surprising finding has linked infant walking with both receptive and productive vocabularies using the MacArthur Communicative Development Inventories (CDI) in cross-sectional and longitudinal studies (Walle & Campos, 2014). The current study had two objectives. First, to report further findings on the link between walking and vocabulary spurts in non-English-speaking infants, extending the work of He, Walle and Campos (2015). Second, to begin a thorough investigation of the match between parental reports and actual assessments of the child's understanding and production of words. Notably, the external validation of CDI reports against objective measures of language reception and production has been very limited. To date, 45 infants between 13.5 and 15 months of age from Shanghai, China have been tested, with 22 crawling infants and 23 walking infants. Crawling infants and walking infants do not differ in age or total locomotor experience. Consistent with previous findings, parents of walking infants reported a larger receptive vocabulary (mean difference=42, p=.09) and a significantly larger productive vocabulary (mean difference=5, p=.03) than those of crawling infants. We used a preferential looking paradigm to validate parental reports of vocabulary reception based on previous research showing that 13-month-old infants reliably look at pictorial

representations of the referents of words uttered (Cooper, 1975; Thomas et al, 1981). We also recorded infant language production in two 5-min free play sessions of parent-child interaction in the laboratory. In addition to the CDI report, each caregiver was asked to confirm whether their infant knew or did not know each of 32 nouns. Infants were shown four noun pictures arranged at each corner of a screen (each at 45 degrees of visual angle) on eight 15-second trials. When the infant's gaze was attracted to the center of the screen, an experimenter said "look at the (known word or unknown word)" three times. Data were coded as the percentage of time the infant looked at each noun picture relative to the total looking duration at the screen. Looking toward the pictures varied considerably if the infant knew or did not know the noun referent (looking time to the "known" word = 28%, looking time to the "unknown" word=15%), $p < .01$. During the parent-child interaction, we measured the total number of words and the types of words uttered by the caregiver and the infant. No correlation was found between the CDI productive vocabulary and infant free-play vocabulary. Walking infants produced more words than crawling infants but the difference did not reach significance. These results indicate that parental reports of Chinese parents corroborate similar reports from English speaking mothers from California. The preferential looking paradigm confirmed parental reports of receptive vocabulary but the free play paradigm did not confirm parental reports of productive vocabulary. Future directions will be discussed in the talk.

S1.8vii Is Age of Emergence of Joint Attention Skills Predicted by Maturation of Postural Stability?

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Converging evidence shows that attention-sharing skills emerge slowly, typically starting in the second half of the first year, for typically developing infants (Deák, 2015). These skills are fragile: easily disrupted by contextual factors (Butterworth & Jarrett, 1991; Deák, Flom & Pick, 2000), and apparently subject to considerable individual differences (e.g., Mundy, Block, Delgado et al., 2007). However, the dearth of longitudinal samples make it difficult to infer the causes of individual differences. For example, simulations indicate that both parental input and infant cognitive differences might contribute to rate of acquiring these skills (Triesch et al., 2006; Teuscher & Triesch, 2007). The current study investigates whether age of emergence of gaze-following is predicted by the age of achieving key milestones in postural stability. The current study examines a cohort of infants (N=42) followed from 4 to 12 months of age, tested monthly in a controlled gaze-following and

point-following paradigm that improved on previous studies by ensuring infant attentiveness and motivation (see Deák, 2015). The results show slow emergence of those skills between 6 and 12 months (Figure 1), with performance above chance at the group level (for targets in front of or beside the infant) starting at 7 to 10 months (depending on behavioral criteria). Individual differences were estimated by averaging proportion of gaze-cues followed (first fixation) at 8, 9, and 10 months. Correlations among these months averaged r=0.490, indicating moderate stability. Those average following scores were correlated with the mean ages (in half-months) at which infants acquired three milestones related to postural stability: raising the head while prone, maintaining neck tone when pulled to sitting, and maintaining unsupported sitting. These achievements were chosen because they allow infants to more effectively visually explore their environment, and might permit greater exploitation of visual social cues (e.g., gaze). Mothers reported on these and 20 other milestones twice monthly from 3 to 12 months. Results show no relation between the postural milestones and gaze-following, r=-0.03. Further analysis showed no association with point-following, r=-0.19. This suggests that failures to find gaze-following in younger infants (Deák, 2015) are unrelated to motor skills: infants who achieve relevant postural skills earlier do not show more advanced attention-following skill.

S2.8 Flash talk session 2: Modeling and interpreting individual differences

S2.8i Individual differences in the early lexicon: The child as a source of variability

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By the end of their first year of life, children are typically able to produce a handful of words. Over the second and third year of life, this vocabulary increases dramatically, reaching an average of 553 words by the age of 30 months (Frank, Braginsky, Yurovsky, & Marchman, 2016). Although this general pattern appears stable across children and languages, there are considerable individual differences in the words known to different children: German vocabulary data (Szagun, Stumper, & Schramm, 2009) suggests that, at 20 months, 52% of children produce the word Bagger 'digger' and 48% of children produce the word Bär 'bear'. Importantly, of the children who produce at least one of these words, 52% of them produce the one but not the other. It is not until 30 months that both words are produced by virtually all of the children. This suggests that there is a 10-month period during which some children know a word and others don't. What determines whether a child is a Bär baby or a Bagger baby? While there is little doubt that the quality and quantity of input play a role in early word learning, another source of variability in the early lexicon is the child herself. Curiosity-driven approaches to learning place the child in a more active role, such that learning is guided by the child's desire to reduce uncertainty in her knowledge about the world and an intrinsic motivation to learn (e.g., Oudeyer & Smith, 2016). This study investigated the influence of category curiosity and category density, i.e., number of category members known to the child, on the acquisition of new word-object-associations. 30-months-olds (n=22) were, first, presented with 16 familiar objects from two broad (M = 31 members) and two narrow (M = 11 members) categories and heard their corresponding labels while their pupil dilation response was measured as an index of their interest in the different categories. Next, they were exposed to novel members from each of the four categories and tested on their learning of the new word-object-associations. Analyses indicate that children are able to learn novel members from both broad and narrow categories, but learning is more robust in the broad categories. This suggests that children are able to leverage their existing semantic knowledge to learn new words, which is in line with previous research (e.g., Borovsky et al., 2015, 2016). Furthermore, pupil dilation analysis suggests that learning is impacted by children's inherent curiosity in objects from particular categories: Learning

outcomes for novel members of a category are positively correlated with children's interest in familiar members of the same category, as indexed by pupillary responses to objects from these categories. Our findings suggest that the child herself is a major source of variability in early word learning. What a child knows and what a child is interested in will shape what she learns next, leading to individual differences that are observable early on.

S2.8ii Modeling infants scan paths during free scene viewing as latent strategies

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Studies employing infant eye-tracking often focus on simple eye-tracking metrics, largely ignoring the exploration over time, which may provide a more complete understanding of individual differences in complex cognitive processes (Noton & Stark, 1971). This study aims to explore the usefulness of scan path analysis of free scene viewing data as a tool for measuring cognitive individual differences in infants. To this end, we conducted an experiment consisting of 3 tasks: a recognition memory task, an attentional disengagement task, and a free-viewing task of 29 real-world scenes (van den Berg et al., 2017). Based on studies examining individual differences in adults (Hayes & Henderson, 2017), we would expect scan paths to predict infants' scores on recognition memory and attention. Methods Fifty-four infants (5 - 13 months old) completed a free-viewing (FV) and two cognitive functioning tasks, that is, recognition memory (RM, Rose et al., 2012) and gap-overlap (GO, Cousijn et al., 2017). Analysis The Successor Representation Scan path Analysis (SRSA, Hayes et al., 2011) represents the movement of infants' fixations through the picture state space over time. It aims to detect latent gaze strategies that optimally predict cognitive abilities. The picture state spaces were: horizontal state space, vertical state spaces, and radiating state space (see Figure 1). All state spaces consisted of an outermost rectangle, that, according to Hayes and Henderson (2017) were meant to capture non-central bias tendencies. We formulated an alternative analysis method for detecting latent gaze strategies by a k-means cluster analysis of transition matrices of infants' gaze movement through the picture state space (Kucharsky et al., 2017). Results The FV fixations durations were related to the RM task (Median fixation duration in RM, $r = .54$, $p < .001$) and GO task (gap RT: $r = .29$, $p < .05$; overlap RT: $r = .38$. $p < .01$) but not to the novelty score in RM and the GO effect. The SRSA did find gaze strategies related to cognitive abilities (r^2 between .22 and .38), but results were unstable under cross-

validation. This means that SRSA was unable to explain differences in cognitive functioning, nor was it able to extract robust free-viewing strategies related to individual differences. The alternative scan path analysis shows more promising results in abstracting latent viewing strategies. Two latent gaze strategies were detected, which were consistent for all pictures for almost all infants (see figure 1). One cluster was characterized by less fixations and younger ages (M age = 8.52 months, SD age = 0.04; M fixations = 254.19, SD fixations = 26). The other cluster was characterized by older infants and more fixations (M age = 9.80 months, SD age = 0.10; M fixations =352.38, SD fixations = 2.41). These gaze strategies are stable under cross-validation (first half versus second half of the trials). Figure 1. Examples of scan paths of 5 infants in the clusters plotted on four example images. Different colors indicate scan paths of different infants.

S2.8iii The Role of Attachment Anxiety and Avoidance in Predicting Sensitivity During a Still Face (distress) Task

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Research indicates that maternal sensitivity in the context of infant distress predicts later infant attachment security and socio-emotional adjustment better than sensitivity in response to infant non-distress (e.g., Leerkes, 2011; Leerkes et al., 2009). Further, sensitivity to infant distress and non-distress have been viewed as separate processes with distinct antecedents (e.g., Leerkes, Weaver, & O'Brien, 2012). Yet, relatively little research has focused on identifying the predictors of sensitivity to distress. Prior research demonstrates a link between attachment state of mind and sensitivity to distress (e.g., Ablow et al., 2013; Leerkes et al., 2015). Much less is known about links between self-reported adult attachment style (attachment anxiety and avoidance; Brennan, Clark, & Shaver, 1998) and caregiving in distress contexts (see Jones et al., 2015). Theory suggests that caregiving differences can result from attachment-related differences in perceptions of contextual threat (Jones et al., 2015). Empirical evidence suggests that mothers with insecure attachment representations show greater physiological arousal in response to infant distress (Groh & Roisman, 2009), and experience infant distress as more aversive (Ablow et al., 2013). Hence, it is important to examine attachment-related differences in caregiving in a distress context. Attachment avoidance is linked with lower sensitivity in distress contexts (e.g., Edelstein et al., 2004); yet the links between attachment anxiety and sensitivity in distress contexts have been less consistent (see Goodman et al., 1997 for an exception). We examined whether attachment anxiety, avoidance and their interaction

were associated with global maternal sensitivity as well as specific components of sensitivity (sensitivity to distress, sensitivity to non-distress, positive regard, intrusiveness) after mothers' 6m old infants had undergone a stressful task. Method: Participants included 135 low-income, diverse mothers of 6-month-olds. Mothers' attachment anxiety and avoidance were assessed using the Experiences in Close Relationships questionnaire (ECR; Brennan et al., 1998). Components of maternal sensitivity (NICHD Early Child Care Research Network, 1999) were reliably coded from videotaped interactions following a Still-Face (distress) task. Results: Regression analyses using PROCESS revealed that the positive associations between attachment anxiety and both (a) global sensitivity and (b) sensitivity to non-distress were moderated by level of avoidance (see Table 1). Specifically, as scores on avoidance increased, the conditional effect of anxiety on global sensitivity and sensitivity to non-distress decreased and eventually became non-significant ($p > .05$). Attachment styles were not significantly related to intrusion. Conclusions: Results suggest that in a distress context, mothers high in attachment anxiety may feel less threatened/more needed, thus showing greater sensitivity during distress than mothers lower on attachment anxiety. Yet, high anxiety coupled with high avoidance might make it difficult for mothers to sensitively respond to their infants. On the other hand, mothers high in avoidance might feel more threatened by being "needed" in a distress context, and may find it difficult, compared to mothers low on avoidance, to convey affection or positive feelings in their interactions with their child.

S2.8iv Modeling word segmentation from variable input: comparing monolingual and bilingual experiences

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For a child developing language, learning the phonological forms of words is crucial to be able to associate them with meanings and eventually acquire syntactic structure. Unlike written language, there are no spaces between words when we speak. Models of word segmentation have proposed several explanations to how infants could possibly segment language based on different cognitive strategies (e.g. Brent, 1999). However, those models have been mainly tested with monolingual input and thus nothing is known about how they perform when exposed to a more variable input, notably from two languages. Bilingual language acquisition poses challenges beyond those found in monolingual environments, not the least for segmentation. These children hear sound sequences (phonotactics), syllable sequences, and words in two potentially completely distinct

systems. Moreover, all else equal, bilinguals will hear half as many words as monolinguals. Since variation in input quantity explains significant proportions of individual variation (Hart & Risley, 1995), modeling bilingual word segmentation is extremely informative. This study compares the performance of five word segmentation algorithms on matched monolingual and bilingual corpora. The original corpora consisted of spontaneous interactions between children (age range 10 to 36 month) and caregivers speaking Catalan (Bel, 1998; LlinásGrau, 2001; SerraSolé, 1989), Spanish (Aguirre, 2000; LopezOrnat, 1994; SerraSolé, 1989; Vila, 1990) and English (Bernstein, 1982) extracted from the CHILDES database (MacWhinney, 1991). The bilingual corpora were created by drawing from two sets of monolingual corpora (i.e., bilingual Catalan-Spanish and bilingual Spanish-English) to control for variables such as balance in language exposure (set at 50%) and frequency of language switch (every 4 utterances). To allow comparison, the monolingual corpora was also generated by switching across corpora within languages. To have a more accurate picture of which differences were meaningful, we created 10 such monolingual and bilingual corpora. Orthographic transcriptions were mapped to phonological forms, and word boundaries were removed to mimic running speech. Then we applied five statistical algorithms that detect word-like units using a variety of approaches to infant word segmentation. We could describe our algorithms as belonging to two families: Sub-lexical; which compute boundaries using local cues and Lexical; which learn a set of minimal recombinable units. Performance was evaluated by comparing the hypothesized word breaks an algorithm supplied versus the actual word breaks (i.e., precision and recall), which can theoretically range from 0 (terrible) to 1 (perfect). Analyses revealed that scores varied greatly across algorithms (lexical algorithms outperforming sub-lexical ones), less so across languages (monolingual English and Catalan scoring higher than Spanish), and only slightly (and seldom significantly) as a function of whether corpora were bilingual or monolingual (see Figure 1 and Figure 2). These results show the robustness of the models when faced with more variable input, both to large differences in quantity (since bilingual models got 50% as many sentences in each language) and to discrepancies in the linguistic system present in the input. Overall, computational modeling proves to be very useful when assessing how differences in input could influence word segmentation abilities in childhood.

S2.8v Assessing causality in the relationship between perinatal depression and infant temperament

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Multiple studies have indicated links between maternal depression and child temperament. However, the results of these studies are typically ambiguous with respect to the direction of causality and the role of other intervening factors. The few studies that have employed longitudinal designs to examine the relationship between maternal depression and child temperament have typically used multiple regression analysis (e.g., Austin et al., 2005; Melchior et al., 2012; Chong et al., 2016; Lin et al., 2017), which could have resulted in inadequate estimates of the longitudinal relations between the variables examined. The present study, in contrast, used path analysis to explore the longitudinal relations between maternal depression and infant temperament to generate greater inference about the direction of causality. In addition, the analyses examined whether this relationship is mediated by maternal self-esteem, and included maternal trait anxiety in the model as a control variable. Our sample consisted of 135 women who gave birth to a singleton, healthy full-term infant, and for whom data regarding the course of labor and health status of the newborn were available. Mothers completed questionnaires at three time points (T1 - the last trimester of pregnancy; T2 - 6 weeks postpartum; T3 - 9 months postpartum). Well-established questionnaires were used to assess depressive symptoms (EPDS, Cox & Holden, 2003) (T1, T2, T3), trait anxiety (STAI, Spielberger, 1994) (T1), maternal self-esteem (MSRI, Farrow & Blisset, 2007 - T1, T2; PSOC, Johnston & Mash, 1989 - T3), and infant difficult temperament (ICQ, Bates et al., 1979) (T2, T3). Preliminary univariate regression analyses showed that neither sociodemographic (maternal age, educational level, marital status, child's sex) nor biomedical (parity, delivery type, breastfeeding status at discharge from maternity hospital and six weeks postpartum) factors were significantly associated with infant's temperament 6 weeks and 9 months postpartum. The final path model containing only significant associations showed good fit (RMSEA = 0.037, NNFI/TLI = 0.985), and revealed that infant difficult temperament 9 months postpartum is predicted by infant temperament 6 weeks postpartum but not by previously measured maternal depression, anxiety, or self-esteem. Also, no significant cross-lagged regressions between maternal depression and self-esteem were found, suggesting that these two variables, though correlated, do not cause changes in each other. Significant longitudinal relations between different variables included the effects of 6-week difficult temperament on maternal self-esteem and depression 9 months after birth, and the effects of maternal trait anxiety on both depression and self-esteem in the postpartum period. The results suggest that infant difficult temperament increases maternal depressive symptoms and not vice versa. Maternal self-esteem does not mediate the relationship between depression and temperament, but it is negatively affected by infant difficult temperament. As maternal variables were not predictive of infant

temperament, it can be assumed that mother's assessment of her child's temperament was not biased by her depression, anxiety or low self-esteem. Overall, the results suggest that the temperament of infants can shape their own familial environment by affecting their mothers' self-esteem and depression.

S2.8vi Individual Differences in Infant Stress Reactivity: Identifying Homogenous Subgroups

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Introduction Understanding the human stress response is important because accumulating evidence shows that individual differences in stress response are associated with outcomes such as psychological wellbeing and physical health (Allwood et al., 2011). The stress response system is composed of two main components, the locus-coeruleus, norepinephrine/sympathetic nervous system (LC-NE/SNS) and the hypothalamic pituitary adrenal (HPA) axis (Chrousos, 2009). Although a significant number of research studies have examined the two components of the stress response system separately, theorists have suggested that simultaneously examining both components of the stress response system would be the most appropriate approach to further our understanding of this system (Bauer et al., 2002). The purpose of the present study was to examine, from a person-centered approach, whether homogenous patterns of stress reactivity across both components of the stress system can be seen in infants 6 months of age. Method Participants included 228 infants and their mothers who participated in a larger study of maternal caregiving. When the infants were approximately 6 months old, they were brought into the lab to complete a variety of tasks. Infants provided saliva samples shortly after arriving in the lab and then again, following a stressor task. Infants were subjected to the arm restraint procedure (Goldsmith & Rothbart, 1999). Saliva samples were assayed for Cortisol (HPA) and Alpha Amylase (sympathetic nervous system; SNS). Infants were 41% male, 50% female, 35.1% Black/African American, 21.5% biracial/multi-racial, 14.9% White/European American, 13.2% Latino/Hispanic, and 1.3% Asian/Asian American. About half of the sample reported an income of $10,000 or less per year. Results A Latent Profile Analysis (LPA; Williams & Kibowsky, 2016) was conducted to identify homogenous subgroups of participants based their stress reactivity (i.e., change in salivary alpha amylase and salivary cortisol post-stressor). Salivary samples were obtained at 10, 20, 30, and 40 minutes post stressor. Peak reactivity was calculated as greatest increase from baseline at any time point. The goal of this approach is to identify subgroups of individuals

who are similar to one another but different from other groups. To select the best model, fit statistics of the latent profiles of a two through four class solutions were examined. Fit statistics supported a three-class solution (see Tables 1 and 2 for fit statistics, means, and class descriptions). Results suggest a class composed of infants with low stress reactivity across the whole system, a second class of high SNS but low HPA reactivity, and a final group of high SNS and moderate HPA reactivity. Discussion These findings are in line with theoretical work (Bauer et al., 2002) positing that individual differences in the response to stress across components of the stress reactivity system are important markers of overall functioning. The findings suggest that there is in fact variation patterns of reactivity to a standardized stressor, and that these differences can be seen as early as 6 months of age. We will examine links between class membership and child outcome variables at 12 months of age (internalizing and externalizing).

S2.8vii The Interplay between OXTR Methylation and Maternal Caregiving on Children?s Early Developing Theory of Mind Abilities

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Background: Theory of mind--the ability to represent the mental states of others--is an important social cognitive process, which contributes to the development of social competence. Recent research has suggested a possible gene-environment interaction, between variation in oxytocin receptor (OXTR) genotypes and observed maternal behavior, may explain individual differences in preschool aged children's theory of mind performance (e.g., Wade et al., 2015). However, the potential influence of DNA methylation of the OXTR gene remains unclear. The current study investigated the roles of maternal behavior, OXTR methylation, and their interaction on toddlers' early emerging theory of mind abilities. Method: A community sample of mothers (Mage = 35.56 years) and their 2 to 3 year old children (Mage = 2.89) agreed to participate (n = 189 dyads). Children provided a saliva/buccal sample, which was used for DNA extraction and determination of OXTR methylation. Five minutes of free play were filmed and coded using the Emotional Availability Scales (Biringen et al., 2000), which assesses four dimensions of maternal interactive behavior: sensitivity (e.g., contingent responsiveness to the child's communications, acceptance, and affect regulation); structuring (e.g., supportive and appropriate organization of child's play, allowing exploration, and providing assistance when needed); non-intrusiveness (e.g., avoid over-stimulating or interfering with child's play); and non-hostility (e.g., warmth, not being harsh or rejecting.

Three experimental tasks were administered to assess early developing aspects of children's theory of mind, including visual perspectives (Muller et al., 2000), pretend play and false-beliefs (Hughes & Esnor, 2005). Standardized z scores were computed for each task and an aggregate theory of mind score was computed by taking their average. Mothers also completed the MacArthur Communicative Development Inventory (Fenson et al., 2007) to control for children's verbal ability. Results: Bivariate correlations indicated that more maternal structuring was associated with better theory of mind performance ($r = .212$, $p = .011$), while higher OXTR methylation was associated with worse theory of mind performance ($r = -.227$, $p = .010$). Path analysis bootstrap estimates revealed a significant interaction between maternal structuring and children's OXTR methylation on theory of mind performance ($b = 0.017$, 95% CI: .011-.022) when controlling for children's sex, age, verbal ability and maternal education. Simple slopes analysis revealed that maternal structuring was only related to theory of mind among children with higher levels of OXTR methylation (i.e., one standard deviation above the mean; $b = .212$, $p = .006$). Conclusions: Both maternal behavior and children's OXTR methylation are associated with early emerging theory of mind abilities. However, it appears that maternal behavior becomes important for promoting theory of mind development when children's OXTR gene is more highly methylated. Maternal behavior may buffer the negative effects of suppression of OXTR gene expression and function.

S3.8 Flash talk session 3: The interrelation of motor, cognitive, and social development

S3.8i Finding your Own Way: Comparison of Interventions for Infants with Motor Delays to Improve Movement and Problem-Solving

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Background/objectives: Early exploration in infancy provides opportunities to learn about objects, leading to functional problem-solving in later infancy. In order to explore, infants must utilize developing motor skills such as sitting, reaching, and quick eye movements and fixations to support increasingly sophisticated manipulation of the environment. Infants with motor delays are at risk for deficits in motor experience and exploration, which cascades to future deficits in both motor and cognitive areas. Therapists may choose to facilitate advancement of motor skill by following one of two opposing theories. One approach is based on the assumption that training of motor skills is best done by selecting the optimal strategy for the child based on normal movement patterns, and assisting and guiding the child to repeat that normal pattern, while discouraging other patterns (Optimal strategy=OP). A second approach encourages the child to find their own strategy for movement by setting up the environment to present incremental problems for the child to solve with their own strategy (PS=problem solving strategy). The purpose of this study was to compare whether these two intervention approaches led to different outcomes for motor skill and problem-solving for infants with significantly delayed motor function. Methods: Twenty infants (age range 9 to 30 months) who were receiving early intervention because of motor delays were included. Entry criteria was the ability to sit when placed, propping on the arms. We randomized 9 children to the OP group and 11 to the PS group, and all children continued to receive their usual early intervention services. Intervention proceeded twice weekly for 12 weeks. The Gross Motor Function Measure (GMFM) measured change in sitting skill from baseline to the end of the 12 week intervention. The Early Problem Solving Indicator (EPSI) was the outcome measure for problem-solving. Assessments were videotaped at baseline and after 12 weeks of intervention. Trained coders blind to group assignment scored all videos. For a subset of 8 of the 20 infants, we utilized eye-tracking (Positive Science) during the EPSI (Fig. 1). Trained coders used Datavyu video coding software to measure frame-by-frame location, onset and offset of gaze and touch. Coders also categorized touch as active or passive. We calculated speed of gaze-shifting to areas of visual interest on the EPSI

objects. Results: For the full group of 20 infants, GMFM scores changed significantly from baseline to final testing (p=0.00); however, GMFM change scores did not differ significantly between the two groups. Infants participating in the PS group had significantly greater change scores in the EPSI than infants in the OP group from pre to post intervention (p=0.02). Infants in the PS group increased in the percent of active touch from baseline to post-intervention (Fig. 2), while the percent of active touch in the OP group stayed the same. A regression model indicated two factors contributing significantly to improved problem solving (EPSI change): a change in eye-shifting (faster) (p=0.04), and higher scores on the GMFM (p=0.05). Conclusions: Our findings support the use of the problem-solving approach in infants with motor delays when the goal of intervention is to advance both motor and cognitive skills. Allowing infants to find solutions to motor problems, rather than prescribing solutions, may support general problem-solving skill.

S3.8ii It's in the Hands: A Sensorimotor Analysis of Parent-Toddler Attention Coordination across Different Social Contexts

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Parents' and toddlers' ability to coordinate attention shapes early cognitive (Bigelow et al., 2004), language (Tomasello & Farrar, 1986), and social (de Barbaro et al., 2016) development. Research shows that coordinated attention - or joint attention (JA) - is more likely when parents follow into toddlers' attention than when parents direct it (Mendive et al., 2013; Tomasello, 1995). An advanced account of attention coordination involves not only knowing when JA is more likely, but also how it is achieved (Deak et al., 2017; Yu & Smith, 2017). Further, because mature coordination involves the ability to coordinate across contexts (i.e., when parents follow and when parents direct), an understanding of how JA is achieved across contexts is critical. Here, we present a micro-level, sensorimotor analysis of JA across contexts. Our findings point to the central role of toddlers' manual engagement in coordinating attention. Parents and their two-year-olds, both equipped with head-mounted eye trackers, were observed at play in the laboratory (Figure 1). From the video-recordings of their play, we identified episodes of play with different objects, and classified each episode as either parent-following or parent-directing. Within episodes, we coded frame-by-frame the target of parents' and toddlers' gaze, as well as the target of their manual actions. Our analyses focused on joint visual attention (JA) across episode types and on the hand-eye coordination patterns (e.g., moments when

toddlers visually attended to their own manual actions, moments when toddlers attended to their parents' actions, etc.) that correlated with JA. Consistent with previous studies, JA was more likely when parents followed toddlers' attention (Figure 2A). Across both parent-following and parent-directing contexts, JA was correlated with the extent to which toddlers and parents visually attended to the object with which toddlers were manually engaged (Figure 2B-2C). Thus, even in episodes that began with parents directing toddlers' attention - and actually consisted of more parent than toddler holding - the key to achieving sustained JA was to get toddlers manually engaged with the target object (see Figure 2D-2E). These results raise the possibility that toddlers' manual engagement may underlie the difference in JA between parent-following and parent-directing. This idea was supported by a mediation analysis demonstrating that individual differences in toddler manual engagement mediated the link between parents' tendency to follow-in and the amount of parent-toddler JA (Figure 2F). There has been a recent surge of interest on the role of early motor development on non-motor domains of development (e.g., Iverson, 2010). This study highlights the merit of this trend by showing how toddlers' manual engagement is a magnet for joint attention. Manual engagement may shape joint attention by stabilizing and sustaining toddlers' own attention - which simplifies parents' task of coordinating attention with their toddlers - and by providing a strong signal to parents regarding toddlers' attention. This study also underscores the value that micro, sensorimotor analyses play in understanding early social and cognitive phenomena. Discovering the micro-level sensorimotor processes of these phenomena offers mechanistic accounts and provides the transparency that may prove useful for translation.

S3.8iii Infants' visual preferences for prosocial behavior and other-race faces at 6 months: Impact of profile analysis

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In the past decade, there has been an increasing interest in infants' ability to produce sociomoral evaluations (e.g., Hamlin, Wynn & Bloom, 2007). How do infants process the social world and, in particular, social interactions? There is growing evidence that infants display preferences for prosocial agents (e.g., Holvoet, Scola, Arciszweski & Picard, 2016). However, recent studies have reported conflicting results and difficulties to replicate these results (e.g., Salvadori, Blazsekova, Volein, Karap, Tatone, Mascaro, et al., 2015). The first aim of this study is to see if young infant display the same preferences for the prosocial

agent with a different material. In addition, a recent study by Burns & Sommerville, (2014) tests whether the preference for prosociality resists a change in facial appearance. They find no preference for the actor's face in this context, leading the authors to suggest that infants do not use information about the individual's race when making social selections. However Scola, Holvoet, Arciszweski & Picard (2015) show that 12- to 36-month-old infants still prefer a prosocial character despite changes in this agent's facial features (dark skin, or a scrambled face). The second aim of this study is to clarify the role played by facial appearance, and specifically ethnical differences, in infants' evaluation of prosocial behavior. The current study investigated the relative influence of behavior and face/race on 6-month-old infants' evaluation of social agents when these two aspects are in competition. In this study, we investigated infant's preferences looking time by an eye-tracker Tobii? X2-60 of 31 6 months old infant. The material rely of three different colors animated cartoons (built with Adobe Animate ©) where three agents (game player, game breakers and central partner) interacted in a ball game. We used eye-tracking methodology to assess infants' preferences 1) for prosocial behavior, 2) for other-race faces, and 3) when the two aspects were pitted against one another. Our first result, regarding aspects of behavior (prosociality), showed that young infants exhibited a significant visual preference for the prosocial agent (the game-player). The second result, regarding aspects of appearances, shows a significant preference for other race faces within this material. In the experimental condition, the third one, no preference could be found at group level, where these two aspects competed. However, a profile analysis which took individual infants' preferences into account (see Table 1) revealed that when this situation was a source of conflict in terms of the preferences identified in the control conditions, infants significantly uses faces information over behavior in their visual preferences. These questions are core questions when trying to understand the early development of social cognition and their ability to produce social evaluation. This will be discussed both in the general framework of the development of social skills that explore social evaluation beyond basic behavior and in light of questions raised about the research material used with children.

S3.8iv Infants' understanding of action sequences: Motor abilities support goal imitation

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Observational learning relies on the ability to parse continuous action sequences and evaluate which of the actor's actions are causally linked to achieving the goal. To date, there is limited research on what information infants glean from multi-step actions. Most studies in this area investigate simple goal-directed actions or simple means-ends actions and suggest that infants' own action experience shapes action understanding (e.g., Gerson & Woodward, 2014; Sommerville, Hildebrand, Crane, 2008). Across 3 studies, we investigate whether action experience is linked to infants' understanding of multi-step actions. To investigate infants' understanding of multi-step actions, we utilized a goal imitation paradigm (modeled after Hamlin et al, 2008) whereby infants observed an experimenter retrieve a small toy from a small transparent box using a pincer grip. After retrieving the toy, the experimenter placed the toy on one side of the tray and the box on the other side of the tray. The infant had up to 15 seconds to act on the objects. If the infant did not choose within 15 seconds, the experimenter withdrew the tray and proceeded to the next trial. Based on previous research, we hypothesized that if infants interpreted the action sequence about the toy, they should selectively reproduce the toy. If infants do not perceive the goal as being the toy or perceive the goal as the box, they should selectively reproduce the box. Study 1 (n=40) demonstrates that infants selectively reproduce the goal of obtaining a toy from a box but only when the goal is causally linked to the sequence ($p<.001$; See Figure 1a). Results also show that females (M=.85) imitated the goal more than males (M=.49, $p<.004$; See Figure 1b). This pattern was specific--it was not found when instead of using a pincer grip the actor dumped the toy out of the box ($p>.082$). In Study 2 (n=20), we investigate whether this gender difference could be a function of infant's differing motor skill. To do so, we gave infants the transparent boxes with toys inside and coded retrieval strategy. Results demonstrates that there are gender differences in pincer grip production--females produce more pincer grips when retrieving the toys than males ($p<.014$). In study 3 (n=82), we test goal imitation and action production in the same individuals. Here infants either observed demonstrations of an actor using a whole hand grip to obtain a toy in a large box (WH condition) or an actor using pincer grip to obtain a toy in a small box (PINCER condition). Then we measured infants' own use of pincer vs. whole hand grips. In the PINCER condition, there was a significant relation between infants' pincer grip production and goal imitation ($r=.474$, $p<.003$; See Figure 2). There was no such relation in the WH condition. Together, this work demonstrates that infants can deploy their action knowledge of complex action sequences rapidly (i.e., after a single demonstration) and provides strong novel evidence of a link between motor and social-cognitive processes (i.e., goal imitation).

S3.8v Facing down sitting up: How face type familiarity and sitting status influence infants' face discrimination

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Infant motor development, face perception, and experience are likely interconnected. For example, development of motor capacities changes infants' face exposure (e.g., crawlers and walkers; Kretch et al., 2014) and infants who are learning to sit fail to show holistic face perception while non-sitters and expert sitters process faces holistically (Cashon et al., 2013). The faces infants experience (primarily female and own-race; Sugden et al., 2014) are also the face types with which they show most robust face discrimination (Sugden & Marquis, 2017). Although experience, motor capacity, and face discrimination have traditionally been considered separately, sitting likely impacts infants' discrimination of familiar and unfamiliar face types differently. If sitting reorganizes the face processing system (as argued by Cashon et al., 2013), it would likely have its greatest impact on the most fragile face processing abilities - discrimination of face types with which infants have the least experience (male and other-race faces). As compared to non- and expert sitters, do infants learning to sit show decreased discrimination of faces? Is this particularly true of face types for which infants have the least experience and for which discrimination is fragile? In our preliminary analysis, 23 6-month-olds (M= 195.01 days, SD=9.57 days; 15 female) participated in a total of 42 habituation tasks (up to one of each own-race female, own-race male, other-race female, and other-race male). Overall, infants evidenced an ability to discriminate the faces of all types (all ps < .045). Their parents also provided assessments of motor capacity: 2 infants were non-sitters, 11 were learning-sitters, 12 were near-sitters, and 17 were expert-sitters. We predicted that non-, learning-, and expert-sitters would discriminate the faces whereas near-sitters would not because of the sitting-related cortical reorganization posited by Cashon et al., (2013). Although near-sitters showed the weakest evidence for discrimination (M = 52.45, SD = 14.55), there were no significant differences between groups according to sitting ability ($F(3, 38)=.45$, $p =.079$). Age was not significantly correlated with face discrimination or sitting ability. Data has been collected from an additional 34 infants and will be included in the final analysis allowing the examination of whether and how sitting status influences own- and other-race male and female face discrimination, hypothesizing that sitting status will show the greatest impact on male other-race, lesser impact on male own- and female other-race, and the least impact on female own-race face discrimination. If true, this would

suggest that the disruption of social-cognitive abilities caused by reorganization of motor capacities depends also on the fragility or robustness of the ability.

S3.8vi The role of sensorimotor experience in newborns' ability to match non-speech sounds and facial gestures

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Infants are immersed in a complex multisensory world since very early in life. However, we know very little about multisensory processing at birth. Some multisensory skills seem to be present early in life (Lewkowicz, 2010; Guellaï, 2016) and, at birth, audio-visual (A-V) processing seems to rely on redundant temporal information across senses (Lewkowicz, 2010). Yet, to date, no study has investigated newborns' abilities to match facial gestures and sounds that are part of their own sensorimotor experience, like non-speech sounds (yawns, hiccups) and their corresponding facial movements. Crucially, these familiar audio-visual stimuli could bootstrap newborns' ability to match audio-visual information also in the absence of temporal synchrony. To assess this issue, looking times were measured within an intermodal matching procedure while 2-days-old newborns concurrently viewed two videos of a woman's face performing a yawn and a hiccup in silence and then in the presence of a sound that matched only one of the two gestures. Preferences across silent and in-sound condition were then measured. Further, newborns were assigned to three different experimental conditions: in Experiment 1, A-V presentation was in synchrony, while, in Experiment 2, A-V synchrony was absent. In Experiment 3, facial gestures were presented in asynchrony with an artificial tone analog in duration to the natural corresponding sound. Newborns revealed a strong tendency to match the facial gesture with the corresponding sound both in the presence (Experiment 1) and absence (Experiment 2) of A-V synchrony as testified by longer looking times to the sound-matching gesture in the in-sound condition compared to the silent one. Conversely, no evidence of A-V association was found when an artificial tone, instead of the natural sound, was presented in asynchrony (Experiment 3), showing that newborns' ability to match A-V stimuli didn't rely on low-level perceptual features other than temporal synchrony (e.g. duration). The present study is the first to demonstrate that at birth newborns are able to match facial gestures and non-speech sounds that are part of their experience in the absence of temporal synchrony. Pre- and postnatal sensorimotor experience is likely involved in the development of these early skills which will refine during development thanks to significant postnatal experience and brain maturation.

S3.8vii Infant manual abilities and Sticky Mittens influence on the development perception of object invariance and language development

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The task of learning labels for novel objects requires children to solve several problems of visual perception. Children must recognize individual objects in multiple contexts and from multiple visual angles--they must understand shape invariance. Thus, learning words requires interdependencies between visual perception and word learning. Prior work demonstrates that 12-, but not 10-, month-old infants can use object properties such as shape, color, and texture to decide whether two things not seen at the same time are actually the same or different instances (Carey and Xu, 1996). Infants were familiarized with two objects emerging one-at-a-time from behind two sides of an occluder. Looking time to a subsequent display of one or two objects was used as a measure of individuation. In a subsequent study, Xu (2002) used this task to show that 9-month-old infants could individuate objects if labels were also given. Here we use a variant of Carey and Xu's task to examine perception of object invariance by changing the orientation of the object across viewing presentations. We situate this work in a larger developmental cascade wherein young children's experience manually exploring objects helps them solve problems of visual perception. Children who are skilled at manual object exploration demonstrate better 3D object completion and sparse object recognition, and are able to form categorical representations of novel objects (Soska et al., 2010, James et al., 2014, and Mash et al., 2012). Furthermore, children who are able to identify sparse object representations, also tend to have larger vocabularies and show more adult-like patterns of visual exploration when manually manipulating objects (James et al., 2014 and Smith et al., 2011). Ninety-four 3- to 12-month-old infants participated in a visual familiarization novelty preference task with variations in object orientation (Figure 1) and in a manual exploration task. We coded mouthing, fingering, hand switches, rotations, drops, and coordinated visual exploration. Preliminary analysis revealed that vocabulary size and manual exploration skills were significantly related to object perception. Children who engaged in more advanced manual object manipulations (coordinated visual manual exploration, switches, rotations, and fingering) looked longer at the multiple object display suggesting perception of a single object that had been rotated. In contrast, children with less well developed manual abilities, those who had more drops and mouthing, looked longer to the single object display, suggesting perception of multiple

objects. Additionally, the children who demonstrated more advanced manual manipulation abilities had higher vocabulary overall. Current work is examining whether increasing our youngest participants' exposure to multiple object views via sticky mittens increases their ability to detect object invariance. Our work thus shows how early developments in manual exploration support critical object perception skills. This work complements prior work demonstrating a developmental cascade in which manual exploration, object perception, categorization and word learning are mutually supportive (Iverson, 2012). We discuss additional implications for understanding the development of word learning biases such as shape bias, as well as delays and atypical developmental pathways.

S4.8 Flash talk session 4: Are bilingual infants really all that special?

S4.8i Monolingual infants can learn multiple structures in a simulated bilingual environment

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It has been suggested that bilingual experience enhances infants' ability to learn multiple streams of information, such as two interleaved artificial languages (Antovich & Graf Estes, 2017). Two cues have been proposed to facilitate learning: the presence of different speakers (i.e., people who primarily speak just one language) and different sounds across languages (Ronjat, 1913; Bosch & Sebastián-Gallés, 2001). However, the challenge of language learning is not so different for monolinguals. They too must learn from variation across speakers and from distributions of different sounds (Maye et al., 2002). We hypothesized that bilingualism is not unique, and that monolingual infants could use speaker- and sound-based cues to successfully learn in a simulated bilingual environment. Method. Familiarization: Monolingual 9-10-month-olds heard two separate speech streams, produced by a male and female talker. 50% of the input (Target stream) consisted of 3-syllable strings that followed a pattern (AAB or ABA). The remaining 50% (Non-target stream) consisted of similar strings with no regularities. Streams were presented in alternation, with four 30-sec blocks of each stream (Fig.1). Test: Using the Headturn Procedure, we tested infants' listening to Familiar items that followed the Target regularity vs. Unfamiliar items that violated that pattern. Test materials were produced by the female speaker and always involved sounds not found in either familiarization stream. Study 1: Unique Phonology. In Study 1, the Target and Non-target streams used entirely non-overlapping sounds. Infants (n=40) were assigned to one of two conditions. In the Consistent Speaker condition, each speaker produced a single stream during Familiarization; the female speaker produced the Target stream; the male produced the Non-target stream. In the Variable Speaker condition, each speaker produced half of each stream. Results. Infants learned the Target regularity in both conditions: a mixed ANOVA (Condition: Consistent vs. Variable speaker, Test type: Familiar vs. Unfamiliar) revealed a main effect of Test item [$F(1,38)=13.05$, $p<.001$], but no interaction [$F(1,38)=.30$, $p=.59$]. Infants' longer listening to Familiar items in both conditions suggests they discovered the patterns when provided with both phonological and speaker cues. Study 2: Overlapping Phonology. In Study 2, we removed the phonological distinction between streams, and

asked if pairing structured information with speaker would suffice to support learning. The Target and Non-target streams now involved the same syllables. Infants (n=40) were assigned to either the Consistent or Variable Speaker condition. Results. Unlike Study 1, a mixed ANOVA showed no main effect of Test type [F(1,38)=.68, p=.42] and no interaction [F(1,38)=.32, p=.58]. Thus, without phonological cues, infants failed to demonstrate learning. Discussion. Provided with ecologically valid cues, monolingual infants can display learning of two separate speech streams. Infants' successful learning in Study 1, but not Study 2, demonstrates that phonological cues allowed them to segregate different sources of information. These simulations further suggest monolingual infants do not rely on speaker differences to achieve this separation. These studies highlight that even without regular exposure to multiple languages, monolingual infants successfully exploit useful cues in their auditory and social environment to find reliable structure.

S4.8ii Using Markov matrices and intra-individual variability measures to study how bilingual infants explore talking faces

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As opposed to adults, when presented with a face talking in their native language, infants in their first year of development tend to shift their visual attention from the eyes to the mouth of the speaker. This preference is stronger in infants growing in a bilingual environment, suggesting they need to rely more on the audiovisual redundant cues provided by the mouth area of talking faces to deal with their dual language learning (Pons, Bosch & Lewkowicz, 2015). In a previous study computing mean preference scores on eye-tracking measures, we showed that the preference of 12-month old monolinguals and 15-months-old bilinguals for the mouth area of a speaker prevent them from anticipating subsequent non-speech gestures displayed in her eyes region (Eyebrow-raise movement as opposed to Lip-Protrusion movement, Figure 1). In this work, our aim was to measure the stability (within participants) of their patterns of visual exploration of the speaker's face (Eyes, Mouth, Rest of the Face and Elsewhere, see Figure 2A), independently of their mean scores. To do so, we computed Markov matrices of transition probabilities of each participant's gaze locations across the 19 trials of the experiment (Figure 2). Results show (see Figure 2B) that controlling for age, condition (Eyebrow-raise and Lip-protrusion) and mean preference scores, bilinguals tend to switch more to the irrelevant

regions of the speaker's face during the Speech Event (Rest of the Face & Elsewhere) while monolingual remained more on the relevant regions (Eyes and Mouth). These results suggest that bilingual infants, as compared to their monolingual peers, exhibit different attentional strategies when perceiving faces talking in their native language. More precisely, our observations can be interpreted as resulting from different equilibria between top-down attentional constraints and bottom-up saliency capturing attention. These results may provide new answers regarding the cognitive mechanisms at play in early language acquisition in bilinguals. Pons, F., Bosch, L., & Lewkowicz, D. J. (2015). Bilingualism modulates infants' selective attention to the mouth of a talking face. Psychological Science, 26(4), 490-498.

S4.8iii Memory interference in monolingual and bilingual 18-month-olds

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Introduction of novel information can result in retroactive interference as early as 3 months of age and persists across the lifespan (Rossi-George & Rovee-Collier, 1999). The present study examined whether there are differences in retroactive interference between monolinguals and bilinguals at 18 months using a deferred imitation paradigm. Bilingual children show consistent advantages when there are conflicting demands on attention: they are better able to selectively attend to the relevant cue in order to process the current goal compared to monolingual children (e.g., Rhee-Martin & Bialystok, 2008). Given that bilinguals have an earlier emerging ability to respond to response conflict than monolinguals, we predicted that bilinguals will be less likely to experience retroactive memory interference. Participants. 23 participants have participated (15 monolingual, 8 bilingual) in the interference condition. Data collection is ongoing. Stimuli. There are three sets of test stimuli (puppets: cow, duck, tiger; rattles: A, B, C; and animals: rabbit, monkey, panda). There are three target actions for each set of stimuli (see Table 1). Procedure. Infants saw target actions demonstrated on two different stimulus sets (set A and B). Then the experimenter tested infants with stimulus A. For example, a participant saw the duck puppet demonstrated 2x, the tiger puppet demonstrated 2x, and then was tested immediately with the duck puppet. Based on pre-established parameters, the puppet test phase lasted 90 s and the rattle and animal test phases both lasted 60 s each. The order of imitation tasks was counterbalanced. Imitation scores were calculated for each task (max = 3 target actions per task) and a composite score (max = 9) was created. Performance was compared to pooled baseline estimates collected via multiple prior

studies using the same imitation tasks. Results. The results were not in line with our prediction. Due to our small sample size, our preliminary data analysis involved a series of t-tests. When comparing the composite score, there was no significant difference between monolinguals and bilinguals, t(17) = 1.14, n.s. However, when comparing monolinguals to bilinguals on the puppet task, bilinguals performed significantly worse, t(17.5) = 2.34, p=.04. Note df is due to unequal variances. There were no differences on the rattle or animal tasks, both t's <1. Performance by each group was also compared to pooled baseline controls (puppet = .17, animal = .30, rattle = .60). Every group on each test performed above baseline except for the bilinguals tested with the puppet. Discussion. The findings suggest that bilingual infants were more susceptible to interference on the puppet task when the perceptual features of the test objects were very similar. There was no difference in performance on the animal and rattle tasks where the perceptual features were more distinctive. Bilingual infants may be highly sensitive to visual perceptual cues early in development.

S4.8iv Executive Function in Young Spanish-English Bilingual Children: Are They Really Special?

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Bilingual individuals activate both languages when speaking and must inhibit one language when using the other (Greenberg, Bellana, & Bialystok, 2013). Inhibitory practice may support enhanced executive function (EF) in bilingual children, who outperform monolingual children in task switching and cognitive flexibility (e.g., Bialystok, 2011, but cf. Duñabeitia et al., 2015). We explore the EF advantage in preschoolers, its timing, and its relation to individual differences in proficiency and exposure. Recently, Crivello et al. (2016) found that growth in translation equivalents (TEs; synonyms across languages) predicted EF performance in French-English bilingual children in Montréal at 30 months. Of interest is whether this effect holds in children in a different linguistic and cultural setting: Spanish-English bilingual children in San Diego. Children were studied longitudinally: 60 English-speaking monolingual and 40 bilingual children at 24 and 31 months and 29 monolingual and 12 bilingual children at 39 months of age. At 24 and 31 months, TEs were obtained from the MacArthur Bates Communicative Development Inventories (Fenson et al., 2003; Jackson-Maldonado et al., 2003). EF was measured on reverse categorization (Kochanska, Murray, & Harlan, 2000) and shape Stroop tasks at 31

months (Carlson, Mandell, & Williams, 2004). At 39 months, TEs were obtained from the Peabody Picture Vocabulary Test (Dunn & Dunn, 1997; Dunn, Lugo, Padilla, & Dunn, 1986) and EF was measured on the Dimensional Change Card Sort task (DCCS; Zelazo, Frye, & Rapus, 1996). We observed no bilingual advantage at 31 months of age in contrast to findings in French-English bilingual children. Notably, Spanish-English bilingual children acquired only half as many TEs (calculated as proportion change over time) from 24 to 31 months compared to their French-English peers (M=.05 and M=.11, respectively) and TE growth was not associated with EF. In contrast EF performance was correlated with exposure: children with more balanced exposure across languages outperformed less balanced peers ($r(39)=.43$, $p=.007$). By 39 months, bilingual children outperformed monolingual English-speaking children in the DCCS task ($t(39)=3.09$, $p=.004$). Descriptively, bilingual children with perfect DCCS scores had a greater proportion of TEs in their vocabularies (M=.39) and were more balanced in exposure (L1 M=.59) compared to children with less than perfect scores (M=.15 and M=.67, respectively; see Figure 1). We will analyze data from 10 additional bilingual participants prior the meeting to assess the significance of the contribution of exposure and TEs to EF at 39 months. Together, results suggest differences in the timing of the emergence of an EF advantage in different samples of bilingual children as a function of relative proficiency and exposure. Children who know more TEs and are more balanced in exposure across languages may have more practice in inhibition and selective attention and consequently perform better on EF relative to bilingual peers with less practice. These differences may speak to why an EF advantage is found in some studies and not in others. Thus, when evaluating whether bilingual children are "special", researchers must consider individual differences in language proficiency and exposure across languages, factors that may vary with language and culture.

S4.8v Statistical word segmentation across languages: The role of experience

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To acquire language, bilinguals face hurdles beyond those encountered by single language learners, yet they follow similar acquisition timelines (e.g., Hoff et al., 2012). Bilinguals may develop strategies to navigate two languages efficiently, but whether the effects of bilingualism are specific to language, or affect cognition more broadly is still under debate. One early bilingual challenge is locating words in multiple speech streams. Past work suggests that bilingual infants can track statistical regularities across languages

to support word segmentation, but that monolingual infants cannot (Antovich & Graf Estes, 2017). Performance differences may originate from bilinguals' experience segmenting two languages or from the hypothesized cognitive advantages of bilingualism in infancy (e.g., inhibitory control, Kovacs & Mehler, 2009; encoding efficiency, Singh et al., 2015). These advantages could support fluid switches between languages and rapid encoding of speech information, benefiting segmentation. The present study assessed whether bilinguals' cognitive and linguistic abilities differ from monolinguals, and whether individual differences in these areas are predictive of dual language statistical word segmentation. Twenty-one bilingual and 23 monolingual 16-month-olds have been tested (planned final n= 50). Monolinguals came from English speaking households, and bilinguals heard English (M = 59% of language exposure) and a second language. The two artificial languages (see Table 1) each comprised four nonce words concatenated to form 4 min of speech. Infants listened to the languages in eight interleaved blocks. Afterward, segmentation was assessed in a preferential listening task. At test, infants heard repetitions of words versus part-words from one language. Part-words were syllable sequences that occurred in the speech, but did not form words. Additionally, we collected measures of infant vocabulary size, general cognitive abilities (Bayley Scales), and inhibitory control (A-not-B task). Infants' pattern of listening to word and part-word test items differed by language group ($p = .045$). As shown in Figure 1, monolinguals did not have a reliable preference for either trial type ($p = .32$). Bilinguals exhibited a trend toward preferring the more novel part-word stimuli ($p = .08$), suggesting many had segmented the dual speech streams. For infants with complete secondary measures, we found no differences between language groups on measures of English vocabulary size, general cognitive abilities, or inhibitory control ($ps > .13$). Monolinguals' performance in the segmentation task was predicted by receptive vocabulary size, $r(18) = .49$, $p = .04$, with larger vocabularies associated with stronger word preferences. No cognitive or language measures predicted bilingual performance in the segmentation task. Our preliminary results suggest that bilinguals segmented the speech streams more reliably than monolinguals, and that bilinguals' success was driven by experience processing two languages, rather than differences in cognitive or linguistic abilities. On the other hand, monolingual segmentation was predicted by vocabulary size, suggesting that underlying speech processing abilities contributed to their performance in this difficult segmentation task. We did not find cognitive advantages for bilinguals, but our results suggest that experience with two languages helps bilinguals adapt to the challenges of segmenting dual speech streams.

S4.8vi Dónde está la ball? Examining the effect of language mixing on bilingual children's word recognition

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Parents frequently name objects in sentence frames that add little substantive information ("This is a _____!"). Nevertheless, Fernald & Hurtado (2006) reported that sentence context facilitates word recognition. Given the high incidence of bilingualism worldwide, many children grow up receiving input in more than one language and this includes frequent exposure to sentences that "mix" the two languages (Byers-Heinlein, 2013; Place & Hoff, 2011; Bail, Morini, & Newman, 2014). Previous findings suggest that this type of input does not delay overall vocabulary development in bilingual children (Bail, Morini, & Newman, 2014). However, whether or not hearing mixed-language sentences influences word recognition in "real time" in this population remains unclear. Here we compare bilingual toddlers' ability to identify familiar words when they are in a sentence that only uses one of their languages, compared to a sentence where the languages are mixed together. In this study 24 Spanish-English bilingual children 18-24 months (12 males) saw pictures of familiar objects presented in pairs on a screen and simultaneously heard speech stimuli in three possible conditions: (i) single word (ball!), (ii) same-language sentence (where's the ball?), or (iii) mixed-language sentence (dónde está la ball?). A total of 18 test trials (6 in each condition) were included. Additionally, participants saw 3 baseline trials (one per object pair) where there was no audio and hence no specific object was defined - these were used to rule out any pre-existing object biases. The language of the sentences and target words were counterbalanced across participants, with half of the children hearing target words in English and half in Spanish. Using a split-screen preferential looking paradigm (Golinkoff, Hirsh-Pasek, Cauley, & Gordon, 1987) we examined children's looking behavior to determine whether they were accurately identifying the objects on the screen. As shown in Figure 1, data suggest that accuracy is highest for the same-language condition (63%), followed by the mixed-language-sentence (57%), and then the isolated-word condition (54%). All of these are significantly above chance. Additionally, there is an effect of sentential-context $F(2, 46) = 7.38$, $p < .005$, with significantly higher accuracy in same-language-sentences than isolated-word ($t(23)=4.40$, $p<.001$) or mixed-language-sentence ($t(23)=2.28$, $p<.05$). However, accuracy between the mixed-language-sentence and isolated-word conditions does not differ significantly ($t(23)=1.33$, $p>.05$). These findings suggest that while language mixing does not lead to delays in bilingual children's vocabulary learning, it does influence their ability to recognize spoken words. Children were successful at identifying words in all three

conditions; however, the previously reported advantage that results from hearing a word in a sentence frame was only present when the sentence and target word were heard in the same language. Hearing a mixture of the two languages within the same sentence may result in greater processing costs for bilingual children (compared to when all the information in the sentence is presented in a single language), as they must first process the information that is being provided in each language and additionally focus on retrieving the correct word-object mapping to achieve identification.

S4.8vii Relations between maternal dual language proficiency, child bilingualism, and attentional control in Mexican-American families

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Introduction: The extent to which executive functioning, namely attentional control, can be augmented by other factors is not currently well understood. Bilingualism is one such factor that has sparked controversial discourse in recent years due to its proposed connection to executive functioning. While some researchers consider bilingual experiences to enhance executive functions (Bialystok, 2009), others question the existence of an advantage at all, calling attention to the methodological issues and biases in the studies supportive of a bilingual advantage (Paap et al., 2015). Few studies investigating this purported bilingual advantage have included those who become bilingual out of necessity. Consequently, low SES immigrant populations are underrepresented in the existing literature. These debated advantages may manifest differently in minority populations who maintain their native language while adapting to another culture. The goal of the current study is to examine the influence of maternal dual language proficiency on children's emerging bilingualism as well as the relation between emerging bilingualism and later sustained attention. Methods: This study utilized data from Las Madres Nuevas Project, a longitudinal data set following a sample of 322 low-income, Mexican-American mother-child dyads prenatally through 6 years of age. A multimodal method of data collection was used, including computer assessments and structured interviews. A structural equation model was fit using data from child age 9 months (maternal dual language proficiency), 36 months (child vocabulary), and 54 months (child sustained attention). Sustained attention was indexed as the proportion of responses that were not errors of omission on the Continuous Performance Test (K-CPT V.5). An interaction term of child Spanish and English vocabulary at 36 months was included in the pathway model to capture child bilingualism (See Figure 2). Results:

Maternal dual language proficiency at 9 months predicted the interaction of child Spanish and English vocabulary at 36 months, controlling for concurrent maternal dual language proficiency (ß = 0.220 p=.004). Greater child bilingual ability (i.e., interaction) at 36 months was negatively related to sustained attention at 54 months (ß = -0.400, p=.01). In contrast, greater sustained attention was positively predicted by greater English vocabulary (ß =0.351, p=.03) and greater Spanish vocabulary (ß =0.448, p=.000) at 36 months (See Figure 1). Discussion: These results suggested that maternal dual language use early in development influences emerging bilingualism in children even after controlling for later maternal language use. Additionally, emerging bilingualism at 36 months may present challenges for children in terms of sustained attention. Given that executive functioning dramatically increases between the ages of three and five years (Carlson et al., 2005), it is possible that this initial deficit would diminish as executive skill continues to emerge similar to the lag seen in bilingual children compared to monolingual children in single language comparisons (Hoff & Core, 2015). Examining the pathways of influence on domains of child executive functions in low-income immigrant populations may call for a different conceptualization of the bilingual advantage.

Poster Session 1, Sunday 1st July

A: Motor and Sensorimotor Processes

P1-A-1 Early characteristics of infants at high-risk for autism

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The prevalence of autism spectrum disorders (ASD) has increased dramatically in the last decade. Specifically, based on the Centers for Disease Control and Prevention Autism Developmental Disabilities Monitoring about one in 68 children has been identified with an autism spectrum disorder. The increasing occurrence of ASD creates an imperative need for clinicians to identify as early as possible ASD related deficits in order for these children to receive access to early intervention services and possibly a greater chance to improve quality of life. We examined motor and perceptual characteristics in 19 infants at low- and 9 infants at high- risk for ASD (familial risk) at 6 months of age. Infants at high-risk were identified as those with a sibling clinically diagnosed with ASD, whereas infants at low-risk were identified as those with no familial history of ASD. We used the Mullen Scales of Early Learning (MSEL) as a standard measure of motor and perceptual development. Sitting postural control was evaluated using a simple paradigm where infants sit on a force platform while center of pressure data are acquired to describe body sway. We utilized traditional tools of COP analysis, such as root mean square (RMS) and range as well as non-linear tools such as Sample Entropy (SampEn) for both the medial-lateral (ML) and anterior-posterior (AP) directions of movement. We also had the infant look at social and non-social images on a screen while sitting on their parent's lap. A FaceLab eye tracker was used to examine the percentage of time that infants spent looking at social vs non-social images. Infants at high-risk for ASD presented greater RMS and range values in the ML direction, suggesting greater excursions of postural sway in the ML direction. However, SampEn was significantly lower in the ML direction, suggesting that even though infants move to the extremes of their mediolateral stability, they achieve that by engaging in a very repetitive and periodic pattern of movement behavior. Differences were not observed in the AP direction. Eye tracking data revealed no differences between the groups in terms of how much time they spent looking at social and non-social images. The MSEL was not different between the two groups of infants. The question that remains, is whether this repetitive postural behavior persists during development, if it is related to diagnostic criteria for stereotyped movements and if it is unique to infants at high-risk for ASD or other developmental disabilities.

P1-A-2 Motor Development in Taiwanese Toddlers with Autism Spectrum Disorder

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Background- Previous studies have suggested that motor developmental problems typically occur in the early childhood of people with autism spectrum disorder (ASD). The motor function was more impaired in young children with ASD then typically developing children, such as delayed motor milestones, delayed posture achievement, and stereotyped motor movements. However, few studies have used standardized developmental assessment instruments for evaluating early motor developmental disorders in toddlers with ASD before 3 years of age. Furthermore, the existing studies only demonstrated total motor scores instead of reporting subscale scores that may further help to understand multiple motor functions in young children with ASD. Objective- To examine the motor performance in toddlers with ASD (ASD) using the standardized motor assessment instrument, Peabody Developmental Motor Scales, Second Edition (PDMS-2), and to compare with typically developing (TD) toddlers at ages of 30 and 36 months. Methods- In total, 15 toddlers with ASD and 15 TD toddlers aged 30 or 36 months were included. All toddlers' motor functions were examined using the PDMS-2 Scales. Four assessors with the specialty in physical therapy were served as the examiners for PDMS-2. The PDMS-2 composed of 6 subscales, including Reflexes, Stationary, Locomotion, Object Manipulation, Grasping, and Visual-Motor Integration Scales. The raw score of 6 subscales can be converted to standard scores and quotient scores based on the American normative data. The summed standard scores of Stationary, Locomotion, and Object Manipulation Scales are converted to the Gross Motor Quotient (GMQ); and the summed standard scores of Grasping and Visual-Motor Integration Scales are converted to the Fine Motor Quotient (FMQ). Both the GMQ and FMQ can be summed as the Total Motor Quotient (TMQ). The Mann-Whitney U test was conducted to examine the differences in each standard or quotient score in the PDMS-2 between two groups. Results- The results revealed that toddlers with ASD achieved significantly lower scores in the TMQ, GMQ, and FMQ than did TD toddlers (all p's < 0.05) (Tables 1). Furthermore, toddlers with ASD had significantly lower standard scores in the Locomotion ($p < 0.001$), Object Manipulation ($p = 0.003$), Grasping ($p < 0.001$), and Visual-Motor Integration subscale ($p < 0.001$) than did TD toddlers (Table 1). Discussion and Conclusion- The results revealed that the toddlers with ASD exhibited poor motor functions at ages of 30 and 36 months than the TD toddlers, especially poor performance in locomotion, grasping and visual-motor integration skills. The discrepancy may be due to decreased motivations to observe or imitate other peoples' movements and tended to be more frustrated to keep

social attention and engagement during the activities. Furthermore, insufficient motor experiences might limit the ability to explore and integrate multiple sensory cues in the sequences of motor activities. The future study could further explore the potential factors related to the motor problems. Our findings highlight the needs for clinicians to be aware of early identification and intervention for the early motor problems.

P1-A-3 Exploration and selection of objects in 11-month-olds

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From birth infants are tasked with making sense of the chaotic sensory information that surrounds them. They need to learn how to integrate perceived properties of the environment so that they can navigate and interact with their surroundings. Integration of perceptual properties is something that is slow to develop during the first year of life. Further, associating perceptual information with action plans continues to develop beyond the first year of life. It has been suggested that development occurs via a cyclical relationship between perception and action, such that perception of object properties influences motor behavior and that motor behavior, in turn, influences subsequent perception of objects. The current study investigated how this cycle of perception and action influences the discovery of perceptual properties of objects via repeated visual and manual exploration and selection of objects. Twenty 11-month-old infants were recruited for this study. Each infant was presented with two objects initially out of their reaching distance for 5s to obtain eye-tracking on the objects. Then, the objects were moved toward the infant. Infants then had 30s to manipulate the objects. Up to 10 trials were collected from each infant. The stimulus objects were wooden eggs painted with solid colors, comparable in hue. One object had rice inside so that if shaken or banged it would provide auditory and tactile feedback. The other object was empty inside. We predicted that if infants discovered the different sound/tactile properties of the objects, they would increasingly modulate how much time they would spend looking at and manipulating each object, and they would shake and bang objects differentially. Accumulated looking behavior by object was analyzed by identifying fixations on each object. Manipulation duration by object was defined as the accumulated time infants were in contact with each object, and accumulated duration of shaking and banging by object was also calculated. All dependent variables were normalized out of total looking at the scene or total manipulation time for each infant. Preliminary analyses of six infants revealed that infants did not differ in the amount of time they spent looking at each object or the amount of

time they spent manipulating each object overall. However, infants engaged in shaking and banging behaviors significantly more with the perceptually interesting object than they did with the less interesting object (p=.009). Analyses confirmed that this effect was not due to a color bias. These preliminary results suggest that the discovery of an auditory-tactile object property through object manipulation did not influence visual behavior or overall contact time with the objects, but did influence how the infants explored the objects in terms of specific actions on them. Analyses on the full sample are being performed to confirm these results. So far, our preliminary findings allude that 11-month-olds, despite the cyclical nature of perception and action, discover object properties mainly once the objects are in their hands. There is no sign of visual selection formation of the perceptually "interesting" object properties resulting from such manipulation.

P1-A-4 Providing motor affordances at home may positively impact cognition in infants living in poverty

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Introduction: Families with low-socioeconomic status (SES) or living in poverty may have a home environment, which does not provide opportunities for the infant to develop properly, and poor quality of child-parent relationships (Adolph et al., 2012; Bradley et al., 2001; Guo & Harris, 2000). Previous studies had showed that infants at 6-12 months from low-socioeconomic families might present deficits in cognition and attention problems compared to high-SES infants (Clearfield & Niman, 2012; Clearfield & Jedd, 2013). Perceptual-motor experiences can broadly affect cognitive development (Lobo et al., 2013), thus, providing motor affordances at the home environment might positively influence cognitive skills in infants at environmental risk. Aim: To verify the effect of a motor affordances program at home on cognition for infants living in poverty. Methods: Twenty-eight infants at 7.3 ± 1.1 months of age living in poverty were randomized assigned into two groups: motor affordances group 1 (G-1), and motor affordances group 2 (G-2). Their cognition performance were assessed into 3 visits: Visit 1 (baseline), Visit 2 (after 4 weeks), and Visit 3 (after 8 weeks) using Bayley Scales of Infant and Toddler Development- 3rd edition (Bayley-III, 2005). Both groups received the same motor affordances program, however, G-1 only received the intervention between Visits 1 and 2, and G-2, only between Visits 2 and 3. The parents/caregivers received a booklet and 3 toys appropriate to infants' age (rattle, stacking/nesting cups and a baby plastic book).

Parents/ caregivers were taught by a pediatric physical therapist how to interact with the infants to stimulate spontaneous movements and transitions into different positions (prone, supine, sitting and standing) and also promote opportunities to explore the three toys for at least 20 minutes a day for 4 weeks. Two-way repeated measures ANOVA and effect sizes (Cohen's d) were performed. Results: There was difference between groups [F (1, 26)= 4.582; p=0.042], which G-1 presented greater composite score than G-2 at the Visit 2. Moreover, in G-1, there was large effect between the Visit 1 and Visit 2 (d=0.75), and very large effect between Visit 1 and Visit 3 (d=-1.22). In G-2, there was a large effect between Visit 2 and Visit 3 (d=-0.81), and very large effect between Visit 1 and Visit 3 (d=-1.29). Conclusion: The motor affordances program at the home environment positively influenced cognition of these infants living in poverty. Amplifying motor affordances at home may be an efficient/low-cost early intervention strategy for infants at environmental risk.

P1-A-5 Measurement of global form and motion processing in very preterm infants

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Global form and motion processing was measured with VERP in a study of Very Low Birthweight (VLBW) infants. Study A consisted of 24 VLBW infants, whose gestational age at birth varied from 22 to 32 weeks. At 5 months corrected age the infants were examined with VERP to investigate the sensitivity and topographical organization of response to global form and motion. The global motion stimuli consisted of dots moving along short arcs making a global rotation motion, alternating with dots moving in random directions. The global form stimuli consisted of short arc segments organized concentrically to create a global circular pattern, alternating with random arrangements with no global structure. EEG signals were recorded using the EGI 300 system (Electrical Geodesics Inc, Eugene, Oregon, USA) with a 128-electrodes HydroGel Geodesic Sensor Net and the vertex electrode as a reference. The results showed that brain activity was significantly less enhanced in the infants born between 22-27 weeks gestational age than for those born between 27-32 weeks gestational age. The results indicate that the maturation of motion sensitive structures in the brain is substantially influenced by processes occurring during the later part of pregnancy.

P1-A-6 All in a day: Everyday experiences of 12-month-olds in two cultures

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The role of culture and context has largely been ignored in motor development. Studies of Western infants--where the potential influence of typical childrearing practices is often taken for granted--guide knowledge about how infants acquire basic motor skills. But, commonplace childrearing practices are not inconsequential. Cross-cultural work highlights special handling routines, positioning during sleep and wake, and dressing and diapering that show surprising effects on infant development. Yet, researchers know little about how long infants spend in various daily activities that may affect opportunities for practicing posture, balance, and locomotion. We asked about daily opportunities for movement in infants in Tajikistan where caregivers use a "gahvora" cradle (Figure 1). In the gahvora, infants lie supine with limbs extended and bound. Using a time-diary, 83 mothers of 12-month-old infants reported restriction in the gahvora and other furniture during the previous 24-hour day. All infants (n=40) in rural areas and most from urban (n=39, 93%) were cradled at birth and spent up to 18 hours/day in the gahvora. By 12 months, 95% from rural and 74% from urban areas were still cradled and spent M=11.5 hours/day in the gahvora. Time in bassinettes, strollers, and baby walkers was minimal because few families owned these types of restrictive furniture. When out of the gahvora, infants were unrestricted on the ground either awake (M=7.9hr) or asleep (M=3.3hr). Mothers (n=70) reported onset ages of crawling and walking, and we observed infants crawling and walking during structured assessments. Infants showed striking delays compared to World Health Organization standards: At 12 months, when the WHO reports 97% of infants crawl and 50% walk, only 62% of Tajik infants crawled and 9% walked. Walkers spent fewer hours (M=4.8) in the gahvora than infants who were not yet walking (M=10.2), $p<.05$. Currently, we are scoring infants' crawling and walking behaviors from video to confirm maternal reports. For comparison, we are collecting time-diaries from mothers of 12-month-olds in an urban U.S. city to examine restrictive placements and opportunities for movement. Preliminary data from 12 time-diaries show infants spent M=11.7 hours/day in cribs, comparable to gahvora hours for Tajik infants. Unlike Tajiks, U.S. infants also spent time in highchairs (M=1.5hr/day), strollers (M=0.7hr/day), bouncers (M=0.22hr/day), carriers (M=1.2hr/day), and car seats (M=1.1hr/day). Infants spent M=6.69 hours/day unrestricted on the floor, slightly less than Tajik infants. All 12-month-olds could crawl or walk. Tajik and U.S. infants experience similar time restricted but vary on the form of restriction: Equipment restricts infants in space but gahvoras additionally

restrict infants' posture and limb movements. Unrestricted time to roam is comparable; Tajik infants have similar opportunities to explore once they are let loose from gahvoras. Findings shed light on similarities and differences in childrearing practices in infancy and ways in which childrearing may support or hinder opportunities to practice posture, balance, and locomotion.

P1-A-7 Progress of gross motor development among infants living in different countries: comparing Dutch and Canadian infants on the AIMS

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Background: The Alberta Infant Motor Scale (AIMS) is an elegant, psychometrically strong and widely used observation instrument. Pediatric physical therapists use the instrument to assess gross motor development of infants from birth until independent walking. It is well known that child rearing practices and beliefs differ between societies and cultures, which in turn possibly influence infant motor development. This raises the question whether the (original) Canadian reference scores of the AIMS are applicable to infants living in other countries. The aim of this study is to compare the Canadian normative data of the AIMS with data obtained among a sample of Dutch infants. Method: This cross-sectional cohort study aimed to study at least 450 Dutch infants in the age of 14 days to 19-month-old representative of the current Dutch population. Infants with known neuromotor impairments were excluded. A validated eHealth method, the AIMS home-video method, was used for data-collection. In this method parents are asked to record their infant's movements according to an instruction film and checklist at the most suitable time for parents and child. The recordings were assessed on the AIMS by two trained researchers/pediatric physical therapists. Recruitment took place in 2013-2017. Data analysis was comparable to the scaling method used in a recent re-evaluation of the Canadian norms. AIMS scores of the Dutch infants were compared to those of the infants included in the original Canadian norm study (n=2202) matched on age. Standard logistic regression of probability of 'passing' an item as a function of age was calculated. Infants were divided in 19 different age-groups (14 days-1 month; 1-2 month; ..... 18-19-month-old). The number of infants in each age group is a 450/2202 ratio of the original Canadian dataset, with a minimum of 10 infants per age group. Results: Of the infants in the age of 14 days to 19 months, 450 home-videos were assessed. Approximately 4% of the infants had (grand)parents with a non-Western ethnic background and 7% of the infants were

born prematurely. The sequence of AIMS items, i.e. the order of the milestones was similar between Canadian and Dutch infants. However, differences were observed in the average ages of emergence of the AIMS items: most AIMS items emerged at a later age among Dutch infants compared to the Canadian norms. Conclusion: Given the differences between Dutch and Canadian infants in emergence of AIMS items we conclude that in the Netherlands the current AIMS norms used are not suitable for assessing the gross motor development of Dutch infants. The results suggest that applying the Canadian norm values might indicate an abnormal development falsely. Therefore, new Dutch percentile scores should be developed. This raises the question of what exactly underlies the differences between the progress in gross motor development in infants in these two (Western) cultures?

P1-A-8 Impact of Cognitive, Fine Motor, and Gross Motor Development on Means-end Problem Solving

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Introduction. Means-end problem solving (MEPS) involves the intentional execution of a planned sequence of actions to achieve a goal (Brandone, 2015; Piaget, 1953; Willatts, 1999). In means-end tasks, infants demonstrate an understanding that they can act upon one object to affect another object. Previous research suggested that MEPS depends upon requisite motor, perceptual, and cognitive abilities, such as reaching and object manipulation, visual attention to objects, motor-perceptual coupling, ability to distinguish between the means and end objects, to understand the concepts of support and causal relations, to identify goals, and to select actions that will produce identified goals (Bremner, 2000; Lobo & Galloway, 2008; Sommerville & Woodward, 2005). The aim of this study was to empirically evaluate foundational skills that allow and facilitate MEPS in infancy. Investigating these complex behaviors can provide insight into the early learning mechanisms (Bonawitz et al., 2010; Bremner, 2000; Gibson & Pick, 1988). Methods. The study included 24 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). Infants' MEPS was tested at 6, 9, 12, 18, and 24 months in two 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. All recorded behaviors were categorized into means-oriented behaviors (MOB; not likely to result in goal attainment) and end-oriented behaviors (EOB; likely to result in goal attainment). Percentages of MOB and EOB out of

the total assessment time were calculated. Infants' cognitive and motor development was assessed at 6, 9, 12, 18, and 24 months using the Bayley-III Scales of Infant Development: Cognitive, Fine Motor, and Gross Motor scales. MEPS (MOB and EOB percentages) were related to infants' performance on the three Bayley scales using Hierarchical Linear Modeling (HLM; Raudenbush et al., 2004). Results. Infants' performance of MOB, which does not indicate infants' planning in a means-end task, did not relate to their cognitive or motor development levels estimated from Bayley scales. In contrast, infants' performance of EOB, which is indicative of infants' planning during problem solving tasks, were significantly related to Bayley Cognitive and Fine Motor, but not Gross Motor, developmental scores (Table 1). Conclusions. Whereas infants' development of gross motor skills did not relate to their goal-directedness in MEPS, fine motor and cognitive skills significantly related to infants' ability to plan and execute correct MEPS action sequences. These results suggest that means-end performance improves as infants' fine motor and cognitive abilities develop, while ongoing gross motor development may not impact performance in the means-end tasks assessed from 6 through 24 months of age. Infants must both understand the concept of the means-end causal relations between objects and be able to use their fine motor abilities to execute the necessary sequence of actions required to succeed in the task. Current results highlight the intricate interplay between infants' motor and cognitive abilities in the development of means-end problem solving.

P1-A-9 Motor Training and Attention Engagement in Early Infancy

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Motor training has been shown to facilitate the development of reaching behaviours and increase infants' awareness of others' actions (Libertus & Needham, 2011). A method often utilized for implementing motor training is the sticky mitten paradigm (Libertus & Needham, 2011; Needham et al., 2002). Sticky-mittens have Velcro attached to their palms, and are worn by infants during training sessions wherein a parent brings the infant's attention to blocks that contain the corresponding pieces of Velcro. When the infant contacts the toy, the Velcro on the mittens and the toy stick together, resulting in a successful grasp. This paradigm has increased our understanding of development; however, there are limited studies evaluating its long-term impacts (Weisen et al., 2016). This study evaluated the long-term effects of sticky-mitten training in 3-month-olds. 20 infants were trained for two-weeks by their parents, with 10 infants assigned to an active

training (AT) group, and 10 to a passive training (PT) group. AT infants were trained with sticky-mittens that allowed them to successfully "grasp" the blocks upon contact, whereas PT infants, also trained with sticky mittens, were not afforded the same grasping opportunities because their blocks did not have Velcro. Motor activity and attention were assessed before and after training, and at 5-months-old. Infants also interacted with their parents for 4-minutes to determine the effects of motor training upon these interactions. Assessments were conducted in participants' homes to determine the ecological validity associated with this training. Preliminary findings indicate a number of compelling trends that provide an important basis for future research. During the third visit, PT infants showed significant increases in the number of attempted reaches relative to the second, when the toy was placed beyond their reach ($p=.023$). This result was not observed in AT infants ($p>.05$). These findings suggest AT infants exhibited greater intentionality, as seen by increased reaching attempts only when the toy was placed within reach (and was thus obtainable). There were also interesting trends observed between-groups regarding infant attention when interacting with parents. At 5-months-old, AT infants tended to look at the toy for a greater duration, and PT infants tended to for a shorter duration relative to the second visit (Figure 1). Further, at the second visit, AT infants tended to share their attention with their parent for a greater duration than when coordinating attention towards a toy (i.e., parent and infant both looking at toy). PT infants demonstrated the opposite effect, such that they coordinated their attention with their parent toward the toy for a greater duration than they did toward one another (Figure 2). These results indicate that there may be differential effects of active and passive motor training on shared attention. This study extended previous sticky-mitten research by evaluating its long-term effects and its impacts on parent-infant interactions. This research has important implications for conducting future studies, specifically for atypically developing populations (e.g., infants at a high-risk of developing autism), as this training could impact upon motor and attention processes as they develop.

P1-A-10 Characterizing normative longitudinal trajectories of restricted and repetitive behaviors in infants, toddlers, and preschoolers.

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Background: Restricted and Repetitive Behaviors (RRBs), which include repetitive motor mannerisms/stereotypies, rigid adherence to routines, insistence on sameness behaviors, and circumscribed interests are common features in young children diagnosed with ASD

and various anxiety disorders (Bodfish et al., 2000). However, they can also be normative and transient in toddlers and preschool aged children. The Repetitive Behavior Scales for Early Childhood (RBS-EC) is a 34-item parent-report questionnaire designed to capture normative variation in RRBs in toddlers and young children. To compliment and extend an initial psychometric validation of the measure (Wolff, Boyd, & Elison, 2016), we examined longitudinal change across the infant, toddler, and preschool age range in the total composite score and in each individual subscale of the measure: Repetitive Motor, Ritual and Routine, Restricted Behavior, and Self-directed behavior. We hypothesized that patterns of longitudinal change would vary by subscale. Methods: Parents of typically developing toddlers between 7-44 months (M=20.7, SD=7.8) were administered the RBS-EC over multiple time points. Complete/valid data were collected from 212 toddlers (107 with three or more data points), yielding a total of 610 data points (585 collected before 36 months of age). Linear mixed-effects modeling was used to estimate longitudinal change in RRBs, with age as the primary fixed factor, and sex and birthweight as potential covariates. Random effects for age were included to account for non-independence among participants. Likelihood Ratio Testing was used to test significant changes over time, and Maximum Likelihood Estimation was used to adopt the fixed- and random-effect structure that best fit the data. Results: Likelihood ratio testing indicated that age significantly predicted RRBs for the RBS-EC Composite score, and for each of its four subscales (all p's<.0001). While composite RBS-EC scores decreased over toddlerhood (Fig 1a), the relationship between age and outcomes varied across subscales: Self-Directed, Repetitive Motor, and Restricted Interests behaviors decreased over time (Figs 1b-1d), while Ritual and Routine behaviors increased until roughly two years of age, before declining (Fig 1e). There was an effect of Sex for the Restricted Interest behaviors, with boys demonstrating more restricted play behaviors at all ages. The effect of Sex interacted with time for Self-directed, Repetitive Motor, and Ritual and Routine behaviors: While boys and girls show similar levels of these behaviors early in development, girls show a steeper decline in these behaviors over time than boys. Discussion: By analyzing parent-reports of RRBs measured repeatedly between 7-44 months in 212 children, we found that these behaviors change significantly over this time period. Each subscale was characterized by a distinct longitudinal profile, adding further evidence that these subscales tap into separable constructs. Future studies will examine whether these trajectories predict quantitative autistic traits in the 2nd & 3rd year of life, and whether distinct profiles of change over time are associated with specific social and cognitive outcomes. Additional validation for the instrument will come from studies of infants at risk for adverse developmental outcomes.

P1-A-11 Spontaneous Movements and Autonomic Nervous Activity during Crying in 3-month-old Infants

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For several decades, infant crying has been researched in the context of assessing their pain stress or physiological states, especially in the medical field (Wasz-Höckert, Michelsson, & Lind, 1985; Shinya et al., 2016). Most of previous researches focused on its acoustic properties (e.g. fundamental frequency) of cry utterance in early infancy. Nevertheless, far too little is still known about the characteristics of spontaneous movements and autonomic nervous activity during crying. Here, we investigated how spontaneous movements and fluctuations of autonomic nervous activity (indexed by heart rate measures) would change from neutral to crying states in 3-month-old infants. Participants were 20 healthy full-term infants at 3-month-old age. We recorded the accelerations of the left and right legs' spontaneous movements and the electrocardiogram by multi-channel telemetry system (Nihon Koden, WEB-1000) from neutral to crying state. According to the definition of Prechtl (1974), their behavioral states were classified as neutral (state 4) or crying (state5). As motor measures, we calculated mean acceleration, mean jerk, number of movement units (a movement with increasing and decreasing acceleration > 0.5ms/s2) per min, and correlations between both legs' acceleration for each state. As autonomic measures, we used heart rate and heart rate variability indexes: low frequency [LF, 0.04-0.24Hz], and high frequency components [HF, 0.24-1.04Hz]. Paired t-test showed that spontaneous movements during crying state showed higher mean acceleration ($t=-2.02$, $p=.058$) and jerk ($t=-3.05$, $p=.007$), more number of movement units ($t=-3.40$, $p=.003$), and lower correlations between both legs ($t=2.01$, $p=.059$), compared to neutral state (Figure1). Moreover, infants exhibited higher heart rate ($t=-8.07$, $p<.001$), and lower LF-HRV ($t=2.81$, $p=.011$) and HF-HRV ($t=2.89$, $p=.009$) during crying (Figure1). Our findings revealed that, in infants at 3-month-old age, the spontaneous movements during crying can be described as more active with jerky and less coordinated movements of legs. Simultaneously, infants exhibit the dynamical change of autonomic nervous activity such that heart rate increases and overall HRV decreased rapidly. These observations suggest the covariance and interaction between spontaneous movements and autonomic nervous activity from neutral to crying states. Further studies are needed in order to understand the neurophysiological aspects of infant crying. Figure1. Box plots for (a) motor and (b) autonomic measures during neutral and crying states in 3 month-old-age infants (n = 20). Boxes represent medians with upper and lower quartiles; whiskers represent maximum and minimum values, excluding outliers

indicated by circles, at least 1.5 times the interquartile range (i.e. 1.5 box lengths from the upper or lower edge of the box). ***p < .001; **p < .01; +p < .10.

P1-A-12 Influence of Proximity and Similarity on Sequential Object Exploration

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Much of cognition--including word-referent mappings, counting, and following a conversation--depends on coordinating what and where information. There is growing interest in how this coordination of what and where develops. Johnson, Mareschal and Csibra (2001) conjectured that significant changes in the coordination of what and where may be found in the second year as toddler action becomes more sophisticated and more object specific. Xu and Carey (1996), reasoning about the integration of object tracking and object category learning, also hypothesized that there were significant changes in this integration after the first birthday. This experiment examines infants' patterns of sequential touching to study developmental changes in the coordination of "what" and "where" information in goal-directed action. Sugarman (1983) observed that given haphazardly arranged spatial arrays of objects usually composed of four objects from one category (e.g., cubes) and four from another (e.g., cups) infants would with increasing systematicity between the ages of 12 months and 18 months reach to perceptually similar things in sequence, for example, touching all the cups in a row. We proposed a conceptual framework for understanding sequential touching in terms of a dynamic priority map that coordinates sequences of goal-directed action. The central idea is that there may be many possible targets but a single hand can only reach to one location at a time, and thus, action forces a decision. The competition and resolution of that competition may be understood in terms of a topographical map that represents the "salience", "relevance", or "priority" of target locations in terms of their activation. Within this framework, the key theoretical question is whether salience in this system spreads via space or via the similarity of object features. In order to explore how space and similarity maybe organizing sequential reaches in the second year: two distinct kinds of objects were attached to springs and assembled into spatial arrays as shown in Figure 1 and presented to 12, 15 and 18 month-olds. In the task, the center object in the array was jiggled by the experimenter and infants were given the opportunity to reach to objects in the array. Each infant participated in 4 trials were the distance of the matching object was varied. The order of presentation of the trials as well as the left configuration of the arrays and which object sets were at what distances were all counter balanced. Figure 2 shows the

proportion of first reaches to objects. At all ages infants reached most often to the matching object (M) when it was closest to the cued object (T). The tendency to reach to the cued object varied by age and distance of matching object. The 18 month olds showed a decreased tendency to reach to T as distance to M increased. The overall pattern of results indicates that relationship between spatial layout and the spread of priority by object property is changing in the second year. This trend may indicate a shift in what kind of information directs action.

P1-A-13 The influence of object carriage on barrier crossing in young toddlers

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Learning to move around the world represents one of the most significant developmental achievements of infancy. However, locomotor skill does not development independent from the growth of other motor abilities, such as the ability to maintain one's balance, the ability to carry objects from one location to another, and the ability to navigate around, across, under, or through barriers in one's path. Accordingly, examining the young toddler's ability to integrate these varying motor tasks is of central importance in understanding the larger context of the development of mobility in the world. The current study explored this issue by examining the impact on locomotion of two of these components - carrying objects while navigating over barriers varying in height. Previous work with toddlers found that although object carriage influenced arm posture, it had little influence on spatial components of gait (e.g., stride length, step length). Similar to this earlier research, the current study induced 14- and 24-month-old toddlers to walk down a hallway towards a parent carrying a single object (the object condition) or with their hands unencumbered (the no object condition). Halfway down this hallway was an adjustable barrier that children needed to cross to navigate. Thresholds for successful barrier crossing were calculated as a function of no object and object conditions. Additionally, using a gait mat spatial and temporal gait parameters were gathered during toddlers' approach towards the barrier in both conditions. Analyses of barrier thresholds revealed that carrying an object lead to significantly higher thresholds for barrier crossing that not carrying an object. Additionally, analyses of spatial (stride length, step length) and temporal (gait cycle, step time) gait parameters revealed that carrying objects consistently modified temporal gait parameters, but not spatial parameters, with carrying objects leading to slower locomotion in the walking leading up to the barrier. Even more interestingly, carrying object carriage interacted with the subsequent outcome of the

barrier crossing attempt (successful versus unsuccessful). For temporal gait parameters, carrying objects produced equivalent temporal gait parameters regardless of whether the attempt to cross was successful or not. In contrast, not carrying objects led to significantly longer temporal gait parameters on trials leading to unsuccessful crosses, as opposed to successful crosses. Together, these findings demonstrate that barrier crossing, and that gait parameters during the barrier approach, are influenced by object carriage. Given the pattern of these results, these findings suggest that object carriage serves to stabilize gait, enabling toddlers to perform more difficult motor actions (cross over higher barrier heights) and to equalize gait parameters in response to less versus more difficult motor demands (subsequently successful versus unsuccessful barrier crossing).

P1-A-14 Is Toy Carriage During Walking Related to Language Ability?

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Onset of independent walking is linked to increases in receptive and productive language abilities in infants (Walle & Campos, 2014); however, the mechanisms underlying this relationship remain unclear. Whereas exploration and movement through the environment are likely important factors in explaining this relationship (Oudgenoeg-Paz et al., 2015; 2016; Walle & Campos, 2014), another possible explanation could be that independent walking provides infants with unique opportunities to walk while carrying toys, which may contribute to an increase in word learning. Newly standing infants are more stable when holding toys (Claxton et al., 2012; 2013) and newly walking infants are less likely to fall when carrying toys while walking (Karasik et al., 2014). This increased stability may result from infants stabilizing their visual attention on the toy that they are holding in order to aid in learning the toy's name (Smith, 2013). Therefore, we investigated if amount of time walking while carrying a toy was related to receptive and productive language abilities in newly walking infants. Thus far, 15 13-month-old infants (3 males, Mean_age = 13 m, 17 d, range: 13 m, 2 d - 13 m, 30 d; average walking experience: 8 weeks) have participated. Data collection is ongoing. Parents and infants engaged in a 20-minute free-play session during which they were provided with a variety of toys and were instructed to play and interact as normally as possible. The session was video recorded for offline coding. Trained coders identified walking bouts, which consisted of at least four continuous forward steps, and determined if the infant was walking while carrying a toy (toy walking bout) or walking with no toy (no-toy walking bout). Total time in motion (seconds) was the sum of the toy and no-toy walking bout times. Receptive and

productive language abilities were measured using the MacArthur-Bates Communicative Development Inventory. Bivariate correlation analysis was used for comparisons (Table 1). Similar to previous research (e.g., Walle & Campos, 2014), walking experience was positively correlated with productive language and trended toward a positive correlation with receptive language. Total time in motion did not correlate with language. However, when separating total time in motion into toy and no-toy walking bouts, toy walking bouts was positively correlated with receptive (Figure 1), but not productive language. There was no correlation between no-toy walking bouts and language. As expected, infants who spent more time walking while carrying a toy had higher language abilities. Although this relationship only existed for receptive language abilities, perhaps the relationship with productive language abilities develops later, given that productive language lags behind receptive language development. The finding of no relationships between language ability and total time in motion and the no-toy walking bouts further suggests that time spent engaged in toy walking bouts may be an important factor underlying this relationship between language and walking onset. Given that stabilization of the body while in motion may be driving this relationship, future research should measure infants' ability to modify their gait and stabilize their upper bodies while walking and carrying toys.

P1-A-15 Using discovery learning to motivate selective motor control of infants at high risk for cerebral palsy: a pilot study

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Background. Children with spastic cerebral palsy have gait impairments resulting from decreased selective motor control, an inability to move the hip, knee and ankle joints independently of one another resulting in closely coupled flexion and extension of the three joints. Infants with brain insults are at high risk for cerebral palsy (HRCP) and have reduced selective motor control as early as 1 month of age. We developed an in-home discovery learning task to motivate selective hip-knee control. We use a Microsoft Kinect to track infant leg movements to activate an overhead infant mobile based on specific kicking actions. Objectives. (1) Determine the feasibility of the in-home mobile task, (2) Determine if infants at HRCP and infants with typical development (TD) learn the contingency between leg movement and mobile activation, (3) Determine if infants in each group exhibit increased selective hip-knee control during the mobile task when they demonstrate learning, versus when they do not demonstrate learning. Participants. 7

infants at HRCP (Grade III or IV intraventricular hemorrhage, periventricular leukomalacia) and 12 infants with TD at 3¨ö-months of age. Methods. Each infant participated in an 8-10 min/day, 5 day/week, 6-week in-home mobile task. On the first day of each week, the spontaneous kicks of each infant were assessed for 2-min, followed by 8-min of the infant playing with a mobile that activated based on specific kicking actions. For the next 4 days, the infant played with the mobile for 8-min each day. This continued for 6-weeks. Learning was assessed weekly based on an increase in the proportion of time that the infant demonstrated the reinforced leg actions (RLA) when playing with the mobile compared to spontaneous kicking. Selective hip-knee control was assessed based on the hip-knee correlation coefficient (hip-knee CC) of kicks while participating in the mobile task. For each group, mixed regression methods using repeated measures were used to analyze RLA and hip-knee CC. Results. Feasibility: Adherence (computer recorded) averaged 89% for infants at HRCP and 98% for infants with TD. Learning: For only 1 of 6 weeks, the group at HRCP demonstrated learning (a statistically significant increase in RLA when activating the mobile compared to spontaneous kicking), whereas the group with TD demonstrated learning for each of the 6 weeks. We then classified each 2-min increment of each infant interacting with the mobile, as the infant either demonstrating learning (RLA ¡Ã 1.5x when activating the mobile compared to spontaneous kicking) or not learning (RLA < 1.5x). Selective hip-knee control: For 4 of 6 weeks, both the infants at HRCP and the infants with TD demonstrated a statistically significant decrease in hip-knee CC (more selective motor control) during the mobile task when they demonstrated learning, versus when they did not demonstrate learning. Conclusions. Participation in the mobile task may motivate more selective hip-knee control of infants at HRCP. Further research is necessary to determine if the mobile task has potential as an intervention to promote selective hip-knee control and improve future walking outcomes of infants at HRCP.

P1-A-16 Investigating motionese: analysis of kinematic characteristics of mother's movement while interacting with her infant

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Background and aims: When adults interact with very young children, not only they modify their speech (so-called motherese or infant-directed speech), but also, they modify their movements (so-called motionese or infant-directed-action). If the former has been well documented since last decades, recent attention has been paid to the latter. To date,

motionese has been mostly studied in demonstration/learning context. (e.g. Koberta & Iverson, 2009; Williamson & Brand, 2014) and to our knowledge, motionese in natural face to face interaction has not been studied yet. This is the main purpose of this study. More precisely, we focused on the kinematic characteristics of adult's movement during interaction by using a kinematic approach. Vaever, Krogh, Smith-Nielsen, Harder and Køppe (2013) were the first to use a kinematic approach to measure mother-infant spatial interaction to examine difference between typical mothers and mothers meeting criteria of postpartum depression (PDD). Less variability in spatial proximity has been showed for the PPD dyads. Thus, the present study aimed at describing the pattern of changes in kinematic characteristics of mothers' movement while interacting with her infant compared to while interacting with an adult. We hypothesized that the kinematic parameters (e.g. amplitude, distance, speed) would differ according the mother's interacting partner (infant vs. adult), providing evidence of motionese. Method: Four mothers of 10-12 month-old full-term infant were instructed to tell the Little Red Riding Hood using puppets to either their infant or to a female adult during a 5-min period. Four female adults were instructed to tell the same story to either the same infant or to the mother's infant. All adults were aged from 25 to 45 years old and were right-handed. To collect kinematic data of adult's movements, six-camera Qualisys Pro Reflex® Motion Analysis System (Sweden) captured adult's head and right wrist trajectories on the three axes (X, Y and Z). Two spherical infrared passive reflective markers (diameter= 10 mm) were used: One was placed on top of adult's head and the other was placed on adult's right wrist. Results Higher head and wrist movement amplitude were observed on the three axes when mother interacted with their infant than when interacting with an adult ($F\ 1, 6 = 13{,}3250$; $p = 0{,}01$ (head), $F\ 1, 6 = 13{,}2407$; $p = 0{,}01085$ (wrist)). No difference in movement speed has been found according to the mother's interacting partner. An unexpected result highlighted a difference in movement modification according to the adult "status" (mother of the infant or unfamiliar to the infant): While mothers increase their movement amplitude both on lateral and vertical plane, unfamiliar-to-the infant female adult, modify her movement amplitude rather on the horizontal plane ($F\ 2, 12 = 3{,}9523$; $p = 0{,}48$)

P1-A-17 Effect of optimal support on infant behaviors during development of sitting

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Background: During the first year of life, infants' learn to control degrees of freedom (DoF) in their trunk against gravity and perturbations. This acquisition of control does not occur all at once but progresses in a top-down fashion - first developing control over the head, followed by spinal segments in the upper trunk, then lower trunk, and then finally independent sitting. During this time, significant changes in biomechanics, behavior and neuromuscular control take place. In this study, we used an adjustable trunk stabilization device and frontal plane perturbations to investigate how infants respond behaviorally to two levels difficulty (more or less DoF to control) as independent sitting is emerging. Methods: Five typically developing infants were examined longitudinally from onset of head control (2 to 4 months) to onset of independent sitting (6-8 months). The Segmental Assessment of Trunk Control (SATCo) was used to determine the infants' segmental level of control (Butler et al 2010). External support was provided at the SATCo level (L1) and one level (~ 4cm) below (L2). The support levels gradually moved down from axilla to the pelvis throughout the longitudinal study. Infants were evaluated during quiet and perturbed sitting. Continuous pseudorandom tilts of a bench (2° and 8° peak to peak) were used to perturb balance across a range of frequencies. Data analysis: Variability of body sway was calculated using root mean square (RMS). RMS of body sway was used across trials to determine to the influence of the perturbations and across test sessions to determine the influence of emerging postural control. In addition to analyses of kinematic responses, we completed video behavior coding to identify "error" episodes when infants were not actively engaged in posture control (i.e., turning to look around, reaching for objects, slouching forward, etc.). This step allowed us to identify compensatory strategies and emergence of exploratory behaviors as infants interacted with external forces over time. Summary of data: RMS body sway responses were larger for support at L2 compared to L1. There was a decrease in body sway across sessions for the larger (8°) stimuli, suggesting a change in the way infants respond to larger perturbations as postural control emerges. The mean frequency of "error" episodes was larger when less trunk support was provided (15/trial for L2, 10/trial for L1). Duration (mean percent of trial with "errors") was also higher with lower support (54% L2, 23% L1). No overall difference in behaviors was observed when comparing the two perturbation amplitudes. Episodes of leaning forward and backward increased with age, crying decreased with age, and there was an abrupt onset of reaching and trunk rotation around 5 months of age (SATCo level ~Lower Thoracic). Conclusion: The effect of support level on behaviors was stronger than the effect of perturbation amplitude. Infants demonstrated noticeable compensatory responses to inadequate levels of support even when the external support was only lowered ~4cm. The ability to handle larger perturbations improves as postural control emerges and this is accompanied by increased exploratory behaviors during postural

testing. It is important to consider the level of support provided when observing behaviors in young infants.

P1-A-18 The impact of locomotive experience on infant spontaneous motor tempo from 4- to 33-months-of-age

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One of the simplest measurable rhythmic capacities is the ability to produce an internally generated regular beat. Understanding the development of Spontaneous Motor Tempo (SMT), or our natural rate of rhythmic movement (Fraisse, 1982), provides the opportunity to better understand the roots of our rhythmic predispositions. Across the lifespan, SMT is influenced by individual differences in age and body size, but little is known about the SMT of infants. In Study 1 we document the SMT of 115 infants from four- to 33-months-of-age, as measured by a free drumming procedure. Concomitant with the lifespan literature, we predicted that infant SMT would slow across the first years of life. However, we find that older infants show a faster SMT ($r(114) = -.279$, $p = .003$). Further, studies of adults suggest larger bodies prefer to move at slower rhythms. This relationship may be the product of biomechanics, or, effects may be driven by rhythmic experience, particularly vestibular, such as locomotion: Larger adults take longer steps, yielding slower walking cadence. We used infants, whose body size is dissociated from their predominant experience of locomotion as their parent often carries them, to test this argument. With parent body size measurements, infant body size measurements and infant age entered as predictors of infant SMT, the resulting model was significant ($F(6,55) = 3.321$, $p = .007$, $R2 = .266$). Infant Age ($\beta = -.459$, $t(55) = -2.596$, $p = .012$) and Parent Height ($\beta = .413$, $t(55) = 2.577$, $p = .013$; Figure 1) were significant predictors of SMT, such that the infants of taller parents drummed more slowly. Measures of infant body size did not predict infant SMT (all $p > .05$). The results support the idea that the rate of early rhythm may be set by the rate of the repetitive vestibular stimulation received by the infant when carried by the caregiver. In Study 2 we tested this hypothesis, manipulating infant SMT with novel carrying experience. Infants were tested with the free drumming procedure before and after ten minutes experience of being carried by an experimenter walking at a slower (98 BPM) or faster (138 BPM) than average tempo. We find that infant SMT is indeed differentially impacted by carrying experience dependent on the tempo at which they were carried: Infants in the slow-walked group exhibited a slower SMT from pre-test to post-test, whilst infants in the fast-walked group showed a faster SMT from pre-test to

post-test ($F(1,27) = 6.799$, $p = .015$, $\eta p^2 = .201$; Figure 2). Further, we measured infants heart rate before and after the carrying experience and do not see a change in arousal, with evidence supporting the null ($F(1,18)= 1.585$, $p = .224$, $BF10 = .263$). Taken together, our results illuminate how infant SMT changes as a result of age and experience. We argue that experience of being carried during caregiver locomotion is a predominant experience for infants throughout the first years of life, and as a source of regular, vestibular, information, may form the basis of their sense of rhythm.

P1-A-19 Sensorimotor activation in response to human action sounds: an EEG study in 14-month-old infants

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It is well known that listening to others' actions activates one's own sensorimotor system both in monkeys and human adults, and that this activation is somatotopically organized (Buccino et al., 2001; Keysers & Gazzola, 2006). Despite accumulating evidence of sensorimotor responsiveness to action sounds in adults (Lahav, Saltzman & Schlaug, 2007), information regarding sensorimotor activity is lacking in developmental samples. Mu rhythm suppression at central electrode sites is considered an index of sensorimotor cortex activation in response to visual and auditory representation of others' actions in adults. Some studies further suggest that mu rhythm suppression occurs in response to observation of others' actions already in infancy (Saby, Meltzoff & Marshall, 2013; de Klerk, Johnson & Southgate, 2015). This study aimed to determine whether the sensorimotor cortex is activated, and eventually somatotopically organized, during the perception of action related sounds in early infancy. Electroencephalography was recorded while 14-month-old infants listened to human action sounds (footsteps, clapping) and mechanical sounds (blender, engine). Time-frequency analysis was carried out on electrodes overlying the functionally defined hand (C3, C4) and foot (Cz) representation of the sensorimotor cortex. A repeated measures ANOVA showed a selective activation of the foot area in response to footsteps and a more widespread activation in response to clapping sounds confirming a sensorimotor activation in response to human action sounds. Specifically, the activation for footsteps in infants that are learning to walk might be due to the active motor experience contributing to the corresponding motor representation (Canon et al., 2014; Quadrelli & Turati, 2016). The wider activation in response to clapping might reflect the arousal elicited by the social connotation of the stimulus.

P1-A-20 Learning the Designed Actions of Everyday Objects

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How do young children learn to use everyday objects--doorknobs, latches, zippers, Velcro fastenings, and so on--in the ways the objects were designed to be used? Designed actions can be easy or difficult to implement (e.g., pushing a fire door vs. lifting up a garage door) and more or less hidden from view (e.g., press-turn-pull a pill bottle lid vs. lifting a sugar bowl lid). Although the designed actions for everyday objects seem obvious to adults, they are not necessarily obvious to young children. Surprisingly little is known about how young children learn to implement the designed actions of the objects that populate their everyday environment. We investigated the developmental progression in 12- to 36-month-old children's learning of the designed actions for two types of containers: clear plastic jars with twist-off lids and transparent Tupperware with pull-off lids. We hypothesized that the designed action of pulling is easier to discover than the designed action of twisting, especially because twist-off lids require arbitrarily turning to the left to open ("leftie-loosie, rightie-tightie"). Accordingly, we predicted younger children would display more non-designed, exploratory actions while trying to open the containers than older children. We varied container size to examine effects of the actor-environment fit on successfully implementing the designed action. We hypothesized that larger containers are more difficult to open because of a poor fit between children's hand size and lid size for twist-offs and the need to stabilize a large base against the table or their body for pull-offs. Results showed a developmental progression from non-designed, exploratory actions to discovery of the designed twisting or pulling actions to successful implementation. As shown in Figure 1 and 2, younger children showed a range of exploratory actions (rotating, banging, etc.) that diminished with age. Exploration decreased with age as discovery of the designed action increased. Successful implementation lagged behind discovery at younger ages. Children displayed the designed action but were still unsuccessful in opening the container. Why? For twist-offs, younger children often twisted to the right instead of the left, thereby tightening rather than loosening the lid; they did not persist in consecutive turns to the left; or they twisted back and forth, right and left. Moreover, larger twist-off lids were difficult to manipulate because children had to stretch their fingertips across the lid. For pull-offs, younger children did not consistently direct their efforts to the corners, and thus had difficulty

opening the lids. And larger pull-off containers required new strategies to stabilize the base, such as holding the container against the tabletop or their chest. Our findings provide insights into the perceptual-motor factors that facilitate children's discovery and implementation of the "hidden affordances" inherent in the artifacts of daily living.

P1-A-21 The combined assessment of both level and quality serve as early markers of later motor ability in toddlers born very preterm

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Background: Very preterm infants are at risk of later motor difficulties such as developmental coordination disorders and cerebral palsy. Identification of infants at risk is difficult but should increase the possibilities for interventions. Early motor ability is often assessed as achievement of milestones relative to age. Few methods integrate the quality of the movement, i.e. how a child achieves the goal. The Structured Observation of Motor Performance in Infants, SOMP-I, is a method in which both the infant´s level of motor development and the quality of the motor performance at that achieved level are taken into account. First, level of motor development is analysed in a structured, detailed manner, and then the infant's motor performance is assessed by comparing that performance to a pre-described definition of quality. Aim: To investigate the utility of a detailed assessment of the level of motor development together with an assessment of quality of motor performance in a group of infants born very preterm (VPT, <32 gestational weeks) in relation to later motor ability. Methods: SOMP-I assessments were performed at 2, 4, 6 and 10 months corrected age (CA) in a population-based cohort of 113 VPT infants, born 2004-2007 in Sweden. Result categories include adequate, slight and pronounced delay for level of motor performance and adequate, slight and pronounced deficit for quality of motor performance. The toddlers also underwent an assessment with the Bayley Scales of Infant and Toddler Development, BSID III (n= 99) at 3 years CA. Outcome was classified as BSID III motor index results, categorized as standard deviations (SD) in relation to a national control group: No negative motor outcome (i.e. ≥- 1 SD), Motor outcome between < -1 SD and -2 SD, Motor outcome < - 2SD, and Cerebral Palsy (CP). SOMP-I assessments and outcome were then related for each child individually. Results: Of the 99 children, 69 had no negative motor outcome, 16 had a BSID III motor index result <-1 SD to -2 SD, and 7 < -2 SD, another 7 had CP but were ambulatory. Five of the children with cerebral palsy performed < - 2 SD on the BSID III, one < -1 SD and one child with CP had normal outcome on the BSID III. In Figure 1, the

panels A through D represent the SOMP-I assessments at 2, 4, 6 and 10 months CA. For the 7 infants later diagnosed with CP (black dots), a majority of the assessments were in the categories slight or pronounced delay combined with slight and pronounced quality deficits. Infants who later performed < 1 or 2 SD on the BSID III (yellow and red dots) were primarily in the slight/ slight categories, while the infants with no negative motor outcome (green dots) were predominantly in the adequate or slight delays but adequate quality. This pattern became more obvious with increasing age. Conclusion: Assessing early motor performance in high-risk infants is complex. Many infants with later motor deficiency achieve an adequate level, but deviate in quality - or the other way around. Thus, including a detailed assessment of quality with the achieved level of motor development strengthens the conclusions the clinician is able to draw and functions as a support in identifying not only infants with later severe motor problems such as cerebral palsy but also other motor problems that may hinder further development. In addition, identifying quality deficits may serve as an aid in setting goals for the intervention.

P1-A-22 The crux of moving infants. Implications of movement exclusion criteria on infant EEG findings on action mirroring

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Since the discovery of mirror neurons, a rapidly increasing number of developmental EEG studies has investigated the ontogeny of action mirroring (Woodward & Gerson, 2014). This steadily growing body of research on action mirroring contributes significantly to the understanding of how action and perception are linked in early childhood. Crucially, all studies examining this fundamental issue, rely on the logic that infants' neural motor system is active when they are not acting themselves but observing others' actions. This logic poses particular challenges for any infant EEG study on action mirroring. That is, to provide interpretable results, any observation trial containing the infants' overt movements needs to be excluded because otherwise the neural response could be attributed to infants' own and not the observed action. Given the limits of constraining infants' movements during typical EEG recordings, extensive post-processing is necessary to exclude overt movements. Video-based movement coding, however is non-trivial, requiring extensive time and resources to code for and extract movement-contaminated trials. Still, there are no established standards in the field for how and which movements should be video-coded and excluded nor how to report them. So far, each lab relies on their individual protocol impeding comparability across studies. Despite its theoretical

importance and the immense resources spent on movement coding, surprisingly little is known about the effect of different types of movement coding on neural findings. In this talk, we will present a systematic investigation on the effect of movement coding on the results of an infant EEG study on action mirroring. We tested 58 9-month-olds (range: 8- to 10-months) in a live paradigm. With a 128-channel system, we collected EEG data while infants are grasping toys (execution) and observing an experimenter grasp toys (observation). The within-subjects design consisted of 20 trials per condition, each preceded by a baseline. The EEG data were time-locked to the moment of contact with the toy. Importantly, EEG sessions were video-recorded and coded offline separately for goal-directed grasping, fine and gross motor movement. To assess neural motor activity we analyzed infants' brain oscillations focusing on the alpha rhythm (Fox et al., 2016). We ran separate analyses for the different types of exclusion criteria (i.e. only excluding goal-directed grasping or excluding any movement during baseline and observation) for the first eleven participants with further analyses ongoing. As indicated in Figure 1, initial results suggest that while substantially more participants and trials remain in the analysis for the first criterion, mu suppression over sensorimotor areas (i.e. motor activity), is more pronounced for the second, more conservative criterion. Figure 2 illustrates how many trials are rejected dependent on different criteria. Implications for findings on infants' action mirroring will be discussed. In addition, we will share our coding scheme and suggest guidelines for how to code and report movements in infant EEG studies on mirroring. This is a first step to open up a broader discussion on movement coding with the long-term aim of defining widely-accepted standards making infant EEG research on action mirroring more comparable and meaningful.

P1-A-23 Exploration of familiar and unfamiliar tools in the first year of life

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Objective: Tool use in infants is a highly complex phenomenon and is dependent on several factors such as the perceptual properties of the tool, motor abilities of the infant, the infant's familiarity or prior experience with the tool, and functionality of the tool. The current study examined the effect of familiarity/prior experience on the visual and manual exploration of tools by infants during the first year of life. Further, we explored whether infants demonstrated any changes in tool exploration after observing adults using similar tools. Methods: Thirty-two 9-month old infants and thirty-two 12-month old infants explored two familiar tools (i.e. spoons) and two unfamiliar tools (i.e. peelers), both before

and after watching a video of tool use demonstration. The video included an adult hand approaching and demonstrating the grasp for each of the tools. The videos were shown on a remote eye tracker to obtain the percent duration of infants' visual fixations in areas of interest (AOIs) as they watched the videos. Additionally, infants' behaviors while interacting with the tools were coded. Repeated measures ANOVAs were used to analyze the grasping and looking fixations with age and gender as between-subject measures and timing (before vs. after video demonstration), grasp location (handle, usable), tool (spoon, peeler), and AOI (hand, handle, usable) as within-subject measures. Results: The ANOVA for grasping indicated significant timing x grasp location, as well as tool x grasp location interactions ($p<0.05$). Post-hoc t-tests revealed that regardless of the age, gender, tool, and the timing, all infants showed greater grasping of the tools' handles compared to their usable ends. Also, infants reduced grasping of the tool handle after compared to before watching the video demonstration. Additionally, infants showed greater grasping of the peeler's usable end compared to the usable end of the spoon. Conclusions: Overall, infants demonstrated functional grasping of familiar tools by holding them by their handles, as well as generalizing this learning to a comparatively unfamiliar tool. Secondly, infants show preferential looking at social stimuli, such as the moving hand in the current study compared to non-social stimuli such as tool parts. Lastly, there was no significant effect of watching the tool use demonstration on the grasping behaviors of infants, which could highlight the importance of active exploration over passive observation during the first year of life. We will discuss how these results fit into the literature on tool use in infancy as well as the possibility that when there is no clear goal for use of the tool, infants may grasp tools for the purposes of further exploration (e.g., grasping the usable end) in addition to more conventional handle-grasping.

P1-A-24 Sticky mittens reaching experience: linking behavioral changes to potential neural correlates

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Background/Aims: The sticky mittens paradigm provides a scaffolded, controlled experience for a motor skill prior to its typical onset by allowing non-reaching infants the opportunity to independently pick up objects using Velcro mittens and toys (Needham, Barrett, & Peterman, 2002). Research indicates that sticky mittens use can change infant object engagement and face preference (Libertus & Needham, 2010; 2011; Needham et al., 2000). To date, the neural mechanisms underlying sticky mittens-related changes are

relatively unknown. The current study aims to use EEG coherence as a measure of neural reorganization in relation to sticky mittens to help characterize the cascading effects of infant motor experience at the neural level. Higher coherence indicates greater synaptic connectivity between regions, while lower coherence indicates greater neural efficiency or regional differentiation, and thus greater maturation (Bell & Fox, 1996). Changes in EEG coherence are previously linked to shifts in motor skills, where greater motor experience is related to decreased coherence (Bell & Fox, 1996; Corbetta, Friedman, & Bell, 2014) Methods: Infants participated in a two visit study at 3 months of age. At visit 1, infants completed behavioral and EEG tasks including a four-step reaching assessment and collection of resting EEG. Infants were then randomly assigned to training groups: active training (AT) or passive training (PT). The AT group received Velcro-covered mittens and Velcro-covered toys that allowed the infant to pick up blocks independently. The PT group received toys with black tape attached in place of the Velcro which did not allow for independent reaching. Participants completed 10 minutes/day of AT or PT training at home for 2 weeks. Infants returned for visit 2 and completed the same behavioral and EEG tasks as visit 1 to assess changes within and between groups. Results: Data collection is ongoing (current N=8). Preliminary results from the reaching assessment indicate that behavioral data are trending toward replicating previous mittens findings comparing AT versus PT looking to the experimenter (Figure 1a), reaching and grasping (Figure 1b) and frequency of looking to toy (Figure 1c; e.g., Libertus & Needham, 2010). Preliminary baseline EEG coherence analyses indicate similar levels of EEG coherence between frontal (Fz) and central (Cz) sites at visit 1 for both groups. At visit 2, the AT group demonstrates a marked decrease in EEG coherence compared to visit 1, and compared to PT EEG coherence at visit 2 (Figure 2). Conclusions: Replication of previously reported behavioral outcomes indicates effective implementation of the sticky mittens paradigm. After sticky mittens experience, the AT group demonstrated decreased synaptic connectivity between frontal and central regions compared to AT group pre-sticky mittens coherence and also compared to the PT group. Thus, data indicates neural reorganization towards greater neural efficiency and regional differentiation for the AT group. Future analyses include EEG mu rhythm during infant observation of reaching, the negative central (Nc) component in relation to infant processing of dyadic and triadic social contexts, and behavioral changes in mother-infant interaction in relation to sticky mittens training.

P1-A-25 The relation between manual object exploration and predictive grasping in 9-month-old infants

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Several studies have shown that infants' fine-motor experiences facilitate the development of spatial cognitive abilities (for an overview, see Schwarzer, 2014). For example, 7-month-old infants with a high level of manual object exploration (Kubicek, Jovanovic, & Schwarzer, 2017) perform better in visually predicting the reappearance of a moving partly-occluded object as compared to infants with lower proficiency in manual exploration and crawling. The aim of the present study was to investigate whether there is a similar relationship between infants' manual exploration performance and their predictive reaching towards a moving target. Our sample consisted of 34 9-month-old infants. A new manual prediction paradigm was developed which was similar to that used by Kubicek et al. (2017). In this task, the infants were familiarized to an object moving around its horizontal axis. As the object was moving it uncovered the target objects, and stopped after a completing path of 90° around its horizontal axis (see Fig. 1). During this task we recorded the grasping movements of the infants with a video camera and a Vicon motion capture system and analyzed the manual prediction rates (the number of predictive grasping movements in relation to the total number of predictive and reactive grasping movements). All of the infants also participated in a manual object exploration task, in which they freely explored five toy blocks. We analyzed how often the infants explored the objects with their fingers (fingerings), transferred it from one hand to the other (transfers), or rotated the objects (rotations). Depending on their performance on this task, infants were assigned to different exploration categories (high vs. low exploratory activity) based on a median split. The results revealed that infants' manual prediction abilities were related to their frequency of fingerings, $F(1, 26) = 6.390$, $p = .018$, $\eta^2 = .197$. However, the frequency of transfers and rotations had no influence on infants' predictive performance (all ps > .05) (see Fig. 2). Taken together, our findings are in line with previous research that showed a relation between manual exploration and predictive abilities (e.g. Kubicek et al. 2017), especially with regard to fingerings. This seems plausible, given that during fingerings, the fingers follow the contours of an object, revealing information about its exact shape (e.g. Bushnell & Boudreau, 1993; Lederman & Klatzky, 1987). A focus on object shape, in turn, might sensitize infants to relevant spatial locations at which hidden parts of the object parts could be found.

B: Developmental Neuroscience

P1-B-26 Oxytocin Receptor Gene and Postpartum Depression: Correlation with Infant's, but not Mother's, OXTR Genotype

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Maternal depression in the postpartum period is associated with non-optimal parenting and elevated risk for a number of child-developmental problems. Individual differences in the kinds of stresses linked to maternal depression depend in large part on cultural and environmental factors, but these interpenetrate with biological factors. Oxytocin is a neuropeptide that plays roles in birth, lactation, parental care, and generally "pro-social" behavior. Variations in the oxytocin receptor gene (OXTR), located on gene 3p25, have been linked to psychological and behavioral differences. A single nucleotide polymorphism (SNP) in oxytocin receptor gene OXTR_rs53576 --involving a guanine (G) to adenine (A) substitution -- is associated with maternal sensitivity in dyadic interactions and with an elevated risk for maternal depression, but the latter effects have not been consistent. Although the "A" allele has been considered a risk allele for reactivity to stress, other research points to GG individuals as both more sensitive than A carriers and also more susceptible to depression, a possible emotional "price" for increased sensitivity. We characterized the OXTR_rs56576 genotype in 56 mother-infant dyads, in which the mothers also were assessed for depression (using both self-reports and structured clinical interviews), the infants were assessed for temperament (using the Infant Behavior Questionnaire; IBQ), and dyadic responsiveness was assessed during a free play interaction using the Emotional Availability Scales (EAS). Results showed a non-significant trend toward higher self-reported depression scores in mothers with the GG versus the AG or AA OXTR genotypes. A novel finding was that mothers of infants with the GG genotype were significantly more likely to report elevated symptoms of depression, as well as to receive DSM-IV Axis-I depression-spectrum diagnoses, relative to mothers of infants with AG/AA genotypes (for diagnoses shown in Table 1: Chi square = 7.84, p = .05). Hierarchical linear regression demonstrated that the association between infant genotype with maternal depression remained significant even after demographic risk factors correlated with depression and maternal OXTR genotype had been taken into account. Analysis of maternal reports of infant temperament using the IBQ revealed that self-reported and clinician-based indices of maternal depression were significantly positively correlated with maternal ratings of infant fussiness, but that infant fussiness was unrelated to maternal or infant genotypes. No other temperament scales correlated with either depression or OXTR genotype. There were no effects of maternal OXTR genotype on maternal sensitivity and structuring, or on infant responsiveness to the mother. Mothers of GG infants were rated as significantly higher on intrusiveness sub scale of the

EAS than were mothers of AA/AG infants, but maternal intrusiveness did not mediate the relationship between infant genotype and maternal depression. These results suggest that previous findings of a link between maternal depression and maternal OXTR genotype may have been inflated due to failure to control for infant OXTR genotype. How infant OXTR_rs56576 genotype relates to maternal depression is unclear, but these findings cast doubt on a mediating role for infant temperament and dyadic emotional availability.

P1-B-27 On rhythms and social learning: Neonatal medullary activity and motherese predict Mu rhythms at 8 years

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Infant-directed maternal speech, coined 'motherese', has been associated with social development. Infants show an early attraction for motherese, plausibly due to its efficacy in fostering social learning. Yet, the mechanisms involved are currently debated. Two key neurophysiological measures were recently suggested to serve a role in social learning; brainstem evoked responses- linked to mid-brain activity, and EEG Mu rhythm (alpha band activity in the sensory motor region). Taking a long-term follow up approach, the current study aims to explore how neonatal brainstem integrity and motherse are linked to EEG Mu rhythms at 8 years of age. Twenty-two participants were followed from preterm birth (GA = 32.5±1.2 weeks) through 8 years of age (mean = 8.5±0.8 y). Recordings of auditory brainstem evoked responses (ABR) were measured at birth followed by observation of a mother-child free-play interaction at 18 months, and finally EEG recordings at resting state were administered at 8 years of age. A multiple regression analysis predicting Mu activity was conducted with gestation age entered in the first step; and neonatal ABR inter-peak latencies I-III and duration of motherese during free-play entered in the second step. Results showed that neonatal ABR development and maternal speech at infancy significantly predict resting state Mu activity in 8 year olds ($R2=.451$, $p<0.01$). Findings suggest that early integrity of brainstem mid-brain development, along with maternal infant-directed speech are related to a child's later developing electrophysiological activity representing social understanding.

P1-B-28 The Development of Cortical Source Responses to Emotional Expressions in the First Year of Life

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Introduction: Facial emotional processing undergoes substantial development in the first year of life (Grossman, 2010; Leppänen and Nelson, 2009). The study of infants' ERP responses (e.g., the N290, P400, and Nc) to facial expressions has advanced our understanding of the neural correlates of infant emotion processing. However, limited information on the underlying cortical mechanisms can be inferred from the ERP activity on the scalp. The objective of the current study was to examine the development of the neural mechanisms underlying facial emotional processing during the first year using cortical source analysis with high-density EEG recordings. Method: The final sample included 137 infants who were tested at five (N = 44), seven (N =46), and twelve (N = 47) months. The participants were presented with images of female faces expressing angry, fear, or happy emotions (Tottenham et al., 2009) while their EEG was recorded with a 128-channel HydroCel Geodesic Sensor Net (Electrical Geodesic Inc., Eugene, OR). Cortical source reconstruction (CDR) of the ERP electrical activity was conducted with realistic (FEM) head models created with age-appropriate average MRI templates (Richards et al., 2015). The CDR amplitude (i.e., source power) was averaged across the N290 (190 - 290 ms) and the P400-Nc (300 - 650 ms) time windows respectively. The comparison of the CDR amplitudes between different emotional expressions was conducted for several brain regions of interest (ROIs) extracted from the LPBA40 brain atlas (Shattuck et al., 2008). Results: The fusiform face area (FFA) and the occipital face area (OFA) were observed to show greater responses to fear than happy faces in the N290 time window for the 12 months group (Figure 1), $F(2, 92) = 6.12$, $p = 0.0032$. This distinguished cortical response to fearful faces was not found at 5 months, and only a trend of the effect was found at 7 months. In addition, clear peak activity whose latency matches the N290 ERP latency was observed in the FFA (Figure 1) but not in other brain ROIs (Figure 2) at 7 and 12 months. A broader effect of emotion processing on cortical source activities was observed in the P400-Nc time window. Greater responses to fearful and angry than happy faces during this time were found in a number of ROIs in the temporal, occipital, and parietal lobes (Figure 1, 2) for all three ages. Discussion: The current results suggest that the early (N290) and late (P400-Nc) processing of emotional expressions might rely on distinct brain mechanisms. The enhanced N290 response to negative emotions is likely to be generated by the "face areas", whereas the P400-Nc effect might indicate an overall increase of brain

arousal that has a broad impact on a larger network. The current findings also suggest differentiated developmental trajectories of the mechanisms underlying the early and late processes of emotions. The mechanism underlying the "N290" process might start to emerge at 7 months but is not well established until 12 months. In contrast, the mechanism underlying the "P400-Nc" process might mature at an earlier age.

P1-B-29 Functional segregation of prefrontal and motor cortices across infancy is related to language competence in children

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The left prefrontal and motor cortices are thought to play important roles in language processing (Pulvermüller, 2005). However, the functional connectivity of these regions across infancy has not been thoroughly investigated. To address this gap, the current study examined longitudinal changes in left fronto-central EEG power and coherence across infancy in relation to early language competence. An overproduction of synapses followed by selective pruning of connections in early life is thought to foster the emergence and refinement of skills (Greenough, Black, & Wallace, 1987). Increases in EEG power have been observed across infancy consistent with widespread synaptogenesis (Bell & Fox, 1994). EEG coherence is considered an indicator of the functional association between separate neuronal populations (Thatcher, 2012). Increases in power and decreases in coherence over time would be expected to occur between proximal sites where the underlying cortical regions are becoming specialized for different functions. In previous studies, a lesser proportion of left fronto-central to fronto-parietal EEG coherence at 14-months was related to greater declarative gesturing and word production at 18- and 24-months (Mundy, Card, & Fox, 1999; Mundy, Fox, & Card, 2000), suggesting that functional segregation of left prefrontal and motor cortical regions supports language development. Thus, increases in frontal and central EEG power and decreases in fronto-central EEG coherence in the left hemisphere across infancy were expected to relate positively to language. Baseline EEG was recorded from 16 scalp locations at 5-, 10-, and 24-months (N=300); power and coherence from left frontal and central sites were focally analyzed in the 6-9 Hz developmental alpha band. EEG power and coherence composites were calculated by averaging frontal and central power values, and medial and lateral fronto-central coherence values in the left hemisphere at each age (Figure 1). Change scores were created by subtracting 5- and 10-month values from 10-

and 24-month values; positive values reflected increases. Toddlers' expressive and receptive vocabularies and MLUs were assessed at 24- and 36-months via maternal report or observation. A path analysis (Mplus, v.17) was conducted to examine their unique associations with developmental EEG changes controlling for demographics. Model fit was good (CFI=.99; RMSEA=.02). Changes in left fronto-central EEG power were positively associated with expressive and receptive vocabulary (Figure 2). Changes in left fronto-central EEG coherence were not significantly related to vocabulary sizes, but were negatively associated with MLU. In this study, different aspects of brain development were associated with different aspects of language competence in typically-developing children. That infants who exhibited greater increases in left fronto-central EEG power across the first 2 years of life had larger expressive and receptive vocabularies in early childhood suggests that neural processing in these cortical regions is important for learning what words mean. That decreases in left fronto-central EEG coherence were associated with larger MLUs, but not expressive or receptive vocabularies, suggests that functional segregation of these cortical regions may be important for learning to use words as tools to communicate. Findings underscore the importance of including measures of both power and coherence in developmental EEG studies.

P1-B-30 Emotional dummy? Implications of pacifier use for emotion face processing

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Facial mimicry, or imitation of another person's facial movements, is a social behaviour relevant for emotion resonance (Adolphs, 2002; Jones, 2006) and empathy. Research links this process with accurate decoding of emotional expressions and suggests that blocking face movements disrupts emotion recognition in adults (Oberman et al., 2007). Pacifiers (or dummies), which engage babies' lower face muscles, may have similar effects. They are widely used by parents as an emotion regulation tool and their continued use extends into critical stages of infants' emotional development (Campos et al., 2003). For example, recently research has shown a shift between 5 and 7 months in infants' attention towards fearful facial expressions (and away from happy) suggesting the emergence of neural mechanisms involved in processing fear (Peltola et al., 2009). Our research systematically explores the effects of pacifier use on emotion recognition at this sensitive period for face processing development. Event-related potentials (ERPs) were recorded while 7-month-old infants viewed static faces of women displaying happy and fearful expressions, using

a pacifier for half of the trials (N = 30/emotion). Amplitude of the N290 and P400 were calculated for both emotions and with or without the pacifier. We hypothesized that pacifier use would affect the N290 and P400 amplitudes for fearful faces, but not happy faces. Preliminary data analyses (N = 8 processed; 30 collected) revealed a small effect of an emotion x pacifier interaction on the N290 ($F(1,7)=.10$, $p=.76$, $\eta p2=.014$) and a medium effect of the interaction on the P400 ($F(1,7)=.957$, $p=.36$, $\eta p2=.12$) suggesting that pacifiers increase P400 amplitude to fear faces, but decrease the amplitude for happy faces (Figure 1). Data collection and processing is still ongoing; however, the current evidence suggests that pacifier use may impact the neural correlates of emotion face recognition, particularly in periods of plasticity for specific emotions (Peltola et al., 2009). This is the first systematic study of the effects of pacifier use on emotion face processing in early infancy and benefits from a within-subjects design. Additional planned analyses will further explore the individual differences in experience with pacifiers and their relation on face-related ERP amplitudes.

P1-B-31 Infant brain activation during gaze following; an fNIRS study

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Eye contact and mutual gaze have high social importance and are involved in many learning processes. From birth onwards, infants are focused on the eyes (Farroni et al., 2002). Moreover, 4-month-old infants and even newborns show a gaze cueing effect (Farroni et al., 2000; 2004), which means that even the youngest infants are able to shift their attention in response to an eye movement. Findings from child and adult fMRI studies indicated that the superior temporal sulcus (STS) is an important brain area for gaze following (Ethofer et al., 2011; Mosconi et al., 2005). Yet, which brain areas are involved in gaze cueing in infants is still unclear. Studies examining joint attention in infants point to involvement of prefrontal areas (Grossmann et al., 2010; 2013). The question remains whether these brain areas are also involved in the gaze cueing paradigm. We aim to explore which brain areas are involved in this process by conducting an fNIRS study, a suitable measure for infant brain imaging. We tested 10-month-old infants (n= 15) with a gaze cueing paradigm in a block design. The task consisted of two types of trials, which were either congruent (eye gaze in the direction where the target will appear) or incongruent (eye gaze in the opposite direction of where the target will appear). As a baseline, we used a period of 10s in between blocks in which we showed a

screensaver. Brain activation was measured with a 22-channel array over the right hemisphere, which covered pre-frontal areas to occipital areas, as shown in Figure 1. We analyzed two areas of interest, the STS area and the prefrontal cortex (PFC), in which we examined changes in oxygenated (HbO) and de-oxygenated (HbR) blood. Preliminary results revealed activation in both the STS and PFC areas for congruent trials, yet we only observed STS activation for the incongruent trials. When examining differences in activation between the two types of trials we found differences in both areas as well. For activation on channel level see Table 1. This first infant brain imaging study examining the brain areas involved in gaze cueing revealed that, regardless of congruency, gaze shifts elicit activation in the STS area. Differences between congruent and incongruent trials are observed in prefrontal (increased attention?) and more occipital (perceptual novelty?) areas.

P1-B-32 Perception of Facial Emotional Expressions during Infancy: A 6-month-old EEG and Schizotypy Study.

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Face-to-face interactions are critical for the development of social-cognitive abilities during infancy. This EEG study aims to investigate whether the influence of a parent's personality affects this early social-cognitive awareness during the first 6-months. Schizotypy is a dimension of personality which presents itself as a harmless manifestation along a continuum with the clinical disorder schizophrenia at its extremity. Individuals on the schizophrenia-spectrum demonstrate poor abilities to process facial emotional expressions (Van't Wout, 2007), and greater sensitivity to negative expressions (Evans et al., 2011). If deficits contribute to the development of psychosis by influencing the development of psychosis-like characteristics, they may also be observable in neurotypical individuals with schizotypal traits. Facial emotional expressions communicate important social signals that require accurate recognition, with neonates displaying the ability to detect this information in their first few days of life (de Haan, 2001). Thus, if face-to-face interactions are atypical, would this result in atypical social-cognitive development? Maternal parenting has a direct effect on determining the development and clinical outcomes of their infants (Wahlberg et al., 2004). If the parent illustrates schizotypy traits, will their infant display alternate ERPs alike to those displayed in the schizophrenia-spectrum? This research aimed to see whether 6-month-old infants of mothers with schizotypy display atypical negative-central (Nc) ERPs when presented with

happy and fearful faces. 71 infants were shown a series of standardised faces. It was hypothesised that the 22 infants of schizotypy mothers would be characterised by a disproportionately high exposure to negative facial expressions. This would therefore make positive faces more novel, influencing the Nc component, which is involved in automatic attentional orienting. A significant Nc effect of expression across left central ($F(1,69)=4.02$, $p= .049$) and left posterior regions ($F(1,69)=6.74$, $p=.012$) were observed, with a latency effect displayed predominantly across the right hemisphere ($F(1,69)=4.29$, $p=.042$). When differentiating between controls, intermediate, and schizotypy participants, a between-subjects effect of group was observed in the right central region for the Nc component ($F(2,68)=3.19$, $p=.047$); illustrating a difference between the perception of facial emotion expressions in 6-month-old infants. In addition to the Nc component, the N170 was significantly observed across the whole occipital area (left ($F(1,69)=10.08$, $p=.002$)-central ($F(1,69)=9.73$, $p=.003$)-right ($F(1,69)=8.44$, $p=.005$)), with an effect of the differing expressions illustrated consistently. The P600 demonstrated a significant effect of expression in the right posterior regions ($F(1,69)=6.18$, $p=.015$), and a significant slow wave effect across both left ($F(1,69)=9.60$, $p=.003$) and right posterior regions ($F(1,69)=6.06$, $p=.016$). It was predicted that the 6-month-old infants of mothers who demonstrate schizotypy scores would illustrate different ERP amplitudes compared to those of control mothers. The results indicate differential processing of the two facial expression conditions across a number of different ERP components. The Nc component displayed distinctions between control and schizotypy groups; suggesting that the infants' right-central Nc amplitudes were influenced by their mothers' personality status.

P1-B-33 Perception of occlusion of moving objects in young infants: A high-density EEG study

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Visual scenes in our daily life consist of several objects hiding behind and overlapping each other, yet we are able to perceive single items as enduring entities and meaningful units. While a great deal of behavioural studies using gaze and/or reaching movements have investigated the development of occlusion perception during infancy (e.g., Van der Meer, Van der Weel, and Lee, 1994), little is known about the development of mediating neural structures (Agyei, Van der Weel, and Van der Meer, 2016). In this study, electroencephalography (EEG) was used in six 8- to 12-month-old infants to study brain electrical activity as a function of perception of a temporarily occluded object. To record

the infants' brain signals, a Geodesic Sensor Net (GSN) 200 consisting of an array of 128 electrodes was used. The infants watched a red car moving along a rectangular path during which it disappeared twice behind a green occluder (see Figure 1A). Three different car speeds were included to vary the spatiotemporal information available in each trial so that the infants could not rely on an automated gaze shifting response. The car moved along the path in 2352 ms, 1802 ms, and 1486 ms for slow, medium and fast speed, respectively, and was occluded for 317 ms, 231 ms, and 155 ms. An infrared Tobii X50 camera was used to track the infants' gaze during the experiment. Frequency analysis (or temporal spectral evolution, TSE) was used to investigate the infants' induced brain activities. The eye data analysis showed that the infants tracked the car with saccadic eye movements in 65% of the trials, and used more mature smooth pursuit in 35% of the trials. The infants also showed a predictive gaze shift to the end of the occluder before car reappearance in just under half of the trials. Both smooth pursuit and predictive occluder tracking rely on the ability to anticipate future motion based on the representation and prediction of a continuous motion trajectory of a moving object (Rosander & von Hofsten, 2004). Before occlusion of the car, synchronized oscillatory activities were observed in the lower beta frequency band (see Figure 2A). During occlusion, the frequency analysis showed both desynchronized and synchronized neuronal gamma oscillations in response to occlusion (see Figure 2B). This may be interpreted as being related to the infants' mental representation of the occluded object (Kaufman et al., 2003; 2005). Synchronized gamma oscillations were observed after occlusion of the car (see Figure 2C). The results may contribute as further evidence for the use of different frequency oscillations during the processing of visual information before, during, and after occlusion for the control of prospective actions in infants.

P1-B-34 Development of diffuse optical tomography sensitivity in infants.

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'Near-Infrared-Optical-Spectroscopy' (NIRS) is a tool for neuroimaging in infant participants. NIRS measurement works by emitter/detector optodes placed on the scalp that measure reflected light from oxygenated / deoxygenated hemoglobin. Diffuse optical tomography (DOT) describes the scattering of light through the interior of the head. The sensitivity profile derived from DOT may be used to identify the underlying cortical anatomy that is reflected to the detector optodes. The current study used simulated photon migration methods to map the DOT sensitivity of infants in the first year. The DOT

sensitivity profiles were used to complement spatial projection methods for a comprehensive database of scalp-location-to-cortical-anatomy for infants. The DOT sensitivity volumes may be used for inverse modeling of cortical activity from NIRS recordings (e.g., Homer2 and AtlasViewer) for either individuals or average MRI templates from the Neurodevelopmental MRI Database. The structural MRI volumes came from individual infants and average templates (3, 4.5, 6, 7.5, 9, and 12 months; also 2, 4, 12, and 20-24 years) from the "Neurodevelopmental MRI Database". The DOT sensitivity was estimated on each MRI with photon migration simulation programs (e.g. MCX; tMCimg; MMC) by projecting 100M photons from scalp locations into a segmented MRI volume and recording the flux from the projection at each voxel in the MRI. The scalp locations were scattered semi-uniformly on the scalp (10-5 EEG placements). These locations were used as emitter/detector DOT channels centered on the 81 locations of the 10-10 EEG placement system. Figure 1 shows the fluence (summed flux) as a function of the distance from the 10-10 locations for a 6-month-old participant and for the average over all participants for this age. The peak, slope derivative location, and half-height-half-width location are marked on the graphs. These results imply that about 15-22 mm is the maximum depth sensitivity for NIRS recording (bottom panel); though this differs across the head (top panel). The fluence level was smaller and the sensitivity profile was flatter for emitter/detector distances from 30 to 40 mm, than from 15 to 29 mm. Figure 2 shows the avg peak depth for the MCX DOT sensitivity profile over age. There was a decrease in the depth of the peak location from 3 to 12 months, and this increased from 2 years through adults. The DOT sensitivity profiles were used to estimate the contribution of cortical ROIs to the NIRS signal recorded on the scalp. Stereotaxic atlas volumes were used to define the cortical ROIs. Several methods for detecting the ROI contribution were compared (location of max DOT. average DOT in 3 mm sphere, distribution of DOT sensitivity across ROIs). 'Lookup tables' were constructed that have anatomical locations from three stereotaxic atlases separated by each 10-10 location, age, average or aggregated individuals. There was good consistency for the ROis across the photon simulation methods, and DOT sensitivity locations. The DOT sensitivity profiles provided a quantitative measure of the photon sensitivity across the multiple ROIs for a single emitter/detector channel.

P1-B-35 NICU-related stress exposure, telomere length erosion and HPA axis stress reactivity in very preterm infants

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Background. Even in absence of severe morbidities, very preterm (VPT) infants (gestational age < 32 weeks) present a neurobehavioral immaturity at birth and they require long-lasting hospitalization in the Neonatal Intensive Care Unit (NICU). During the NICU stay, VPT infants are exposed to life-saving interventions which include invasive and painful skin-breaking procedures (i.e., NICU-related stress). This early exposure to NICU-related stress has been previously associated with dysregulation of the hypothalamic-pituitary-adrenal (HPA) axis in response to stressful conditions even later during infancy and childhood. Telomeres are repeat-sequence at the end of chromosomes, which shorten with age and are highly susceptible to early adversities: the exposure to early stressful conditions is associated with shorter telomere length (TL). Unfortunately, previous research did not assess longitudinally the association between NICU-related stress and TL in VPT infants. Moreover, the involvement of TL shortening on HPA axis dysregulation is understudied in VPT infants. Aims. In the present study, we assessed the association between (1) NICU-related stress and birth-to-discharge TL shortening in VPT infants and (2) TL shortening and HPA axis regulation at 3 months (corrected for prematurity). Methods. Leukocyte TL was assessed from cord blood at birth in 46 VPT infants and in a group of 31 full-term (FT) control infants, as well as at NICU discharge in VPTs only. NICU-related stress was measured as the number of skin-breaking procedures occurring throughout the NICU stay. HPA axis reactivity was assessed in the two groups at 3-month-age (corrected for prematurity) in response to socio-emotional stress elicited through the maternal Still-Face procedure. To assess HPA axis reactivity, salivary cortisol was obtained before (baseline) and after (+10, +20, and +30 minutes) the Still-Face procedure. Salivary cortisol was available for 23 VPT and 30 FT infants. HPA axis reactivity was measured as the highest post-stress salivary cortisol sample for each infant. Results. A significant difference emerged for TL between VPT infants and FT counterparts at birth, $t(75)=2.22$, $p<.05$. TL decreased from birth to discharge in VPT infants, although the change was not significant, $t(75)=1.78$, $p<.10$. The amount of NICU-related stress emerged as the primary predictor of TL erosion in VPT infants, even controlling for neonatal and clinical confounders, $R2=.27$, $B=-.11$, $p<.05$. At 3 months, VPT infants showed a blunted HPA axis reactivity to the Still-Face procedure, compared to FT infants, $t(51)=-2.22$, $p<.05$. The birth-to-discharge TL shortening in VPT infants associated with reduced HPA axis reactivity at 3 months, $R2=.55$, $B=-.76$, $p<.01$. Discussion. The present study confirms previous evidence of longer telomeres in VPT infants at birth compared to FT controls, presumably due to lower gestational age. Moreover, NICU-related stress emerged as a key regulator of TL erosion from birth to discharge in VPT infants. This biomarker of early

adversity in VPT infants appears to contribute to blunted HPA axis reactivity at 3 months. Future research is warranted to further explore TL erosion in VPT infants and the factors associated with individual differences in NICU-related stress susceptibility at the epigenetic level.

P1-B-36 Infant Temperament Predictors of EEG Frontal Activation Post-Still Face Task: Electrophysiology Behind Regulation

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The frontal electroencephalography (EEG) asymmetry patterns have been shown to represent individual dispositional differences, with greater right hemisphere activation linked to withdrawal behaviors and greater left asymmetry associated with approach. Whereas baseline asymmetry values are thought to represent trait aspects of emotional reactivity, responses in the context of experimental manipulations reflect state-related fluctuations in frontal activation. The latter can also represent markers of regulation, given that the experimental context requires the child to lower her level of arousal. One experimental manipulation has been considered a hallmark in eliciting regulatory responses in infants: The Still Face task, during which the caregiver disengages from the infant emotionally, physically, and verbally (Tronick et al., 1978). The post-Still Face recovery was also shown as informative with respect to regulation (Mesman et al., 2009), although EEG recording has not been conducted during this episode to date. In this study, we aimed to identify unique contributions of fine-grained infant temperament scales obtained via the Infant Behavior Questionnaire-Revised (IBQ-R; Gartstein & Rothbart, 2003) to the frontal EEG power value shifts post-Still Face task. Individual electrode power values, as opposed to traditionally utilized asymmetry scores, were considered because of concerns raised with the latter, essentially difference scores (e.g., Vuga et al., 2008). It was hypothesized that infants scoring higher on Extraversion/Surgency (ES) scales would display greater left frontal activation (lower power), with higher Negative Affectivity (NA) scores predictive of greater right frontal activation during the post-Still Face task. Higher scores on Regulation/Orienting (RO) scales were predicted to be associated with lower right and greater left frontal activity. Infant age and sex were also considered as covariates. Infants 6-12 months of age (N=33) participated in a 1-hour laboratory visit during which EEG signals were recorded, and their mothers responded to the IBQ-R. The post-Still Face task EEG recording was processed and analyzed according to standard procedures (Bell

& Cuevas, 2012), with left (F3) and right (F4) frontal power values natural log-transformed to normalize the distribution. Hierarchical multiple regression analyses revealed several ES scales as significant predictors of the right frontal region (F4) activation during recovery subsequent to the Still Face manipulation, when all scales were entered simultaneously. Higher Activity and Smiling/Laughter scales were predictive of greater right frontal activation/lower power values, whereas greater Vocal Reactivity was predictive of lower right activation post-Still Face task. Notably, greater Duration of Orienting scores predicted greater right frontal activation; greater Soothability and, marginally, Low Intensity Pleasure scores were associated with lower right frontal activation. No significant relations between NA scales and frontal activation were noted. This pattern of results is indicative of complex relations between infant temperament attributes and right frontal activation, as self-regulation is required in the aftermath of a social stressor, and should be examined further in future research. Overall, our results indicate that the fine-grained scales associated with ES and RO IBQ-R factors appear to be uniquely predictive of the right frontal activation.

P1-B-37 Investigating EEG Power as a Biomarker for Stress Exposure during the First Year of Life

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There is accumulating evidence that exposure to adversity during childhood (e.g., poverty, maltreatment, neglect, parental mental health problems) increases later risk for problems in learning, behavior, and health, in large part through the effects of chronic "toxic stress" on the body (i.e., prolonged activation of stress response systems that elevate heart rate, blood pressure, serum glucose, stress hormones, and inflammatory cytokines). Toxic stress exposure has been associated with short and long-term consequences including developmental delays, substance abuse, anxiety, and depression, which may arise from early alterations to developing neural circuitry that create a weak foundation for learning, behavior, and health. Crucially, the earlier in life adversity occurs and the longer it lasts, the more profound (and less recoverable) the negative effects. Prior studies have found, using electroencephalography (EEG), that infants and children from low-income households (Tomalski et al., 2013), and those who experienced extreme psychosocial adversity (e.g., Marshall et al., 2004), have reduced EEG power in high frequency bands

(e.g., alpha, beta, gamma) compared to infants who did not experience these stressors. EEG power may therefore provide a) a biomarker to identify children at risk for long-term effects of exposure to chronic stress, and b) a means to understand mechanisms by which stress impacts neurodevelopment. Currently, however, the unique impact of stress on neurodevelopment, especially during the first few months of life, is not well understood. The present study recorded baseline EEG longitudinally from a predominantly low-income sample of infants, a subset of whom were exposed to a range of early stressful experiences (e.g., parental unemployment, financial and housing insecurity, exposure to community violence). EEG was recorded when infants were 2 (n = 66) and 6 months (n = 68) of age while they watched a 5 minute video of moving infant toys with white noise audio sounds. Demographic information (e.g., income, education) was collected from families and maternal stress was assessed by self-report on the Perceived Stress Scaled (PSS). Spectral power was computed from the EEG signal and absolute power in six frequency bands (delta (2-4 Hz), theta (4-6 Hz), low alpha (6-9 Hz), high alpha (9-13 Hz), beta (13-30 Hz), and gamma (30-50 Hz)) was calculated and log transformed. Maternal PSS scores were negatively associated with infant EEG power in the beta and gamma bands at 2 months (beta: $r = -0.314$, $p < 0.05$, gamma: $r = -0.332$, $p < 0.05$) (Figure 1) and in the high alpha, beta, and gamma bands at 6 months (high alpha: $r = -0.347$, $p < 0.05$, beta: $r = -0.339$, $p < 0.05$, gamma: $r = -0.382$, $p < 0.05$) (Figure 2). In a linear regression model, maternal PSS scores negatively predicted beta and gamma power above and beyond family income, suggesting a unique contribution of stress on infants' neurodevelopment. We are continuing to follow these infants at 9 and 12 months of age to establish the stability of this pattern, examine emergent effects across the first year of development, and assess relationships to behavioral outcomes.

P1-B-38 Toddlers with ASD on the edge between hypersensitivity and hyposensitivity to social stimuli: an EEG study of voice processing

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Infant studies suggest that children at high risk for autism spectrum disorder (ASD) have an increased sensitivity to social stimuli compared to their low-risk peers, whereas results from older children point to a reduced neural response to social stimuli in participants with an established ASD diagnosis compared to typically developing (TD) children. To gain a better understanding of the transition from hypersensitivity to hyposensitivity to social stimuli, including speech, we ran an EEG study in toddlers with a clinical diagnosis of ASD.

We collected EEG data from 14 children with ASD (2 girls, mean age 39 months ± 6) and 16 TD controls (5 girls, mean age 34 months ± 12) who heard auditory stimuli while watching age appropriate movies. The experimental task was a passive oddball task with two types of target sounds (speech vs. non-speech: vowel /i/ or 800 Hz complex tone, 10% of occurrence each) and two conditions (train of speech sounds vs. train of non-speech sounds: vowel /a/ or 500 Hz complex tone, 80% of occurrence). Stimulus durations was 200 ms, and stimulus onset asynchrony was 700 ms. A ROI was defined that included Fz and Cz electrode sites, and task effects were examined for the average magnitude of three ERP components: P1 (100-300 ms), P3 (300-450 ms) and N4 (450-600 ms). In the P1 time-window we did not find any main effects or interactions. To compare our results with those of Whitehouse and Bishop (2008), who used a similar paradigm with older children (mean age was 10:4 years), we conducted an independent samples t-test to compare the response to the standard sounds in the two groups, and replicated the original finding of a reduced P1 response to repeated voice sounds in children with ASD already at a younger age, $t(28) = 2.268$, $p = .031$. In the P3 time-window we found a marginally significant TARGET X CONDITION X GROUP interaction, $F(1,28) = 4.110$, $p = .052$. The TARGET X GROUP interaction was significant in the non-speech condition, $F(1,28) = 9.646$, $p = .004$, in which the response to novel speech sounds was different in the two groups, $t(28) = -2.545$, $p = .018$, with a more positive P3 in the ASD group than the TD group. In the N4 time-window we found a significant TARGET X GROUP interaction, $F(1,28) = 7.085$, $p = .013$, triggered by the effect of TARGET in TD children, $F(1,15) = 6.444$, $p = .023$, who had a stronger negative deflection in response to speech sounds. Additional data from structured and semi-structured observations is currently being analysed to explore possible correlations between the brain response to speech sounds and behavioural or cognitive traits, like expressive and receptive language development (as measured by specific subscales of the Mullen Scales of Early Learning), ASD symptomatology (as observed in the Autism Diagnostic Observation Schedule), and non-verbal communication skills (as measured with the Early Social Communication Scales, Mundy et al., 2003). Our results suggest that toddlers with ASD are at a critical point in their developmental pathway, as they show both increased attentional orienting to language stimuli and a tendency to suppress the sensory processing of speech (suggested by the reduced P1 component to repeated speech sounds). Importantly, in young children with ASD the orienting advantage to speech sounds seems not to be relevant for further cognitive processing: the strongly reduced N4 component may in fact point to a failure to categorise speech stimuli as such.

P1-B-39 Effects of visual and auditory trajectories (towards or away from the observer) on visual ERPs in 5- and 9-month-old infants

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The ability to detect the trajectory of moving objects, typically signalled by visual or auditory cues, is highly adaptive and particularly important for both defensive and interactive behaviours (de Vignemont & Iannetti, 2015). Given the fundamental importance of perceiving object trajectories for physical and social interactions, this is an area of importance to address in early development. In this study, we investigated the neural correlates of the perception of visual and auditory trajectories in infancy, specifically at 5 (n = 20) and 9 (n = 18) months of life. We chose these ages as they correspond to the achievement of two important milestones in the motor development, i.e. the mastering of reaching and grasping abilities (Konczak & Dichgans, 1997; von Hofsten, 1991; von Hofsten & Rönnqvist, 1988), which could play a role in the perception of the trajectories of moving objects. We recorded the spontaneous electrical brain activity of the infants while they were attending auditory and visual stimuli simulating motion either approaching them or receding towards the background. Each experimental trial started with the presentation of a visual attention getter, with the aim to attract the infants' attention to the screen. This was followed by the appearance of a black rectangle on a light background. The rectangle stayed on the screen for the whole duration of the trials, serving as a common visual environment between the visual and the auditory trials, presented 100 ms later. In fact, the visual stimuli appeared within the rectangle, while the auditory stimuli were played by a loudspeaker positioned behind it. We looked for effects of: i) the modality of presentation of the moving stimuli and, ii) the direction of the trajectories of the stimuli (approaching vs. receding) on visual evoked potentials (VEPs) recorded form a cluster of 7 electrodes located over occipital sites in response to the appearance of the black rectangle. In both age groups, we obtained the individual mean amplitude of the early event related potentials recorded over these channels. Five-month-old infants' VEPs (Fig. 1) showed that the amplitude of the first positive peak in the recorded waveforms (78-120 ms) was influenced by the perceived direction of the stimuli, being larger for approaching vs. receding stimuli, in accordance with a few findings on adults showing a smaller amplitude of the P100 in response to behaviourally salient stimuli (Vagnoni, Lourenco, & Longo, 2015). Crucially, the modality of presentation of the stimuli did not have any effect on the amplitude of this peak, indicating that putative VEPs

were similarly influenced by the direction of both visual and auditory stimuli, irrespective of the modality of presentation. In 9-month-old infants, instead, the amplitude of the first positive peak (70-130 ms) seemed to be modulated by the perceived direction of the visual stimuli only (Fig. 2). These findings lend support to the proposed role of primary sensory cortices in processing inputs from multiple sense modalities (e.g., Driver & Noesselt, 2008; Ghazanfar & Schroeder, 2006), and extend such observations to infants in the first half year of postnatal life. Here we have found that auditory influences on visual processing appear to decline in the first year of life, which supports arguments that early postnatal multisensory development is characterised by the pruning of crosscortical connections (e.g., Maurer, Gibson, & Spector, 2012).

P1-B-40 Infant Use of Functional Categories for Object Individuation

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Introduction: Object individuation is the ability to recognize whether two objects, seen at different points in time, are the same object or two numerically distinct objects (Wilcox, 2003). Previous literature has shown that infants are sensitive to the functional properties of objects as early as four months old (Stavans, & Baillargeon, 2016); however, it is not until about 12 months that infants categorize novel complex objects based on function, and it is unclear when infants use functional categories to individuate objects (Träuble, & Pauen, 2007). This study evaluated the development of infants' ability to individuate objects on the basis of a functional category to which the object belongs. Methods: Infants aged 3 to 8 months (n = 51; M = 162.88 days; range = 91- 253 days) and 12 to 18 months (n = 85; M = 466.67 days; range = 364-562 days) with 60% male (n = 81) were shown videotaped events and looking behavior was recorded using a Tobii eye tracker. Infants were assigned to one of two conditions: category or no category. Infants in the category condition saw two familiarization trials (Fig 1a): one trial displayed three exemplars of a tool that rolled; the other displayed three exemplars of a tool that cut. This provided the opportunity for infants to form a "roller" and "cutter" category. Next, infants were presented with an individuation task in which a novel exemplar of a roller and a cutter were seen to opposite sides of the screen and then the screen was lowered (Fig 2). Duration of looking to the center of the platform in the final phase of the test event was recorded. Infants in the no category condition were tested using a similar procedure, except that the familiarization trials contained mixed exemplars, so that category formation was hindered (Fig 1b). If infants build a functional category during the

familiarization trials, and then individuate the test objects on the basis of these categories, they should expect to see a second object behind the lowered screen in the final phase of the test event. Results: For the older age group, the infants in the category condition showed longer looking to the center of the platform during the final phase of the test event than the infants in the no category condition. This outcome suggests that the infants in the category condition (but not the infants in the no category condition) formed a functional category during the familiarization trials, individuated the objects in the test event, and found the presence of only a single object in the final phase unexpected. In contrast, the younger infants in both conditions failed to show prolonged looking to the center of the platform during the final phase. Conclusion: Infants aged 12 to 18 months are more likely to individuate on the basis of category, or kind, information than infants 3 to 8 months. This joins a growing body of work demonstrating emergence of individuation-by-kind later in infancy and reveals conditions under which this capacity is supported.

P1-B-41 Electrophysiological learning markers in infants with macrocephaly: An EEG pilot study

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Introduction and Hypotheses: Macrocephaly is defined by an head circumference (HC) of more than two standard deviations above the mean. The consequences of macrocephaly on brain function is unknown, however, increased HC has been associated with reduced long-distance connectivity in the brain, enlargement of the brain structures and greater conduction delays of neural responses (Changizi & Shimojo, 2005; Karbowski, 2003). Noteworthy, macrocephaly is thought to be a biomarker of ASD, some ID, and some ADHD symptomatology (Courchesne, Carper, & Akshoomoff, 2003; Rommelse et al., 2011). The purpose of this study is to examine how abnormal variations of HC affect brain responses of the repetition suppression (RS) phenomenon during the first year of life. This mechanism is linked to learning abilities and is a sign of a typical neurodevelopment. RS can be assessed by looking at the brain response amplitude following the presentation of a repeated stimulus. We posit that the brain response is altered in infants with macrocephaly in the first year of life, babies with abnormal HC will show an atypical mechanism of RS. Methods: A sample of 40 babies (6-10 months) has been recruited (20 controls, 20 macrocephalics). EEG recordings have been done in an infant-friendly setting

at CHU Sainte-Justine which includes a soundproof room with a 128 electrodes EEG system (Electrical Geodesics System Inc.). The stimuli presented is four frames of a male and female face during the articulation of vowel /a/ (3 presentations) who is normally supposed to trigger the RS response. We analysed RS on the P2 and N2 components by looking at the latency and the amplitude of the EEG signal. Using the data of 16 babies (8 macrocephalics), a repeated measures ANOVA has been performed on the event-related potentials data in order to analyse the brain responses. Preliminary results: In the control group, we observed a statistically significant (SS) decrease in latency for all of the components (Table 1). For the amplitude, P2 decrease is statistically significant ($p<0.05$), but the N2 did not show significant changes (Table 1). In the macrocephalic group, N2 showed an repetition enhancement instead of a RS (Table 2). However, P2 revealed a normal RS with a diminution of latency and amplitude (Table 2). Conclusions: The results of this research suggest RS is atypical in infants presenting with a macrocephaly. It seems pertinent to pursue our research in order to determine precisely how atypical brain growth impacts on development. It would be important to follow the evolution of the macrocephalic children to see if their atypical RS is linked to their cognitives abilities. It is crucial to identify biomarkers of atypical neurodevelopment as early as in the first year of life. Head Circumference (HC) measuring and head growth evaluation constitute simple and inexpensive tools to assess the development of the central nervous system and may identify neonates at risk of NDs (Garcia-Alix and al., 2004).

P1-B-42 Prolonged Auditory Brainstem Response in Newborns with Autism Spectrum Disorder

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Background: Autism spectrum disorder (ASD) is a neurological disorder that is characterized by impaired social interaction and communication and stereotypical behavior such as adverse response to specific sounds. The prevalence of ASD is estimated at 1 in 68 children and the median age of behavioral diagnosis is 4.1 years. Detection of increased risk for ASD via biomarkers may allow earlier diagnosis and treatment, which is associated with improved outcomes. One promising biomarker is auditory brainstem response (ABR). ABR is an event related potential test that records the brainstem-evoked response to a sound stimulus. The test is quick and non-invasive and it is routinely used to screen hearing impairment on newborns in hundreds of hospitals across the United

States. Recent studies showed prolongation of the ABR in infants later diagnosed with ASD. Those studies examined a small group of infants that were mostly born premature. No study to date has examined the relation between ABR and ASD in a large cohort of newborns from the general population. Method: We retrospectively examined ABR records from hearing impairment screening of the general population, performed between 2009-2014 by MEDNAX® at 35-decibels above normal hearing level using the SmartScreener-Plus2. We found 8,511 records for newborns who passed the hearing test during their first week of life, 21 of which were later diagnosed with ASD according to the University of Miami-Center for Autism & Related Disabilities database. The ABR wave V latency for left and right ears was compared between the ASD group and the remaining newborns, which served as controls. Mean group differences were examined with a t-test. Result: The age range of both groups was 0-6 days. The ASD group consisted of 24% females, while the control group had 50% females. Wave V latency was significantly prolonged in ASD compared to controls in the left ear (ASD: mean= 8.94 milliseconds (ms), SD= 0.9; Control= 8.41 (ms), SD=0.7; Cohen's d=0.69, t = 2.6, p=0.018) but not in the right ear. Conclusion: Prolonged ABR was shown in newborns with ASD using a general population cohort which suggests that the prolongation is not limited to preterm infants. Further replication on larger samples is needed to examine the potential of prolonged ABR as a biomarker for ASD risk.

P1-B-43 Hyperscanning of mother-infant brains: synchronized cerebral activities during interaction

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Human social activity is a continuous dynamic behavior consisting of live social signal exchanges; thus, studying interaction between multiple humans is critical to understanding social cognition. Indeed, social neuroscience focusing on such aspects - interactive social neuroscience - is emerging field of interest. Functional Near-Infrared Spectroscopy (fNIRS) has played a significant role in accelerating this field by enabling real-world neuroimaging for various populations. By employing fNIRS based hyperscanning, the present study measured brain activity in mothers and 3- to 4-month-old infants under three conditions, one of which included interaction between mother and infant. Methods: Among 50 mother-infant dyads participated, data set of 36 dyads (20 girls, infants' averaged age = 121days-old ±17, mother's averaged age = 33years-old ±4), which had 4 minutes of clean signals without artifact for each session, were included in

the final data set. Cerebral hemodynamic changes in mother-infant dyads were measured with fNIRS (Hitachi ETG-7000) under three conditions: i.e. (1) breast feeding, (2) resting state during mother holding her sleeping infant and (3) resting state during separation (control). Bilateral temporal area and frontal areas were measured using 44 channels (CH) for both the mother and the infants. Each condition lasted more than 5minutes. Along with fNIRS experiment, we tested infants' general development using Kyoto Scale of Psychological Development. We also asked mothers to fill in three standardized questionnaires, that were Temperament Character Inventories (TCI) for mothers and infants and Postpartum Bonding Instrument (PBI). After preprocessing the data with the hemodynamic modality separation method (Yamada et al., 2009) and Kurtosis-based wavelet filtering, we applied wavelet transformation to the mother and infant data. Then we decomposed each CH data into 10 frequency bands (88CH X 10 = 880 bands), to which we applied non-negative matrix factorization to extract 50 shared components across mother and infant. For these components, we compared signal amplitude between Holding and Control, and between Resting and Control. Results and Discussion: There were no stronger synchronized components for Holding condition than for Control. Strong synchronizations were mostly found within mother's single brain. Namely, mother showed enhanced synchronization (connectivity) between aOFC and frontal pole and between R-STS and R-IFG. The latter connectivity was positively correlated with PBI score ($p<.05$). On the other hand, Breast feeding condition connected mother and infant brains; stronger synchronization between mother's R-DLPFC and dmPFC and infant's frontal areas including aOFC, R-IFG and dmPFC were observed. This inter-brain connectivity amplitude was positively correlated with infant's RD score (TCI) which reflects emotional sensitivity ($r=0.63$, $p<.01$). Our fNIRS hyperscanning study successfully detected inter-brain synchronized activity between mother and infant during breast feeding. Because synchronized brain areas were related to the social brain network, this synchronized activity may reflect social attachment between mother and infant.

C: Perception

P1-C-44 An own-race specific relation between category formation and scanning of face race at 6 and 9 months of age

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Prior studies have found that experience with own-race faces shapes the development of category formation for faces and scanning of faces in infants. For example, Caucasian infants develop different category structures for own-race Caucasian faces and other-race African or Asian faces (Anzures et al., 2010; Quinn et al., 2016). Infants also come to scan own- and other-race faces differently: Asian infants maintain fixation time on the nose region of own-race faces from 4 to 10 months, but exhibit decreased fixation time on the nose region of other-race faces (Liu et al., 2011). However, the relation between category formation and scanning for own- and other-race faces is unclear. The current study therefore focused on the relation between category formation for face race and eye movement patterns in 6- and 9-month-olds. We tested 43 six-month-old (own-race condition = 21, other-race condition = 22) and 41 nine-month-old (own-race condition = 17, other-race condition = 24) Asian infants. In the own-race condition, infants first saw 3 own-race female faces. Each face appeared on the left and right sides of a screen for 15 seconds. The 3 faces were presented consecutively twice for a total of 6 trials. Following familiarization, category formation was tested with two new female faces, one each on the left and right sides of the screen. One face was from the familiarized Asian race, and the other face was from a novel race (African). The procedure of the other-race condition was identical to that in the own-race condition, except that infants were familiarized with African faces. A visual preference for the novel race should be observed if infants formed a category of the familiarized race. An eye tracker was used to record infant looking behavior. Both 6- and 9-month-olds exhibited a novel category preference for face race in the own- and other-race conditions (ps <= .051, Figure 1). No difference of age or familiarized race was found for the novel category preference. This result indicated that the infants were able to form the category distinction between own- and other-race faces. By examining the relation between visual attention to own- and other-race faces and category formation, we found that nose looking time in the test phase positively correlated with category formation based on face race (i.e., novel category preference), which was specific to the own-race familiarization condition (r[6-months] = .47, p = .034; r[9-months] = .50, p = .039), but not the other-race familiarization condition (r[6-months] = .29, p = .184; r[9-months] = .05, p = .816, Figure 2). A possibly related finding is an advantage in looking time to the eye region of other-race faces in the familiarization phase (M = 48.09%, SE = 2.30%), as opposed to that of own-race faces (M = 41.33%, SE = 2.61%). The results indicate an own-race specific relation between face scanning and category formation based on face race in the first year of life. The findings suggest that perceptual experience not only shapes category formation for and scanning of faces, but also their interconnection.

P1-C-45 iTemplate: A template-based eye movement data analysis approach

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Eye tracking is widely used to study the development of perceptual, cognitive, and learning process in infancy. The ability to obtain accurate eye movement measurements is crucial for correct interpretation. However, measuring infants' eye movement is challenging and often noisy due to measurement errors. Some of the errors is due to the nature of infants, who are less likely to keep their heads still throughout an experiment session. Moreover, the current method for eye movement analysis also contributes to the measurement errors. This is mainly due to the fact that the current method relies heavily on manual operations, which are not only slow, but also subject to human errors, which are practically unable to detect or correct. Thus, to achieve reliable and accurate eye movement measurements, one needs to revolutionize the current manual-based analysis approach. To this end, we propose a novel template-based eye movement analysis approach, which not only reduce analysis errors substantially, but also improve analysis efficiency greatly. We also created a software with graphic user interface to implement this analysis approach. Current eye tracking analyses relies heavily on Areas of Interests (AOIs), in which researchers define meaningful regions on stimuli (e.g., the eye region on faces). However, AOI definition is based on subjective judgement to determine the size, shape, and location. Given the fact that studies usually include multiple stimuli (e.g., multiple face images used in one experiment), researchers need to create a unique set of AOIs for each stimulus, which introduces additional errors among the sets of AOIs in terms of the size, shape, and locations. These manual operations inevitably lead to errors in eye movement measurements that are based on AOIs, which further affects the accuracy of subsequent data interpretation and comparisons among studies. To resolve this issue, we proposed a novel template-based approach for analyzing eye movement data. Specifically, we used linear transformation to register every experiment stimulus to a template space through spatial registration. For example, registering idiosyncratic face images to a template face (Figure 1). The registration process generates a series of transformation matrices used to define the transformation. Given the fact that eye tracking coordinates share the same spatial coordinate system as pixels of each stimulus, eye tracking data (e.g., raw sample data & fixation data) can be registered to the same template space with the transformation matrices derived from registering each individual face images. Thus, after the transformation, all eye movement data originally from different stimuli would be registered to a single template. The fact that all eye movement data are registered to a template enables serval unique advantages: 1) only one set of

AOIs is required to process eye tracking data from different stimuli. This not only eliminate the errors among creating multiple sets of AOIs, but also boosts the data processing efficiency. 2) eye movement data from studies using different stimuli can be compared directly after being registered to the same template; 3) bridge advanced eye movement data processing methods (e.g., iMap), allowing examining eye movement at a fine-grained level, rather than at regional level. In sum, iTemplate would benefit our eye movement community greatly with these advantages. GitHub: https://github.com/DrXinPsych/iTemplate

P1-C-46 Individual differences in statistical event segmentation relate to vocabulary knowledge

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Events are continuous, with no reliable breaks in motion to mark beginnings and endings of actions. Infants can uncover structure in novel events by detecting statistical patterns that distinguish action units from non-units (Roseberry et al., 2011; Stahl et al., 2014). Finding event units would seem to contribute to lexical acquisition, just as speech segmentation serves as a prerequisite for language development (Newman et al., 2006), yet no research has tested that assumption. Do individual differences in children's action segmentation abilities relate to their vocabulary knowledge? Three-year-olds (n=54), who generally have vocabularies that contain many words describing relational events, participated in a statistical action segmentation task followed by assessments of verbal and non-verbal outcomes. The segmentation task began with children viewing a 126-second video displaying a statistical sequence of human body actions (Figure 1). The sequence included twelve distinct actions grouped into four units (i.e., triads), each with transitional probabilities (TPs) of 1.0. Additionally, the sequence arrangement formed part-unit triads, spanning the last action of one unit and the first two actions of another unit (Aslin et al., 1998; Saffran et al., 1996). Part-units had TP of 0.5 between the first and second actions and TP of 1.0 between the second and third actions. Non-unit triads were novel orderings of three actions from the sequence, with TPs of 0.0, created just for the segmentation test. The segmentation test utilized a split-screen preferential looking paradigm and contained six test trials (Figure 2). Children viewed an action unit or part-unit presented on one side of a screen and a non-unit on the other side, and were asked, "Which video do you remember seeing?" The proportion of looking to units vs. non-units was averaged across trials as the dependent variable. Language outcomes in vocabulary

and syntax were assessed through the Quick Interactive Language Screener (QUILS; Golinkoff et al., 2017). Non-verbal visual-spatial working memory skills were evaluated through the Zoo Locations subtest of the WPPSI-IV (Wechsler, 2012). Controlling for age, working memory, and language syntax, individual differences in children's performance on the action segmentation task accounted for 11.4% of the variance in vocabulary, $F(1,49) = 11.64$, $p < .01$. Segmentation scores were related to working memory skills but were not related to language syntax. These findings are the first to reveal a link between event segmentation and lexical development. Statistical learning is a potent mechanism that may enable streams of events to be reliably unitized for word learning. Future research is necessary to evaluate how event segmentation could facilitate word learning, particularly for terms describing dynamic events such as verbs.

P1-C-47 Adaptation to gaze direction in children at high- and low- risk for autism spectrum disorders (ASD): An ERP study

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Predictive Processing accounts of autism spectrum disorders (ASD) posit that individuals with ASD rely less on expectations than those without ASD when it comes to interpreting incoming sensory information (Pellicano & Burr, Trends in Cognitive Sciences, 2012; van de Cruys et al., Psychological Review, 2014). This difference has been proposed to originate from those with ASD having weaker expectations overall (Pellicano & Burr, Trends in Cognitive Sciences, 2012) or from a tendency to over-adjust expectations in response to even slight violations (van de Cruys et al., Psychological Review, 2014). Since these expectations are claimed to underlie all perception, any differences in how they are formed or adjusted should be persistent across multiple cognitive domains and detectable much earlier than clinicians can currently diagnose ASD, around 3 years of age. This experiment is part of a longitudinal prospective study of young children at increased familial risk of ASD. Around 20% of these high-risk children will receive an ASD diagnosis themselves, compared to 1% of the general population. The current combined EEG and eye-tracking study used an adaptation paradigm (Jenkins, Beaver & Calder, Psychological Science, 2006) to investigate whether a reduced effect of expectations is already present in high-risk 2-year-olds, before ASD can reliably be diagnosed. Participants saw a previously published stimulus set and procedure (Jenkins et al., Psychological Science, 2006; Pellicano, Rhodes & Calder, Neuropsychologia, 2013). Participants were first familiarised with the stimuli, which consist of models looking to the left, right, or straight

ahead. Participants were then adapted to one extreme gaze direction in block 2, which biases perception of later stimuli in typically developed children (Pellicano et al., Neuropsychologia, 2013) and adults (Jenkins et al., Psychological Science, 2006), but to a much lesser extent in children and adolescents with ASD (Pellicano et al., Neuropsychologia, 2013). In block 3, participants were shown test stimuli with various gaze directions and their EEG responses were recorded to examine the influence of the adaptors on subsequent perception. High-risk children are expected to differentiate less between the adapted and the unadapted direction in block 3 than typical children, as indexed by smaller ERP-amplitude differences between conditions in the N290 face-specific component (the infant equivalent to the adult N170) and the P400 component which has been observed to be modulated by gaze direction. This would indicate that the high-risk group adjusted their expectations less based on the adaptation block, and that their perception was less biased by the adaptors. Preliminary analyses indicate that the high-risk group actually differentiates more between the adapted and unadapted gaze directions. There seems to be a differential P400 response to adapted and unadapted stimuli, which appears to be modulated by risk group. These analyses are based on an initial subsample of 16 children (9 high-risk; 7 low-risk) and the full sample will be presented at the conference. Predictive Processing ideas are new to developmental science, and discussions are only just beginning about how expectations are formed and adapted in typically developing infants. Understanding how this works in atypical populations will provide a useful contrast and highlight the conditions required for such mechanisms to function successfully.

P1-C-48 Real-world scene perception in infants: What factors guide attention allocation?

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Introduction: Interpretation of visual attention during unconstrained free-viewing tasks represents an important theoretical challenge towards understanding perceptual development in infants. Method: In this study we modeled the foci of visual attention as a function of general exploration strategies, scene characteristics, and differences in attentional control between infants (N = 45, age range = 3 - 15-month-olds). See Figure 1 for a schematic representation of the different factors that were measured in this study. We used a novel analysis approach that allowed us to simultaneously incorporate these factors, measured on different levels (i.e., the location, the scene and the individual) and

assess their predictive value, while accounting for the influence of the others. Results: The results (see Table 1) show that general exploration strategies are the best predictor of where infants look, followed by perceptual salience and semantic information. Semantic information was also a better predictor of the foci of visual attention in older than younger infants. In a separate analysis we assessed fixation durations. Fixation durations decreased with age and were found to interact with orientation skills such that fixation durations decreased faster with age for infants with high orienting skills, relative to infants with low orienting skills. There was a further interaction between fixation durations with sustained attention abilities, infants with low sustained attention showed a decrease of fixation durations with age, whereas infants with higher sustained attention showed a slight increase in fixation durations with age. Discussion: This study provides information on the where and when of infants' attention allocation. Such information is vital to developing a complete understanding as well as a computational model of infant gaze patterns when viewing natural scenes.

P1-C-49 Seeing morphing faces of own and other race: Comparing the development of face discrimination in infants, preschoolers, and adults

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Introduction. Abundant evidence from cross-cultural studies has pointed to an early onset of the other-race effect (ORE) in the first year of life. Although the empirical research with infants and toddlers aged 1 to 3 is lacking, several studies explored the ORE in preschoolers and school-age children. Owing to the intrinsic discrepancies in the methodology and the stimuli, it is difficult to compare the findings between the preverbal infants and preschoolers. Therefore, the present study employed the morphing face paradigm, aiming to compare the development of the ORE in infants and 3- to 7-year-old preschoolers with a simultaneous morphing face discrimination task. Methods. A set of oval-cropped, morphed images of Caucasian and Asian faces was used. In Experiment 1, 4- to 10-month-old infants (N=42) were tested with a familiarization/visual paired comparison procedure. Infants were first familiarized with an Asian or Caucasian parent face , followed by a test phase where they viewed a pair of comparison faces, with one being the "same parent" face and the other as a "different" morphed face (i.e., 30%, 60%, or 90% contribution from the other parent face). The infants' fixation times on the stimuli were recorded. Experiment 2 adopted exactly the same stimuli. 3- and 4-year-old children (N= 42) were tested with a forced-choice simultaneous pointing task where they viewed

a target parent face followed by a pair of comparison faces, and were asked to point out the same face with their fingers. In Experiment 3, 5- to 7-year-old children (N=46) and adults (N=20) were tested with a forced-choice simultaneous matching task. The stimuli and procedures were the same as in Exp. 2, but the participants responded with a keypress. Results. In Experiment 1, infants of all age showed a significant novelty preference for the 90% morph face (the most dissimilar one) of the Asian-parent condition. Infants exhibited a novelty preference for the 60% morph Asian face around 7 and 8 months and progressed to the 30% morph level around 9 and 10 months. In Experiments 2 & 3, the accuracies of correctly identifying the different face increased as the morph level increased for all age groups, with the 90% morph level reaching ceiling performance at age 5. Overall, adults and 5- to 7-year-old children outperformed 3- and 4-year-olds at all morph levels, and the mean accuracies for the Asian- and Caucasian-parent conditions were about equal. Conclusion. In sum, using the same set of morphing face stimuli with three different procedures adapted to the developmental ages, our study revealed that 4- to 10-mo-old infants exhibited an own-race advantage, while at age 3 to 7 years, children showed an equal discriminability for the Asian and Caucasian morphed images, indicating an absence of ORE in the preschool age. Nevertheless, a clear developmental progression in processing morphing faces of the same race was observed in this age range.

P1-C-50 The Center Bias in Infant Scene Perception

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How do infants explore the complex visual world? The available information is overwhelming, whereas attentional resources are limited. Necessarily, infants must select certain information to process, while ignoring other information. Infants have several attentional mechanisms that help them to explore their surroundings efficiently. A well-known attentional mechanism adults use during real-world scene viewing is the center bias. This center bias is a strategic bias, as looking towards the center minimizes the distance to other parts of the scene and important objects are often located at the center. Having a center bias is therefore helpful to efficiently process complex real-world scenes. Given the several attentional mechanisms infants are known to have, we hypothesized that infants have the center bias when viewing real-world scenes. As perceptual salience is also known to influence gaze behavior, we hypothesized that the location of perceptual salient regions would moderate the bias. Finally, we hypothesized that the center bias

would be stronger for older than younger infants, as older infants are more likely than younger infants to have learned that important objects are often located at the center. These hypotheses have been pre-registered with the Open Science Framework. To test the hypotheses, we showed 48 infants (5 - 20-month-olds) a total of 30 real-world scenes in 3 conditions (salient in the center, in the periphery or uniformly, see Figure 1) and manipulated the start position such that the scene center was always equally far as the scene boundary. The measure of the center bias was whether the first fixation was in the center or in the periphery of the scenes. An General Linear Mixed Model analysis confirmed that infant fixation locations were more likely to fall in the center, than in the periphery of scenes (Beta = 0.85, z = 4.86, p < .001). As expected this effect was weaker when salience of biased towards the periphery (Beta = -1.53, z = -6.29, p < .001). The third hypothesis was not confirmed, there was no significant effect of age (Beta = -0.01, z = -0.41, p = 0.685). Exploratory we compared infants with adults. Figure 2 shows that both infants and adults have a clear center bias when information is in the center or uniformly distributed across scenes. In the uniform condition, the saliency distribution of the scenes cannot explain why both infants and adults show a center bias which implies this is likely a cognitive strategy. The fixation distributions in the periphery condition are bimodal for infants and adults. In infants, the means of these modes falls away from the center and the largest mode at the bottom overlaps with one of the modes in adults. This is also where the scenes are most salient, as can be seen in the bottom middle panel. Adults also have a mode around the center, which indicates a center bias, even in the absence of a salient center. Overall these results suggest that infants' gaze is influenced by both bottom-up salience and top-down attentional mechanisms.

P1-C-51 Eye tracking 10-month-old infants viewing static and dynamic facial expressions

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Previous research has shown that 10-month-old infants discriminate and categorize static and dynamic versions of emotional expressions (Ludemann, 1991; Touchstone, Spence, & Atchison, 2008); less information is available about the specific facial features infants attend when exploring emotional expressions. Ten-month-olds' eye-tracking was assessed to determine if their scanning patterns differed for happy and disgust facial expressions and if facial motion affected scanning. Ten-month-old infants (N = 65) were presented with three different exemplars of either a 5 s happy or disgust expression

portrayed by one female. Additionally, these expressions were video versions displaying dynamic facial expressions, or static images of the expression at the peak intensity of the expression. Total fixation duration for the entirety of the first stimulus to Areas of Interest (AOI), eyes and mouth, were measured with Tobii eye-tracker T60XL. Fixation duration to AOIs as a proportion of gaze time to the face was analyzed (PTLT). A mixed ANOVA of Motion (static, dynamic) X Emotion (happy, disgust) X AOI (eyes, mouth) revealed no significant effects for PTLT. A second dependent measure, Visit Count, defined as the number of gaze shifts to an AOI as a proportion of visits to the face, was also measured and entered into a mixed ANOVA. Visit count analysis resulted in a significant interaction of AOI X Emotion, $F (1, 36) = 4.034$, $p = .052$. When viewing happy expressions, infants made more gaze shifts to mouths ($M = 1.68$) than eyes ($M = 1.16$), ($t (18) = -2.11$, $p = .04$), but did not differ in gaze shifts to AOIs when viewing disgust expressions. Interestingly, no differentiation of scanning as a function of motion of the stimuli resulted. The lack of motion effects was surprising because motion affects perception of other visual events (Touchstone, 2008). The next question asked was whether infants are more likely to orient faster to dynamic compared to static facial expressions. To examine this question, Time to First Fixation to the face, or the time elapsed between first presentation of the facial stimulus and the infant's first on-face fixation was measured with Tobii T60XL. For the first test trial, univariate ANOVA of Time to First Fixation X Motion (static, dynamic) X Emotion (happy, disgust) revealed a significant between-subjects motion X emotion interaction, $F (1, 64) = 5.386$, $p = .024$, indicating longer time to first on-face fixation for static happy images ($M = 1.019$) vs. all other stimuli types. Data trended toward an effect of motion but did not reach statistical significance, $F (1, 64) = 3.777$, $p = .057$. These data include analysis of scanning during only the first trial; in order to determine if these data are representative, analyses will also be presented testing these effects across the three experimental trials. The results have implications for understanding factors that impact infants' attention to rapidly moving facial expressions.

P1-C-53 Bimodal Distribution of Performance in Discriminating Major/Minor Modes in 6-Month-Old Infants

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A common feature of western music is the presence of major ("happy" sounding) and minor ("sad" sounding) musical modes. In a previous study, when adults were asked to discriminate tone-scrambles that contained either major or minor modes, approximately

70% of adults were unable to discriminate the tone-scrambles above chance performance, whereas the remaining 30% of adults expressed near perfect performance (Chubb et al., 2013). Interestingly, even prior exposure to musical training revealed only a modest correlation with performance, suggesting the possibility that this discriminatory capacity is inherent to the individual. If so, then this capacity should be evident in early infancy. The present study, therefore, was designed to investigate if the perceptual ability to discriminate major and minor modes from one another is present in the early months of life. Six-month-old infants' ability to perceptually discriminate tone-scrambles that contained either major or minor modes was investigated 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 tone-scrambles (major and minor) were paired with the same central visual cue, but each randomly presented tone-scramble predicted a visual target appearing on either the left or the right of the screen. If 6-month-old infants could discriminate tone-scrambles containing either major or minor modes when paired with a centrally-presented visual cue, then they would be able to anticipate the location of succeeding cued targets at a rate above chance. Results revealed a bimodal distribution of performance in 6-month-old infants' ability to successfully discriminate the tone-scrambles and incorporate this information into their visual expectations when there was a predictable tone-scramble-target relation. That is, 40% of infants exhibited the capacity to discriminate between the tone-scrambles, whereas 60% were not, consistent with the distribution found with adults. Furthermore, as with adults, there was only a weak correlation between the ability to discriminate and prior musical exposure. These findings seem to indicate that the perceptual ability to discriminate major and minor modes from one another either develops during the very first months of life due to exposure during perhaps a sensitive period or is fully biologically determined. Future studies will attempt to distinguish between these possibilities.

P1-C-54 Intersensory Matching to Social Events at 1 Year and Its Developmental Growth Predict Receptive Vocabulary at 18 Months

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Detecting intersensory redundancy--synchronized stimulation across the senses--fosters a unitized perception of multimodal events (e.g., the sights and sounds of a speaking person). In turn, attention to synchronized audio-visual events facilitates object-label mapping and, thus, forms a crucial building block for language development (Bahrick & Lickliter, 2012). Documenting how the development of intersensory matching supports the development of language requires indexing fine-grained individual differences in intersensory matching within a longitudinal approach. The Intersensory Processing Efficiency Protocol (IPEP) addresses this need by assessing individual differences in the speed and accuracy of intersensory processing. Participants are shown six dynamic visual events. Only one is acoustically synchronized with an accompanying soundtrack, emulating the task of localizing an audio-visual event within a noisy environment. Previous research found developmental relations between language-learning skills (on the Mullen) at 6 months and intersensory matching on the IPEP from 6-12 months (Soska, Todd, & Bahrick, 2016). The present study examines subsequent development in intersensory matching and its relation to 18-month receptive vocabulary (using the MacArthur Bates Communicative Development Inventories, MCDI). Infants (N=20, collection ongoing) from a larger longitudinal study received the IPEP and parents completed the MCDI at 12 and 18 months. In the IPEP, infants viewed 48 8-s trials of a 2x3 grid (Figure 1) of dynamic social (women speaking; 24 trials) and nonsocial events (objects striking a surface; 24 trials). On each trial, a natural soundtrack was synchronous with one target event and asynchronous with five distractor events. Fixations were recorded using a Tobii X120 eyetracker (useable data M=55.8%). Intersensory matching was scored as proportion of total looking time to the target event (PTLT) averaged across trials. Receptive vocabulary was indexed as number of words understood on the MCDI. Intersensory matching (PTLT) from 12-18 months increased from M=.169 to .180 for social events and from M=.166 to .185 for nonsocial events. Receptive vocabulary increased from M=84.0 to 206.8 words understood from 12-18 months. Vocabulary growth from 12-18 months, as expected, predicted 18-month vocabulary (Table 1; Model 1, $p<.001$). Intersensory matching (PTLT) at 12 months and 12-18-month PTLT growth each independently and significantly predicted 18-month vocabulary (Model 2, $ps<.01$). High 12-month PTLT and larger 12-18-month PTLT growth were associated with larger 18-month vocabulary, even after controlling for baseline level of vocabulary growth (predicting 30% additional variance in 18-month vocabulary). In contrast, intersensory matching to nonsocial events (at 12 months and growth from 12-18 months) showed no relations to receptive vocabulary, $ps>.8$. Intersensory matching to social but not nonsocial events at one year of age and its development predicted receptive vocabulary six months later. Both initial social intersensory skill and subsequent growth were unique predictors.

This highlights the importance of a longitudinal approach for characterizing the developmental relations from early intersensory processing skills to later receptive language. These findings also reveal that fine-grained measures of individual differences in intersensory processing are effective predictors of language acquisition.

P1-C-55 Perceptual and Affective Responses to Possible and Impossible Figures in Early Infancy

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Previous studies demonstrated that infants look longer at pictures of impossible objects relative to possible ones. However, we still do not have a clear understanding of infants' conceptual knowledge of global coherence and structural possibility. Does longer looking at impossible displays indicate a violation of infants' inherent expectations about real 3D objects and global coherence? Are they really surprised by impossibility? Oftentimes, studies simply assume that infants are surprised when they look longer at a stimulus. Here, we tested the assumption that longer looking toward one display is driven by surprise in response to a violation of expectation about object coherence. This is an important step toward understanding why infants might be looking longer, and may lead to insight on what they are "thinking" when they do so. Our goal was to determine if increased looking times toward impossible figures co-occurred with facial expressions of surprise and puzzlement. Based on Izard and colleagues' facial affective coding schemes, these sentiments have been documented as universal responses consisting of raised eyebrows, wide eyes, and an open rounded mouth. Hence, these affective expressions could be used to make inferences about infants' internal conceptual understanding of globally coherent objects. Therefore, their facial expressions of surprise toward impossible objects relative to possible ones may reveal that impossible figures violate infants' inherent expectations about 3D structure. There were 6 test trials with 3 presentations of each display type alternating in sequence. Order was counterbalanced across infants (e.g., A-B-A-B-A-B, B-A-B-A-B-A). We used an infant-controlled looking procedure. An observer, who could see the infant but was blind to the stimulus conditions, pressed a button to record looking behavior and released when the infant looked away. Test sessions were digitally recorded and coded offline for facial expressions using pencil and paper. Coders of facial expressions were also blind to stimulus conditions and hypotheses. We predicted that infants would display more facial expressions consistent with "surprise" when viewing impossible objects relative to possible ones. Indeed, impossible cubes evoked both longer

looking times ($p < .001$) and more reactive expressions ($p < .04$) in the majority of infants. Results also revealed that infants in the neutral perceptual control group, who viewed simple line junction stimuli in the absence of binding contours, showed no reliable differences in looking times or in observed facial expressions toward either display type. Infants can clearly make a perceptual distinction between possible objects and their impossible counterparts consisting of spatially inconsistent arrangement of lines that render an object structurally incoherent. Additionally, they respond with facial expressions of surprise when viewing impossible objects relative to possible ones. Increased looking accompanied by surprised expressions toward the impossible figures may be indicative of infants' expectations about real 3D objects. This effect is driven by detecting an anomalous region that is spatially irreconcilable with other parts of the object, thus rendering it globally incoherent in three dimensions. This work sheds light on infants' increasing understanding of 3D objects in the physical world and the development of mental representations of global object coherence.

P1-C-56 Visual fixation patterns to multimodal infant- versus adult-directed speech by three clusters of 6-month-olds

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Prior research suggests 6-month-old infants' visual preference to the mouth over eyes of faces may predict language development (Young et al., 2009); however, stimuli has varied greatly among studies, 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). We previously reported three clusters of 6-month-olds whose visual fixation patterns replicated the clusters identified by Merin et al. (2007), whose infants viewed their mothers' faces during three phases of the Still-Face paradigm. Infants in our study (n=40), however, viewed 10-s trials of both infant-directed (ID) and adult-directed (AD) speech that was spoken by either their own mothers or an unfamiliar speaker in various modalities (audiovisual, visual-only, and audio-only). Like Merin et al., 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. As previously reported, hierarchical cluster analysis (HCA) on the ID-only stimuli identified three clusters of infants: a high EMI cluster of 14 infants with an Eye preference across the three modalities; a low EMI cluster of 12 infants with a Mouth preference across the three ID modalities; and a low-high-low EMI cluster of 14 infants

with a Mouth preference during the visual-only and audiovisual ID clips and an Eye preference during the audio-only (still-face) ID clips (Figure 1). A repeated-measures ANOVA indicated an interaction of Cluster x Modality, $F(4,74)=6.01$, $p< .001$, and main effects of modality, $F(2,74)=27.43$, $p< .001$, and cluster, $F(2,37)=242.24$, $p< .001$. In our current analyses, we further examined the visual fixation patterns to the AD stimuli by each of the three previously-identified clusters of infants. Similar to the ID stimuli analyses, we found significant effects of cluster and modality when viewing AD stimuli. A repeated-measures ANOVA indicated an interaction of Cluster x Modality, $F(4,66)=3.15$, $p= .02$, and main effects of modality, $F(2,66)=22.11$, $p< .001$, and cluster, $F(2,33)=33.28$, $p< .001$. Specifically, the high EMI cluster had an Eye preference when viewing AD stimuli across the three modalities, the low EMI cluster had a Mouth preference when viewing AD stimuli, and the low-high-low EMI cluster had a Mouth preference for the visual-only and audiovisual AD clips, but an Eye preference for the audio-only (still-face) AD clips (Figure 2). These results corroborate both our previous findings of individual fixation patterns among groups of 6-month-old infants when viewing ID stimuli, as well as the cluster findings of Merin et al. (2007). Eye versus mouth preferences across modalities, as well as across infant- and adult-directed speech styles, suggest perceptual constancy in the way 6-month-old infants attend to social stimuli. These findings should guide further research into the mechanisms through which infants learn language. As such, additional analyses are ongoing on how clustered fixation patterns relate to language development.

P1-C-57 Estimating Variability and Accuracy in Remote Mode Infant Eye Tracking

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Eye tracking with infants has become a common method to investigate a multitude of phenomena concerning infant cognition. However, some critical publications recommend caution to avoid an overestimation of measuring accuracy (e.g., Aslin, 2012; Oakes, 2012). Interindividual variability in fundamental perceptual abilities makes it difficult to rely on theoretical assumptions when predicting the impact of different calibration targets on infants' gaze behavior. In addition, fussiness caused by the repetition of calibration stimuli and body movements during testing are frequent constraints on measurement quality. Here, we systematically investigated these constraints with 29 infants (8 - 12 months of age) and 25 adults using EyeLink® 1000 Plus (SR Research Ltd. 2013 - 2015). To our knowledge, this is the first investigation of these questions with infants and this particular technical configuration. Both participant groups performed several tasks that allowed us

to compare looking time and dispersion of gaze points elicited by stimuli resembling commonly used calibration animations. To enhance infants' commitment towards the repeated presentation of the stimuli, we randomly alternated the accompanying sound and changed background colors while keeping the luminance level stable. The adult group additionally performed a variety of body movements during gaze recording, equivalent to movements that infants spontaneously produce during testing. Our results showed infants' preference for a particular calibration target did not predict recording quality after calibrating with that same target. Instead, targets with globally distributed complexity or targets that exhibit the strongest contrasts in their center resulted in the smallest dispersion of gaze points. Infants' gaze towards the videos was also affected by changing target size and presentation time (see Fig. 1). After about 3 seconds, the spread of infants' gaze points increased also for stimuli that initially had elicited more central fixations. Further, for the infant sample, changes in head - camera distance after calibrations substantially added to the explained variance of spatial accuracy ($X^2(1) = 4.5$, $p = .03$). For the adult movement tasks, type and direction of head movement, as well as the attended screen location, differentially affected gaze measures. Specifically, movement towards the screen resulted in lower dispersion during a fixation ($\beta = -.11°$, $t = -4.9$, $p < .001$), but increased measured gaze distance to the targets ($\beta = .87°$, $t = 8.8$, $p < .001$) especially at peripheral screen locations (interaction with central location: $\beta = .55°$, $t = 2.8$, $p < .001$). Following the stimuli with head turns resulted in low overall precision and reduced accuracy (see Fig. 2). These heterogeneous effects of movement on gaze measures should be taken into account when planning infant eye tracking experiments. For example, more reliable screen locations for intermittent drift checks could be specified. Future studies could investigate the usefulness of including changes in head distance as a control variable during Remote Mode infant eye tracking. Additionally, to improve data quality, infants' commitment to repeated calibrations could be enhanced by alternating between precise calibration targets and background colors during the calibration procedures.

P1-C-58 Direct Eye Gaze Elicits Face Processing

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Abstract Data from our lab shows that newborns looked longer at their mothers' face only if they had been previously exposed to her voice and direct eye gaze for at least 5 minutes. Recognition however, vanished when information about the eyes was removed from birth.

The role of the eye gaze was further investigated in the present study using a spontaneous visual preference. Newborns (Mean 5. 11 hours) were first naturally exposed to their mother's face and voice, and then tested for recognition of their mother's face in the upwards eyes condition (Exp 1) or upwards eyes right and upwards eyes left conditions (Exp 2). The internal portion of the mother's face was paired with that of a female blood relative. Information about the external features of the faces was masked during testing. The results showed no significant preferences. Experiment 3 replicated Exp 1 and Exp 2 on students (Mean age = 19 years old). The participants were naturally exposed to their class mates for 2.30 hours per week over a Spring semester (3 months). The participants' external features were masked prior and during testing. The removal of direct eye gaze impaired face recognition in adults as well, suggesting that face processing partly depends on direct eye gaze rather than on the features of the eyes. Key words: newborn, direct eye gaze, voice

P1-C-59 Visual Attention and Brain Response to a Difference in Hue Saturation

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This work examines the hypothesis that infants' attention is governed by the level of activity of neurons in the visual system selectively sensitive to specific stimuli. Experiment 1 investigated infants' attention to two levels of chromatic saturation, and Experiment 2 investigated infants' preference in relation to visual system activity. In the first experiment, fifteen 6-month-old infants with no family history of color-vision deficiency participated in an eye tracking study. Stimuli were paired rectangular regions of the same hue (red) and brightness, but differing in saturation level (see Figure 1a and 1b). Each stimulus was presented twice over 4 10-s trials alternating the left-right position of the saturated region while fixations were measured with an eye tracker. Out of their total looking at both regions of the stimulus display, infants fixated the saturated region proportionally more, $M=0.61$, $SD=0.16$, $t(13)=2.70$, $p=.017$. Thus, infants attended more to stimuli with higher saturation levels. In the second experiment, brain electrical responses of infants and adults were examined in relation to the same colors used in Experiment 1. Ten 6-month-olds and ten adults with no family history of color-vision deficiency participated. Recordings were digitally filtered and segmented into saturated and destaturated trials, and signals were decomposed into sine wave frequency components. To identify responses, time-frequency maps of responses were averaged over trials, participants, saturation levels, and channels for each cluster of electrodes analyzed (Figure 2), and grand average maps were

examined. Infants' initial responses were apparent around 80 ms within the beta and lower gamma bands (23-43 Hz), waning by 210 ms. Adult responses appeared at 30 ms in a similar range of frequencies (13-53 Hz) and extending through 235 ms. To examine response dynamics, the frequency and the latency of response peaks were calculated and analyzed. The maximum power value was identified in each response and indexed by its frequency and its latency from stimulus onset. For overall power, there was a significant main effect of saturation level $F(1,18)=6.00$, $p=.025$, with greater power in response to saturated ($M=.59$, $SD=.62$) than desaturated stimuli ($M=.15$, $SD=.53$). In an analysis of the frequencies of response peaks, adult responses peaked at higher frequencies ($M=35.89$, $SD=2.63$) than infant responses ($M=27.65$, $SD=3.76$), $F(1,18)=33.85$, $p<.001$. For latencies to response peaks, there were shorter latencies in response to saturated stimuli at midline sites in adults ($M=106.34$, $SD=23.84$) than in infants ($M=136.04$, $SD=21.59$), $F(1,18)=5.52$, $p=.009$. Infants and adults viewed red stimuli of two different saturations. Behaviorally, infants attended more to regions with higher saturation levels, replicating previous research showing preferences for saturated stimuli (Bornstein, 1975; Franklin & Davies, 2004). Electrophysiologically, spectral power in the beta and gamma frequency bands increased more in response to the saturated than the desaturated stimuli. Adult responses peak earlier and at higher frequencies than infant responses. These results accord with a hypothesis that brain electrical activity which is evoked by selected stimulation may guide the level of attention displayed by infants.

P1-C-60 How Travel Changes Infants' Visual Preferences

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Infants´ predominant experience with females (Rennels & Davis, 2008; Sugden et al., 2014) is related to their visual preferences for familiar race females (Liu et al., 2015; Quinn et al., 2008). Visual preferences ensure infants attend to those most likely to invest in their care and acquire expertise in processing their faces, which could be important to develop before becoming independently mobile. Infants´ perceptual, cognitive, and socio-emotional abilities change when they become independently mobile (Campos et al., 2000). Such reorganization might affect looking behavior within a visual preference task. Indeed, cross-sectional data (N = 83) showed that motor development (not crawling [NC], inconsistent crawling behavior [IC], crawling regularly [CR]) predicted differences in 6-10-month-olds' visual preference for females. To examine the process of change, we collected data from 16 infants with mostly White female caregivers every two weeks

between 6-10 months (nine visits total). At each visit, infants viewed four female-male face pairs posing neutral (n = 8) or pleasant expressions (n = 8). Face pairs (two Black, two White) differed at each visit. Prior to each visit, parents completed a motor development checklist that produces reliable data (Bodnarchuk & Eaton, 2004). Using GridWare (Lamey et al., 2004), we created lagged phase plots (an autocorrelation of data at time t on the x-axis with itself at t+1 on the y-axis) of infants´ looking toward female or male faces or away for each trial (Hollenstein, 2013). We expected infants experiencing a transition in motor development would show decreased attractor states (shorter durations of attention and longer return times for female faces). Motor development and face pair race and expression served as predictors. Preliminary results from 435 trials revealed mean duration of looking (duration per cell) did not change for male faces as a function of motor development, $p = .11$, but increased for away looks between IC to CR, $p = .01$, and changed between NC and IC for female faces based on face race, $p = .013$ (Figure 1). Return times marginally increased between NC and CR for male faces, $p = .09$, and significantly decreased between IC and CR for away looks, $p = .04$. Return times for neutral expression White female faces significantly decreased between NC and CR, $p = .02$, but did not change for Black female faces, $p = .28$ (Figure 2). Data suggest that motor development interacts with face characteristics to predict changes in looking toward female faces, whereas only motor development predicted changes for male faces and away looks. Changes in looking toward females typically occurred before infants exhibited changes in looking toward male faces and away. Results suggest that looking patterns reorganized differently for female faces compared with male faces and away looks in terms of both time of transition and type of transition, possibly due to female expertise. Because visual preferences for females seen in the lab are evident during social interactions (Rennels & Davis, 2008), the process of reorganization described here might generalize to infants´ social environments.

P1-C-61 Visual Preference for kinetic patterns in infancy and adulthood: Evidence for an aesthetic of motion.

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Studies of attractiveness revealed shared visual preferences between adults and infants indicating that the low-level stage (e.g. perceptual analysis) can by-pass the cognitive levels to directly produce an aesthetic feeling. Infants look longer at different kind of stimuli that have been rated more attractive or more beautiful by adults, like faces (Damon

et al., 2017; Quinn, Kelly, Lee, Pascalis, & Slater, 2008) and artworks (Krentz & Earl, 2013). In adults, Zeki and Stutters (2011) found a link between the brain activity of areas specialized in motion processing (V5, V3 complex) and the liking for moving dot patternsthe level of preference of a kinetic is associated with astronger brain activity . Using the same stimuli, we investigated infants' sensitivity of beauty for moving dot patterns. We hypothesized that the preference ranking of the eight kinetic patterns by adults will predict the visual orientation for both adults and infants from 3-to-24-months of age. An adult groups (n = 28) explicitly rated the moving dot patterns by choosing the preferred one for each pairing. We presented then the dot patterns in a classical visual preference task, each pair was made of one highly rated motion and one lowly rated. . There was 56 paired-comparison for adults (n = 41) and 12 for infants (n = 145). We collected their eye gaze using an eye-tracker. As expected, the preference ranking of adults predicts the mean looking time of both adults and infants, $t(1) = 14.54$, $p < .001$, $\eta^2p = .12$. Not surprisingly, we also found that age in days predict the mean looking time ($t(1) = 8.75$, $p < .001$, $\eta^2p = .05$), meaning that adults looked longer at the stimuli on average than infants. Importantly, there was no interaction between preference ranking and age in days ($t(1) = 0.61$, ns, $\eta^2p = .00$) meaning that the influence of preference ranking was not influenced by the subject experience. These results suggest that adult's aesthetic value can influence looking time even though participants have no experience with a specific category of motion.

P1-C-62 Large-Scale Evaluation of Infants' Scanning Dynamic Face+Voice Displays

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The emergence of social attention during infancy and early childhood has important implications across several developmental domains, including emotion, cognition, and language. Although studied in a variety of ways, one dominant experimental approach is to examine patterns of attention to static faces. Overwhelmingly, typically developing infants attend more to the eyes than other areas of faces, whereas atypical infants (e.g., at risk for autism) do not. As such, eye regard has evolved as a common biomarker for typical social motivation. Interestingly, our lab has conducted a large number of eye-tracking studies with infants at various ages using dynamic (as opposed to static) presentations of speakers. That is, we are interested in how infants attend to and process visual+auditory speakers. Surprisingly, we have rarely found much attention on the eyes of the speaker; most attention is concentrated on their mouths. However, our individual

samples tend to be relatively small, so in order to examine the robustness of this finding, we conducted a meta analysis of scanning patterns across several studies involving 103 infants from 11-15 months. Although methodologies of the experiments differed, each participant experienced a visually dynamic presentation of a female speaker in an infant-directed style (using a Tobii T60 eye tracker). In all studies, infants experienced trials where the voice track aligned with speaker movement. However, certain other trials disrupted the face+voice relationship through either incongruence (mismatched voice track) or silence (no voice track). The main areas of interest (AOIs) were defined as eyes and eyebrows (eyes region) and the bottom of the nose to the mid chin line (mouth region). Raw data were filtered to remove invalid frames, and then collated for percent look duration (PLD). During AV congruent trials, infants looked significantly more at the mouth than at the eye regions ($F(1,102)=7.33$, $p=.008$; $\eta p2=.07$); 62% of infants showed more attention to the mouth region. Interestingly, when the speaker was silent, no differential attention to eye v. mouth region was seen ($F(1, 35)=.79$, $p=.38$; $\eta p2=.02$), and when the speech was incongruent, infants attended more to the eyes than the mouth ($F(1,11)=13.25$, $p=.004$; $\eta p2=.55$). Several interpretations are possible: (1) when viewing bimodal speakers, infants focus their attention more on mouth than eyes (but effect size is small); (2) distributed attention to eyes and mouth occurs when the speaker's mouth is moving but no voice is available; and (3) incongruence between mouth movement and speech shifts infants' attention to the eye region (largest effect size). Thus, in normal interactions, focused attention on mouth is high and not driven purely by movement because attention to eyes increases when mouth is moving but its relation to speech is disturbed (e.g., silence, incongruence). We interpret this pattern as indicative of infants' emergent sensitivity to social cues and their relevance for directing and maintaining attention. We are also exploring individual difference factors as they may relate to scanning patterns (e.g., temperament). ηη

D: Communication and Language

P1-D-63 The production effect across early development

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Studies with children and adults have demonstrated that producing words during training benefits later recall of items, compared to items that are heard-only (Icht & Mama, 2015; Mama & Icht, 2016; MacLeod et al., 2010; Zamuner et al., 2016). Yet, studies have also found that the production effect is reversed when children and adults are tested on stimuli

with non-native sound patterns or non-words (Baese-Berk and Samuel, 2016; Kaushanskaya and Yoo, 2011; Zamuner et al. in press). The effects of production have been argued to depend on task-, attentional, linguistic- and experience-related factors; however, little work has addressed this from a developmental perspective. We adapted Icht and Mama's study with 5-year-olds to examine the production effect with 3-4 year-olds (current n=20) and 5-6 year-olds (current n=36). Children were asked to teach a stuffed dog some words, but that the dog was currently sleeping. There were three training conditions: Look (images were presented silently), Heard (images were presented and children heard prerecorded tokens), Produced (images were presented and children named the images aloud). Children were trained on 30 familiar words, across three counterbalanced blocks. There was a separate block for each training condition, and each block had 10 unique words. Afterwards, the dog was woken up and children were asked to recall the words. Children recalled the fewest words from the Look condition and responses from this condition are not included in the analysis. The remaining data were analyzed using a 2x2 ANOVA with age (3-4 yrs, 5-6 yrs) and training (Heard, Produced). There was a significant effect of training: more produced words were recalled than heard words ($F(1,30) = 4.69$, $p = .013$). Older children also recalled more words than younger children ($F(1,30) = 8.27$, $p = .047$). There was also a significant interaction between training and age ($F(1,30) = 5.01$, $p = .03$), see Figure 1. While 5-6 year-olds recalled more words from the Produced vs. Heard training condition, 3-4 year-olds showed no difference in the types of words that were recalled. A second analysis was done on the difference score to look at whether the production effect increased with age. There was a significant positive correlation ($r=.35$, $p=.048$), Figure 2. As children's age increase, the production effect is stronger. Our results from 5-6-year-olds replicated Icht and Mama's finding: more words were recalled when they were produced rather than heard only during training. However, no production advantage was found with the younger children. One possibility is that the task was more complex for the younger age group. If so, this would be in line with findings from other domains in language development (Curtin et al., 2011). It has been argued that production experience facilitates word learning by supporting memory for words, as they require less processing resources to link words and their referents (Vihman, 2017). However, if the task is complex enough, even at a very young age, production may not always lead to an advantage on a word-recall task.

P1-D-64 Phonological development in preterm babies and babies from lower SES families

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Two major developmental trajectories have been identified as markers of infants' specialisation on their native language. First, there is an increase in infants' ability to process native sounds and consequently, a preference emerges for the sequences that are either legal or have a high frequency of occurrence in their native language (e.g., Jusczyk, Cutler, & Redanz, 1993; Jusczyk, Luce, & Charles-Luce, 1994; Höhle, Bijeljac-Babic, Herold, Weissenborn, & Nazzi, T. 2009). Second, infants' ability to process non-native sounds decreases over time, a process known as perceptual narrowing (e.g., Werker, & Tees, 1984; Mattock, & Burnham, 2006). These processes of learning have been assumed to be "universal" (Arnett, 2008). However, the vast majority of developmental studies have relied on "convenience samples", consisting of infants born full term and from higher-SES families, which are, for the most part, unrepresentative of the larger population (Henrich, Heine, & Norenzayan, 2010). There is thus no evidence as to how much the time course of learning is affected by maturational and environmental factors. The present project addresses this issue. To do so, we investigated early phonological development in cases where: a) maturation is following an altered timetable: infants born preterm; and b) the environment is different: infants from lower-socio-economic status families. The linguistic abilities of both populations have been found to lag well behind their advantaged peers during the school years. Preterm children and children from low-SES families show poorer auditory discrimination and memory, reading difficulties, poor vocabulary, a specific delay in verbal processing and reasoning, less complex expressive language and lower receptive understanding than their matched controls (e.g., for data on preterm children see: Jansson-Verkasalo et al., 2004; Guarini et al., 2009; 2010; Sansavini et al., 2010; for data on low SES children see: Fernald, Marchman, & Weisleder, 2013; Farkas, & Beron, 2004; Halle, et al., 2009). Three longitudinal studies explored infants' phonetic, prosodic and phonotactic development, respectively, at 7.5, 9, 10.5 and 12 months of age. Preliminary analyses for 32 infants showed no significant differences between the phonetic or the phonotactic development of the preterm and the full-term infants. However, a time-lag between preterm and full-term developmental timing for prosody was found. Socioeconomic status didn't have a significant difference on prosodic or phonetic development. Nevertheless, phonotactic development was affected by SES, infants from lower SES showed a preference for high-frequency sequences later than their more advantaged peers. Overall these results suggest that different constraints apply to the acquisition of different phonological subcomponents.

P1-D-65 Language Discrimination abilities of 4.5 mo monolingual and bilingual infants

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Previous research indicates that infants can discriminate between languages belonging to different rhythmic classes already at birth. However, within rhythmic class discrimination starts to take place around the fourth-fifth month of life (Nazzi, Jusczyk, & Johnson, 2000). What type of information infants use to perform such discrimination is yet to be determined. Although infants have not yet established vowel categories at such a young age, they may already have some rough knowledge about the distributional properties of their vowel system. Therefore, they might use such distributions to discriminate languages. We tested this hypothesis by investigating the discrimination capacities of 4.5 month-old infants when listening to sentences from two dialects of Catalan (Southern and Central) -in experiment 1- and when listening to sentences of Southern Catalan and Spanish -in experiment 2. Spanish and (Central-Standard) Catalan have quite different vowel distribution due to the existence of vowel reduction in Catalan (resulting in very few mid vowels), but not in Spanish (see figure 1). Interestingly, Southern Catalan does not bear vowel reduction, yielding a distribution of vowels very similar to the Spanish one. We used the same procedure as in Bosch and Sebastian-Galles (2001). In the first study, 21 4.5-month-old infants having Central Catalan as their dominant language were tested. In the second study, 13 4.5-month-old infants having Spanish as their dominant language were tested. The preliminary results of the two experiments are shown in figure 2. Infants were able to discriminate the two dialects of Catalan ($t(20)= 3.5244$; $p<0.0021$, two-tailed) but they could not discriminate Southern Catalan from Spanish ($t<1$). We are currently finishing the collection of the data. Current results support the hypothesis that infants are sensitive to differences in the distribution of vowels across languages and that they can use these differences to distinguish languages or dialects.

P1-D-66 Young Infants' Learning From Native and Foreign Speakers

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Recent evidence suggests that infants exhibit increased attention to stimuli after listening to a native speaker's speech (Begus, Gliga, & Southgate, 2016; Marno et al., 2016). These findings have been interpreted as early attentional biases for native speakers (Kinzler, Dupoux, & Spelke, 2007) reflecting infants' preference for potential sources of information. However, the question of whether early social biases lead to better learning of new information remains unclear. This study aimed to ask whether infants' selective listening to novel tunes introduced by native speakers (Soley & Sebastián-Gallés, 2015) also extends to better learning of those tunes. To answer this question, three experiments were conducted (n = 16 per experiment) with 7-10 months old infants. Using a habituation paradigm, Experiment 1 first established that infants cannot readily discriminate two novel tunes, Tune A and Tune B (See Figure 1 for the notation). After being habituated to Tune A, infants' listening times to Tune A and Tune B during test trials did not differ ($t(15) = .756$, $p > .4$). Accordingly, in the next experiments infants were initially familiarized with Tune A, either by a native speaker (Experiment 2) or a foreign speaker (Experiment 3). During each one of the three familiarization trials, a female actor appeared on the screen, she spoke briefly in infant-directed way and then played Tune A by pressing a button on a music player standing next to her. She silently smiled while Tune A was played for ~21 s. After this brief familiarization phase, infants' discrimination of Tune A and Tune B was measured using a habituation paradigm as in Experiment 1. The female actor was bilingual and she spoke in infants' native language in Experiment 1, while she spoke in a foreign language in Experiment 2. Listening times to Tunes A and B differed significantly between Experiments 1 and 2 ($F(1, 30 = 4.66$, $p < .05$). In Experiment 2, infants listened longer to Tune B compared to Tune A during test ($t(15) = -2.15$, $p < .05$). In contrast, listening times did not differ between Experiments 1 and 3. In Experiment 3, infants listened equally to Tune A and B during test ($t(15) = -.487$, $p > .6$). Across Experiments 2 and 3, infants listened longer to Tune B compared to Tune A ($F(1, 30 = 4.64$, $p < .05$), and there was also a marginal interaction between the listening times and Experiment ($F(1, 30 = 4.66$, $p = .09$). Infants attended equally to familiarization videos in native and foreign conditions ($p > .6$). Thus, while some learning happened in both conditions, infants could discriminate the two tunes in the native language condition, but not in the foreign language condition. These findings suggest that early attentional biases might have important ramifications for young infants and that infants might more readily acquire information when it is introduced by native speakers.

P1-D-67 Predictors of language development in children with autism spectrum disorder: A Follow-up Study

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Background: Previous studies have shown that early language ability is related to long-term outcomes and adaptive function in children with autism spectrum disorder (ASD). It is an important issue to explore predictors of language development in young children with ASD. Joint attention and imitation were supported that they could enhance language development in young children with ASD. However, there were few longitudinal studies to examine that both joint attention and imitation contribute to language development in young children with ASD under 36-months-old. Objective: The purpose of this longitudinal study was to examine that joint attention and imitation predict language development in young children with ASD less than 36 months. Methods: The participants were 74 young children with ASD aged 17-35 months (M = 24.2, SD = 4.4) at initial assessment who were followed up 18 months after their initial assessment. The Screening Tool for Autism in Two-Year-Olds, Taiwan version (T-STAT; Chiang et al., 2013) was modified for measuring joint attention and imitation, including initiating joint attention, responding joint attention, object imitation and manual imitation. In addition, Mullen Scales of Early Learning (MSEL; Mullen, 1995) was used for assessing language abilities, including receptive language, expressive language and overall language. Joint attention and imitation were assessed at initial assessment and language abilities were assessed at two time points. Results: Language abilities at 24 months, all of receptive language, expressive language and overall language were concurrent correlated with joint attention and imitation. The significant concurrent predictors of receptive language and overall language were responding joint attention and manual imitation. In addition, the significant concurrent predictor of expressive language was manual imitation. Language abilities at 42 months, all of receptive language, expressive language and overall language were longitudinal correlated with responding joint attention and imitation. The significant longitudinal predictors of receptive language and overall language were responding joint attention and manual imitation. In addition, the significant longitudinal predictor of expressive language was manual imitation. Conclusions: Results of this longitudinal study showed that responding joint attention and imitation were concurrent and longitudinal correlated with language abilities in young children with ASD. However, initiating joint attention was only concurrent correlated with language abilities in young children with ASD. The results showed that manual imitation was the stronger predictors for receptive language, expressive language and overall language at 24 months and at 42 months in young children with ASD. In addition, the results also showed that responding joint attention was the stronger predictor for receptive language and overall language at 24

months and at 42 months in young children with ASD. However, the results showed that initiating joint attention was not a predictor for language abilities in young children with ASD. The current findings provide implications for early intervention in young children with ASD.

P1-D-68 Do bilingual and monolingual infants differ in their abilities to recognise familiar words in a non-native accent after exposure?

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Evidence suggests that bilinguals differ from monolinguals in development of speech perception (Bosch & Sebastian-Galles, 2003), and word learning skills (Fennell, Byers-Heinlein, & Werker, 2007). Our aim is to establish whether bilinguals differ from monolinguals in their ability to take advantage of short-term pre-exposure when recognising familiar words in a non-native accent, a skill that has not yet been assessed. The effects of accent variation on speech processing have been studied primarily in monolinguals, except for a recent study by Mulak and Escudero (2016). They found that 17-month-old bilinguals showed poorer native and cross-accent word identification than monolinguals, but seemed to "catch up" to monolingual peers by 19 months. The current study examines the extent to which bilinguals differ from monolinguals in benefitting from pre-exposure to an unfamiliar accent in subsequent word recognition, by presenting 16- to 18-month-old Australian English (AusE) children with a pre-test exposure story told by speakers of Jamaican Mesolect English (JaME), an accent unlikely to be experienced by AusE young children. Sixteen 17-month-olds (8 bilinguals and 8 monolinguals) from Sydney, Australia first heard a four-minute story in JaME. The pre-exposure passage was followed by two word-familiarity preference tests, one in the native accent (AusE), and the other in the non-native accent (JaME). Each test had eight trials, four trials included words that children were likely to know (familiar) and four trials had words they were unlikely to know (unfamiliar). In a preferential looking task, toddlers' preference for listening to familiar over unfamiliar words was used to index word recognition. We reasoned that if bilinguals are delayed in cross-accent word recognition relative to monolingual peers, pre-exposure to the unfamiliar accent should induce word recognition in JaME by monolinguals but not bilinguals at this age (see Mulak & Escudero, 2016). To test the delay hypothesis, we fit a mixed-effect linear model to toddlers' log-transformed looking time with test trial type (unfamiliar vs. familiar words), test accent (JaME vs. AusE), and language experience (bilingual vs monolingual) as fixed effects, and participant and test

order as random effects. A main effect of familiarity revealed a significant preference for familiar over unfamiliar words, F(1,236.77)=8.625, p=.003. However, main effects for accent and for language experience were non-significant, as were all interactions. Bilinguals exposed to the JaME passage performed similarly to their monolingual peers on both the AusE and JaME tests. The results suggest that pre-exposure in the non-native accent may have compensated for the delay Mulak and Escudero (2016) had found in bilinguals' ability to process familiar words in an unfamiliar accent. The pre-exposure to the non-native accent seems to bring bilinguals up to doing cross-accent word recognition at a comparable level as monolinguals, even at 17 months, in contrast to the previous findings of a bilingual "deficit" in cross-accent word identification at 17 months. We are currently testing more toddlers to determine whether bilinguals are more negatively impacted than monolinguals at this age in cross-accent word recognition following pre-exposure to the story in their native accent (AusE).

P1-D-69 Lip movements enhance bilingual toddlers' word retention

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Bilingual infants face the challenge of simultaneously learning two languages. As such, they may rely on additional cues to assist them in language learning. One cue that has been hypothesized is visual information in talking faces (Weikum et al., 2009; Sebastian-Galles et al., 2012). Substantial work has demonstrated that adult listeners' benefit from visual articulatory information in challenging environments (Brancazio, 2004; Fort et al., 2013; Sumby & Pollack, 1954). Infant listeners are also highly sensitive to information available from the mouth. Monolingual infants attend preferentially to the mouth in a talking face from around 6-months-old (Lewkowicz & Hansen-Tift, 2012), are affected by visual articulation in the perception of speech sounds (Burnham & Dodd, 2004), and match phonetic information in the face and mouth (Kuhl & Melzoff, 1982, 1984; Patterson & Werker, 1999; 2003). Moreover, visual information influences monolingual 13-month-olds' word recognition (Weatherhead & White, 2017). Recent work suggests that bilingual infants may pay even more attention to the mouth during speech perception than monolingual infants do (Ayneto & Sebastian-Galles, 2017), and that they continue to attend to the mouth longer throughout development (Pons et al., 2015). In the current study, we investigate whether audio-visual speech information enhances 24-month-olds' retention of words in a fast-mapping task. Following Bion et al. (2012), toddlers were presented with Familiar, Disambiguation and Retention trials. In all trial types, two objects

first appeared on the screen in silence, followed by the naming phrase (e.g., "Find the car"), and then the two objects remained on screen for 3000ms. Critically, whereas toddlers just heard the words in Bion, et al., here they saw the speakers producing them during Familiar and Disambiguation trials. Attention to the mouth of the speaker during Disambiguation and Familiar trials in which a novel item was on the screen was measured, as these were trials in which a new word could potentially be learned. Finally, parental reports of toddlers' vocabulary were recorded using the MacArthur-Bates CDI. Both monolingual and bilingual infants looked above chance to the target object on familiar and disambiguation trials (ps < .001). These results demonstrate that bilingual toddlers show disambiguation if new words are presented in an audiovisual manner, whereas previous studies in auditory conditions suggest that slightly younger (17-month) bilingual toddlers do not (Byers Heinlein & Werker 2009, 2013). However, neither group differed from chance in retention trials (ps > .05). Interestingly, for the bilinguals, there was a significant correlation between retention and attention to the mouth during potential word learning trials, $r(24) = .410$, $p = .047$, suggesting that attention to the mouth facilitated word retention. For monolinguals, attention to the mouth was not correlated with retention, but rather, the toddlers' vocabulary sizes were $r(13) = .874$, $p < .001$. Overall, visual articulatory information only appears to facilitate bilingual toddlers' word retention. This indicates that previous linguistic experience (in this case, bilingualism) affects how toddlers' make use of additional articulatory cues during word learning.

P1-D-70 Parent-Child Interactions in Bookreading Contexts in Low-Income Latino Families

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Family socio-economic status and parental language input are strong predictors of early language development and subsequent academic achievement (Hart & Risley, 1992; Páez, Tabors, & Lopez, 2007). Many Latino children come from low-income households, and are less likely to start school ready to meet academic expectations than non-Latino children. Understanding factors that contribute to language development in children from low-income, Latino families is critical to reducing these disparities. Parent-child bookreading (BR) is a key context for promoting language development and early literacy. Yet although BR interactions are viewed and performed differently between income groups and

cultures (e.g., Hoff-Ginsberg, 1991), there is limited study of BR interactions in Latino families, particularly in infancy. The overall goal of this study is to better understand parent-child BR interactions in low-income, Latino families starting in early infancy. There are two specific aims: 1) To examine differences in the quantity of language interactions between BR and non-BR contexts during a typical day in the home; 2) To describe the types of interactions that take place during BR. Participants were 2-mo-old infants (n=21) (Mean age= 10.4 weeks, SD= 1.3 weeks) and their parents who were recruited from a study of a pediatric-based intervention delivered in a public hospital serving low-income families. All participants were Latino and spoke primarily Spanish at home. Daylong audio recordings were collected using LENA, a digital recorder and software system that records infants' audio environments and conducts automated analysis of sounds and speech. On the recording day, caregivers completed a logbook indicating the activities taking place during each 1-hour interval (e.g., eating, bookreading). For aim 1, we used multi-level models to compare the quantity of adult words (AW), conversational turns (CT), and child vocalizations (CV) between 1) families who reported BR and those that did not, and 2) intervals identified as BR and non-BR intervals. For aim 2, we conducted qualitative coding of the types of interactions during BR intervals. Eleven families reported BR; ten families did not. There were no significant differences in AW, CT, or CV between families who reported BR and those who did not. However, among families that reported BR, BR intervals were significantly higher in AW ($b=40.79$, $p< .001$), CT ($b=1.19$, $p< .001$), and CV ($b=2.58$, $p< .01$) than non-BR intervals (Figure 1). During BR intervals, parents engaged in different types of interactions including singing (M=18% of the time), playing (M=9% of the time), teaching (M=22% of the time), and reading (M=6% of the time). Figure 2 shows the proportion of bookreading intervals with each interaction type for each of the eleven families who reported BR, illustrating variability in types of interactions during bookreading contexts. This suggests that booksharing in Latino families involves a variety of interaction types, including but not exclusively reading, which can result in high quantity and quality of language input and may stimulate children's language development. These findings suggest that programs promoting booksharing may be an effective way to enhance Latino children's language environments.

P1-D-71 Lexical, Gestural and Nonverbal Abilities in Toddlers with Williams Syndrome Predict Later Intellectual and Vocabulary Abilities

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Introduction: Previous studies have found that early gestural and lexical abilities predict later cognitive and language abilities for both children in the general population and children with intellectual and developmental disabilities (Ozcaliskan et al., 2015; Zampini & D'Odorico, 2011). The aim of the present study was to determine the predictive validity of deictic gestures, expressive vocabulary (EV), and nonverbal ability at 24 months for cognitive and language abilities at 4 years of age in children with Williams syndrome (WS), a rare neurodevelopmental disorder. Method: Participants were 38 children (18 girls, 20 boys) with classic-length WS deletions. Mean age was 24.51 months (SD=0.31; range=23.95-25.00) at Time 1 and 4.07 years (SD=0.11; range=4.01-4.67) at Time 2. Deictic gestural ability (coded dichotomously as 1: produces both showing and pointing gestures or 0: produces only one or neither of these gestures) and expressive vocabulary (EV; maximum =680 words) at 24 months were determined from parental report on the MacArthur-Bates Communicative Development Inventories (CDI; Fenson et al., 2007). The mean of the T scores for the Mullen Scales of Early Learning (MSEL, Mullen, 1995) Visual Reception and Fine Motor scales was used as the measure of nonverbal ability at 24 months. Intellectual abilities at age 4 years were determined from the Differential Ability Scales-II (DAS-II; Elliott, 2007), receptive vocabulary ability from the Peabody Picture Vocabulary Test-4 (PPVT-4; Dunn & Dunn, 2007), and expressive vocabulary ability from the Expressive Vocabulary Test-2 (EVT-2; Williams, 2007). Results: Table 1 presents descriptive statistics for the continuous variables included in the study, and Table 2 presents the correlations among the dependent and predictor variables. Of the 38 children, only 21 (55.3%) were both pointing and showing at age 24 months. A series of multiple regressions was performed with EV at 24 months, deictic gestural abilities at 24 months, and MSEL nonverbal T score at 24 months as predictors. The dependent variables for intellectual abilities at age 4 years were DAS-II GCA (similar to IQ), DAS-II Verbal standard score (SS), and DAS-II Special Nonverbal Composite (SNC). Dependent variables for language abilities were PPVT-4 SS and EVT-2 SS. The model explained 72% of the variance in DAS-II GCA, $F(3,34)=32.80, p<.001$, with all three predictors contributing significantly. All three predictors also contributed significantly to the variance in DAS-II SNC, explaining 71% of the variance, $F(3,34)=31.48, p<.001$. The model explained 54% of the variance in DAS-II Verbal SS, $F(3, 34)=15.84, p<.001$, with only EV contributing significantly. With regard to vocabulary abilities, the model explained 57% of the variance in PPVT-4 SS, $F(3,34)=17.63, p<.001$, with EV and nonverbal abilities both contributing significantly, and 50% of the variance in EVT-2 SS, $F(3,34)=13.52, p<.001$, with only EV contributing significantly. Discussion: Similarly to findings for TD children, 24-month expressive vocabulary size significantly predicts overall intellectual ability, verbal and nonverbal intellectual ability, and both receptive and expressive vocabulary ability at 48-

months for children with WS, with 24-month deictic gesture and/or nonverbal ability also contributing significantly to the variance in several of these measures. Theoretical and practical implications will be discussed.

P1-D-72 Determining quality input: The role of parent child interactions in early vocabulary development

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In 1995, Hart and Risley demonstrated in a simple, compelling way that children who heard more words said more words. While celebrated for its emphasis on quantity of input, Hart and Risley also noted that the important of the quality of early language interactions. Recent research examined this claim by studying the communication foundation, dyadic interactions characterized by the fluidness of the communication and the extent to which symbols are infused into the conversation or routines (Hirsh-Pasek et al., 2015). Indeed, this type of interaction accounted for more of the variance in language outcomes than did the number of words spoken to the child. Here, we extend the findings from Hirsh-Pasek and colleagues (2015) to examine how the communication foundation predicts language outcomes when compared to diversity of vocabulary (e.g., word types) and complexity of utterances (e.g., mean length utterance), both measures used by others to evaluate the quality of language input. We hypothesize that even when these other aspects of quality are accounted for, the communication foundation will remain a unique predictor of children's vocabulary. Using the NICHD Study of Early Child Care and Youth Development database, 180 children were selected across low-, middle- and high-SES strata. The communication foundation was assessed at 24-months using the three-box task, a semi-naturalistic play session in which the parent is instructed to play with her child as she normally would with the contents of three boxes, the first of which contains a book and the other two of which contain toys. Three behaviors, symbol-infused joint engagement, bouts of shared attention infused with words and gesture, routines and rituals, such as book reading, and fluency and connectedness, the balance and flow of the conversation, were rated on a 1-7 scale based on the quantity and the quality of the behavior. The average of these scores was used for the rating of communication foundation (Hirsh-Pasek et al., 2015). Language input variables were also drawn from this task and included the total number of words per minute, the VOCD score (a measure of lexical diversity) and the average length of utterance. Overall parenting quality, a control variable, was a composite of maternal sensitivity (NICHD ECCRN, 1999) and cognitive

stimulation (HOME; Caldwell & Bradley, 1984) and children's expressive vocabulary at 36-months, our outcome measure, was assessed using the Reynell Developmental Language Scales (Reynell, 1991). When analyzed individually, controlling for overall parenting quality, both VOCD and communication foundation are significant predictors of children's 36-month language outcomes (β=.218, t(177)=2.727, p=.007; β=.311, t(177)=4.044, p<.001, respectively). However, when all of the language input variables are entered into a simultaneous regression along with the communication foundation score and overall parenting quality, only the communication foundation score remains a significant predictor of language outcomes (β=.273, t(174)=3.379, p=.001) accounting in an additional 5.7% of variance in language outcomes over the language input variables. This finding suggests that even when the quantity and the quality of the language input is accounted for, the communication foundation is still a potent predictor of children's language outcomes.

P1-D-73 Simulating bilingual learning: Monolingual infants can use cross-situational statistics to learn two labels for the same object

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Infants are quickly able to map object labels to their referents by tracking the co-occurrence of objects and labels across multiple events, even in the absence of overt naming (Smith & Yu, 2008). This process of cross-situational statistical learning has been demonstrated to be a powerful mechanism that infants possess. However, the utility of this mechanism may depend on a child's language environment. For a bilingual infant, this task is more complex because she must learn to associate two labels to the same referent, one label in each language. Poepsel and Weiss (2016) demonstrated that adults can perform cross-situational statistical learning of dual labels for the same referent, but late-bilingual adults show stronger learning of dual labels than monolingual adults. For infants in the early stages of vocabulary development, it is not clear whether monolingual infants can learn multiple object labels for the same novel object using information gleaned across different presentations or if this ability requires bilingual experience. In the current study, we tested monolingual 18-month-olds' ability to associate either one or two labels to a referent using cross-situational statistics. Infants were assigned to either a single label condition (n= 23) in which each object was paired with one label, or a dual label condition (n= 31) in which each object occurred with two different labels across trials (see Figure 1). During training, infants viewed two objects on a screen at the same time

and heard both the objects' corresponding labels. At test, infants again saw two objects, but only one was labeled (see Figure 2). Infants' looking to the screen was recorded and then coded frame-by-frame (Fernald, Zangl, Portillo, & Marchman, 2008). We analyzed the proportion of time infants looked at the target (labeled object) relative to the duration of looking to the target + distractor (unlabeled) object. Chance performance was 50%, indicating equal looking to target and distractor. Our results in the single label condition replicate Smith & Yu (2008)'s finding that monolingual infants successfully learned object labels for referents using the statistics of across-event label-object co-occurrences. Infants' mean proportion of looking at the target was significantly greater than chance (M=.53, p=.03). In the dual label condition, infants also displayed evidence of learning the dual labels for the objects, exhibited by reliable looking at the target near the end of testing, after infants had accumulated additional experience with the labels (M=.54, p=.04). To our knowledge, this is the first work to show monolingual infants can use cross-situational statistics to learn more than one label for a referent. We are currently collecting data from bilingual infants (n=15) as well. While our current evidence suggests that bilingual experience is not necessary for learners to use cross-situational statistics to learn dual labels, it is possible that natural language experience mapping two labels to a single referent makes bilinguals more adept at this process.

P1-D-74 Stress processing in the first year of life in preterm vs. full-term infants: A maturation study

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There is growing evidence that prosody is a powerful cue infants make use for segmenting spoken utterances into word-like units. The language specific segmentation, as well as the syntactic elements are bootstrapped via perceptual patterns available at both lexical and phrase levels. Supposedly, the attunement to the native language prosodic properties starts prenatally, emphasizing the prominent role of the intrauterin period in language acquisition. Two age groups of infants (6 and 10 month olds) were included in our study. 34 of 82 of the total sample infants were pre-term of slight gestational age deviation. For age comparison we made use of the widely accepted clinical practice that is age correction. Mismatch negativity event related brain potential (ERP) component (Mismatch response, e.g. MMR in more general) was recorded and analyzed. The ERPs elicited by frequent (standard) and rare (deviant) pseudo-words by using a passive oddball paradigm

of two conditions: (1) standards of legal stress patterns interspersed with deviants of illegal one (stress on the second syllable), and (2) standards of illegal stress and deviants of legal one. Our results show differences in MMR responses between the full-term and preterm infants' group, and differences between the very preterm and moderate late preterm infants (illegal deviant condition). These results strengthen the view that the longer extra-uterine language exposure doesn't redound as a compensatory effect for the preterm infants.

P1-D-75 Acoustic characteristics of infant-directed speech in Latin American immigrants

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When speaking to infants and children, caregivers use a special register, infant-directed speech (IDS), characterized by more exaggerated intonation, slower speech rate and shorter and simpler utterances as compared to adult-directed speech (ADS). More research is needed to examine IDS properties and functions across different languages and cultures. The study examines whether speaking English as a Second Language (ESL) affects the modification of prosodic characteristics in ID relative to AD speech produced by native Spanish speaking mothers who are immigrants to the USA. Two groups of mothers were recorded during a play interaction with their age-matched infants. The first group included monolingual English (N = 8, mean infant age 23.8 months, F4, M4) and Spanish (N = 8, mean infant age 23.8 months, F3 M5) mothers who talked to their infants in their native language respectively. The second group consisted of native English (N = 4, mean infant age 21.8 months, F2, M2) and Spanish (N = 4, mean infant age 23 months, F2, M2) mothers with intermediate to advanced ESL proficiency evaluated using the American Council on the Teaching of Foreign Languages guidelines. These mothers spoke to their infants in English, Spanish and ESL. Average age of mothers in both groups was 34 years. Average length of residence in the USA for all Spanish speakers was 15 year. Twenty-five utterances from each mother's speech sample were extracted. For each utterance mean pitch (Hz), mean pitch range (Hz), utterance duration (seconds), and speaking rate (number of syllables per utterance duration) were measured. The mixed-effects ANOVA with one between-groups variable, Language (English, Spanish) and one within-groups variable, Register (ID, AD) was run for all prosodic characteristics in the first group. The results demonstrated a significant effect of Register for mean pitch, $F(1,14) = 24.4$, $p < .001$, pitch range, $F(1,14) = 14.3$, $p = .002$, and utterance duration, $F(1,14) =$

40.6 , p < .001. The same mixed-effects ANOVA with one between-groups variable, Language (English, Spanish, ESL) and one within-groups variable, Register (ID, AD) was run in the second group. There was a significant effect of Language, F (2,9) = 8.4, p = .009 for speech rate. Following Tukey posthocs demonstrated a significant difference between English and ESL, p = .004 and Spanish and ESL, p = 0.12 groups. There was also a significant effect of Register for mean pitch, F(1,9) = 39 , p < .001) and pitch range, F(1,9) = 22.5 , p = .001). The results suggest that English and Spanish speaking mothers used an IDS when interacting with their infants. Compared to ADS, they used higher and more variable pitch and longer utterance duration. Mothers speaking English, Spanish and ESL exhibited the same pattern, except for utterance duration. Native Spanish speakers slowed down their speech rate irrespective of register when using ESL. These results indicate that the modification of prosodic characteristics of IDS may be a universal feature across languages. Further data collection is necessary to understand how ESL proficiency may affect characteristics of IDS.

P1-D-76 Word recognition in familiar and unfamiliar accents across infancy

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The pronunciation of words can vary greatly between accents. The word "ball" spoken by an Australian talker, for instance, may sound very similar to "bowl" spoken in a North American accent. Such between-accent differences have been claimed to impede infants' word recognition. In fact, children seemingly do not recognize familiar words in unfamiliar accents until shortly before their second birthday (e.g., Best et al., 2009; Mulak et al, 2013; Van Heugten et al., 2015) and it takes another few years for them to reach adult-like performance in this task (Bent, 2014). Although the mechanisms underlying this developmental trajectory have been debated (c.f. Best et al., 2009; Schmale et al., 2012; Van Heugten & Johnson, 2014; White & Aslin, 2011), it is still unclear what factors might best explain children's growing ability to contend with accented speakers. This is at least partially due to individual studies testing relatively homogeneous groups of children within narrow age ranges, thereby limiting the variability on potentially important predictor variables. The current study takes a different approach and tests infants' word recognition in the local and in an unfamiliar accent across a much more variable subject population differing widely on variables such as age, vocabulary size, and language input. By examining which factor best predicts performance, we can gain a better understanding of what drives word recognition in unfamiliar accents. Recruitment was restricted to

typically developing North American infants between 8 and 30 months of age (N=58, recruitment ongoing). A detailed language and family background questionnaire was administered and parental vocabulary checklists were obtained, which provided estimates of children's exposure to English and other languages, their experience with various accents, parental education and income, as well as infants' vocabulary sizes. Using the Preferential Looking Procedure, children were presented with two images side-by-side on a computer screen. Their eye movements were recorded as they listened to sentences instructing them to look at one of the objects (e.g., "Look at the shoe!"). On half the trials the speaker spoke in the dominant local accent. On the other half of the trials, an unfamiliar Australian accent was used. Talker accent was blocked and counterbalanced for presentation order. If infants can recognize words in this task, looks toward the target picture after target word onset should exceed chance level (.50). Results revealed that across all infants and all trials, this was indeed the case (proportion of fixations to target = .60; $p < .01$). Reaction time analyses (cf. Fernald et al., 1998) furthermore revealed that the mean latency to shift to the target image was 598 ms. However, infants' comprehension of native and accented words was predicted by different factors. Although target fixation after noun onset was best predicted by infants' age both when listening to the local and when listening to the accented speaker ($\beta = .613$, $p < .01$ and $\beta = .493$, $p < .01$, respectively), receptive vocabulary size best predicted the speed of word recognition, but only in the unfamiliar Australian accent ($\beta = -.339$, $p = .01$). This suggests that knowing more words (each of which has likely been heard more frequently) might help infants cope with unfamiliar accents faster, potentially as the result of word representations becoming more robust to variation in the input.

P1-D-77 fNIRS reveals a sensitive period for non-adjacent dependency learning in the linguistic domain

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Infants master the daunting task of acquiring the grammatical rules of their native language with remarkable ease. The ability to implicitly extract and generalize abstract rules between non-adjacent elements in a non-native language is present very early in life but largely lost in adulthood (Friederici, Müller, & Oberecker, 2011). The limited ability of adults to implicitly learn non-adjacent dependencies was attributed to an increasing involvement of the prefrontal cortex (PFC) through cognitive control with age (Friederici,

Mueller, Sehm & Ragert, 2013). This increase in cognitive control might impede associative learning processes, which are assumed to guide implicit grammar learning in infants. This raises the question when the sensitive period for non-adjacent dependency learning closes and whether the underlying learning mechanisms are specific to language or domain-general. We aim to answer these questions by testing the implicit learning abilities of 2- and 3-year-old children in a grammar learning paradigm using both linguistic materials (short Italian sentences) and non-linguistic materials (tone sequences). Using functional Near-Infrared Spectroscopy (fNIRS), we test implicit learning of non-adjacent dependencies by assessing the detection of violations after a familiarization period. Moreover, fNIRS allows us to determine which brain regions are involved in implicit learning and whether and how activation patterns change with age. Preliminary data with 12 infants per age group and stimulus type (48 data sets in total) show learning of the non-adjacent dependencies in the linguistic domain in 2-year-old but not in 3-year-old children. No evidence of learning was found in the non-linguistic domain for either age group. Two channels over the left and one over the right temporal lobe show significant differences between the familiarized grammar and violations in oxygenated hemoglobin (HbO). Deoxygenated hemoglobin (HbR) levels reveal a trend. Moreover, our data show increased activation of the bilateral temporal cortex for linguistic compared to non-linguistic stimuli, as measured by HbO and HbR levels. These data suggest that the sensitive period for learning non-adjacent dependencies closes during the third year of life and that temporal regions subserve implicit learning of these dependencies within the sensitive period. Furthermore, non-adjacent dependency learning in infancy appears to be domain-specific. The overall difference in activation in response to the domains further supports this notion by suggesting that infants of both ages are more sensitive to linguistic compared to non-linguistic stimuli.

P1-D-78 Infants require sufficient time to use novel verbal information when reasoning about others' actions

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Infants use verbal information when reasoning about others' goals. Six-month-old and older infants understand that an agent's verbal information signal her goal object in a two-object situation (e.g., Vouloumanos, et al., 2014). By 12 months, infants understand that a change in agents' words may signal a change in her upcoming actions. For instance, after hearing a change in an agent's word, 12-month-olds can expect her to pursue a

new-goal object (Jin & Song, 2017). However, this finding is contrasted with previous evidence that 12-month-olds failed to generate a specific expectation about which goal object an agent would choose after they detected a change in word (Song et al., 2014). Here we attempted to reconcile the mixed findings. There were procedural differences between the two prior studies. In Song et al. (2014), infants heard the novel words only twice, once per second, without a pause. Plus, the agent's face was hidden from the infants' view. In contrast, in Jin and Song (2017), the infants were given more time to process words: the agent repeated the novel words three times and paused 1 s between each word token. The source of verbal information was also clear: the agent's face was visible. These factors in Jin and Song (2017) might have facilitated infants' reasoning about the relationship between the agent's words and goals. The current research aimed to tease apart the contributions of these factors. Specifically, we examined whether 12-month-olds can reason about a change in an agent's goal object after hearing her new word when they are given a clear source of verbal information but have less time to process words. Twelve-month-olds received four familiarization, one pre-test display, and two test trials. A female agent sat at a large window and her face was clearly visible. During the familiarization, the agent uttered a novel word ("Modi!") twice without a pause, and then reached for one of the two objects on the apparatus floor. During the pre-test display, the locations of the two objects were switched. During the test, the agent said a different word ("Papu!") twice without a pause, and reached for the same object (old-goal event) or the other object (new-goal event). According to preliminary data, 12-month-olds looked about equally at the new- and old-goal test events. These results resemble the findings of Song et al. (2014), suggesting that even when the source of verbal information was clear, the infants (1) detected the change in word at the start of the test trial, (2) realized that this change in word might signal a change in the agent's actions, but (3) could not immediately reason that the agent would now reach for the new-goal object. In contrast, in Jin and Song (2017), 12-month-olds looked reliably longer at the old-goal event than at the new-goal event when an agent's word changed, suggesting that they established a specific expectation about change in the agent's goal. Thus, 12-month-olds appear to require more time to use verbal information when reasoning about an agent's goal.

P1-D-79 Effects of Speaking Style and Context on Online Word Recognition in Young Children

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Previous research has found that Clear Speech (CS) improves intelligibility for adults (Smiljanic & Bradlow, 2009) and that Infant Directed Speech (IDS) aids perception and development for children (e.g. Cooper & Aslin, 1994). These listener-oriented speaking styles are similar, but differ in terms of exact acoustic characteristics and (positive) affect. It is not known whether listener-oriented speaking styles enhance intelligibility in general, or if only IDS features are beneficial to young children. Additionally, listeners rely on contextual information (lexical, semantic, and syntactic) when decoding a message (Nittrouer & Boothroyd, 1990). This study investigates how clarity of the speech signal interacts with availability of contextual cues for younger listeners, by looking at time course differences in online word recognition for different speaking styles and semantic context. In Experiment 1, 18 4-year-olds were tested in a visual word recognition paradigm. They heard sentences with a high- versus low-predictability semantic context, 'He pointed at the cheese' vs. 'Mice like to eat cheese' (Fallon et al., 2002), while viewing two pictures on a screen: a target that matched the last word of the auditory stimulus and a distractor. Following a similar set-up with adult listeners (Van der Feest, Blanco & Smiljanic, 2016; under review), children heard target sentences in Conversational (Conv), IDS, and CS speech. A mixed-effect logistic regression model (MELR) was fit to the data of participants' first shift to the target object in the first one-second window after target word onset (Figure 1). Results (Table 1) showed that young children benefitted from contextual cues within each speaking style. Unlike for adults (Van der Feest et al., 2016), in low-context sentences both CS and IDS improved word recognition compared to Conv: Children benefited from speech clarity even in the absence of contextual cues, and they benefited from adult-directed as well as infant-directed listener-enhanced speech. Participants in Experiment 1 (who were not explicitly instructed to look at a target) had relatively low overall target-fixations. In Experiment 2 (ongoing, n=6), we test younger 2- to 3-year-olds in a similar paradigm, but removed the contextual factor to more directly investigate whether young children benefit from adult-directed listener-enhanced speech (CS) compared to IDS. Participants hear direct instructions to fixate the target object within a neutral carrier phrase, e.g. 'Oh look, what do you see now? Look at the cheese'. Target fixations will be compared on Conv, IDS and CS sentences and analyzed with the same MELR model as Experiment 1. Findings from Experiment 1 show that a combination of semantic cues and listener-oriented acoustic enhancements enables the most reliable and rapid lexical access in young children, and that adult-directed CS may be as beneficial as IDS despite differences in acoustic characteristics and affect. The findings suggest that children rely on bottom-up (sensory) processing more heavily in word recognition of low-context sentences compared to adult listeners in previous studies, as we explore further

in Experiment 2. For young children, speech clarity may be even more crucial for reliable word recognition.

P1-D-80 Some Complex Concepts Require Language: An eye-tracking study with 12- to 24-mo-old infants and adults

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What is the relation between language and thought? The possibilities range from these being completely separate cognitive systems, to them being two sides of the same cognitive coin. One specific proposal (De Villiers, 2014) suggests and provides empirical evidence for the idea that language might particularly be required for building complex conceptual representations. For example, the thought "dogs push cars" not only represents a specific asymmetric relation between a dog and a car, but does so across all instances of any dog pushing any car. In this study, we examine the building of such abstract, three-term transitive events (e.g., dog-pushes-car) in 12- to 24-mo-olds (n=26) and in adults (n=20). In separate groups of infants (n=20) and adults(n=25), we compare these to two-term, intransitive events (e.g., dog-jumps) using visually comparable stimuli. Adult participants were further divided into two groups: a group that underwent simultaneous verbal shadowing to restrict language use and a control group without verbal shadowing. We used an eye-tracker and an anticipatory looking paradigm to examine the development of an abstract representation, as measured by anticipatory looks towards target events (e.g., a dog pushing a car) versus role-reversed events (a car pushing a dog), with novel cars, dogs, and their combinations. For the intransitive events we found significant anticipations towards targets vs. non-targets in both infants and verbal-shadowing adults. For transitive events, only control adults showed significant target anticipations. We suggest that representing three-term transitive events may be at a level of complexity that cannot be accomplished without language.

P1-D-81 Can infants segment words from two interleaved languages?

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Many studies have shown that infants are sensitive to syllable co-occurrence patterns, or transitional probability (TP), when segmenting words from a single language (e.g., Saffran

et al., 1996). However, there has been little research on whether infants can succeed when receiving two language inputs. The key to successfully segmenting words from two languages is representing the language structures separately, so that learners can accurately track the TP of each language. Adults can represent two language structures when the languages were paired with salient between-speaker cues, such as two differently gendered voices (Weiss et al., 2009) or two distinct faces (Mitchel et al., 2010). Similarly, bilingual 14-month-olds can segment words from two languages when the languages were marked by two different gendered voices (Antovich et al., 2017). However, two distinct languages are not always marked by strong between-person cues in a naturalistic bilingual environment, where individual bilinguals often alternate between two languages in conversations with each other (Poplak, 1980). This study explored whether acoustic cues within an individual's speech can be effective for dual-language statistical segmentation. We used accented speech to mark the differences between Language 1 and 2, since phonetic realizations mark differences across languages (e.g., realization of French /p/ ≠ English /p/). A female speaker recorded two artificial languages in different accents (e.g., Language 1 in an English accent and Language 2 in a French accent; Table 1). Using a visual fixation procedure (Thiessen et al., 2012), we presented 9.5-month-olds with the language(s) during familiarization and compared looking times to words and part words at test. In Experiment 1, monolingual English infants (n=14) looked significantly longer to words than part-words when receiving only one of the two accented languages [t(13)=-2.38, p=0.034] (see Figure 1 for all results), confirming that each language was learnable individually. In Experiment 2, we explored whether monolingual infants can separately represent two interleaved languages marked by accent. The TP across languages were incompatible, meaning that a failure to separate the languages would result in no discernable statistical cues to word boundaries. After training, infants were tested on either Language 1 or 2. Monolingual English infants (n=30) succeeded, looking significantly longer to part-words than words [t(29)=2.30, p=0.029] in both languages. Experiment 3 extended Experiment 2 to bilingual English-French infants (n=27), who have experience with phonetic cues in both English- and French-accented speech. Bilinguals did not show any looking time difference between part-words and words [t(26)=0.17, p=0.869], suggesting that they did not track TP separately between languages. Our results indicate that accented speech is an effective cue for 9.5-month-olds to differentiate two interleaved languages, but surprisingly only for monolinguals. We suggest that monolinguals may have heightened attention to the stimuli due to the unfamiliar French accent. Further, based on familiarity with the accents, bilinguals may have accepted the two languages as instances of the same underlying language (e.g., English-accented French and native-accented French represent the same language), thus

conflating statistical cues and failing to segment words. Further research with different cues can elucidate these possibilities.

P1-D-82 Effects of referential labeling on facilitating phonetic discrimination of non-native consonants

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Infants begin life with the language-universal speech perception ability. Around the 10-12 months of age, infants begin to show the language-specific consonant perception (e.g., Werker, Yeung, & Yoshida, 2012). Recent studies suggested that contextual cues of presenting speech sounds, e.g., referential labeling in the word-learning condition, enhanced phonetic discrimination of non-native lexical tones in 9-month-old English-learning infants (Yeung, Chen, & Werker, 2014). Consonants are included in phonetic inventory of every language, but lexical tones only exist in tonal languages. Therefore, one goal of this study was to assess effect of referential labeling on distinguishing non-native consonants in 11-month-olds. The better word-learning ability of older infants (e.g., 17 months) than younger infants might facilitate phonetic discrimination in the referential labeling context. Another goal of this study was to explore developmental changes of referential labeling to facilitate phonetic perception. Experiment 1. Participants. Sixty-four Mandarin-learning 11 and 17-month-old infants participated in the experiment. Equal number of infants were assigned to either the Non-referential condition or the Referential condition (see Figure 1). Procedure and stimuli. Figure 1 illustrates the stimuli and procedure. Pre-Training phase was running only for the referential labeling condition. Animations of objects were paired with their corresponding labels. All infants went through the Training phase, in which English stimuli [ði] and [θi] were paired with moving objects. The Test phase contained Non-alternating/Alternating trials begun immediately following the training phase. Results Separated 2 (Referential condition) × 2 (Trial type: alternating trials vs. non-alternating trials) mixed two-way ANOVAs were run on the looking time of test trials. Only 11-month-old infants demonstrated the facilitation effect of referential labeling, by showing a significant Referential condition × Trial type interaction, $F(1,30) = 5.57$, $p = .03$. In contrast, the interaction effect was not significant in 17-month-olds, $F(1,30) = .53$, $p = .47$. Experiment 2 Correct labeling between familiar words and corresponding objects in the referential labeling condition might promote phonetic learning in 11-month-old infants. Therefore, the experience of incorrect labeling would not facilitate phonetic discrimination of non-native consonants. Participants,

procedure and stimuli. Sixteen 11-month-old (Mean age = 11.33 months) infants participated in the experiment. Auditory and visual stimuli were the same as in Experiment 1. For pre-training phase in the incorrect labeling condition, the video monitor displayed the false labeling events (see Figure 2). The procedure was identical to referential labeling condition in Experiment 1. Results The one-way ANOVA (Trial type: Alternating vs. Non-alternating trials) failed to show any significant Trial type effect, $F(1,15) = .29$, $p = .60$. Thus, 11-month-old Mandarin-learning infants were not able to discriminate the English contrast when the word-object labeling presented in infants' native language was incorrect. Conclusion. Results of two experiments not only demonstrate the word-learning context effects on phonetic perception development, but also reveal that correct labeling is the requite condition for infants to detect phonetic differences in the word-learning context around the first birthday.

P1-D-83 Environmental influences on early vocabulary development: The impact of maternal education and language input

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Recent evidence suggests that before their first birthday infants already recognize the names for common objects (Bergelson & Swingley, 2012). Work with 2-year-olds has found that maternal education and language input are related to children's lexical recognition and vocabulary development (Fernald et al. 2012). However, infants' lexical recognition exhibits nonlinear improvements in the second year of life (Bergelson & Swingley, 2015). This raises questions about whether the factors that are important for early word learning the same as those for later word learning. The present study examined whether maternal education and language input impact infants' lexical recognition in the first year of life. We tested 9-month-olds' (N=38) knowledge of four common nouns using the looking-while-listening procedure (Fernald et al., 2008). On each trial pictures of two familiar objects were presented simultaneously, and infants were asked to look at one of the pictures. Lexical recognition was measured as the amount of looking to the target picture after label onset. Maternal education was assessed as the highest level of education attained. Infants' language environment was measured using the LENATM audio-recording and analysis system (Xu et al., 2009). Infants wore the LENA recorder for 8 continuous hours on consecutive days, for a total of 16 hours. The LENA system provided estimates of the adult word count (AWC) heard by the infants over the two days. Overall, infants performed above chance on the lexical recognition task, $t(37)=2.42$, $p <.05$. Infants'

lexical recognition was positively related to their mother's educational attainment, $r(37)=.37$, $p < .05$, and to the AWC infants heard in their environment, $r(37)=.33$, $p < .05$. Next, we divided the sample into groups to examine performance as a function of maternal education (less than a 4-year degree, 4-year degree, and more than a 4-year degree) and language input (high and low AWC). A 2 by 3 ANOVA revealed a significant AWC by maternal education interaction, $F(2,32)=5.04$, $p < .05$ (Figure 1). Follow up tests revealed that for both the infants with the highest and lowest levels of maternal education there was no difference in recognition performance for those who heard more vs. less adult speech, $ps > .05$. But for infants whose mothers' had 4-year degrees, accuracy on the lexical recognition task differed as a function of AWC; infants who heard more speech were more accurate than infants who heard less speech $t(15)=-4.87$, $p < .05$. Finally, only infants who heard more speech and had mothers with a 4-year degree or more than a 4-year degree performed above chance on the lexical recognition task, $t(8)=4.13$, $p < .05$, and $t(6)=2.52$, $p < .05$. In sum, we found that by 9-months of age, infants know the names for some common nouns. But, this ability is related to infants' maternal education and language input, in line with research examining lexical recognition in the second year of life (Fernald et al., 2012). Infants whose mothers were highly educated and spoke more demonstrated the greatest recognition on the common words we tested. This suggests that there is continuity in the factors important for language development from the earliest word learning to the vocabulary burst. Before infants start producing their first words, environmental influences are already affecting infants' language development, which may have far-reaching consequences for infants' language learning trajectories.

P1-D-84 Lexical Access and Organization of Language in Monolingual and Bilingual 18-Month-Olds

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A rapid increase in word acquisition characterizes the second year of life (Ganger & Brent, 2004; McMurray, 2007; McMurray, et al., 2012). Accompanying this increase is a reduction in the time that it takes children to process words. These two developments are related: vocabulary size is correlated with lexical access in monolingual children (DeAnda, et al., 2017; Fernald, et al., 2006; Fernald, et al., 2001). Also during the second year, children show evidence of lexical-semantic organization (Arias-Trejo & Plunkett, 2009), creating semantic connections between words as early as 21 months. There are significant changes occurring in language development during the second year with respect to vocabulary,

lexical access, and lexical organization. However, further research is necessary to explore how these processes relate to one another across monolingual and bilingual children. This proposal examines relations between vocabulary size, lexical access, and lexical organization in the second year. Participants were 35 monolingual English, 31 monolingual Spanish, and 33 bilingual Spanish-English children. We present preliminary data on 19 monolingual English children (Mage=18;5, range=17;15-19;5). Vocabulary size was measured using haptic response on the Computerized Comprehension Task (CCT; Friend et al., 2003; 2008; 2012). Haptic response time (RT) was coded via the EUDICO Linguistic Annotator (ELAN; Wittenburg et al., 2006) as a measure of lexical access. Lexical-semantic priming was assessed using a modified Intermodal Preferential Looking Paradigm (Arias-Trejo & Plunkett, 2009). Children saw target and distractor image pairs in semantically related or unrelated conditions with respect to a prime. We focus here on the semantically-related condition. Zero-order correlations revealed a relation between vocabulary size and haptic RT (r=-.46, p=.03) and between vocabulary size and proportion of target looks on the priming task (r=.440, p=.06). However, target looks and haptic RT were unrelated (p=.49). We explored these factors together in a hierarchical regression with RT on the first step, vocabulary on the second, and lexical organization as the dependent measure. The model with RT alone was not significant (p=.66) however the inclusion of vocabulary significantly improved fit (R^2=.349, p=.012) and accounted for 65% of the variance in lexical organization. A similar model with lexical organization and vocabulary as predictors of RT yielded a marginal effect of vocabulary (p=.06) but not of lexical organization. We found that, as expected, vocabulary size was associated with speed of lexical access and lexical-semantic organization in monolingual English 18-month-olds. However, lexical access and lexical-semantic organization were unrelated (see Figure 1). It's possible that lexical access is related to speed of lexical-semantic priming rather than proportion looking. Alternatively, early in development, lexical organization may not be sufficiently stable such that vocabulary drives both lexical access and organization. To evaluate these competing accounts, we will analyze our full sample of Spanish-English bilingual children and their monolingual English and Spanish peers in preparation for the meeting of the ICIS. We will use growth curve analyses to assess the relation between the timing of lexical access and lexical-semantic organization and the role of vocabulary size in guiding these processes.

P1-D-85 Have you heard about the bird? Maybe, but have you seen it? 6-month-olds' attention to human & bird audio & visual vocalizations

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Infants show rapid tuning to the speech signals of their environment. By 6 months, infants discriminate their native from a non-native language in multiple modalities (e.g.,visual-only, Weikum et al., 2007), are shifting attention to diagnostic facial features (e.g., mouth, Lewkowicz & Hansen-Tift, 2012), and can use primate vocalizations (but not non-speech) to which they have been given some experience to support categorization (Perszyk & Waxman, 2016, 2017). This suggests an early flexibility, albeit constrained, that is neither strictly modality- nor species-specific. Here we investigate the boundaries of that flexibility in infants' treatment of vocalizations. We ask whether infants attend preferentially to own-species over other-species vocalizations in a modality-specific way. We hypothesized that 6-month-olds' overall visual attention would not differ by species or modality. Data collection is ongoing with the aim of testing 24 infants (current n = 10; M = 6 months 7 days old). Infants viewed up to 8 5-second clips of audio-only (A), silent video (V), and audio-video speaking humans and singing birds while their visual attention was recorded. Video presentation began when the infant oriented to the screen and continued playing until the task ended or the infant became fussy, permitting infants to naturally vary their visual attention. Visual attention was coded offline, frame-by-frame for infant looking. Consistent with our hypothesis that early attention to vocalizers is not species-specific, there were no significant differences in infant attention between humans and birds (A, $p = .754$; V $p = .754$). Similarly, infant looking was not modality-specific in birds, in that there was no significant difference in infant attention between V and A ($p = .754$). In humans, this was not the case: providing a face resulted in significantly increased looking for humans (V as compared to A, $p = .021$; AV as compared to A, $p = .004$; AV as compared to V, $p = .508$). This suggests that infants' attention to vocalizations and vocalizers depends both on the species generating the vocalizations and the modality in which they are presented. Although preliminary, this implies that at 6 months infants' are generally prepared to visually attend to potentially-linguistic vocalizations, regardless of species, whereas their use of the information provided by the face of the vocalizer may be confined to conspecifics. This preferential attention to faces for humans and not birds would facilitate infants' use of visually diagnostic information about vocalization production, potentially facilitating language development.

P1-D-86 Parents' attitude toward technological consumption of children learning Spanish: an age effect

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At the present time, infants are active users of technological devices. It is well known that there is a lot of content designed and directed to children, so they can easily become active consumers of apps and different mobile devices even before their first birthday. However, the consumption of technology in infants can occur with or without adult supervision, making it difficult to study infants' tech-habits. Previous literature with English speakers has shown that children up to 9 years old consume mobile media since early ages, and that technological habits increase according to infants' age. From a general background, smartphones, tablets and TV are the most popular devices between infants, in which they mainly consumed children's TV shows, music, movies and videos through the Internet. Likewise, studies with Spanish learners have shown that technological habits are similar to those reported on children learning English (Gutnick, 2011; Suárez, Alva & Ferreira, 2016), in terms of contents and favorite devices chosen by the infants. Recent studies with 3 to 6 year-olds have shown a difference in technological consumption (number of apps downloaded) depending on family income; lower income families prefer more free apps compared to middle and high-income families. However, regardless of income level around 50% of the parents "somewhat agree" that the use of technology (for example, educational apps) are valuable learning tools for their children (McClure, Vaala & Spiewak, 2017). In order to examine socio-cultural differences in technological habits, the aim of this study was to determine, in Spanish learners (N=200; between 1 and 4 years of age) the type of devices used as well as the attitude of parents towards technology consumption by their children; taking age as a guiding variable. Income and education level, as well as age of both parents was controlled. According to the parents' report in a telephone survey, the main questions were related to the favorite device of the infant, the attitude toward the use of technology (positive/negative), plus if the infants have a technological device of their own. Among the main results it is highlighted that at 1 and 2 years of age, infants prefer smartphones versus watching TV, and that this preference is reversed at 3 and 4 years being the TV the most popular device. In regard to parents' attitude toward the use of technological devices, it was found that 66% of 1 year-olds' parents consider the use as positive and that this percentage increases according to children's' age to 76% at 4 years. Surprisingly, infants who own a technological device increase from 6% at 1 year of age, to 16% at 4 years of age. The present study shows, in Spanish learners, findings regarding the effect of age in the attitude of parents toward technological consumption as well as in the increase in the number of infants who own a device. The results shown here are proposed as useful in the field of education and pioneering regarding the use and owns of technology according to infants' age.

P1-D-87 Parents learning to ask questions from an interactive, dialogic storybook

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Research documents the value of adult-child interactions for promoting language development (Hoff, 2006; 2013; Huttenlocher et al., 2010). Caregivers of all SES backgrounds talk more with a wider variety of words while reading picture books compared to other activities (Hoff-Ginsberg, 1991). A specific method of prompting conversation called "dialogic questioning" promotes vocabulary acquisition (Whitehurst et al., 1988). This technique involves asking children open-ended questions to get them to talk about the story. We built dialogic questioning into an e-book and tested its effectiveness in promoting parent-child conversation with low-SES families (qualified for free/reduced lunch). On each page, after the story narration concluded, a helpful character appeared in the corner of the page to ask a question. Following a dialogic-style progression of difficulty, initial questions were simple; on later pages (and in a second reading of the book), questions became more challenging. On the title page, the questioning avatar told parents that he would not always appear, and encouraged parents to ask their own questions. If they were stumped, parents could touch an icon to trigger a hint. Parents and their 3- to 4-year-old children read the two versions of the e-book with the questioning character (experimental condition--N = 15 dyads) or the e-book without this helpful questioner twice (control condition--N = 12 dyads transcribed). Parents who read the book with the dialogic questioner talked much more during the session (M = 913 words) compared to parents who read the control version without the questioner (M = 257 words), Welch's t-test(25) = 4.76, p = .000. A similar difference emerged in parents' use of unique words (M = 180 vs. 74 words, t(25) = 5.28, p = .000). Although children produced fewer words/unique words than parents, the condition differences were similarly robust (all p's < .001). A higher proportion of parent talk supported by the avatar's example was content related, compared to without the avatar's model of questioning (73% vs. 47%; p < .01) and less of parents' talk with the avatar support was directed at regulating children's behavior (24% vs. 52%, p < .01). Thus, dialogic training with an avatar's model of story-related questions was effective at encouraging family talk. During the second reading of the experimental book, the dialogic avatar did not automatically appear on five pages; rather, the parent or child could tap an icon to receive a dialogic prompt. However, families did not continue to rely on the avatar

for his pre-determined prompt. On these pages, parents more often asked their own independent questions (M = 9.9 questions across the 5 pages, SD = 8.3). Thus, low-SES parents learned and adopted the technique of asking questions related to a story's content. This encouraging results suggests that a painless method to promote parent talk and children's language development might be embedded in electronic books.

P1-D-88 French-learning infants' adaptation to a novel accent: The role of consonant/vowel asymmetry

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During language acquisition, infants develop a language-specific sensitivity to phonetic detail, which allows them to distinguish phonemes, but that is also flexible enough to accept variation introduced by different voices and accents. White and Aslin (2011) found that while American-English-learning 19-month-olds reject a word with a one-feature vowel mispronunciation as an acceptable variant, they accept it when they are familiarized to it as a novel accent. Flexibility for consonants and vowels, however, may not be the same. Consonants carry more weight in lexical processing (C-bias, Nespor, Peña, & Mehler, 2003), but this varies cross-linguistically. Here, we examine the impact of French-learning toddlers' C-bias in lexical processing when they are exposed to novel accents that change either a vowel or a consonant. Adapting White and Aslin (2011), we examined French-learning 19-month-olds' adaptation to a novel accent that changed either a vowel (/a/ - /ɛ/; Experiment 1; n = 18/40) or a consonant (/p/ - /t/; Experiment 2, n = 18/40). For each experiment, half of the toddlers were first familiarized with looming images of familiar words pronounced correctly (control group) or with the novel accent (accent group). In the test phase, toddlers were presented with familiar target and novel distractor image pairs. After 3 seconds of silence (pre-naming phase) toddlers heard the label of the target image, pronounced with either the standard or shifted (accented) pronunciation and their looks to the target were monitored until the end of the trial (3 seconds, post-naming phase). To examine whether toddlers were able to generalize the accent beyond the familiarized words, word recognition was also examined for words that were not labeled in the familiarization phase. The mean proportion of target looks (logit transformed) was calculated for both the pre- and post-naming phases and modeled using a mixed-effects model with the fixed effects of Naming (pre-, post-naming), Group (accent, control), Pronunciation (standard, shifted), and Generalization (labelled,

unlabelled). Preliminary results for both Experiment 1 (Figure 1) and Experiment 2 (Figure 2) show a significant effect of Naming (Experiment 1; Estimate = 2.25, SE = 0.70, $p < .01$; Experiment 2; Estimate = 1.90, SE = 0.60, $p < .01$). This suggests that toddlers recognized (i.e. increase in target looks from pre- to post-naming) the target words tested. The lack of effects or interactions with the other fixed effects suggest that the toddlers tested so far do not show sensitivity to the difference between standard and shifted pronunciations and that exposure to a vowel or consonant change accent does not modulate word recognition. In the final dataset, we predict that toddlers will adapt to the vowel change accent, as in White & Aslin (2011). The results of the consonant change accent will have implications for our understanding of the toddler phono-lexical system. Toddlers might not adapt to the consonant change accent due to their C-bias in lexical processing. If French-learning toddlers do adapt to the consonant change, however, it would indicate that they are able to flexibly suppress their C-bias when learning patterns of accent variation.

P1-D-89 Phonological Competition during Spoken-Word Recognition - Comparing Real Words and Pseudowords

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An ongoing debate concerns whether spoken word recognition happens in an incremental or continuous manner (Marslen-Wilson & Zwitserlood, 1989; McClelland & Elman, 1986). While adults have consistently been found to look at objects that start with the same sound as a word they hear (onset competitor), results regarding rhyme competitors are still inconclusive. Such rhyme effects would support continuous models of spoken word recognition. Furthermore, there is a lack of studies investigating such phonological competition in infants. We compare results from two eye-tracking studies using a visual world paradigm to examine whether infants look at objects that are phonologically related to words they hear. In the first experiment, 49 infants aged 24-30months were presented with four images of objects while they heard a sentence like "Look at the cat". Among the images was one object that rhymed with the spoken word (e.g. hat), one object that shared its onset (e.g. cup) and two phonologically unrelated objects. Using this paradigm, infants showed no preference for either type of phonologically related competitor. In a second experiment, we replaced the spoken real words with spoken pseudowords. Infants now heard a sentence like "Look, pus!" while seeing a bus (rhyme competitor), a pear (onset competitor) and two unrelated distractors.

We further manipulated the degree of phonological similarity between the pseudoword and the rhyme competitor: The onset of the pseudoword was either very similar to the onset of the rhyme competitor by differing only in terms of voicing (e.g. poat - boat) or was very dissimilar from the onset of the rhyme competitor (e.g. silk - milk). Data from 32 30-month-old infants revealed a preference for the rhyme competitor over the onset as well as the unrelated distractors. No preference was found for the onset competitor over the unrelated distractors. The degree of phonological similarity between the spoken pseudoword and the visual object did not modulate looking proportions, indicating that 30-month-old infants may not be sensitive to subtle phonological dissimilarities when engaging with rhyming pseudowords. Comparing results from the two experiments suggests that using real words in a visual world paradigm with infants may lead to a high level of lexical engagement overshadowing any phonological processing that may take place. Pseudowords or mispronunciation paradigms may therefore be a preferential methods when trying to examine phonological processing during spoken-word recognition in infants.

P1-D-90 Heritage Language Development in Spanish-Speaking Toddlers: Identifying Early Predictors

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Language experience strengthens processing skills that aid language growth (Weisleder & Fernald, 2013). Further, vocabulary and processing speed in infants have strong relations with later language and cognition (Fernald, Perfors, & Marchman, 2006). However, language development in Spanish speakers in the U.S. does not mirror that of English speakers with the same level of language exposure in part due to the contexts in which children are exposed to their dominant language (Hoff, 2017). This study contrasts sentence-level processing across Spanish- and English-speaking children with similar levels of dominant language exposure. Participants were 46 monolingual English and 16 monolingual Spanish children followed longitudinally from 30 to 36 months of age. All children had at least 80% exposure to the dominant language since birth. At 30 months, early language production was measured using the English and Spanish adaptations of the MacArthur-Bates Communicative Development Inventory (MDCI; Fenson et al., 2007; Jackson-Maldonado et al., 2003) and language exposure was calculated using the Language Exposure Assessment Tool (LEAT; DeAnda, Bosch, Poulin-Dubois, Zesiger, & Friend, 2016). At 36 months, we assessed children's sentence repetition (SR) based on

procedures used by Devescovi and Caselli (2007) and calculated the number of morphemes produced for sentences with varying levels of complexity: simple, one argument, and two arguments. Omnibus analyses revealed no significant effects of income on performance. A repeated measures ANOVA with sentence complexity as the repeated measure, sex as a predictor, and language exposure and language production as covariates was run for each language group. For both Spanish- and English-speakers, there was a main effect of language production ($F(1,42)= 21.91$, $p<.001$ and $F(1,12)=8.38$, $p=.013$, respectively). Larger expressive vocabulary at 30 months was positively associated with the ability to repeat a larger number of morphemes at 36 months across levels of sentence complexity in both groups of children. Correlations by sentence complexity (least to most complex) were $r(50) =.799$, $p<.001$, $r(46)=.709$, $p<.001$, and $r(45)=.38$, $p=.009$, for English, and $r(18)=.615$, $p=.005$, $r(17)=.628$, $p=.005$, and $r(15)=.392$, ns, for Spanish. See Figure 1 for relation between expressive vocabulary and morpheme repetition in a two-argument sentence structure. However, Spanish- and English-speaking children differed significantly in expressive vocabulary size ($t(68)=3.94$, $p<.001$). Descriptively, Spanish-speaking children's sentence repetition appeared depressed, relative to English-speaking children, with the exception of only the simplest sentence constructions (see Figure 2). Interestingly, there was no significant effect of exposure on sentence repetition. This may be due to the fact that we selected children who had high levels of primary language exposure. The present findings have implications for heritage language maintenance as they suggest that maintenance of expressive vocabulary size may be critical to the ability to process and produce language at the sentence level. These findings also illustrate more generally the connection between early vocabulary and the construction of language with implications for cognitive development. We note however that the data on Spanish speakers is preliminary and anticipate having complete data on a sample of 26 Spanish-speaking children at the time of the conference.

P1-D-91 Infant-directed-speech enhances neural activity during face perception

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Developmental studies have previously shown that infants are sensitive to communicative cues, such as infant-directed speech (IDS) and eye gaze. IDS is commonly used by adults during their interaction with infants. Compared to adult-directed speech (ADS), it has high and more variable pitch, limited vocabulary, shorter utterances, vowel alterations. IDS increases the allocation of attention to language and fosters social interactions between

infants and caregivers (Golinkoff, Can, Soderstrom, & Hirsh-Pasek, 2015). IDS elicits also increased neural brain activity compared to ADS (Naoi et al., 2012), particularly in response to familiar words (Zangl & Mills, 2007). As for eye gaze, infants exhibit enhanced N170 (known for face processing) in response to faces with direct than averted eye gaze (Farroni, Csibra, Simion, & Johnson, 2002). Therefore, the aim of the present study is to extend these findings and determine whether IDS, as a communicative cue, enhances face processing while maintaining eye gaze constant. Thirty-five infants (age range: 3 months and 21 days to 5 months and 24 days) took part in the study. Infants sat on their caregiver's laps facing a monitor screen and heard the word "hello" pronounced either in IDS or ADS followed by woman's face (NimStim), while their event-related brain potentials (ERPs) were recorded. Offline, the data was segmented into 1000ms epochs from sound and picture onset and averaged according to a 200ms pre-stimulus baseline. Trials including artifacts exceeding ±150uV were rejected. Segments were averaged and re-referenced to an average reference. Two ERP components of interest were analysed: the auditory N600-800 sensitive to IDS (Zangl & Mills, 2007) and the visual P100 known to reflect early visual processing. For both components, mean amplitudes of five posterior channels (including O1, O2, PO7 and PO8) over the left and right hemisphere were averaged. For the auditory N600-800 (n=18) the mean number of trials was 15 (range: 10 to 27 trials) and 13 (range: 8 to 25 trials) IDS and ADS respectively and for the visual P100 (n=17), the mean number of trials was 9 in ADS (range: 8 to 21 trials) and 10 (range: 8 to 17 trials) in IDS. Preliminary results show that the auditory N600-800 was modulated by speech type ($F(1,17)=6.66$, $p=.02$). The mean amplitudes were significantly larger in the IDS (-20.30uV) compared to the ADS (-15.12uV) condition ($t(17)=2.58$, $p=.02$). The visual response to faces was also modulated by the speech type ($F(1,16)=5.14$, $p=.04$) with increased P100 mean amplitude for IDS (14.44uV) compared to ADS (11.36uV) condition ($t(16)=2.27$, $p=.04$). There was no significant hemispheric difference between conditions. These findings demonstrate that IDS elicits more attention than ADS and enhances face processing. Currently, we are running a control study to determine whether the effects obtained are specific to faces.

P1-D-92 What did you say, Mommy?: The impact of electronic toy noise on understanding speech

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In the past decade there has been a rapid increase in the number of electronic toys that are designed for infants and toddlers. These toys, increasingly affordable and often marketed as enhancing children's learning, have become quite common in children's homes. Yet such toys could potentially have a negative impact if their music and sounds "cover up" the language input children need for language learning. It has been well documented that infants and young children have more difficulty recognizing speech in noise than adults (e.g. Nozza et al., 1991; Nozza et al., 1990). One important question then is whether sounds from electronic toys are engaging young children in a positive way, or are instead creating a listening environment that is just too distracting and not conducive to language comprehension and potentially language learning. We presented 8- to 10-month-old infants with a word comprehension in noise task, using a version of the head-turn preference procedure (HPP) identical to the one used in Newman (2009). To date, thirty-one infants have participated; infants were seated in a three-sided booth on their caregiver's lap and heard an audio signal that consisted of names repeated multiple times by a female speaker in an infant-directed manner, mixed with electronic music and animal sounds from a popular infant jumper toy. Each infant listened to a total of four names across trials: the infant's most frequently-heard name or nickname (e.g., Mary), a foil name matched to the infant's name/nickname for number of syllables and stress pattern (e.g., Lisa), and two additional foil names having the same number of syllables as the child's name - but a different stress pattern (e.g., Denise, Justine). Background music from the electronic toy was combined with the target speech at one of the following signal-to-noise ratio (SNR) conditions: 0dB (where both the background noise and target speech were heard at the same intensity), +5dB, +10dB, or +20dB (where the target speech was more intense than the sounds of the toy by 5, 10, or 20 decibels). We measured infants' listening times to the different names presented across 16 trials (four blocks of four names), with the idea that if infants could recognize the name being called despite the background noise, they would be expected to listen longer to their own name than to the foils. Average listening times are shown in Fig. 1. Preliminary results do not show an own-name listening preference in any of the four tested SNR conditions. In light of previous work, showing successful name recognition by infants of the same age in multitalker speech babble at a +10dB SNR (Newman 2009), the failure of the infants in the current study to demonstrate recognition under equal and much easier (+20dB SNR) noise conditions suggests a strong effect of attentional distraction. Results indicate that even at levels that pose little difficulty for adult listeners, noise from electronic toys can be considerably distracting for infants, potentially limiting their ability to recognize, learn from, and engage with the speech of their caregivers during play.

P1-D-93 Baby Talk: Sex-Related Differences in Infants' Word Recognition Skills and Vocabulary Development in IDS

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Infants favor hearing infant-directed speech (IDS), a preference hypothesized to promote language development (Cooper & Aslin, 1994). For example, the exaggerated differences between speech sounds and attention-getting properties of IDS may support real-time encoding and word-recognition; however, little is known about how experience with IDS impacts language development. We tested whether hearing more IDS at home predicts vocabulary size and word-recognition (Experiment 1) and whether hearing words in IDS promotes encoding familiar words (Experiment 2) and found evidence of sex-related differences in the relationship between IDS and both word-recognition and vocabulary size. In Experiment 1, we collected home-recordings of the speech in 12-month-olds' environment and coded how much IDS they heard. Infants' (N= 38, male = 19) ability to recognize common words (e.g. baby, doggy, shoe, kitty) was assessed using the looking-while-listening paradigm. Only females whose caregivers used more IDS showed a trend towards recognizing familiar words, p= .074 (Figure 1). Females who heard more IDS also had larger receptive vocabularies at 12-months, p= .048 and 15-months, p= .044. However, males showed the opposite effect, such that hearing more adult-directed speech (ADS) predicted larger receptive vocabularies at 12-months, p= .027 and 15-months, p= .02. This suggests that hearing more IDS may benefit females' early language development, but hearing ADS may be advantageous for males. In Experiment 2, we examined 21-month-old infants' (N= 50, male= 23) ability to recognize correct pronunciations and mispronunciations of familiar words spoken in the IDS or ADS register in the lab. To familiarize infants with the speaker, they first heard sentences containing correct pronunciations of four familiar words (e.g., baby, doggy, car, ball) in IDS or ADS while viewing pictures of their referents. At test, infants saw two pictures and heard the label associated with the pictures, produced in IDS or ADS. Labels were correctly-pronounced on half the trials (e.g., baby), and mispronounced on half (e.g., vaby). We found that females and males recognized correctly-pronounced and mispronounced words in both IDS and ADS. Females were more accurate at recognizing correctly-pronounced words than mispronounced words in IDS, p= .006, however, this trend was diminished in ADS, p= .084. In contrast, males did not show any differences in word-recognition for correct pronunciations and mispronunciations in either speech register, all ps >.05. (Figure 2). These results indicate that females and males recognized labels when spoken in both IDS and ADS. However, females generally encode and interpret correct

pronunciations better than mispronunciations in IDS, suggesting that IDS may enhance accurate encoding of familiar words for them. By 12-months hearing more IDS at home was related to better encoding of familiar words and also larger receptive vocabularies for females and hearing more ADS was associated with larger receptive vocabularies in males. By 21-months females also showed greater sensitivity to mispronunciations in IDS than in ADS, while males responded to correctly-pronounced and mispronounced words similarly in both registers. These findings suggest that the mechanisms through which males and females process language may differ in the first and second year of life.

P1-D-94 Cultural change and language input in Yucatec Mayan homes

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When a non-dominate culture adopts the institutions or characteristics of a dominant culture, this can impact socialization patterns with infants (e.g., Crago, 1993). However, little is known regarding the process through which cultural adaptations exert their effects. Here we shed light on this issue, by considering how cultural change might impact the properties of early language input. Specifically, we consider one marker of cultural change: the adoption of a majority language (Spanish) by a minority group (Yucatec Mayan dominant speakers). We ask whether the use of Spanish changes the manner by which Yucatec Mayan caregivers provide linguistic input for children. Research has demonstrated that, as compared to children growing up in the United States, Yucatec Mayan infants receive relatively little language input in child directed speech (Shneidman & Goldin-Meadow, 2012). This is likely due to cultural values that caregivers place on speaking directly to children (e.g., Gaskins, 1999) as well as differences in contact with formal schooling institutions that model directed teaching (e.g., Rogoff, 2003). Here we ask whether a similar interaction pattern holds for Mayan speakers who utilize Spanish in the household. Mayan caregiver's adoption of Spanish may reflect greater contact with the dominant Mexican culture that values speaking directly to children. Thus, one possibility is that bilingual Spanish/Mayan households will be more likely to direct speech to children as compared to monolingual households. 32 Yucatec Mayan 18-month-old infants and their families were video-recorded for one hour in natural interaction in their homes as part of a larger study on cognitive development. To date, 9 of these videos have been transcribed and coded for the number of utterances directed to the child, the number of utterances overheard by the child, and whether the utterance was in Spanish or Yucatec Mayan. Children received on average 47% of their total input in directed

speech and 53% of their input in overheard speech. Of the 9 families, 6 families used Spanish to or around the target child, this input ranged from 6% to 70% of the total input the child heard. There was a positive relationship between the extent to which families utilized Spanish and the percentage of utterances directed to the child r=.47, however this relationship failed to reach significance p=.2. Among the 6 Spanish-speaking families, there was dissociation in the language used by speakers depending on who was the addressee. When caregivers spoke directly to the target child they used Spanish, on average, 68% of the time. In contrast when speaking to older children and adults they used Spanish only 11% of the time $t(5)=4$, $p<.05$. These results suggest that Mayan caregivers systematically select Spanish when speaking to infants. Thus, infants growing up in these households may learn that Spanish has priority status, even though the dominant surrounding language is Yucatec Mayan. Future research will consider why speakers select Spanish when talking directly to children, as well as whether the characteristics of directed Spanish and directed Yucatec Mayan differ from one another in ways that could impact language development.

P1-D-95 Screening for Communication Risk Before 12 Months with CISS and CSBS at Pediatrician Well-Baby Visits

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Background: Most assessments screen early communication beginning around 9-12 mo, e.g. CSBS Infant-Toddler Checklist (Wetherby & Prizant, 2003); little is known about early signs of atypical development prior to this age. The CSBS ITC identifies children at 12 mo with 75% positive predictive validity at a well-baby checkup (Pierce et al, 2011). The Communication in Infancy and Social Screener (CISS) is a screener of a broad range of early communication skills that is: based on research-based predictors of communication, modeled after the CSBS-DP Infant Toddler Checklist with the same clusters (social, speech, play), standardized for infants 2-12 mo with and without disabilities. The parent rates 24 CISS items with Usually, Sometimes, or Not Yet, completed within 5-10 minutes. Research Questions: A) Can the CISS questionnaire be quickly and efficiently administered to parents at well baby visits for infants under 12 mo? B) Do the cluster and total scores for the CISS at 6 mo correlate with scores for the CSBS-DP Infant Toddler Checklist at 12-15 mo? C) Are CISS clusters significantly lower for infants who fall below age cutoffs in the same clusters on the CSBS-DP ITC questionnaire at 12-15 mo? Participants 842 infants (44.2% male, 42.1% female, 13.6% not reported) given the CISS parent questionnaire at

6-mo well-baby visits for all infants at a pediatric group of 10 physicians. 30 of the infants were premature, 1 had Down syndrome. ? 477 of the 842 infants had received the CSBS-DP ITC at 12-15 mo by the time of this report; the remaining analyses refer to this group of infants for whom both measures are available Results: A) Physician responses to the CISS and CSBS have been positive and the practice has asked to continue to administer both questionnaires indefinitely. On a 1-5 Likert scale, 93% of the families rated the CISS easy for most or all items. Over 91% considered the CISS to be a good or very good representation of their children's communication and play skills. B) All of the 6-month CISS cluster and total scores significantly correlated with the corresponding 12-15-month CSBS-DP ITC clusters and total scores. C) Outcomes on the CSBS-DP ITC at 12-15 mo., for n = 477: No risk in any CSBS category = 333. ?Risk only in Social category: = 4; infant social CISS scores ns different from TD peers Children with social & multiple CSBS risk had significantly different social CISS scores ?Risk only in Speech category: = 43; infant speech CISS scores significantly differed from TD peers Children with speech & multiple CSBS risk had significantly different speech CISS scores ?Risk only in Symbolic category: = 38; infant symbolic CISS scores significantly differed from TD Children with symbolic & multiple CSBS risk had significantly different symbolic CISS ? Number having one area of concern: = 85, Number with risk in more than one category/total = 49, ?Total having some concern: 134 of 477 (28%) Discussion: ? The CISS is correlated with the CSBS-DP ITC in every cluster and total and children with low scores on CSBS-DP ITC at 12 mo scored significantly low on the same CISS cluster. Preliminary indications are that we can predict communication risk at 6 mo. as well as 12 mo. ? We can't yet say the CISS predicts as well as the CSBS=DP ITC until we see the disability outcomes for the pediatrician samples at age 3, using parent and physician reports.

P1-D-96 Toddlers' Third-Party Word Learning: Relations to Speech and Object Type

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Previous research has shown that toddlers can learn words by observing third-party interactions. The current study examines two factors influencing word learning in this type of situation: the presence of distraction objects, and the speech type used by the third-party participants. In previous studies of observational learning (e.g., Akhtar, 2005), children have been given distractor toys in order to provide a competing source of attention. It is possible, however, that these objects might facilitate learning, if they helped the child to relate to the third-party interaction (Chen & Waxman, 2013). Imitation of

action associated with a novel word also been shown to facilitate word learning. The current study manipulates whether the child receives the same or different objects as those used in the interaction. The current study also examines the use of speech type in the third-party interaction. The use of infant-directed speech (IDS) can aid toddlers' acquisition of new words over adult-directed speech (ADS; Ma, Golinkoff, Houston, and Hirsh-Pasek, 2011). Previous studies have not analyzed speech type in an interaction with distractor objects in third-party interactions. The current study manipulates speech type as well as object type for a 2 (distractor object type: same, different) x 2 (speech type: IDS, ADS) design. Participants are 2-year-old children (N=44). There are four between-subjects conditions in this study: same object-IDS (N = 11); same object-ADS (N = 11); different object-IDS (N = 11); different object-ADS (N = 11). After the child is familiarized with the experimenters through a warm-up game, they are introduced to four novel objects. Before training, the child receives two novel objects: either the same two objects used in the following interaction, or a different set. During training, the child sits across the room from an experimenter and confederate, and watches the experimenter show a confederate each novel object. For the target object (counterbalanced), the experimenter uses a novel label ("I'm going to show you the modi"). For the non-target objects, she uses a neutral label ("this one"). This interaction takes place in IDS or ADS. The experimenter demonstrates a unique action associated with each object, which the confederate repeats. The two objects are labeled 3 times per demonstration, for 6 total labels. During testing, children are asked to identify the target object as well as their favorite. For analysis, a stringent definition of learning was used, where children were marked as having learned only if they selected the target object when asked for the target, and not when asked for their favorite. Considering the type of distractor toy alone, children were more likely to learn when they are holding the same objects as the ones used in the third-party interaction, regardless of speech type used ($p = .075$), Fisher's exact, two-tailed. Speech type was not significant, but further data collection and analysis is ongoing. This research extends previous findings about children's observational learning, demonstrating that a distractor object, if related to those used in third-party interactions, may instead contribute to toddlers' observational learning.

P1-D-97 Deaf Parents Use of Touch with Their Deaf and Hearing Infants

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Infant-directed speech (IDS) is frequently described for hearing parents with their hearing babies (Golinkoff, Can, Soderstrom, & Hirsh-Pasek, 2015). Infant-directed sign and visual "motherese" have also been described for Deaf parents with their Deaf (D) and hearing (H) babies (Cramer-Wolrath, 2012; Roos, Cramer-Wolrath, & Falkman, 2016), not only in promoting the baby's attention to language, but also in fostering social interaction and encouraging native language acquisition. Previous research has shown that Deaf parents tend to sign in their babies' visual fields and use increased pause time to emphasize turn-taking (Koester, Karkowski, & Traci, 1998). In this proposed poster session, we will share data from 9 video clips of 9 parent-infant dyads (4 D mothers, 3 D fathers, 2 mother-father pairs) interacting with their 5 D and 4 H babies to demonstrate how they "typically communicate." All babies were 10-months of age (1 female and 8 male) seated comfortably in an infant seat atop a table, with parents seated in office chairs directly in front (except for mother-father pairs who sat to the L or R sides of their babies). Each parent was provided the same set of age-appropriate books and toys. The video camera was located on a tripod within 4 feet from the participants. Preliminary data were collected from the most interactive 2-minutes of the parents' 5-minute videos. Data were coded into DataVyu software for comparative analysis of location and function across the 9 participants. An independent rater was trained on one video, with reliability minimums set at 80% agreement for inter-coder reliability across frequency of touches or touch events, location, and function. Results revealed an average of 21 (s.d. = 10.8) touches within 2 minutes. Most touches were located distally (n = 193), 115 touches on the legs and 78 on the hands and arm, and used to establish or maintain joint attention to a book or toy (m = 18.4; s.d. = 11.4). H babies received more touches than their D peers (m = 24.75 for H, 18.2 for D), but without statistical difference (t = -.816, p = .27). Four of the 9 parent and parent combinations used touch to model ASL on their babies' bodies, two with H babies and two with D babies. Unlike the distal touches used for attention, these signing touches (n = 27) were directed proximally to the babies' chests, heads, and faces. Additional analyses by conference time include correlations of parent touches and parent signing to parent-reported number of signs (ASL-CDI). Ultimately, we anticipate these results to offer several translations to practice, especially for Early Intervention professionals working with H parents at risk of not incorporating touch or combined audition-vision-touch with their D or HH babies.

P1-D-98 Phonetic correlates of perceived affect in mothers' and fathers' speech to Swedish 12-month-olds

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Infants prefer to listen to infant-directed speech (IDS) over adult-directed speech (ADS). IDS contains a greater amount of affect than ADS (Singh, Morgan & Best, 2002). Affect in infant-directed speech has been said to foster social bonds, maintain attention and teach language. In order to identify phonetic correlates of affect, prosodic features such as fundamental frequency, pitch range, pitch contour, vowel duration and rhythm have been tried (Katz, Cohn & Moore, 1996; Trainor, Austin & Desjardins, 2000). However, affect ratings are typically carried out on low-pass filtered speech in order to obscure semantic cues to affect. It is possible that more than semantic meaning is distorted by the filtering process. In the present study, acoustic-phonetic correlates to affect were studied in unfiltered short speech segments. One-syllable speech segments were rated on a scale ranging from highly negative via neutral to highly positive affect. Formant (F1, F2, F3), pitch (mean, maximum, minimum, range, contour), and vowel duration measures were obtained from the speech samples, and relations between acoustic measures and rated affect were analyzed. The speech samples were the syllables /mo/, /na/, and /li/, produced by Swedish mothers (n = 29) and fathers (n = 21) when talking to their 12-month-old children. Recordings of IDS took place during free play in a laboratory setting, and the syllables were the names of soft toys that the parents were asked to use when interacting with their child. Parents and children participated in a longitudinal interaction study, and this was their fourth visit at the laboratory, so they were familiar with task, setting and toys. ADS exemplars of the syllables were also selected from a sub-sample of the mothers (n = 14), recorded at their first visit to the laboratory. Participants in the perceptual rating experiment (n = 35; 21 female; mean age = 28.6 years; age range = 19-45 years) were presented with one syllable at a time and asked to rate the affect conveyed on a scale from -4 (high negative affect) to +4 (high positive affect), with 0 as midpoint (neutral affect). The experiment was self-paced, and participants could listen to each syllable as many times as they liked. Each experiment session lasted between 30 and 50 minutes. A mixed-effects model was designed with AffectRating as dependent variable, Rater as random effects variable, and RaterGender, RaterHasChildren, F1, F2, F3, MeanPitch, PitchRange as well as VowelDuration as fixed effects variables. Minimum pitch, maximum pitch and pitch contour were excluded from the analysis since they were correlated with pitch range. Significant results were found for F1, F3, MeanPitch, PitchRange and VowelDuration. Higher F1 and/or F3 resulted in more negative perceived affect whereas higher mean pitch, greater pitch range, and/or longer vowel duration resulted in more positive perceived affect. The relation between perceived affect and formant values could be related to differences in perceived affect for different vowels, rather than variations in the formant values per se. It would be interesting to look at variation within separate

vowel categories. The relation between positive affect and prosodic exaggerations suggests that some acoustic characteristics of IDS could be a result of parents conveying positive affect to their children.

P1-D-99 Individual differences in 7.5-month-olds' word segmentation from maternal and unfamiliar voices

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Starting in the mother's womb, language learning benefits from maternal speech exposure (DeCasper & Spence, 1986). Maternal speech has been shown to facilitate discrimination of speech from background noise whereas infants fail to do so if they are exposed to an unfamiliar voice (Barker & Newman, 2004). In line with this boost in learning through the mother's voice, the current study explores whether maternal speech also facilitates infants' word segmentation or whether 7.5-month-old infants are similarly able to extract words from fluent speech of an unfamiliar talker. Fifty-two monolingual German infants of 7.5-months of age were exposed to passages of sentences containing two pseudo words. Importantly, half of the infants were listening to recordings of their own mother whereas the second half listened to a novel speaker. In the test phase, infants were exposed to isolated tokens of the familiarized words and two other novel control words. The analysis of the test phase revealed no significant interaction of infants' word recognition and speaker, $F(1,49)= 0.15$, $p=.698$, $\eta p2=.003$. However, there was a significant interaction between infants' word recognition and their familiarization, $F(1,49)= 6.36$, $p=.015$, $\eta p2=.115$. Splitting by familiarization time, infants with shorter listening times revealed a novelty effect, listening significantly longer to novel control words than familiarized words, $t(51)=-2.52$, $p=0.015$, $d=-0.349$. Infants with longer listening times during familiarization showed a familiarity effect, listening significantly longer to trials with the familiarized words than to novel controls, $t(51)= 2.81$, $p=0.007$, $d=0.390$ (see Figure 1). Together, these results demonstrate that a) there are individual differences in infants' listening behavior which may be related to their listening times during the familiarization phase, and b) infants are able to segment words from maternal fluent speech but also from a novel speaker demonstrating flexibility in recognizing words.

P1-D-100 Fine-Tuning Language Discrimination: Monolingual and Bilingual Infants' Ability to Detect Single-Word Language Switches

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Language discrimination is an essential skill for bilingual infants. Research shows that bilinguals discriminate their languages early in life (e.g., Bosch & Sebastian-Galles, 2001; Byers-Heinlein, Burns, & Werker, 2010; Molnar, Gervain, & Carreiras, 2014). However, all studies to date have tested infants' ability to detect when long passages of speech switch from one language to another, which they could do on the basis of both segmental and suprasegmental information. We ask whether infants can detect a language switch when the change is at the level of a single word rather than a longer passage (e.g., "Do you see the chien [dog]?"). We tested two bilingual populations: French-English (Canada) and Spanish-English (U.S.A.) infants. We also tested French/English monolinguals, to see whether exposure to two languages plays an additional role. We used a head-turn paradigm to measure whether 7-9 month old infants are able to discriminate single-language and switched-language utterances. If infants perceive the language switch, they should show more interest in the switched-language utterances. Both isolated words ("kitty... livre[book]..." vs. "kitty... book...") and words in a sentence frame ("I like the livre/book") were tested, because the rhythmic information in the sentence frame may facilitate detection of a language switch. All infants were tested first on language switching in isolated words (Study 1), and after a short break were tested on language switching embedded in a sentence frame (Study 2). Data collection is ongoing, but preliminary results (Study 1: 18 monolinguals, 17 bilinguals) do not indicate a difference between single and switched trials for isolated words (see Fig. 1, M difference =0.08s, $t(34) = 0.22$, $p = .83$). For words embedded in a carrier sentence (Study 2: 15 monolinguals, 13 bilinguals), preliminary data show longer looking times for switched- than single-language trials, although the difference was not statistically robust (see Fig. 2, M difference =0.51s, $t(27) = 1.27$, $p = .21$).With the current number of participants, we do not have power to detect between-group differences. Taken together, we currently do not have evidence that 7-9 month olds - whether monolingual or bilingual - can discriminate languages based on individual words. Given evidence that 20-month-olds detect a single-word language switch in a comprehension paradigm (Byers-Heinlein, Morin-Lessard, & Lew-Williams, 2017), this may suggest that lexical knowledge is required to detect language switching at the individual word level. Bilingual infants are regularly exposed to intra-sentential language switching from their parents (Byers-Heinlein, 2013). This type of input could be particularly challenging if young infants have difficulty

detecting single-word language switching. Our results indicate that younger infants may require both segmental and suprasegmental information to discriminate their languages (see Ramus, 2003, for evidence for the role of rhythm), which could make it difficult for bilingual infants exposed to many single-word switches to "sort" the words they hear to the correct language (Byers-Heinlein, 2014). Further research will be needed to determine the age at which infants can successfully detect single-word switches, and to determine the implications for early bilingual language learning.

P1-D-101 Examining the role of the mirroring system in early communicative development

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Action understanding is a proposed foundation for communicative development, such that infants can apply a similar process of interpreting the goal-structure of actions to the understanding of others' gestures as well as spoken language (Woodward, 2004). The mirroring system, as indexed by activation of the motor system during both performance and observation of actions, has been implicated as a neural correlate for action understanding (Rizzolatti & Fabbri-Destro, 2008), and may be recruited for understanding both gestures and speech (Moreno et al., 2013, 2015; Schippers et al., 2009). One's experience with actions influences action understanding measured both behaviorally (Cannon et al., 2012; Matthew et al., 2012; Sommerville & Woodward, 2005b) and neurally (e.g., Cannon et al., 2014; Orgs et al., 2008; van Elk et al., 2008). The goal of this study is to examine whether experience with gestures is related to one's recruitment of the mirroring system during observation of gestures, and whether individual differences in this activity might be related to communicative development. To measure mirroring activity, we utilized the EEG mu rhythm while infants observed an experimenter producing gestures. In the current study we focus on pointing gestures, specifically, as it is one of the most common gestures used in infancy. We also manipulated infants experience with pointing gestures through a parent-directed intervention aimed at increasing parents' use of pointing gestures with their child. Infant-parent dyads visited the lab twice. At the first visit, when infants were 10- to 12-months old, parent and infant pointing gesture production was measured during a 10-minute free play, infant vocabulary was measured via parent report, and infant motor system activity was measured via the EEG mu rhythm during observation of pointing gestures. Next, parents were randomly assigned to either receive the pointing intervention, or to a passive control group. One month after the

training, parent pointing, infant pointing and vocabulary, and infant mu rhythm activity were reassessed. Infant vocabulary was measured a final time one month after the post-training follow-up. Data for this study are currently being coded and processed. Reported results are on a subset of the data (n=24). At baseline, parents who produced more diverse points (pointing to more different things) had children who showed stronger mu rhythm activity during observation of points (r=-.484, p=.017). Further, infants who pointed at all at baseline showed stronger sensorimotor activity (t=2.414, p=.025), as compared to their peers who did not point at baseline. The training was effective in increasing parents' points (t=-2.505, p=.021). There were no group differences in child pointing or vocabulary, however infants in the training group showed stronger mu rhythm activity at follow-up compared to those in the control group (Fig. 1; t=2.124, p=.046). There were no relations between mu rhythm and vocabulary at baseline, however across groups mu rhythm at baseline predicted vocabulary size two months later (r=-.467, p=.033). These findings suggest that the mirroring system plays a role in infants' communicative development, and that experience with gestures can impact the mirroring response when observing others' gesture.

P1-D-102 Prediction and learning: A chicken-or-egg problem in language development

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Prediction-based theories propose that prediction supports language learning (e.g., Christiansen & Chater, 2015). In line with this claim, children can generate predictions during language comprehension, and those who do predict tend to have larger vocabularies (Borovsky, Elman & Fernald, 2012). Yet the directionality of this relation is unclear: Does prediction support learning or does learning support prediction (Rabagliati, Gambi & Pickering, 2015)? We aimed to address this question by investigating the emergence of prediction and language comprehension across the second year of life. We hypothesized that prediction and learning have simultaneous and bi-directional effects: Prediction supports learning, and vice-versa. If so, we expected to observe prediction and comprehension developing concurrently. Conversely, a certain level of comprehension expertise may be necessary for prediction (Rabagliati, Gambi & Pickering, 2015). If learning supports prediction, but not vice-versa, we expected to observe a time period wherein infants comprehend words, but do not yet generate predictions. To evaluate these hypotheses, we tested infants (n=66) cross-sectionally in four age groups: 12, 15,

18, and 24 months. In an eye-tracking task, infants viewed pairs of referents (e.g., cookie, shoe) and heard pre-recorded sentences (Table 1). Half of the sentences allowed infants to predict the target noun (e.g., Let's go eat. Oh yum yum! Open your mouth! Where's the cookie? Find the cookie!) and half were neutral (e.g., Look at that! There it is! Do you see it? Where's the cookie? Find the cookie!). We recorded infants' looks to referents during each sentence, and analyzed their proportion of looks to the target referent (e.g., cookie). We operationalized prediction as target looks during the pre-noun time window (i.e., looking to the cookie while hearing 'Let's go eat...') and operationalized comprehension as target looks during the post-noun time window (i.e., looking to the cookie after hearing its label). We found 12-month-olds neither predicted nor comprehended target nouns. Target looks were at chance for both predictable and neutral trials during both time windows (ps>0.05). Fifteen-month-olds had marginally greater target looks for predictable trials pre-noun (p=0.09) and target looks post-noun were above chance for predictable trials (p=0.04) and at chance for neutral trials (p=0.40). Eighteen-month-olds had greater target looks for predictable trials pre-noun (p=0.03) and target looks post-noun were above chance for predictable trials (p=0.002) and for neutral trials (p=0.04). Finally, 24-month-olds had greater target looks for predictable trials pre-noun (p=0.009) and target looks post-noun were above chance for predictable trials and for neutral trials (ps<0.001). Together, these findings reveal behavioral evidence for both prediction and comprehension in the early stages of language development (Fig.1). In sum, we found that prediction and comprehension develop concurrently over the second year of life. As soon as infants comprehended words, they were also able to predict their identity using semantically-related words. This pattern of results suggests that relations between prediction and learning are simultaneous and bi-directional. This study provides developmental support for prediction-based theories and suggests that prediction supports language learning during - not after - the initial construction of language.

P1-D-103 The Impact of Phonetic and Intensity Changes on Word Recognition in British English Learning 5-Month-Olds

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Consonants and vowels are considered to be subject to specialised biases in relation to language processing: a consonant bias for lexical processing and a vowel bias for prosodic/syntactic processing (Nespor, Peña, & Mehler, 2003). In relation to the consonant bias, evidence from adult studies, across a range of languages, suggests there

is a significant reliance on consonants over vowels in tasks associated with lexical learning and lexical access (Nazzi, Poltrock, & Von Holzen, 2016). Research into the developmental trajectory of the consonant bias has revealed that cross-linguistic differences, based on the lexical and/or phonological properties of an infant's native language, exist in the developmental origins of the consonant bias in lexical processing. For example, 5-month-olds acquiring French (Bouchon, Floccia, Fux, Adda-Decker, & Nazzi, 2015), but not British English (Delle Luche, Floccia, Granjon, & Nazzi, 2016), can detect vowel but not consonant changes in their own name. However, post-hoc findings in Delle Luche et al. (2016) found that British English infants used acoustic, and more specifically, energy information rather than phonetic differences in detecting consonant changes. The present study systematically examined how British English-learning 5-month-olds process phonetic and acoustic information changes in a word familiar to all of them - 'mummy'. Using the head-turn-preference procedure (HPP), infants' listening times (LT) towards this familiar word versus manipulations of either the word's phonetic information (i.e. changes in the initial consonant, /m/ to /n/, or vowel, /o/ to /u/) or its intensity (i.e. changes in the energy of the initial consonant or vowel) were measured. A three-way ANOVA was conducted on infant's LTs, with the within-subject factor of pronunciation (Correct Pronunciation vs. Mispronunciation) and the between-subject factors of change (Phonetic vs. Intensity) and phoneme (Consonant vs. Vowel). The effects of pronunciation, change, and phoneme, as well as pronunciation x change, pronunciation x phoneme, and change x phoneme were all non-significant ($p = > .05$). However, there was a significant pronunciation x change x phoneme interaction ($F(1, 60) = 7.88$, $p = .007$), suggesting that infants were not behaving the same in all four subgroups. Planned comparisons found that British English infants could detect the vowel change in this familiar word ($t(15) = -2.27$, $p = .04$), but failed to notice the consonant change ($p = .11$). Moreover, infants did not appear to recognise changes in either the energy of the initial vowel ($p = .09$) or the initial consonant ($p = .80$). The results of this study first reveal that, in contrast to Delle Luche et al. (2016), British English infants rely on phonetic rather than intensity information when recognising a familiar word. Moreover, the findings are the first to demonstrate that British-English-learning infants are comparable to French-learning infants in relation to their development of vowel and consonant biases, establishing that vowel, rather than consonant, changes affect lexical recognition at 5-months. This supports the idea that in their first months, infants across languages are better at processing vocalic changes, even in word-related tasks (Bouchon et al., 2015).

P1-D-104 Pathways of Social Contingency for Navigating Developmental Landscapes of Risk: Mapping Out Intervention Strategies in ASD

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Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder of early onset characterized by deficits in social communication as well as restricted interests and repetitive behaviors. Although spoken language disorders are no longer considered to be core features of the condition, vocal development is delayed in ASD, but the developmental pathway by which this is caused is not yet known. Neurodevelopmental theories of autism suggest that early interventions addressing the core social impairment should alleviate the later emergence of comorbidities such as speech and language delays, but this has not yet been quantitatively demonstrated. The goal of this study is to develop new methods for testing the hypothesis that contingent interaction between infant and caregiver is the active ingredient promoting vocal development in the infant and infant-directed speech in the caregiver, implying that interventions based on scaffolding infant-caregiver interaction should be more effective than therapies targeting infant or caregiver alone. As part of an NIH Autism Center of Excellence (NIH P50 MH100029), we successfully tracked vocal development from birth in a cohort of 44 high-risk infants with a family history of ASD and 30 low-risk controls. Using a miniature digital audio recording device (LENA) sent out in the mail and worn by each child all day, we made audio recordings of each child's language environment at monthly intervals from 2 to 24 months. Using automatic speech recognition technology, we counted the number of vocalizations per hour for infant and caregiver, as well as the rate of conversational turns. Using Functional Data Analysis, we calculated developmental trajectories for each child, as well as mean trajectories for each group (Figure 1). We found significant differences in all three trajectories between risk groups, indicating deviations in: (a) infant volubility starting at 18 months, (b) caregiver volubility starting at 15 months, and (c) infant-caregiver vocal interaction starting at 12 months. Each individual finding in isolation suggests an alternative strategy for intervention: (a) stimulating vocalization directly in the child, (b) encouraging infant-directed speech in the caregiver, or (c) promoting contingent interaction between caregiver and child. Taken together, however, the differential efficacy of each strategy, or the potential interaction between intervention pathways, is unclear. Using the transfer entropy, an information-theoretic metric of statistical causality between the past history of one stochastic process and the future of another, we were able to calculate the graph of information flow between all three developmental profiles to resolve this question (Figure 2). Our results show that early

differences in social interaction have a greater influence on later adult volubility and child volubility than in the reverse direction, consistent with our theory-driven hypothesis. By building bridges between mathematical information theory and the science of infant development, this new technique clearly identifies a developmental cascade relevant to treatment of ASD, and allows us to quantitatively evaluate alternative pathways for navigating the early developmental landscape of risk.

P1-D-105 Bilingual infants process mixed sentences differently in their two languages

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How do infants contend with everyday use of two languages? To date, most research on bilingual language learning has tested whether phenomena observed in monolinguals apply to bilinguals (e.g., Byers-Heinlein & Werker, 2009). However, bilingual environments pose challenges not found in monolingual input, such as use of mixed utterances, where two languages are used within one sentence (e.g., Look at the PERRO!). This type of switching increases processing demands for both infant and adult bilinguals (Byers-Heinlein et al, 2017). But does language mixing always hinder processing? We tested Spanish-English bilingual toddlers in both their languages to provide a comprehensive, bidirectional examination of the effects of language mixing on real-time language processing. Method. Participants were 18-30-month-old Spanish-English bilinguals (N=18). Using the Looking-While-Listening procedure, we monitored toddlers' eye movements as they viewed pairs of familiar objects (e.g., dog, balloon) and heard a sentence labeling one object. On Same-Language trials, toddlers heard sentences in a single language (Look at the doggy). On Switched-Language trials, they heard a sentence with a switch at the noun (Look at the PERRO). Half the sentence frames were in English, and half were in Spanish, so participants heard half of the trials in their Dominant language (the language heard >50% in daily life) and half in their Non-Dominant language. Results. We used a 2x2 within-subjects ANOVA (Frame: Dominant vs. Non-Dominant; Trial Type: Same vs. Switched) to explore how language switching affected infants' accuracy in looking to the labeled target. We found a significant interaction [$F(1,17)=13.83$, $p=.002$, Fig.1]; the effect of switching differed when toddlers were tested in their Dominant vs. Non-Dominant language. Follow-up t-tests showed that when sentence frames were in their Dominant language, toddlers performed significantly better on Same-Language

trials than on Switched trials [t(17)=2.59, p=.02]; they looked to the target significantly above chance on Same trials [t(17)=3.99, p<.001], but not on Switched trials [t(17)=.73, p=.48]. In contrast, when sentence frames were in the Non-Dominant language, toddlers performed marginally better on Switched-Language trials than on Same-Language [t(17)=1.90, p=.07], and performance was above chance in both conditions [Same: t(17)=2.55, p=.02; Switch: t(17)=5.22, p<.0001]. Thus, not all switches affected comprehension equally. Discussion. When toddlers were tested using sentence frames in their Dominant language, they only displayed recognition of familiar words that were also presented in the Dominant language. This pattern of performance is consistent with other reports that single-language sentences are processed more easily. However, we found that when toddlers heard carrier frames in their Non-Dominant language, they could recognize familiar words produced in either language and actually showed marginally better performance following a switch. That is, toddlers benefitted from hearing nouns produced in their dominant language, presumably because they have more robust word knowledge in their primary language. Thus, not all language switching is problematic, and under some circumstances, switching may actually be beneficial for young bilinguals as they navigate a complex linguistic environment. Implications for parents and clinicians, as well as current models of bilingual representation, will be discussed.

P1-D-106 More than distractors: Familiar objects influence toddlers? semantic representations in novel word learning

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When shown a novel object and one or more familiar objects, children select the novel object as the referent of a novel word (e.g., Markman & Wachtel, 1988). Word learning, however, extends beyond success in referent selection, including making connections to other words and referents to form a semantic network. In naturalistic environments, novel objects co-occur with non-random groups of familiar objects (e.g., foods in a kitchen). In the current experiment, we examine whether this systematicity affects novel word learning. Do toddlers expect novel objects that systematically occur with items from the same category to also be members of that category? To address this question, we exposed 26- to 28-month-olds toddlers (n=32) to images of four novel objects. All novel objects were made of play-doh and did not clearly belong to a particular semantic category. On each training trial, toddlers were shown a picture of one of the novel objects paired with a familiar object, and heard a sentence labelling one of the objects. Two of the novel

objects were always paired with foods, and two of the novel objects were always paired with toys. Each object was paired with a unique set of familiar objects. The assignment of novel objects and novel names to condition (food vs. toy) was counterbalanced across participants. We tested whether toddlers induced semantic information about the novel words using an adaptation of the head turn preference procedure. Prior research has used this procedure to examine toddlers' knowledge of the relations between familiar and novel words (Willits, Wojcik, Seidenberg & Saffran, 2013; Wojcik & Saffran, 2013). On each test trial, toddlers listened to repetitions of novel word pairs (in the absence of the visual referents themselves). The novel word pairs either referred to novel objects that were in the same condition during training (i.e., both had been paired with foods or with toys) or in different conditions during training (i.e., one object had been paired with foods, the other with toys). We compared toddlers' listening preferences in the two conditions using a paired-samples t test and found that toddlers preferred to listen to word pairs in the same condition (M=7.6s, SE=0.62s) compared to the different condition (M=6.6s, SE=0.50s), $t(31)=2.14$, $p<.05$, $\eta 2=.13$. This effect is marginally significant after removing an outlier participant, $t(30)=1.96$, $p=.0598$, $\eta 2=.11$. This result indicates that toddlers formed lexical-semantic relations between novel words based on the semantic categories of the familiar objects that were present during training. This is particularly striking since the novel words and objects never co-occurred with one another during training and lacked any phonological or visual similarity. This finding reveals that the presence of familiar objects not only helps children succeed in identifying the referent of a novel word, but also helps children form richer semantic representations during word learning. We are currently coding toddlers' fixations during training to examine whether individual differences in toddlers' attention to the target novel object vs. distractor familiar object during referent selection predict toddlers' success in forming relations between the novel words.

P1-D-107 A universal bias in the perception of vowels by young infants

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Speech perceivers often display directional asymmetries in vowel perception, showing significantly better discrimination of a vowel change in one direction (e.g., /ɪ/ to /i/) compared to the reverse direction (e.g., /i/ to /ɪ/). According to the Natural Referent Vowel (NRV) framework (Polka & Bohn, 2011), these asymmetries reveal a universal perceptual bias that is phonetically grounded in human sensitivity to the way articulatory manoeuvres

shape the physical speech signal. Specifically, perceivers are biased toward extreme vocalic articulations which lead to acoustic vowel signals with well-defined spectral prominences that are salient due to the convergence of formants (focalization). Recent work on adult discrimination of natural and synthesized variants of English [u] and French [u] provides direct support for this account (Masapollo et al., 2017). French [u] is naturally more "focal" than English [u] because it is produced with more lip protrusion and backness of the tongue, which increases the proximity between F1 and F2. English- and French-speaking adults identify both variants as /u/, but assign them different category goodness ratings. When discriminating synthetic variants both groups displayed an asymmetry such that they performed better at discriminating a change from a less-focal/English [u] to a more-focal/French [u] compared to the reverse, regardless of language experience. Comparable results were observed when adults were tested with natural variants produced by a bilingual talker in audio-only, visual-only, and bimodal audio-visual conditions, further supporting that this bias is phonetically grounded. The present study was designed to examine whether pre-lingual infants show an analogous asymmetry when discriminating English [u] and French [u] stimuli in a unimodal audio-only mode. 6- to 8-month-old (including English, French, and bilingual) infants (n=31) were tested using the look-to-listen procedure in a habitation paradigm. During habituation, infants were presented with variants of [u] in either English or French. After reaching habituation criterion, infants were presented with test trials that included novel and familiar trials. Novel trials presented novel tokens of the contrasting vowel while familiar trials presented novel tokens of the familiar vowel. The results indicate that infants discriminated the vowel types when English [u] served as the familiar stimulus but not when French [u] served as the familiar stimulus. This was confirmed by an ANOVA - condition (less-to-more-focal vs. more-to-less-focal) x trial type (novel vs. familiar) - performed on the mean looking times for each infant. Only the condition by trial type interaction ($p < .001$) was significant. Simple effect analyses showed that infants in the "less-to-more-focal" group showed a robust novelty effect ($p < .0001$), providing evidence that these infants noticed the vowel change. In contrast, there was no effect of trial type in the "more-to-less-focal" condition ($p = .364$). There is insufficient statistical power to compare performance across language groups. Further research is needed to assess whether this pattern interacts with language exposure. Nevertheless, the data reveal that infants are sensitive to subtle differences in formant proximity while discriminating stimuli that fall within a given vowel category, supporting the NRV framework and expanding our understanding of the fundamental processes involved in vowe

P1-D-108 Modeling Early Lexico-Semantic Network Development: Perceptual Features Matter Most

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This project explores how semantic feature properties of early-acquired nouns contribute to lexico-semantic development in 16- to 30-month-olds. Adult lexico-semantic systems flexibly encode multiple types of semantic features, including: functional, perceptual, taxonomic, and encyclopedic. However, less is understood regarding whether children encode all of these kinds of featural properties in their early lexico-semantic networks. Some theories argue that perceptual features play a primary role in early lexico-semantic development, while others argue for a primary emphasis on functional relations (Rakison&Oakes, 2003). We approach this issue by exploring whether and how these different feature types contribute to variability in the order of early word learning. Using a database of semantic features of early-acquired nouns (Peters, McRae, & Borovsky, in prep), we constructed graph-theoretic noun-feature networks that represent connections between words according to the 4 feature types (i.e. different networks with perceptual, functional, taxonomic and encyclopedic connections), with nodes representing nouns and links between nodes representing shared features (e.g. Fig.1). The early-acquired nouns consisted of 359 nouns that appear on the words and sentences form of the MacArthur-Bates Communicative Developmental Inventory (Fenson et al., 2007). We estimated age-of-acquisition (Wordbank-AoA) for the nouns using a publicly-available dataset of word-level vocabulary data in 16- to 30-month-old children (Wordbank; Frank et al., 2016). In Experiment 1 we asked how features comprising individual words relate to AoA, while in Experiment 2 we asked whether featural connections across the entire lexicon changed across normative development. Experiment 1 explored how the features comprising individual words related to order of lexical acquisition. Here, words with greater numbers of perceptual ($B=-0.22$, $p<.001$), taxonomic ($B=-0.15$, $p<.01$) and functional ($B=-0.13$, $p<.05$) features were learned earlier than those with fewer of these same features. Follow-up variable selection analyses, using LASSO suggested only perceptual features contributed significant unique variance, as only the coefficient for perceptual feature count did not shrink to 0. Experiment 2 asked how different featural connections between words contributed to normative growth of early lexico-semantic networks. We compared normative lexical growth networks where words were added in order of Wordbank-AOA, to metrics characterizing random lexical growth networks where words were selected randomly. Results (Fig.2) indicated normative networks contain significantly more perceptual and taxonomic lexical-links between words and have significantly higher

density than would be expected to happen randomly. Furthermore, perceptual networks show significantly shorter distances between words than would be expected to happen randomly. These experiments provide converging evidence that children learn words with more perceptual features earlier, and that children have more perceptual connections between words compared to other types of semantic features. While there was also weaker evidence that taxonomic features also contribute to early lexical growth, altogether these findings are most consistent with theories positing that perceptual featural characteristics play a particularly important role in lexico-semantic processing in young children, with direct consequences for learning.

P1-D-109 Do non-native languages support infant cognition?

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Human language is the most powerful means of shaping human thought and communication, and it begins doing so even before infants understand its referential meaning. To acquire language, infants must first distinguish the sounds of their native language from other sounds in their environment and then ascertain how language is linked to the objects and events they encounter. By 3 months, infants prefer human speech to other naturally-occurring sounds (Shultz & Vouloumanos, 2010) and have begun to establish a link between language and object categorization, a building block for cognition (Ferry, Hespos & Waxman, 2010). Yet recent evidence reveals that at this young age, human language is not uniquely privileged in its ability to tap into core cognitive processes: non-human primate (lemur) vocalizations also facilitate object categorization in 3- and 4-month-olds. Moreover, backward human speech--a sound equally complex to human speech--does not have this effect (Ferry, Hespos & Waxman, 2013). Here we asked if a non-native language would support infant categorization. Perhaps, if non-human primate vocalizations support categorization, then all human languages should exert this effect. Alternatively, perhaps the mechanism(s) underlying infants' ability to link human and non-human vocalizations with cognition differ. After all, by 3-months, infants have already begun to specialize in speech, tuning in to the features of their native language (Best, 1991; Nazzi, Bertoncini, & Mehler, 1998; Vouloumanos & Werker, 2004; Werker & Tees, 1984). It is possible that this tuning will be evident in infants' responses to non-native languages. Infants participated in a standard object categorization task (Ferry, et al., 2010; Figure 1); visual images were accompanied by two different auditory signals across two studies. In Study 1 we tested infants' categorization

when listening to German, a non-native language that is rhythmically and tonally similar to English. Surprisingly, neither 3- nor 4-month-old infants formed categories. This outcome, which converges with evidence that even for infants, processing non-native languages may be more demanding than processing their native language (Best, 1991), is the first demonstration that perceptual processing demands affect infants' ability to link the sounds of language with cognition. What if, then, we removed some of these processing demands by filtering out high frequency information in the non-native speech signal? In Study 2 we tested infants' categorization when listening to German that was low-pass filtered at 400Hz. Preliminary results show that 3- and 4-month-olds successfully form object categories. This outcome is consistent with previous work showing that infants form categories in the context of listening to filtered English (Balaban & Waxman, 1997). Together, these studies advance our understanding of what enables infants to link communicative signals with core cognitive processes. Because non-human primate vocalizations support categorization at 3 and 4 months of age, but non-native languages only have this effect when the acoustic details that differentiate the non-native language from the native language are removed, there appear to be different mechanisms by which infants link non-human primate vocalizations and language with cognition.

P1-D-110 How Accurately Do Infants Represent Lexical Stress Information in Recently Segmented Words?

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Extracting words from continuous speech is a demanding challenge that young infants face when learning their native language. To overcome this problem, infants rely on both language-general cues (e.g., transitional probabilities (TP) between syllables) as well as language-specific cues (e.g., stress pattern of infants' native language) to identify words boundaries. Findings from previous research demonstrate that by eight months of age monolingual English learning infants are able to pull out words with good internal co-occurrence statistics from continuous speech in both artificial (e.g., Saffran, Aslin, & Newport,1996) and natural languages (e.g., Pelucchi, Hay, & Saffran, 2009a). Although these findings have been replicated numerous times, we still know very little about how these newly extracted words are represented. For example, if infants use TP information to segment a word with a trochaic (strong/weak) stress pattern in speech, will they recognize the same word if it is presented with an iambic (weak/strong) stress pattern? Here, we build on work by Pelucchi et al. (2009a), but specifically test how well infants

represent the stress pattern of newly segmented words. As in Pelucchi et al., infants (n = 24) were familiarized with Italian sentences that had four embedded trochaic target words. Two of the words were high TP because their syllables never occurred anywhere else in the corpus (HTP; TP =1.0). Two of the words were low TP, because their first syllable occurred in many other words throughout the corpus (LTP; TP =.33). Following familiarization, infants were tested using the Head-turn Preference Procedure on their ability to discriminate HTP words from novel words that had never occurred in the corpus. Importantly, the stress pattern of the words was changed between familiarization and test, such that if the HTP words in the corpus were FUga and MElo, infants were tested on their ability to discriminate fuGA and meLO from the novel iambic words paNE and teMA. Previous work from our lab (Karaman & Hay, 2017, Experiment 3) has replicated the familiarity preference for HTP words found by Pelucchi et al. (2009a), thus, if infants continue to recognize the HTP words when their stress pattern has been modified, they should show a familiarity preference for the HTP words. However, if infants have strong suprasegmental representations of the recently extracted HTP words, they may fail to recognize the HTP words when their stress pattern has been modified. We found that following familiarization, infants did not show a preference for either HTP or novel words. Infants' performance indicates that they did not recognize the HTP words when the stress pattern was modified. This finding suggests that infants even as young as eight months, have a robust representation of word-level stress pattern in words newly segmented from an unfamiliar natural language.

P1-D-111 How well do parent reports reflect their bilingual children's language environment?

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Recent studies have shown a dose-response relationship between input and some aspects of language development in bilingual children. That is, researchers have found that the proportion of exposure to each language is related to language outcomes, including vocabulary growth (Hoff, Core, Place, Rumiche, Señor, & Parra, 2012), syntactic development (Thordardottir, Rothenberg, Rivard, & Naves, 2006), and speech processing efficiency (Hurtado, Grüter, Marchman & Fernald, 2014). To derive information about a child's language experience, researchers typically conduct interviews with the caregivers (e.g., Bosch & Sebastián-Gallés, 2001). But, how well do these parent reports reflect what a child hears at home? Here, we assessed the accuracy of parent-report measures of

language exposure, and identified some of the other ways that bilingual infants experience bilingualism. We recruited eighteen bilingual families with a 10-month-old infant. First, we conducted a standard language interview to gather information about the child's language background. All caregivers reported exposing their child to both French and English. Then, the family completed three full-day recordings using the Language ENVironment Analysis (LENA) recording system, which consists of a small 3 oz. recorder that fits in the chest pocket of a vest. Caregivers were instructed to keep the recorder on at home for 16 hours per day for two weekdays and one weekend day. Afterwards, parents were asked to estimate the language breakdown for each day. A coding scheme was constructed to extract information from the recordings about the social, speaker and language contexts. There was wide variability in the proportion of language exposure in our sample of bilingual infants, whether assessed by parent report measures (Mean exposure to French = 50.22%; Range = 20% - 100%), or by LENA-generated measures that were language coded (Mean exposure to French = 57.58%; Range = 5.38% - 100%). Critically, linear mixed modelling shows a strong relationship between these two measures of language exposure ($\beta = .91$, $t(52) = 9.82$, $p < .001$; Figure 1), suggesting that caregivers can accurately estimate their children's language environments. Nevertheless, further exploratory observations show different patterns of bilingual exposure to children that is not adequately captured by language interviews, including absolute quantity of input, type of language mixing, and differences in language exposure between infant-directed and adult-directed speech. These findings are consistent with a recent study showing that traditional parent-report estimates are sufficient in capturing global aspects of a child's language exposure (Marchman, Martínez, Hurtado, Grüter & Fernald, 2016), providing support for the construct validity of measures derived from language background interviews. Nonetheless, our exploratory observations show that bilingual infants with similar input ratios differentially experience bilingualism at home; we propose that these differences may have separate predicting effects on language outcomes. Indeed, other recent studies report that variation in language abilities can be better explained by direct observation measures of the input rather than parent report measures (e.g., De Houwer, 2011). Our results will be informative for researchers in the pursuit of understanding bilingual language acquisition and may bring new insights to the role of language input in general.

P1-D-112 Toddlers' listening in noise: the role of attention

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The language input children receive is a critical factor in their own language development. But infants and young children often are exposed to language in multi-talker or noisy environments, and this might limit the extent to which they can benefit from the language input they receive. To learn from speech in such environments, infants and young children first must separate the target speech from background noise, a task that poses great difficulty for young children (e.g., Newman, 2009). We hypothesize that one critical factor has less to do with signal degradation per se, but rather has to do with children's attentional skills: young children are more distracted than adults by maskers that are potential sources of information. In the present study, infants aged 24, 32, and 39 months participated in a preferential looking study. They saw two images on a screen (e.g., cat & dog), and listened to a single female talker instructing them to attend to a particular object ("Look at the kitty!"). We examined the amount of time infants spent looking at the named object vs. the foil object; looking longer at the correct object suggests they were able to attend to and understand the speech. The speech was played over one side of headphones, while a masking noise played out of either the same side, or the opposite side. Adults typically are able to ignore noises that are coming from a different location; children, however, may still be sensitive to these noises as a result of poorer selective attention. In addition to this spatial manipulation, the noise itself was either constant in its amplitude, or varying in its amplitude over time. Speech is normally quite variable over time, so this addition to the noise may make it more "speech-like" (more likely a potential source of information.) As such, we expect the amplitude variation will be more distracting (leading to poorer recognition); this might be reduced when the sounds are from different regions in space. So far, we have analyzed data from 15 infants. Children looked at the correct object significantly more than the foil object in all conditions (minimum $t=5.03$, $p<.05$). As expected, noise containing amplitude variations appears to be more distracting than constant-amplitude noise (percentage looking towards the correct object of 68.7% compared to 65.1%). However, there is no evidence of any difference based on spatial information: children were equally distracted by noises coming from a different ear than the target speech as they were by noises coming from the same ear. These data strongly support the notion that a major reason for children's poor understanding in noise has to do with their ability to attend selectively to a particular sound and ignore distractions. We expect to have data from a larger group of infants by the time of ICIS, at which point we will be able to look at age effects. Newman, R.S. (2009). Infants' listening in multitalker environments: Effect of the number of background talkers. Attention, Perception, & Psychophysics, 71, 822-836.

P1-D-113 Infants use speech rhythm to classify wordless children's melodies from different languages of origin

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Music and language are universal, uniquely human behaviors, yet they also exhibit tremendous cultural diversity and variability. This diversity poses a challenge to human infants and children, who must learn to identify features of auditory input that are meaningful in their culture, as well as which features distinguish music from language. Rhythm is at the core of musical abilities such as dance and coordinated music making, but it also plays a fundamental role in speech perception and production. There is evidence of parallels between the rhythm of music and the rhythm of speech in a particular culture. Specifically, when a measure of durational contrast (normalized pairwise variability index) is applied to vowels in speech and notes in music, English speech and songs tend to have higher durational contrast than French speech and songs. In a corpus analysis of English and French songs, we observed that this difference was exaggerated for children's songs compared with other (non-children's) songs, and we also found that French but not American listeners gave higher ratings of child-directedness to unfamiliar songs with lower (i.e. French-typical) durational contrast. To determine whether or not young listeners are sensitive to these features of musical input during the first year after birth, we used a habituation paradigm to examine 4- and 9-month-old infants' classification of songs based on language of origin. We habituated infants to either four French or four English songs, drawn from the above song corpus and performed on "la" by a French-English bilingual female so as to minimize phonetic cues to language. After the habituation phase, infants heard two new songs that had not been presented in the habituation phase, one French and one English. Because post-habituation songs were both novel, greater attention to the song from the novel language category would only be expected if infants can categorize songs from the same language based on their shared features (e.g. rhythm). Nine-month-old infants who met habituation criteria exhibited greater attention to the novel-language than familiar-language song. By contrast, 9-month-olds who did not habituate and 4-month-olds increased their attention to both test songs, but they did not respond differentially to either. This result suggests that by 9 months of age, at least some infants categorize wordless songs based on language of origin, presumably because of shared rhythmic features. Implications for the role of rhythm in music and language learning will be discussed.

P1-D-114 Utterance-final tactile cues enhance verb learning in Korean

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Korean learners' early vocabularies contain a greater ratio of verbs to nouns than English learners (Choi & Gopnik, 1995). This difference might be due to the structure of Korean (e.g., allowing for frequent elision of subjects and objects) but there might be other factors that contribute to the verb-bias in Korean. Based on the recent proposal that touch might help infants' word learning (Abu-Zhaya et al., 2016), we test the hypothesis that Korean mothers might emphasize verbs rather than nouns with their touch. We found that verbs tend to occur with touch more frequently than nouns. This seems to be due to the tendency that touch occurs more at the utterance-final than the initial position. These findings, combined with the verb-final word order, might explain the verb-bias in Korean. We examined a multimodal data of 13 Korean mother-child dyads. Each dyad played freely for about 50 minutes in a mock-apartment composed of a living room, a bedroom, and an eat-in kitchen and was recorded by 4 wall-mounted cameras and clip-on microphones. To investigate mother's use of tactile cues as a function of part-of-speech, we selected a 6-minute segment throughout which the dyads stayed on a mat. Audio was transcribed, and a forced-alignment tool kit was used to mark the boundaries between words, which were then manually fine-tuned and annotated for part-of-speech. The boundaries of touches were coded in ELAN using visual information as in Abu-Zhaya et al. (2016). We first examined touch-word co-occurrence (Mean number of touches=16.4, SD=21.7) by comparing the actual data with random co-occurrence between words and touch generated by shuffling words but not touch. Co-occurrence was defined as sequences in which touch+word boundaries co-occurred within a 250 ms interval. A paired Wilcoxon signed rank test showed that touch tends to co-occur with words at a greater rate than by chance ($V=0$, $p<0.01$). We also investigated the acoustic characteristics of words that co-occur with touch, and found that they are greater in duration and higher in pitch than words that occur without touch ($p's < 0.001$). We then examined the proportion of verbs and nouns co-occurring with touch. Our Chi-square test with Yates' continuity correction showed that the proportion of verbs co-occurring with touch was significantly higher than nouns ($\chi2(1, N =2710)=6.68$, $p<0.01$). To test if the more frequent co-occurrence of verbs with touch can be explained by the meaning of verbs, we categorized the verbs that occur with or without touch into 5 semantic categories but did not find any distributional bias ($\chi^2= 4.4592$, $df=4$, $p=0.35$). To further

investigate the reason for the more frequent co-occurrence of verb with touch, we classified the location of touch with regard to the utterance by calculating the distance between utterance edges with the midpoint of the touch. We found that touch tends to align with the sentence-final more than the initial position (Final=142, Initial=78 instances). Our results indicate that Korean mothers teach verbs over nouns by presenting them more often with well-aligned multimodal cues. The frequency of verbs in utterance and the co-occurrence of verbs with touch and acoustic prominence may contribute to explain the early acquisition of verbs in Korean learners.

P1-D-115 Feeling Speech Sounds: Aerotactile Influences in Infant Speech Perception

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Though speech research often focuses on the auditory signal, speech is multisensory from early in development. Infants are sensitive to both visual (e.g., Kuhl & Metzhoff, 1982; Patterson & Werker, 1999) and sensorimotor speech input (Yeung & Werker, 2013; Bruderer et al., 2015) Here, we build on findings that aerotactile cues interact with speech perception in adults to ask whether infants also sensitive to tactile speech cues. In English, some sounds are accompanied by tiny bursts of air from the speaker's mouth. This airflow, or aspiration, marks a meaningful distinction between certain sounds (e.g., /p/ vs /b/). Interestingly, research suggests that aerotactile input (the sensation of airflow) can influence a perceiver's perception of consonants that differ along this dimension when paired with auditory (Gick & Derrick 2009) or visual speech cues (Bicevskis et al. 2016). For example, when participants feel a puff of air during the presentation of the syllable /ba/, they report hearing the aspirated version /pa/ even though the air puff occurred on a sound lacking aspiration. This effect is robust for adults, but it is unknown when or how this ability emerges. The current study investigated whether infants also integrate aerotactile cues using the Alternating/Non-Alternating paradigm. The auditory stimuli were speech streams containing sequences of /ba/ and or /pa/ syllables embedded in noise. Infants also felt synchronous, gentle puffs of air at the neck. The crucial manipulation was whether the tactile stimulus reinforced or interfered with an existing phonetic category, thereby influencing the infant's perception of whether the auditory stimulus alternated or not during the trial. If the infants integrate the multisensory cues, the presence of the airflow on the unaspirated /ba/ tokens would cause the infants to treat the tokens as more /pa/-like. Over 16 trials, each infant listened to four trial types

that included all possible speech sound and aerotactile pairings (see Table 1). To assess whether the aerotactile information altered infants' perception of the phonetic contrast, infants' looking times to a neutral visual stimulus were measured for each trial type. Data were collected from 24 infants (6:15 to 8:4; 19 more excluded due to fussing out or equipment failure). Infants looked less when a /ba/ accompanied by airflow was paired with a plain /pa/ (baPuff + pa) than when paired with a plain /ba/ (baPuff + ba) in a stimuli stream ($p = 0.01$). Critically, this pattern of looking is consistent with integration: If infants had only been attending to the auditory signal, the opposite looking patterns would be predicted. Similarly, when the auditory signal was held constant and the location of the puff was manipulated (baPuff + pa vs. paPuff + ba), infants did not treat the two stimulus streams equivalently--as predicted without integration--but instead looked significantly longer when the aerotactile cue occurred on the aspirated token (paPuff + ba). Results demonstrate that infants integrate audio and aerotactile cues before they produce the relevant consonant sounds. Our findings offer evidence that infants integrate tactile speech information much like they integrate visual speech cues.

P1-D-116 One way or another: Infants find vowel minimal pairs with less phonetic variability easier to learn regardless of the task

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Before 17 months of age, infants struggle to associate novel words to their referents if the novel words form minimal pairs, i.e., when they differ in a single phoneme (e.g., bin-din). This difficulty does not stem from infants' inability to hear the difference between the consonants, as they can distinguish the words in a task that does not involve a word-object association (i.e., in a consonant discrimination task). Importantly, infants can succeed in this task even at 14 months if computer-based word-learning tasks are made less complex, either by measuring preference for the target object or including contextual cues. This suggests that task demands affect early world learning. Less is known about infants' ability to learn novel words that constitute vowel minimal pairs and the available findings are mixed. Some recent studies find that vowel minimal pairs are difficult to learn at or after 18 months, even in interactive tasks, while other studies show success at 15 months for some vowel minimal pairs when using a cognitively demanding task. To disentangle the role of the task and the type of minimal pair in early word learning, we presented 15-month-olds with vowel minimal pairs in two different tasks. In Experiment 1, we used a preferential looking word-learning task. Infants were habituated to the novel

words "deet" and "doot" paired each with a different novel object. During test trials, infants saw the two novel objects side-by-side and heard one of the novel words (target). Their looks to the target object during test trials were compared to their looks to the same object during a baseline trial where infants saw the two objects side-by-side and heard "wow". In Experiment 2, infants were presented with a discrimination task involving "deet", "dit", and "doot". Infants were habituated to the label "deet". Test trials included a same trial (same label as habituation, "deet") and two trials where the word was changed to either "dit" or "doot". If task demands explain infants' performance, 15-month-olds should be successful in both experiments showing discrimination for all labels. Alternatively, if acoustic properties drive early word learning, the word "doot" should be easier to learn and easier to discriminate from "deet" because it is produced with less spectral change, and it is acoustically more distinct from "deet" than "dit". Experiment 1 results showed that infants were able to learn the word "doot" but not "deet", as they looked longer only to the object paired with the word "doot" in test compared to baseline trials (Figure 1 left). Experiment 2 results showed that infants could only discriminate "deet"-"doot" but not "deet"-"dit" (Figure 1, right). These results suggest that early word learning is driven by the properties of the specific words presented to the infants and not by the task demands. In this case, the word with the most spectral change within the vowel was most difficult regardless of the task (word learning or vowel discrimination). These findings inform theories of word learning and the continuity of perceptual and lexical development in infancy.

E: Attention, Memory, and Learning

P1-E-117 Joint Attention and Language Abilities: The Moderating Effect of a Risky Temperament Profile

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Researchers have demonstrated a persistent relationship between joint attention (JA) and language abilities. For example, 14-month JA is associated with concurrent performance on a word-object association task under control conditions as well as under distraction (Salley et al., 2012). Research has also shown associations between temperament and language. For example, 13-month temperament predicts 20-month productive vocabulary (Dixon & Shore, 1997). It has been suggested that "risky" temperamental profiles, such as when children have high negative affectivity and low effortful control, can especially lead to language delay (Dixon & Smith, 2000). In this investigation, we explored

whether temperamental profile might moderate the relationship between JA and language ability. 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) and the MacArthur-Bates Communicative Development Inventory: Words and Gestures (MCDI-WG). The IBQ-R produced three overarching superdimensions: surgency, negative affectivity, and effortful control, two of which were used to identify children as temperamentally "at-risk" or "buffered." Total receptive vocabulary was derived from the MCDI-WG. Temperamental risk was defined as scoring high in negative affectivity and low in effortful control; while temperamental buffering was defined as scoring low in negative affectivity and high in effortful control. JA was measured using a Brooks and Meltzoff (2005) type gaze-following procedure, with some gaze-following trials subjected to an exogenous distractor (Elmo video playing in the background), and others undistracted. JA was defined as total infant looking time to experimenter-fixated target objects. Overall, receptive vocabulary was correlated with JA in both nondistracted ($r = .30$, $p = .01$) and distracted conditions ($r = .25$, $p = .04$). Although infants did not differ in either JA or receptive vocabulary as a function of temperamental profile, we found that the correlation between JA and receptive vocabulary did. Specifically, JA was not associated with receptive vocabulary for children with risky temperament (see Table 1). But there was a large and positive association between receptive vocabulary and JA among children with a buffered temperament, regardless of distraction condition. Moderation analyses confirmed that temperamental risk was a significant moderator of the JA-receptive vocabulary relationship (moderator control = -1.09, $p = .006$; moderator distraction = -0.75, $p = .01$). These results are partially consistent with theoretical expectations, although they need be supported by further research. They suggest, for example, that the JA-language relationship may be attenuated or enhanced depending on infants' temperament profiles. It may be that children who are low in negative affectivity and high in effortful control can maximize their allocation of attention both in the service of following the gaze of a social partner, and in making word-referent mappings during social exchange. The fact that the JA-receptive vocabulary correlation appeared unaffected by the presence of an exogenous distractor raises the possibility that one means through which a buffering temperamental profile may operate is by desensitizing children to ambient environmental distractions during real-time acquisition of linguistically relevant stimuli.

P1-E-119 Visual Short Term Memory for Faces and Shapes in 5- and 8-Month Olds

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Infant memory -- its capacity and its development -- has been widely studied for the last 40 years. In recent years, a number of studies have examined the capacity of infants to remember visual stimuli over short durations, a process known as Visual Short Term Memory (VSTM). One of the first significant developmental improvements occurs at 6-7 months of age, when infants begin to show the ability to hold more than one object from a display in their memory (Ross-Sheehy et al., 2003). The majority of infant VSTM studies so far have used colored shapes as the stimuli, and have examined group-level differences as the outcome variable of interest. The present study explored individual differences in VSTM capacity in two age groups, using both shapes and faces as stimuli. Faces were chosen as the second stimulus type in order to explore whether social versus non-social stimuli might influence VSTM. We hypothesized that performance on a VSTM task would be superior in older infants, and that performance would be greater at at all ages for faces over colored shapes, but younger infants would fail to show memory for the larger set size regardless of stimulus. Five-month old (N = 14) and eight-month old (N = 15) infants completed a brief look duration task, followed by four trials of a visual disengagement task. This was followed by the VSTM task. Modeled after the continuous streams paradigm reported by Ross-Sheehy et al. (2003; see Figure 1), the memory task tested set size (one vs. two) and stimulus type (faces vs. shapes), with two trials per condition for a total of eight trials. Each VSTM trial lasted 20 seconds. Results of the VSTM task are shown in Figure 2. The data given in Figure 2 and the following analyses only includes participants who met certain looking criteria. There was an expected main effect for set size, $F(1,16) = 14.560$, $p = .002$, where infants performed better at Set Size 1 over Set Size 2. There was no overall main effect for age, $F(1,16) = 1.765$, $p = .203$, nor stimulus type, $F(1,16) = 3.049$, $p = .100$; however, there was an Age x Set Size interaction, $F(1,16) = 6.593$, $p = .021$, where eight-month olds performed better than five-month olds at Set Size 1. A lack of stimulus type main effect aligns with some previous work (e.g., Kwon et al., 2014), though eight-month olds showing lower performance at Set Size 2 was unexpected. Data collection and analysis is ongoing, and further individual differences analysis (e.g., examining whether VSTM correlates with other measures of infant attention such as peak look duration and disengagement speed) will be reported.

P1-E-120 Heading in the Cued Direction: Infants' Gaze Following Behavior is Based on Head Orientation

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In live interactions, infants follow the joint movement of head and gaze of others already at 3 months of age whereas following head and gaze cues separately emerges only at the end of the first postnatal year of life (D'Entremont et al., 1997; Lempers, 1979). However, computer-based studies indicate that infants' attention is covertly shifted by gaze or head movements already in 4-month-olds (Hoehl, Wahl, & Pauen, 2014). The current study investigated overt following behavior to head or gaze orientation in 4-month-olds using eye tracking. Infants were presented with a turned head with frontal gaze (Experiment 1) or shifted gaze in a frontal head (Experiment 2) cueing one of two comic mice at each side of the screen. We measured infants' preference for the cued as compared to the not cued mouse (looking times) and gaze shifts from the face to the cued and not cued mouse. The experiments consisted of three phases: baseline, training and test with test being identical to baseline. If infants are sensitive to gaze and head orientation, we expected infants to spontaneously follow head and gaze cues equally during baseline. During the intermediate training phase, infants were rewarded in a gaze-contingent paradigm for following the cue: Whenever the infant looked at the cued mouse, this mouse started wiggling. To investigate whether this wiggling aroused infants, we assessed infants' pupil dilation in response to the wiggling as compared to the same but static stimulus. If infants thereby learn that gaze or head direction hints on the reward, we expected infants to increase their following behavior from baseline to test. The final sample consisted of 21 4-month-olds (6 female, average age:4 months 14 days) in Experiment 1 and of 20 4-month-olds (9 female, average age:4 months 13 days) in Experiment 2. In both experiments, the wiggling of the mouse during training significantly dilated infants' pupil ($t(20)=2.62$, $p=0.016$ in Experiment 1; $t(19)=3.58$, $p=0.002$ in Experiment 2). In Experiment 1, infants preferred the cued to the not cued mouse in baseline ($t(20)=7.47$, $p<0.01$) and test ($t(20)=2.28$, $p=0.03$) but decreased this preference from baseline to test ($t(20)=-2.698$, $p=0.01$). Infants shifted their gaze more often from the face to the cued than to the not cued mouse in baseline ($t(20)=5.319$, $p<.01$) and test ($t(20)=3.039$, $p<0.01$). In Experiment 2, infants neither showed a preference for the cued mouse nor did they perform more gaze shifts from the face to the cued than to the not cued mouse in baseline or test, all $ps>.05$. 4-month-olds spontaneously followed the head orientation during baseline and continued to do so in test (Experiment 1). In contrast, infants' looking behavior was not guided by gaze orientation (Experiment 2) either because the movement of the eyes was too small or because infants at that age do not yet follow gaze direction. Gaze following behavior in young infants seems to be driven by

the salient head rather than gaze orientation. We did not find effects of reward on looking behavior although the wiggling of the mouse aroused infants.

P1-E-121 Prediction Error in Auditory and Visual Domain of 6-month-old: A Pupillometry Study

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Prediction, or the ability to use past experiences to generate expectations about future sensory input, influences learning. Predictions can be correct or incorrect and numerous adult studies have demonstrated how prediction errors can support cognitive changes. Recent work in developmental psychology have found evidence that infants experience prediction error in the visual domain, suggesting predictions can support cognitive development early in life. Prediction error in the auditory domain, however, was not investigated. The goal of this current study is to compare the prediction error response for auditory and visual stimuli of 6 months old infants. To index prediction error, we used eye-tracking as it allowed us to measure pupil diameter and design the task to be gaze contingent. Pupil diameter has been shown to reflect cognitive surprise in infants, which is closely linked to prediction error. Furthermore, the gaze-contingent nature of the task allowed us to make sure that the stimuli were presented only when the infant was paying attention, which is especially important for a learning paradigm. The task is composed of two conditions: 1) auditory predicting visual (AV) and 2) visual predicting auditory (VA) (Figure 1). In the AV condition, infants learn that a sound predicts a visual stimulus (e.g., A1 -> V1) and in the VA condition, infants learn that a visual predicts an auditory stimulus (e.g., V2 -> A2). After familiarization, infants viewed omission trials, such that A1 was not followed by V1 in the AV condition, and V2 was not followed by A2 in the VA condition, but a blank screen and silence. Using a blank screen, instead of an unexpected stimulus, was critical because it allowed us to isolate surprise from stimulus processing as the presentation of any stimulus causes pupil diameter to change. The order of condition was counterbalanced across participants. Comparing present and omission trials in both conditions will allow us to see how pupil diameter (i.e. level of prediction error) change as infants' predictions were unexpectedly being violated and if it depends on the domain it occurs in (i.e. visual versus auditory). Preliminary analysis of data from ten 6-month-old infants show that there might be a domain-specific prediction error response. Specifically, in the AV condition, the pupil size for omission trials is larger than present trials, however, in the VA condition, the pupil size for omission trials is very similar to present trials (Figure

2). Following data collection of this task, we will use concurrent measures of eye-tracking and fNIRS to investigate the relationship of neural and behavioral measures of prediction error. Overall, preliminary data suggest that prediction errors are experienced in both the auditory and visual domain, but that it may be attenuated in the auditory domain.

P1-E-123 What type of interactional presentation does children help to overcome the saliency-effect in a word learning scenario?

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A number of studies used the effect that infants' attention can be easily attracted by an interesting object in their visual field for word learning. When compared to social cues, for 10-month-old children, perceptual saliency was more powerful to attract attention and thus enable them to map a novel word onto the salient referent (Pruden et al., 2006). However, social cues so far were studied only in terms of join attention (Hollich et al., 2000). In contrast, we considered joint action as a different frame of social learning. The goal of our study was, therefore, to contrast two presentation types using social cues and investigate which of them are more helpful for infants to overcome the saliency-effect and learn the new label for the target object. We hypothesized that 10-month-old infants, who accomplish a goal in a joint action (Rohlfing et al., 2016), perform better in word learning as infants learning words in a joint attention condition, who will not be able to overcome the saliency-effect. We afforded a between-subjects design with previously 42 German 10-month-olds. The participants were randomly assigned to one of two groups, in which we varied the type of interactional presentation: The Joint Attention group (N=21) or the Joint Action group (N=21). In a Pre-test, a new "interesting-boring object-set" was presented in an Intermodal Preferential Looking Paradigm on a Tobii Pro X3-120 eye-tracker to all infants. While the interesting object was highly attention-getting, the visual boring stimulus had an interesting functional. At baseline, as expected, significantly longer fixation duration occurred to the salient object compared to the boring one: $t(41)=2.23$, $p=.03$, $d=.53$. In a following training phase, infants experienced an interactional presentation according to their group. In each group the experimenter first labeled the boring object while showing its functional role. Afterwards, she let the infants explore the item by their own, remaining them in the Joint Attention frame. They did not get any support, whereas in the Joint Action group the dyad jointly repeated the object's function again and again. Preliminary findings from the following eye-tracking post-test suggest that the Joint Attention group proceeds to fixate the salient object significantly

longer, after hearing the target word: t(20)=2.83, p=.01, d=1.23. However, the Joint Action group overcomes the initial saliency-effect, resulting in a non-significant difference in looking time to target and distractor: t(20)=0.41, p=.68, d=.18. With respect to the two ways of interactional presentations, our results suggest that providing social cues and labeling the referent within a joint attention frame does not lead to word learning, because infants' attention is distracted by salient stimuli in their environment. In contrast, within the frame of an active engagement in a joint action by achieving a function together, infants were able to overcome the saliency-effect and focus their attention on the target. We conclude that for word learning, the joint activities, and not only the joint focus, need to be taken into account to explain why children learn language.

P1-E-124 Speed, Accuracy, and Duration of Multisensory Attention to Social Events at 6 Months Predicts Social Competence at 18 Months

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Early identification of social-emotional difficulties is important for developing and implementing early childhood interventions, such as parent training. We developed the Multisensory Attention Assessment Protocol (MAAP; Bahrick et al., under review) to assess individual differences in attention to audiovisual social and nonsocial events in infants. Attention to social events is a critical foundation for normative social development (Bahrick, 2010; Feldman, 2007) and may be an early indicator of later social competence (age-appropriate social-emotional behaviors). In the present study, we assessed whether measures of social attention on the MAAP at 6 months would predict social competence domain scores on the Infant-Toddler Social Emotional Assessment (ITSEA), a parent report of social-emotional behaviors (Carter & Briggs-Gowan, 2006), at 18 months. We predicted that more flexible and efficient processing and coordination of attention to faces and voices at 6 months would predict higher social competence scores at 18 months. Thirty-six infants were administered the MAAP at 6 months, and caregivers completed the ITSEA when infants were 18 months. For the MAAP, each trial began with a silent 3s central visual event (animated shapes) immediately followed by two lateral events (12s) of women speaking, one synchronous with her natural soundtrack (see Figure 1). On half of the trials, the central event remained on throughout the lateral events (high competition) and on the other half of the trials, it was turned off (low competition). For this study, we focused on performance on low competition trials, as high competition trials appeared too difficult

at 6 months. We calculated measures of duration (i.e., proportion of available time looking to lateral events), shift speed (i.e., reaction time to look from central to lateral events), and intersensory accuracy (i.e., proportion of total looking time to synchronous events, or matching). Correlations between 18-month social competence domain scores and the three 6-month MAAP measures ranged from .25-.54 (see Figure 2). To assess whether MAAP measures would predict social competence, we regressed the 18-month social competence scores on to 6-month MAAP social speed, duration, and accuracy scores. Results indicated that the MAAP measures together accounted for nearly half of the variance in social competence scores, $R2 = .47$, $F(3,32) = 9.42$, $p < .001$. Faster shift speeds and greater face-voice matching at 6 months significantly predicted higher social competence scores at 18 months (ps < .025; longer duration marginally predicted higher social competence; $p = .08$). Findings suggest that basic indices of attention to social events at 6 months are predictive of parent-report measures of social competence at 18 months. These findings suggest that early measures of social attention can be used to predict individual differences in later social competence, including identifying infants who may be at risk for social-emotional problems. They may also aid in identifying those infants who will benefit the most from early behavioral interventions, and that training attention to social events may have down-stream effects for improving later social-emotional competence.

P1-E-125 The Role of Different Summative Social Learning Processes in Innovation

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A defining feature of our species is that our cultural products evolve (Laland, 2017). Cultural evolution is widely believed to depend on two "engines," innovation and social learning (Legare & Nielsen, 2015). However, whereas, our species' social learning abilities are exceptional, children (Beck, Apperly, Chappell, Guthrie, & Cutting, 2011) and adult's (McCaffrey, 2012) ability to innovate is comparatively limited. Given this, how do human cultures evolve, nonetheless? One possibility offered by computational models models is summative social learning (Subiaul, Krajkowski, Price, & Etz, 2015), the aggregation of socially-learned skills (Boyd & Richerson, 1985; Lewis & Laland, 2012). Previous research (Subiaul et al., 2015) has shown that preschoolers combine different responses shown by 2 different experimenters in a well-structured problems (a puzzle box). Follow-up studies have shown that 4-5 years old also combine different responses to build an optimally sized tower, an ill-structured problem, where the baseline rate was near 0. However, in

both studies, children observed different discrete actions and faithfully combined them (i.e., summative imitation). Cultural evolution theorists have suggested that emulation may be an equally powerful force allowing for the "blending" or transformation of socially learned skills (Henrich, Boyd, & Richerson, 2008). The present study sought to test this hypothesis. Participants: 120 children between the age of 4-6 years (M = 60.71, SD = 9.11) were randomly assigned to one of three learning conditions prior to testing on the tower task (Fig.1). Conditions: (i) Baseline, children were given the tower pieces and instructed to "build the tallest possible tower." (ii) Imitation: children observed one model stack cubes--Base--and another model combine squares--Apex--(Figure 1B). (iii) Emulation: same as above, except that the model combined squares or stacked cubes behind an occuler. When done, the child saw the final product (Fig.1B) but not the actions used to achieve them. Following the demonstration, children were given the tower pieces and instructed to "build the tallest possible tower." Measures: Tower height (cm), errors (e.g., unstable structures), target responses (stacking cubes, combining squares), summative learning (Figure 1C). Results are summarized in Table 1. Children in the social conditions (imitation and emulation) produced taller towers than children in Baseline (all ps < .05). Children in the social conditions produced more target responses, overall (all ps < .05). Specifically, these children stacked cubes more often than those in Baseline (all ps < .01). Finally, there was a significant difference in the number of children who evidenced summative learning across conditions (X2 = 19.45, p < .001). More children in the imitation condition evidenced summative learning than children in Baseline (Z = -3.75, p < .001) and emulation (Z = -2.86, p < .005) conditions. There was no difference between emulation and Baseline conditions (Z = -.35, p = .73). Summative learning did not correlate with age (ρ = .13, p = .19) or sex (ρ = .05, p = .62). These results build on prior work demonstrating that children can innovate by faithfully combining others' responses. This challenges our conceptualization of innovation as arising from purely asocial cognitive processes. Instead, many (perhaps, most) innovations may result from social learning.

P1-E-126 Infants Use Surprising Information to Modify Their Predictive Internal Models Better Than Adults Do

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From very early on in life, humans generate internal models of their environment in order to predict events in the world. Unexpected events challenge one's current model of the world, as they often demand adjustments of predictions generated by these models. In an eye-tracking study, we examined whether and how 14-month-old infants and adults use surprising events to modify their predictive internal models in a dynamic environment. More specifically, we investigated whether they dissociate between different types of unexpected events in the extent to which they are relevant for updating their predictions. In a saccadic planning paradigm (Figure 1), participants observed differently colored bees that appeared at an unexpected location every few trials. The surprise/update trials were always the first of a series of trials of the same kind and thus indicated that following these trials, the bees would continue to appear at the same location (and in the same color) for on average four trials. Participants were thus expected to update their prediction about the location of the following bees. In surprise/no-update trials, on the other hand, the location of the bee was again surprising in comparison to the location of the previous one; however, as this was a one-time event, participants were expected to not change their predictions about the location of the following bees. In expected trials, the bee appeared where it appeared in the previous trial. We predicted that participants would be slower performing an eye movement to surprising targets because in these trials the targets appeared at a location that was different from the previous trials. If participants dissociate between different types of surprising trials (i.e. surprise/update and surprise/no-update) based on the color cues, we expected them to look at the target locations in the trials following surprising trials (i.e. trials +1, +2, +3 and so forth) significantly faster than in response to surprising trials. As shown in Figure 2A, data revealed that infants were significantly faster to look at the bee locations following surprising trials (trials 0 vs. trials +1: md= 46.08, SE= 19.56, p=0.028; trials 0 vs. trials +2: md= 58.42, SE= 17.96, p=0.004; trials 0 vs. trials +3: md= 80.59, SE= 18.35, p=0.000). These results suggest that infants learned the predictive value of the color cues and dissociated between the different types of surprising information to modify their predictive models accordingly. Although infants and adults who were not instructed had exactly the same prior knowledge about the task specifics, we observed clear differences in their responses. Unlike infants, uninstructed adults exploited a single strategy (i.e. update) and did not differentiate between unexpected events resulting in increased fixation latencies in the trials following the surprise/no-update trials (Figure 2B). When instructed, adults showed a response pattern closer to that of infants. Based on these findings, we conclude that infants are more open to accommodate new information and update their beliefs flexibly, which is an advantageous learning strategy to represent dynamic environments. This

strategy enables developing systems to adjust to changes easily, a capacity that is key to adapting to novel environments.

P1-E-127 Indexing visual working memory capacity in infancy

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Indexing visual working memory capacity in infancy Working memory (WM), central to later-developing executive function (EF), is available to infants from birth (Slater, 1995). WM capacity (WMC) can be quantified as the amount of information successfully retained over a delay to plan, perform a task, or solve a problem. For example, Piaget's A-not-B task requires WM, and performance is a function of delay between hiding and search, and age (Diamond, 2013). A-not-B performance in 10-12 month-olds may be linked to the onset of EF (Diamond, 2013), and early WMC has been shown to be a better predictor of later academic success than early IQ measures (Alloway & Alloway, 2010). Furthermore, WMC has been shown to be relatively stable throughout development: Individuals exhibiting WM concerns at an early age continued to struggle with WM later on (Rose et al., 2012). There is ongoing debate in the literature about the best operationalization and measurement of WM in infancy, and the best tasks to tap WM as a construct early in development. Here, we present a cross-sectional study examining individual- and age-related differences in infant WMC utilizing a range of methodologies. Our goal was to quantify WM in a sample of 70 6-12-month-olds. We compared performance across a battery of WM tasks varying in levels of cognitive load. Protocols were administered with a live experimenter or with an eye-tracker (ET). The WM tasks included a reaching (live) version of the A-not-B task (Piaget, 1955) as well as gaze-contingent ET adaptations of (a) oculomotor delayed response (ODR; Gilmore & Johnson, 1995), (b) change-detection (Ross-Sheehy et al., 2003), (c) delayed match retrieval (DMR; Kaldy, 2015) and (d) a screen version of A-not-B. A range of delay durations were introduced within each task to determine maximum delays that infants may successfully tolerate and still yield above-chance performance. Overall results suggest WM abilities may be readily assessed as early as 6 months. For ODR, infants performed significantly above chance levels (50%) for shorter delays (500ms, 750ms), whereas performance dropped to chance for longer delays (1000ms, 1250ms). For change-detection, infants performed significantly above chance levels across all delay durations. For DMR, infants performed significantly below chance levels across all delay durations. For both ET and experimenter versions of A-not-B, infants performed significantly below chance levels at delays of 3000ms. As task difficulty

increased, age-related improvements in WM performance increased accordingly: Infants showed significantly larger age-related improvements for more difficult tasks. Additionally, average performance across tasks and delays significantly increased from 34% at 6-months to 46% at 12-months. As task delays increased, age-related improvements exhibited the most gain for longer delays. In addition, investigation of individual differences across tasks, delays and modalities will be discussed. The outcomes of this study help inform future work aiming to better understand and quantify infant WM and how it matures throughout early development.

P1-E-128 Infants' ability to consolidate new information depends on the timing of a nap relative to learning and test

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Napping between training and test improves infants' declarative memory for novel actions (Konrad et al., 2016; Lukowski & Milojevich, 2013), their ability to generalize artificial language rules (Gomez, Bootzin, & Nadel, 2006), and their efficiency at motor problem solving (Berger & Scher, 2017). Despite the varied methodologies, these studies all focus on the relationship between learning/training, sleep, and test. However, the underlying mechanism through which sleep benefits learning is still unclear. One possible explanation is that sleep prevents interference from other activities and information. Another is the two-stage model of memory consolidation in which consolidation occurs via activation in the hippocampus and, later, the neocortex. Infants' still-developing hippocampus means that they need more frequent sleep than adults as their smaller storage capacity is filled sooner and subsequently needs to be cleared more often (Seehagan, et al., 2015). The goal of this project was to test whether the timing of naps relative to learning mattered. The two-stage model of memory consolidation would predict that infants benefit more from napping when they are able to sleep immediately after learning a new task as opposed to after a delay. This would prevent the storage capacity of the hippocampus from being overly taxed and would promote consolidation. New walkers (n=12) who were within a week of having given up crawling, were encouraged to crawl through a nylon tunnel. This is a challenging task for novice walkers because it requires a postural shift to fit their body into the shoulder-height tunnel. Experimenters followed a training protocol controlling for when and how to demonstrate task-relevant prompts as infants learned the task. Training ended once infants went

through the tunnel to reach a caregiver at the other end or they were exposed to the maximum number of training steps. In the Learning-Sleep-Interference (LSI) condition, infants (n=6) received training just before their nap. In the Learning-Interference-Sleep (LIS) condition, infants (n=6) received training 3.5 hours before their nap. The total delay between training and test was approximately 6 hours. Infants were video-recorded. Coders documented: the number of training steps (maximum of 15); exploratory postures, or the frequency of shifts in body position before entering the tunnel; and the number of postural shifts while in the tunnel. Difference scores between training and test were calculated for each infant. As shown in Figure 1, the magnitude of improvement across several variables was greater for the infants who slept immediately after training. Positive scores reflect improved performance. Improved motor problem solving from training to test provides further evidence for the beneficial impact of sleep on learning. The differential nature of the improvement, depending on whether the nap occurred just after training or just before test, suggests that sleep is doing more than simply preventing interference because all infants experienced a delay comprising nap and awake time. Rather, the results are in accordance with a model of limited hippocampal storage capacity in infancy. Napping immediately after learning seems to have provided the opportunity to consolidate the information acquired during training before having to compete for storage for other new information. Thus, timing of sleep is very important, particularly for infants.

P1-E-129 The Dynamics of Spontaneous Covert Attention Predicts the Direction of Impending Gaze Shifts at 3 Months

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Do spontaneous (un-cued) fluctuations in covert attention (CA) influence young infants' visual foraging? To explore this question we use the amplitude of steady-state visual evoked potentials (SSVEPs) to monitor changes in CA during looking. SSVEPs are analyzed in real time so visual stimulus events can be delivered contingent on the infant's allocation of CA. Previous results (Fig. 1) showed that when the difference in spontaneous CA to 2 peripheral stimuli is large, subsequent gaze shifts back to the high-CA stimulus (after a visual event) are slower than gaze shifts away, indicating inhibition of return (IOR). Here we report that ongoing spontaneous fluctuations in CA following the initial bout of CA predict the direction of the subsequent gaze shifts. METHODS. 34 full-term healthy 12-week-old infants looked at 3 yellow plastic ducks containing LEDs flickering at different

frequencies. EEG (for SSVEP analysis) was recorded from temporo- and parieto-occipital scalp. Corneal reflections of the ducks (for gaze analysis) were recorded synchronously with the EEG. SSVEPs driven by the flickering ducks were extracted from the EEG and analyzed in real time. Differential CA to one side duck (the "target"), defined as continuously high SSVEP amplitude driven by one side duck and low amplitude driven by the other for at least 250ms during fixation of the center duck, triggered the delivery of a visual event (simultaneous back-and-forth motion of the side ducks at 2Hz for 2s). RESULTS. (a) Gaze shifts back to the initial target of CA (Fig. 2A, 2B) were preceded by complex patterns of ongoing CA, which depended critically on the magnitude of the initial differential CA that triggered the event. When the initial differential CA had been small, it was followed by repeated, brief CA bursts to the initial target; the gaze shift back to the initial target occurred during a final CA burst. However, when the initial differential CA had been large, it was followed by a CA burst to the initial target 400-500ms before the gaze shift, then bursts to both stimuli, and a final burst to the initial non-target; the gaze shift back to the initial target occurred 100ms later. (b) Gaze shifts away from the initial target of CA (Fig. 2C, 2D) were not preceded by systematic fluctuations in CA. CONCLUSIONS. The recent dynamics of spontaneous CA predicts the direction of impending gaze shifts. (a) After initially weak CA to a peripheral object, ongoing bursts of CA to the same object lead to its fixation, suggesting a step-wise build-up of attentional engagement. After initially strong CA, further CA to the same object leads instead to the reallocation of CA away from that object before the gaze shift occurs. The reallocation of CA then appears to bias the subsequent gaze shift back to the initial target of CA, suggesting a "double" IOR. The observed longer gaze shift latency is consistent with this two-step process. (b) After either weak or strong CA to a peripheral object, the absence of systematic ongoing fluctuations in CA leads to gaze shifts away from the initial target of CA, consistent with "simple" IOR. [NIFA grant 1004111]

P1-E-130 Does early exposure to culturally-driven routines modulate visual rule learning abilities? Evidence from Japanese infants

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Recent studies have shown that, in preverbal infants raised in a Western culture by parents who read from left to right, directional spatial information (left-to-right versus right-to-

left) modulates learning of ordered visual sequences. Indeed, de Hevia et al. (2014) reported that 7-month-old Italian infants represented numerical relations defining increasing order when numerical sequences were presented from left to right, but not when presented from right to left. More recently, a similar advantage for a left-to-right over a right-to-left spatial orientation was found by Bulf et al. (2017) during infants' learning of rule-based visual sequences (Rule Learning, RL): 7-month-old Italian infants readily learned rule-like patterns defined by adjacent (ABB) and non-adjacent (ABA) repetitions of elements embedded in left-to-right oriented sequences, but failed with right-to-left oriented sequences. In line with evidence from adults, these findings have been interpreted as demonstration of an early mapping of ordered information into oriented spatial codes, which may reflect a general property of serial order working memory (Van Dijck & Fias, 2011). However, the contribution of experience and biological constraints to the establishment of this mapping is still debated. In the current study, we addressed this question by testing RL abilities in 7-month-old infants growing up in a culture with a complex reading and writing system that combines both vertical and horizontal orientations (Fig.1). The procedure was modelled after Bulf et al. (2017): 34 infants were familiarized with 3-item rule-based sequences of shapes presented in a left-to-right or right-to-left spatial orientation, and subsequently tested with triplets of novel shapes depicting the familiar or a novel rule while maintaining the same spatial orientation as in the familiarization phase (Fig.2). A 2 (spatial orientation: left-right, right-left) x 2 (familiarization rule: adjacent, non-adjacent) x 2 (test trial order: novel-familiar, familiar-novel) x 3 (test trial pair: first, second, third) x 2 (test trial type: novel, familiar) mixed ANOVA revealed a main effect of test trial type, $F(1,52) = 9.53$, $p = .005$, due to longer looking times to the novel rule-based sequences than to the familiar ones. This finding indicates that all infants successfully learned the rules delivered by the familiarization sequences and transferred them to the familiar test sequences, irrespective of the direction with which the sequences were provided. When compared to the results obtained by Bulf et al. (2017) with Italian infants, these findings suggest that implicit, directionally relevant experience provided by exposure to culturally-driven routines, in interaction with biologically-determined attentional biases in exploring the external space (Rosen et al., 1987), shapes the direction of infants' spatial representation of order.

P1-E-131 Word learning strategies and long-term memory of word-object pairs in young children

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In the first stage of word learning, establishing the associative link between a new word and its referent is characterized by an initial slow process that requires multiple exposures to the new word combined with gestural cues (Baldwin & Markman, 1989 ; Hollich et al, 2000). There is a general consensus that toddlers rapidly become expert word learners, a capacity which is likely due to the maturation of the declarative memory system within the second year of life. In this context of age-related memory development, our study aims to investigate how rapidly new words can be acquired and retained over time in different age groups. We assume that memory strength increases roughly linearly with the number of presentations during learning but also that a very limited number of exposures to a new word can be sufficient to enable its encoding without any recall. Based on the ontogeny of brain maturation, we also hypothesize that differences in memory skills could be observed between age groups. To investigate these questions, 2- and 4-years old toddlers were taught 3 new object names, by arbitrary pairing novel auditory labels (pseudo-words) to unknown objects presented during short videos. A touch-screen automated design allowed us to highly control the number of repetition of each word-object pair during learning and to unambiguously record infants' performances during the following forced-choice memory task. In a first condition, we varied the number of presentation of each pair during the learning phase (1, 3 and 5 presentations respectively). We observe that memory performances after a 30 minutes intervening period are positively correlated with the number of repetition, regardless of the age group (linear mixed-model, $p=0.03$, $N=40$). Interestingly, our results show that infants, as young as 24 months old, performed above chance level even for the pair presented only once (binomial test, $p<0.05$). This unexpected result raises the question of 24 month-olds' and 4 year-olds' real capacity to store this new and once-presented word-object pair in memory. Alternatively, they could have used a referent selection strategy which consists in inferring a new word to its referent by exclusion, also known as "fast-mapping"; a word learning strategy that has been identified in infants as young as 17 months (Halberda, 2003). Thus, ongoing experiments are testing 2- and 4- years old toddlers' ability to remember names of 3 novel objects that were i) presented and labeled only once, 30 minutes before test (second condition) or ii) learned by exclusion using a referent selection strategy ("fast-mapping"), 30 minutes before test (third condition). Future experiments will also investigate memory performances for these three conditions following longer delays, in order to determine if such arbitrary semantic information can be maintained in very long-term memory without any recall. Altogether, this work will help better characterize the development of toddlers' long-term memory skills in the

context of vocabulary acquisition and will provide a better insight of the learning strategies used to support language development and learning in an educational context.

P1-E-132 Inattentional Blindness for Letters and Words in Cognitive Development

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The phenomenon known as Inatentional Blindness (IB) occurs when an unexpected stimulus is shown in a given attentional task and the observer is unaware of its appearance. This effect has been related with attentional processes and has been tested in different attentional tasks (e.g. Drew et al., 2013). However, although there is some work done in children, it has been insufficiently explored. In the present work we have studied IB effects in 89 children from 6 to 10 years old during a Visual Search task. The kids had to look for missing items (given targets) from a "Pirate Treasure", all of them target images among distractor images. In two given trials a letter and a word was shown in the VS task. After that, the kids were asked about the letter and the word in a free recall task, and in a recognition task. The results show that the proportion of recall for the letter was significantly smaller than for the word ($p < .001$). No differences were found among different ages, showing similar attentional mechanisms mediated by the IB effect for those ages. However, for the word IB trial response time in the Visual Search Task was mediated by age: elder children spent less time looking for the target ($p=.04$). Maybe, the youngest have more difficulties to disengage attention from the IB stimulus than the eldest, or it just take more time for them to read the word. The nature of the IB stimulus (letters versus words) seems to make a difference in the IB effect for that group of ages, showing that the nature of the unexpected item can modulate IB effects in children. The present study put forward that the study of IB in children can give us important information about the development of attentional processes during childhood.

P1-E-133 Mothers alter how they speak to their infants when playing with books versus manual toys

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Based on evidence that preschool children who read at home demonstrate greater emergent literacy and reading skills (Dieterich et al., 2006; Rodriguez & Tamis-LeMonda, 2011; Sénéchal & LeFevre, 2002; Bus et al., 1995; Edwards, 2014) and have larger vocabularies (Bus et al., 1995; Dodici et al., 2003; Payne et al., 1994; Rodriguez et al., 2009), campaigns have urged parents to read to their children earlier and more often. These boosts from reading likely reflect the fact that reading exposes children to a greater number and variety of words (Gilkerson et al., 2015; Bus et al., 1995; Rodriguez et al., 2009) compared to other daily experiences. Although most research on early reading has focused on 2- to 5-year-old children, mothers are encouraged to read to their children prior to their first birthday. We therefore asked how preverbal infants' exposure to words varied during reading versus playing with a puzzle, as well as how maternal vocalizations varied as a function of visual attention. We observed thirty 8- to 10-month-old infants interacting with their mothers (both fitted with head mounted eye trackers) as they played with an age-appropriate puzzle and a collection of board books (see Figure 1). Mothers vocalizations were classified as object labels (i.e., providing object names), action directive (i.e., instructing infant to do something with their hands), and attention directive (i.e., instructing infant to look). We also recorded infant and mother's looks to the book or puzzle. In general, mothers were more verbal when playing with the books ($M = 22.89$ words/min, $SD = 4.33$) compared to playing with the puzzle ($M = 15.80$ words/min, $SD = 4.97$), $t(29) = 7.49$, $p < 0.001$, $d = 1.37$. In addition, mothers provided more object labels and attention directing vocalizations per minute during the book activity than the puzzle activity (see Figure 2), $t(29) = 3.29$, $p < 0.01$, $d = .64$. In contrast, mothers gave more action directing vocalizations per minute when playing with the puzzle (see Figure 2), $t(29) = -2.97$, $p < 0.01$, $d = -.59$. Thus, reading does expose preverbal infants to a greater number and variety of words than other common play activities. Analysis of vocalization during joint attention suggests that mothers used different vocalizations when they were engaged in joint attention with their infants, but not when the infant was engaged with the toys in periods of non-joint attention. Specifically, the pattern shown in Figure 2 was most evident during periods of joint attention. Thus, mothers were more selective in how they talked during the interactions when mother and baby were engaged in shared attention. Ongoing analyses are evaluating the relation between attention and vocalization between these tasks. In general, these results confirm that reading with preverbal infants exposes them to more language than other common play activities, consistent with the literature and the recommendation to parents. In addition, our investigation will provide insight into the connection between visual attention and mother vocalization during their interactions with preverbal infants.

P1-E-134 Attention in pre-crawling infants using a robotic assisted device for independent locomotion

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In this interdisciplinary study, we used an experimental design to examine the relationship between independent locomotion and attentional behavior in infants. Research suggests that interaction with the environment through independent locomotion contributes to the enhancement of executive functions (EF). This association is possible because actively traversing the environment (e.g., to reach a toy) involves sequenced motor schemes and deliberate, goal-directed actions. These actions train infants' ability to ignore extraneous information and focus on what is relevant for the accomplishment of their immediate goals. Studies suggest that sustained, effortful attention in visual tasks is a potential indicator of developing self-regulatory skills and EF. Cuevas and Bell (2014) found that that shorter Peak Look Duration (PLD) at 5-months was associated with higher EF at age three. However, Papageorgiou et al. (2014) reported that infants between 4-10 months of age with longer PLD demonstrated better effortful control and less hyperactivity-inattention than infants with shorter PLD in early childhood. This difference in findings could be explained by the inclusion in the second study of infants older than 7 months, who have begun to locomote independently. We hypothesized that 7-month-old non-crawling infants using a robotic-assisted device to locomote independently, would look longer to visual stimuli than infants who did not benefit from this experience and that non-crawling infants, not exposed to this locomotor device, would show a decreased pattern of looking behavior, similar to infants younger than 7-months of age. Five-month-old infants were randomly assigned to a locomotor (n=21) or non-locomotor (n=23) condition. Locomotor infants participated in 12 play-sessions over two-months, during which they learned to navigate the environment using a robotic device, outfitted with a Wii Balance-Board, allowing infants to move around by leaning forward, left, or right. The non-locomotor infants also had 12 play-sessions in a similar, but stationary device. Prior to the play-sessions, at 5-months (Time 1), infants completed a visual task to assess their attentional response to a dynamic stimulus. At 7 months of age, infants completed the same task (Time 2). They also viewed a video showing a cat puppet dancing to music. Look duration to the cat puppet was measured using an ASL eye tracker system. Our analyses supported both hypotheses. Independent t-tests showed no significant difference in PLD between non-locomotor (M=15.89, SD= 11.21) and locomotor (M=14.76, SD=8.34) infants at Time 1, $t(42) = .375$, $p = .36$; however, the difference

between non-locomotor (M=11.24, SD=6.50) and locomotor (M=15.37, SD=10.72) infants approached statistical significance at Time 2, t(42) = -1.56, p = .063. Eye tracking from the puppet task also supports these results, with the locomotor infants having significantly longer look time duration. These results show that the two groups demonstrated different patterns of visual behavior at 7-months. The attentional shift downward seen in the non-locomotor condition follows previously observed looking patterns found in infants about 5-month of age. Infants in the locomotion condition might have entered the phase of sustained attention, earlier in development. This suggests that assisted locomotion induces development of regulatory abilities.

P1-E-135 The Effects of Parental Interaction on Infant Learning: When Less is More

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Introduction A recent study examining the effects of parent interaction during an infant learning task suggests parent interaction may not always be helpful (Holt et al., 2017). In that study, 4-month-olds whose parents were instructed not to interact with their infants during a Sticky Mittens (SM) training session performed better on a subsequent causal perception task than did infants whose parents were allowed to interact with them during the preceding play session. One explanation is that parents' interactions were distracting and interfered with infant learning. In the present study, we tested this hypothesis. Method Videos of SM training sessions from Holt et al. (2017) were coded offline and analyzed for this study. Of the 17 parent-infant dyads included (Minfant age = 4.22, SD = 0.47), eight were in the Talking condition and seven were in the No Talking condition. Using Datavyu, infants' on-task looks (i.e., at SM balls or mittens), infants' off-task looks (i.e., not at SM balls or mittens), and parental interaction episodes (i.e., parent was in the infant's field of vision while infant was on parent's lap) were coded frame by frame (see Figure 1). Results Three measures were calculated and compared across groups (see Table 1): (1) proportion of time infants spent "on task," (2) proportion of time parents interacted, and (3) proportion of infant off-task episodes that were preceded by parent interaction. Mann-Whitney Us indicate that the proportion of time infants spent on task did not differ across conditions (U= 43.00, p= 0.54). The proportion of parental interaction was significantly higher in the Talking condition than in the No Talking condition (U= 6.00, p< 0.01). Additionally, the proportion of infants' off-task episodes that were preceded by parent interaction was significantly greater in the Talking condition than in the No Talking condition (U= 12.00, p = .021). In fact, while over half the off task episodes were preceded

by parent interaction in the Talking group (Mdn = .55), fewer than 10% were linked to parent interaction in the No Talking group (Mdn = .08). Discussion In the present study, we found evidence that infants in the Talking condition in Holt et al. (2017), who did not show evidence of causal perception following SM training, were distracted by their parents during the learning task. First, although the proportion of time infants spent on task did not differ between groups, parents in the Talking condition interacted (i.e., were in the infants' field of view) significantly more than did parents in the No Talking condition. Second, infants in the Talking group were more likely to go off task after parental interactions than were infants in the No Talking group. Taken together, the findings suggest that parental interactions in small doses may not interfere with infant learning, but in larger doses parental interaction can have a deleterious effect. Data coding is on-going.

P1-E-136 Gaze cueing in six-month-olds following emotional infant-directed messages

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 Infants rely on social cues like emotion and eye gaze to understand their complex world. Caregivers convey emotion via infant-directed (ID) messages, which, compared to adult-directed (AD) messages, involve exaggerated facial and vocal expressions (Fernald, et al., 1989). Categories of ID messages with unique facial features include approving, comforting and prohibiting messages (Shepard, Spence, & Sasson, 2012). By 6 months, infants discriminate these ID categories (Spence & Moore, 2003) and differentially scan ID faces, with increased attention to comforting eyes (Shepard & Spence, 2012).   Infants also use adults' eye gaze as a social cue. Although little work has examined how facial emotion modulates infants' sensitivity to gaze cues, Niedźwiecka and Tomalski (2015) found a gaze cueing effect when infants viewed static happy, but not angry or fearful, faces. However, it is unknown how the exaggerated facial emotion of dynamic ID messages influences infants' responses to gaze cues. The present study examined infants' face scanning during dynamic emotional ID and AD messages, and their subsequent gaze cueing responses.   Eight Caucasian 6-month-olds (3M; anticipated N=40) completed a gaze cueing task in the context of ID and AD messages (Figure 1). Infants first viewed a silent video of a Caucasian female delivering an ID approving, comforting or prohibiting or AD neutral message. The speech was muted to isolate the effects of dynamic facial emotions. The speaker next looked forward with a neutral expression to

simulate eye contact with the infant and then gazed left or right. The speaker then disappeared and bilateral targets appeared in the periphery, with one target appearing in the gaze-cued location and the second target appearing in the opposite, uncued location. Infants completed 32 trials with the ID/AD message conditions presented in random order.   We used a remote eye tracker to record eye movements throughout the task. Analyses focused on 1) looking time to the eyes during the initial ID/AD message and 2) sensitivity to the speaker's gaze cue, indexed by orienting latency and looking time to cued vs. uncued targets. Compared to approving messages, infants showed increased attention to the eyes during comforting ($t(7)=-2.79$, $p=.027$) and, marginally, neutral messages ($t(7)=-2.15$, $p=.069$). However, this increased attention to the eyes differentially affected gaze cueing for comforting and neutral messages. Infants showed a gaze cueing effect following neutral messages, with marginally faster orienting to the cued target ($t(7)=-2.27$, $p=.057$). In contrast, following comforting messages, infants showed slower orienting ($t(7)=2.81$, $p=.026$) and reduced looking ($t(7)=-2.75$, $p=.028$) to the cued target (Figure 2).   These results suggest that 6-month-old infants' face scanning and sensitivity to gaze cues is influenced by dynamic facial emotion during ID/AD messages. Infants showed similar attention to the eyes during ID comforting and AD neutral messages. Despite this, infants showed a gaze cueing effect following neutral messages, but were slower to orient to and looked less at the cued target following comforting messages. Infants may struggle to disengage attention from comforting eyes during gaze cues, perhaps due to the increased arousal associated with comforting messages.

P1-E-137 Rule learning transfer across linguistic and visual domains in 7-month-old infants

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Rule learning (RL) refers to infants' ability to extract high-order ABB/AAB/ABA patterns from a sequence of elements and to generalize them to new items (Marcus et al., 1999). Studies have shown that infants are able to learn high-order rules both in the auditory (e.g., Dawson & Gerken, 2009; Marcus et al., 2007) and in the visual domain (Bulf et al., 2015, 2017; Saffran et al., 2007). However, to our knowledge no studies have investigated infants' ability to transfer the acquired information across these domains. Here we investigated transfer of rule learning between auditory and visual sequences in 7-month-old infants tested in a visual habituation task. Infants were assigned to an auditory-visual (AV) condition (N = 26) or to a visual-auditory (VA) condition (N = 27). In the AV condition,

infants were habituated to multimodal sequences in which speech sounds, accompanied by uninformative but coordinated shapes, were organized into ABB or ABA rule-governed patterns. Following habituation, infants were presented with ABB and ABA test sequences (6 trials) in which speech sounds were uninformative and rules were delivered by shapes (Figure 1). In the VA condition, in contrast, infants were exposed to auditory rules and tested with visual rules. Because there was a switch between auditory (speech sounds) and visual (shapes) information delivering the rules across habituation and test phases, infants had to transfer their learning across domains to discriminate between the novel and familiar test sequences. We reasoned that a novelty preference for the new rule pattern would provide evidence for learning the original rule. A 2 (condition: AV vs. VA) x 2 (first test trial: novel vs. familiar) x 3 (test trial pair: first vs. second vs. third) x 2 (test trial type: novel vs. familiar) mixed ANOVA revealed a Condition x Test trial type interaction, $F(1,45) = 5.09$, $p = .029$. To explore this interaction, two separate 2 (first test trial) x 3 (test trial pair) x 2 (test trial type) mixed ANOVAs were run, one for each condition. A main effect of test trial type emerged for the AV condition, $F(1,22) = 4.42$, $p = .047$, due to longer looking times toward the novel test sequences ($M = 11.5$ s, $SEM = 1.2$) relative to the familiar ones ($M = 9.7$, $SEM = .89$). No significant effects were found in the VA condition. These results indicate that infants were able to discriminate between the novel and familiar test sequences only in the AV condition, providing evidence for a transfer of learning from auditory to visual information, but not vice-versa. This advantage in auditory-visual transfer of RL in 7-month-old infants resembles the RL advantage for linguistic vs. auditory non-linguistic stimuli found by Marcus et al. (2007) at the same age. That is, infants learned rules from speech, but not non-speech sounds; in addition, infants were able to transfer learning from speech to non-speech sounds but not vice-versa.

P1-E-138 A left-to-right directional bias in infants' rule learning of numerical sequences

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Recent developmental studies have shown the presence of a left-to-right directional bias in infants' learning of ordered visual sequences. For example, Bulf et al. (2017) demonstrated that 7-month-old infants were able to extract high-order ABB and ABA rules from an ordered sequence of shapes and, to generalize them to a new set of items (i.e., visual rule learning) only when sequences had a left-to-right, but not a right-to-left orientation. The same directional bias was found when 7-month-old infants had to extract

ordinal information from ordered ascending/descending numerical sequences (de Hevia et al., 2014): infants learned ordinal relations only along a left-to-right spatial orientation and preferred to attend to left-to-right ascending over descending sequences, congruently with a left-to-right oriented representation of numbers. In two studies, we explored whether infants were able to extract rule-like patterns from numerical sequences and whether this ability was modulated by directional spatial information (left-to-right vs. right-to-left) and/or by numerical ordinal relations (ascending vs. descending). Seven-month-old infants were habituated to series of 3-item numerical displays that followed an ABB rule (6-12-12; 9-18-18; 12-24-24). During the test phase, they viewed triplets of geometric shapes organized into ABB and ABA rules (Fig. 1). In Study 1 (N = 44) the habituation and test sequences were presented from left to right with half of the infants habituated to numbers in an ascending order (e.g., 6-12-12), and the other half habituated to a descending order (e.g., 12-6-6). Therefore, spatial and numerical information were congruent with a left-small and right-large number-space association for the first group but not for the second. In Study 2 (N = 22) the habituation and test sequences were presented from right to left, and all infants saw numbers in a descending order, again in line with a left-small and right-large association. Data from Study 1 were entered in a 2 (numerical order: ascending, descending) x 2 (first test trial: novel vs. familiar) x 2 (test pair: first vs. second) x 2 (test trial type: novel vs. familiar) mixed ANOVA. The analyses revealed a main effect of test trial type for Study 1, $F(1,40) = 15.38$, $p < .001$, due to longer looking times to the novel (M = 12.58, SEM = 1.3) than familiar sequences (M = 8.92, SEM = .72). On the contrary, no significant effects were found for Study 2. These results show that infants were able to extract the ABB rule from numerical sequences and to transfer it to non-numerical sequences only when the sequences were displayed from left to right, irrespective of the direction of ordinal relations (ascending vs. descending) and the congruency with a left-to-right oriented numerical representation.

P1-E-139 Where and Why Infants Look: A recurrent neural network for the development of visual attention

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Visual attention of infants develops as they grow. The scan paths of young infants are scattered over a visual stimulus, whereas the scan paths of older infants and adults converge to a certain pattern. For example, 13.5-month-olds, but not 6-month-olds, tend to attend the eyes and mouth and repeatedly shift their attention between the features

when observing an image of a human face (Kato and Konishi, 2013). Individuals with autism spectrum disorder (ASD), in contrast, do not show such a common pattern. Some people with ASD look only at the mouth and locations without any feature, whereas other people look at the eyes and surrounding areas but not the mouth. Their scan paths exhibit a large divergence among individuals (Pelphrey et al., 2002). An open question here is how humans do (not) acquire the common scan path over development. We introduce a recurrent neural network based on reinforcement learning (Mnih et al., 2014) to account for the underlying neural mechanism for visual attention (see Figure 1). The network receives an image x_t and the attention location l_(t-1) at the previous time step t-1 as input and learns to estimate the category c_t of the image and the attention location l_t at t. Our key idea is twofold: (a) Infants would learn to determine where to attend in order to gain more information from both local and global features of visual input, and (b) integrate the obtained information spatially and temporally in order to optimize the subsequent attention. The scan paths of older infants and adults show repetitive shift between prominent features. They seem to collect detailed information from the features and integrate them to form a global picture of the input. We suggest that two architectures are required to replicate the above behavior: (a) reinforcement learning of visual tasks that require both local and global features of input and (b) a recurrent connection to integrate and internally maintain the obtained information. The network shown in Figure 1 comprises these two architectures. It is trained through reinforcement learning with two types of reward functions r_t: local and global tasks, and the internal state h_t of the network is conveyed to the next time step t+1 through the recurrent connection. We conducted experiments to examine whether the proposed network reproduced the developmental change observed in infants. We designed two tasks: one to estimate the emotion portrayed in a face image, which would require local features of the image (e.g., shape of the eyes and mouth), and the other to estimate the head orientation represented in a face image, which would need global features of the image (e.g., location of the eyes and mouth). Our experiments demonstrated infant-like development of visual attention produced by the network. The network trained for the emotion estimation acquired local but close attention to the eyes and/or mouth (see Figure 2 (a)). The scan paths were rather similar to those of individuals with ASD. The network trained for the estimation of head orientation acquired wider attention shift while gazing not only at the eyes and mouth but also the ears (see Figure 2 (b)). This task seemed to drive the network to obtain global information regardless of what information to be included. There results suggest that the combination of the local and global tasks is crucial to draw typical development of visual attention.

P1-E-140 Attention in Infancy: Links to Childhood Executive Function and Reading Achievement

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Infant cognitive development provides a foundation for later cognition (Bornstein, 2014). Infant attention is a construct that is often assessed cognition in infancy because there is a well-established literature connecting infant looking behaviors to underlying attentional encoding capacities (Colombo, Freeseman, Coldren, & Frick, 1995), and individual differences in infant attention have been linked to later childhood cognition, such as executive functions (EF; Cuevas & Bell, 2014). EF are higher order cognitive control processes that allow for purposeful activities (Miyake et al. 2000), and are often associated with academic achievement (e.g., St Clair-Thompson & Gathercole, 2006). Little is known, however, of the connection between infant attention and academic achievement. We examined a potential meditational mechanism associating infant attention to middle childhood reading achievement through EF at multiple developmental time points. Data are from 156 children seen at 5 and 10 months, 3, 4, and 6 years. Children were part of an ongoing longitudinal study on individual differences in early cognitive development. Infants were full-term with no birth complications. Expectation-Maximation imputation was used to generate scores across the visits based on the 156 participants with completed reading achievement scores. Performance on all tasks measured before age 6 did not differ between those participants included in the final analyses and those not. Children were predominately Caucasian (74%) with highly education parents, 87% mothers and 74% of fathers completed some form of higher education. Attention at 5 months was measured using peak look duration during a brief video clip. EF at 10 months was measured using a looking version of the A-not-B task. EF at 3 years was measured using a composite of performance on a forward digit span task and performance on the incongruent condition of a day-night task. EF at 4 years was measured using a composite of performance on a forward digit span task and performance on a hand game inhibition task. EF at age 6 years was measured using a composite of performance on the backwards digit span task and performance on a number stroop task. Finally, reading achievement was measured using the letter-word identification subscale of the Woodcock Johnson Test of Achievement. Path Analysis was used to examine the mediating role of EF on the relation between infant attention and childhood reading achievement. The model fit was acceptable, $\chi 2$ (10, N=156) = 15.10, p =.128, RMSEA = .057, CFI= .945, and GFI = .971. All direct paths were significant ($p<.05$; see Figure 1). In terms of indirect paths, looking duration at 5 months displayed a significant negative indirect effect on EF at 3 years. The

other indirect pathways from infant attention were not significant, but were approaching significance (p=.06). All other indirect paths were significant (p<.05). Findings suggest that individual differences in infant attention may impact early EF abilities, which in turn impact reading achievement during middle childhood. This is the first study to examine a potential mechanism for the relation between infant attention and childhood academic achievement.

F: Cognitive Development

P1-F-141 Toddlers' false-belief understanding is consistent across non-elicited-response paradigms with similar task demands

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Infants and toddlers succeed in a variety of non-elicited-response false-belief tasks (Scott & Baillargeon, 2017). Yet the extent to which different non-elicited-response measures relate to each other across development remains unclear. In the only prior study to examine this question, infants' performance on looking-time and interactive helping false-belief tasks was not correlated (Poulin-Dubois & Yott, 2017), leading the authors to question whether young children truly possess a robust understanding of belief. However, this null finding might reflect the fact that looking-time and helping tasks impose different response demands. If so, then children should exhibit greater consistency across non-elicited-response measures with more comparable demands, such as two different looking-time paradigms. Here we tested this possibility by examining the relationship between 2.5-year-olds' performance on anticipatory-looking and preferential-looking false-belief tasks, administered approximately six months apart. At Time 1, children (Mean age = 29 months) completed an anticipatory-looking task. Children heard a false-belief story, accompanied by a video, in which Lucas and Jacob played hide-and-seek. Lucas peeked and saw Jacob hide in a tent (location counterbalanced). When Lucas closed his eyes, Jacob snuck under a table. Children then saw Lucas standing between the two locations and heard, "Ready or not! Here I come!" We measured children's looking time to each hiding location. If children represented Lucas' belief, then they should visually anticipate that Lucas would search in Jacob's original hiding location. At Time 2, children (Mean age = 35 months) completed the preferential-looking false-belief task from Scott and Roby (2015). Children heard a false-belief story, accompanied by a picture-book, in which Mia wanted to give her grandmother a cookie. She placed the cookie in a box (location counterbalanced); in her absence, her brother moved the cookie to a bag. Mia

then hurried in to grab Grandma's present; children did not see which container she selected. Finally, children saw two pictures: in one an unidentified individual carried the box, and in the other she carried the bag. Children heard, "There's Mia. She's carrying Grandma's present." We measured children's looking time to the two pictures. Given children's tendency to look at images that match sentences they hear (e.g., Scott et al., 2012), children should look at the person that they thought was Mia carrying Grandma's present. Because children never saw which container Mia selected, they had to infer which container she must have selected given her belief. Thus children who represented Mia's belief should look longer at the image of the person carrying the cookie's original container (i.e. the box). For each task, we calculated a difference score: looking time to belief-consistent location - looking time to belief-inconsistent location. Preliminary results indicate that after controlling for child age, difference scores on the two tasks were marginally positively correlated, $r = .44$, $p = .052$. These results are the first to demonstrate that young children's false-belief performance is consistent across paradigms with similar task demands. This finding casts doubt on the notion that non-elicited-response tasks do not assess a genuine, robust understanding of false belief.

P1-F-142 The Infant Social Relationship Questionnaire

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The relationship between social networks and social cognition has been studied widely in adolescents, adults, and primates. Previous studies exploring this relationship have measured network size as it relates to various social cognitive outcomes including changes in brain areas for adults and primates (Kanai et al., 201; Sallet et al., 2011) and how social network size mediates aversive mental health outcomes in adolescents (Frenkel et al., 2015). Limited work has studied infants' social networks; one study showed that infant network size was related to more social speech and fewer incomplete utterances (Salzinger & Hampson, 1988). However, most measures of social relationships only assess information about network size and lack detailed information about individual relationships. The intensity of infant social relationships can vary on different dimensions including the number and types of activities a person performs with an infant or how emotionally close an infant feels to a person. As yet, no study has explored how these factors vary across infant relationships or how different properties of infants' social networks could affect early social cognitive outcomes (i.e., how diversity of a social network could impact early social cognition). To examine these various dimensions, we

developed a new questionnaire: The Infant Social Relationship Questionnaire. The questionnaire has two main objectives: 1) to measure and quantify aspects of infants' social relationships and networks and 2) to explore whether these aspects vary across infant social relationships. Data was collected from 54 infants (Mean age = 22.7 months, range: 19.6-26.2 months). Through interview, parents were asked to describe their infant's "typical week" of activities. Parents reported infants' total waking hours and a list of people their infant sees regularly. Then, parents provided basic demographic information for each person in their infant's network and the following was computed for each relationship: the number of activities each person performs with the infant, how emotionally close the infant feels toward each person, the proportion of time the infant sees each person, and how many languages that person speaks. To see how these aspects of infants' social relationships vary, we performed a principle component analysis and considered 5 variables for each infant relationship: Emotional Closeness, Number of Activities, Proportion of Time, the overall Network Size each relationship belongs too, and Proportion of Language Diversity (how many different languages an infant hears) for each relationship. The analysis yielded 5 independent components, or linear combinations of the original variables, where the first 3 components accounted for 86% of the variance seen in infant social relationships (Figure 1). Correlations between the original variables and the components revealed that our variables account for 3 distinct parts of the variance present in infant social relationships: Emotional Closeness, Number of Activities, and Proportion of Time vary together and account for the same variance while Network Size and Proportion of Language Diversity in a Network each account for different variance seen in infant social relationships (Figure 2). Future work will examine how these aspects of social relationships map onto both social cognitive outcomes for infants. Additionally, we will explore variability in relationships across different demographic factors.

P1-F-143 Patterned Experience and Neurobehavioral Outcomes in Preterm Infants

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Objective: Although parents are encouraged to be present during their infants' neonatal intensive care unit (NICU) hospitalization, parental presence for significant portions of the day is uncommon in the US. Thus, professional caregivers - primarily nurses - need to provide care consistent with infants' developmental needs. The purpose of this analysis was to examine the effect of a patterned feeding experience (PFE) on neurobehavioral outcomes in preterm infants. Methods: Data were collected as part of a longitudinal

randomized control trial with two groups of preterm infants, one receiving PFE from the first gavage feeding through full oral feedings to discharge and one receiving usual feeding experience that did not include routine caregiver tactile exposure during gavage feedings. One-hundred twenty preterm infants (60/group) were enrolled during the first week of life; infants were included if they were ¡Ü 32 weeks at birth and parents provided informed written consent and excluded if they had known birth anomalies. Infants of both sexes and all ethnic and racial backgrounds were included. Infants in the intervention received tactile exposure with feedings beginning with the first gavage feeding, about 72 hours after birth. Infants in the usual care group did not receive the tactile intervention during feedings. Neurobehavior was measured using the Neurobehavioral Assessment of the Preterm Infant (NAPI), a standardized assessment of important preterm infant functions including motor development and vigor (MDV; assessing neurological maturity through infant responses to active and passive motor items) and alertness and orientation (AO; assessing social orientation, response to auditory and visual stimulation, and ability to maintain an alert state). The NAPI was administered at enrollment, transition to oral feeding, NICU discharge, and at 2 months corrected age (CA) at developmental follow-up clinic. Results: The analysis examined the effect of the tactile components of the intervention (intervention factors) delivered as a function of the type of feeding (gavage only, transition, or oral) on MDV and AO. Because the intervention factors were skewed, we categorized the factors into quartiles for analysis. All models controlled for gestational age of the infant and enrollment NAPI score to control for baseline differences across the intervention categories. Infants who received >75% tactile exposure during early gavage and were held >75% during transition feeds had higher standardized AO scores at 2 months CA; the same effect was not seen for MDV scores. Conclusions: NAPI MDV scores may not vary in response to interventions since motor reflexes comprise a major part of the NAPI motor domain and these reflexes develop endogenously regardless of prematurity. NAPI AO scores are more reflective of apparent brain development and show differences among degrees of prematurity. We recommend adoption of this low tech and inexpensive intervention in routine caregiving for hospitalized preterm infants, especially during gavage feedings, to help ameliorate future disabilities commonly seen in the high-risk preterm population.

P1-F-144 Processing of Spatial Information in Social and Non-Social Stimuli by Opioid-Exposed and Non-Exposed Newborns

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Over the last decade, use of prescription opioids such as morphine, hydrocodone, and oxycodone for pain has increased substantially (Guy et al., 2017). Moreover, there has been a large increase in licit and illicit opioid use among pregnant women. Opioids readily cross the blood-brain barrier and placenta; consequently, maternal opioid use during pregnancy is associated with an increased risk for a number of adverse neurobehavioral effects, including attention and behavioral problems at school age (Konijnenberg & Melinder, 2015). Therefore, it is more important than ever to examine the impact of prenatal opioid exposure on the development of the neonate. Research on both human children and animals converges to suggest that prenatal opioid exposure interferes with the development of cognitive functions, specifically, memory for spatial information and general attention (Wang & Han, 2009). However, very little research has examined the relationship between prenatal opioid exposure and the development of human infants' early cognitive functioning. The current study used a visual paired-comparison procedure to investigate whether prenatal opioid exposure is associated with neonates' processing of spatial information in social and non-social stimuli. Visual paired-comparison procedure/novelty preference scores have been used previously in at-risk populations (e.g., premature infants, infants exposed to PCB's) and the data were found to be reliable and associated with cognitive functioning and intelligence at later ages in those populations (Rose, Feldman, & Jankowski, 2002). Thirty-two non-exposed, full-term newborns (15 male; M = 37.23 hours old; SD = 15.34) and 32 full-term newborns prenatally exposed to opioids, but otherwise healthy, (17 male; M = 173.31 hours old; SD = 126.98) participated in this study. Infants were familiarized to an image until they accumulated 30s of looking. Then, they were tested on two brief test trials for preference between the familiar image and a novel image. Half of the infants were familiarized and tested with face stimuli while the other half were familiarized and tested with non-face stimuli (see Figure 1). An ANCOVA with exposure (non-exposed, opioid-exposed) and stimuli condition (face, non-face) as between-subjects variables and maternal SES, infant age, and infant head circumference as covariates was conducted on infants' novelty preference scores. The group difference between opioid-exposed and non-exposed infants was significant after statistically controlling for maternal SES, infant age and head circumference, $F(1, 57.92) = 6.35$, $p = .015$, partial eta = .10, see Figure 2). The main effect of stimulus condition and the interaction between opioid exposure and stimulus condition were non-significant after controlling for maternal SES, infant age, and head circumference. Thus, on average across stimulus conditions, non-exposed infants' novelty preference scores were greater than opioid-exposed infants' scores, after statistically controlling for maternal SES, infant age, and head circumference. These data suggest that

there is an association between prenatal opioid exposure and newborns' performance on spatial tasks.

P1-F-145 Infants Choice and Exploration of Objects in Plausible Events that Contradict Their Faulty Knowledge

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Infants are exceptional learners; they acquire rules about likely outcomes of physical events and revise these rules when events do not unfold as expected, allowing them to better predict outcomes in the future. At 7.5 months, infants acquire the proportion-of-contact rule for support events and expect an object to remain stable on top of a platform only when half or more of its bottom surface is supported on the platform. Infants responded with prolonged looking to plausible events in which a wide box remained balanced on a narrow platform when released (Wang, Zhang, & Baillargeon, 2016). At 8.5 months, they further acquire the position-of-contact rule, accounting for events where an object remains stable when less than 50% of its bottom surface is supported on a platform (i.e., being balanced on the platform). The present experiments examined 7.5- and 8.5-month-old infants' exploration of objects after they saw the objects violated their current expectation about support events. Building on previous evidence for surprised-induced exploration (Stahl & Feigenson, 2015), we hypothesized that infants would preferentially explore an object that violated the expectation even if it is a faulty one. Specifically, we predicted that infants would choose to explore first and spend more time exploring the "surprising" object. In Experiment 1, 7.5-month-old infants saw two pairs of support events; each pair included an unexpected and an expected event (Figure 1: Pair 1 and Pair 2), with the order of presentation counterbalanced across infants. In Pair 1, the middle 33% bottom surface of the box was supported; the box remained stationary when released (unexpected event for 7.5-month-olds) or when still held by a hand (expected event). In Pair 2, the right 33% bottom surface of the box was supported; the box remained stationary when released (unexpected) or when held (expected). Each pair of events was followed by an exploration trial in which infants were offered the two wide boxes used in the preceding events to explore. The boxes were placed wide apart, allowing infants to choose which one to explore first. Eleven out of 14 infants chose to explore first the box of the unexpected event on the first trial ($\chi 2(1) = 4.57$, $p < .05$) and across two exploration trials ($\chi 2(1) = 4.67$, $p < .05$). A paired sample t-test showed that, on average, infants spent significantly longer time acting on the box of the unexpected than the expected events,

t(14) = 2.16, p < .05. In Experiment 2, 8.5-month-olds saw Pair 2 and Pair 3 (see Figure 1). In Pair 3, a wide box remained stable when released, with its right 33% (unexpected) or its middle 33% (expected) bottom surface supported by a narrow platform. Converging evidence was obtained on 8.5-month-olds' preferential exploration of objects that violated their expectation of support events. Together, the results in the present experiments support that infants' expectation about objects and physical events, even when it is faulty (as with the 7.5-month-olds), guides infants' action to gather information from surprising objects to fill their current knowledge gap.

P1-F-147 Examining the Role of Categorization Training in Infants' Acquisition of Novel Animal-Sound Pairings

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The ability to form category-property links allows infants to generalize a given property to new category members. Previous research has demonstrated that 11-month-olds learnt and generalized animal-sound associations when familiarized with a single exemplar of two naturally occurring animal categories (e.g., a dog barking and a cat meowing; Vukatana et al., 2017), and novel animal-sound associations when familiarized with multiple exemplars, but not a single exemplar (Vukatana et al., 2015). Here, we asked whether orienting infants to the demands of the task, through categorization training, would facilitate infants' property extensions when familiarized with a single exemplar of a novel animal category. Across two studies, infants were trained with naturally occurring animals, and tested on their learning and generalization of novel-animal sound associations. In Study 1 (Figure 1), infants were initially trained with two naturally occurring animals each paired with their characteristic sound (e.g., a dog barking and a cat meowing). Following training, we familiarized 11-month-olds to two novel animals, each paired with a distinct novel sound (e.g., Animal1-Red- Sound1; Animal2-Purple-Sound2; n =35). Testing consisted of same and extension trials in a preferential looking paradigm. Same trials presented infants with the two familiarized animals side-by-side while one of the familiarized sounds playing (e.g., Animal1-Red and Animal2-Purple-Sound1). Extension trials consisted of a novel exemplar of each animal, accompanied by a familiarized sound (e.g., Animal1-Green and Animal2-Yellow - Sound2). Infants' performance did not differ from chance on either same (M = .49) or extension (M = .49) trials, indicating that they did not acquire the original animal-sound pairings nor extend the sound to new members of the same categories. In Study 2 (Figure 2), we reduced the

demands of the tasks and integrated the training trials throughout the familiarization phase. That is, we reduced the number of novel animal-sound pairings presented to infants to one (e.g., only Animal 1 - Red - Sound 1) and we also presented a naturally occurring animal-sound association (e.g., Dog - Black - Barking) throughout familiarization (n=19). Testing trials were similar to those in Study 1, and consisted of two Same and two Extension trials. Each participant was presented with one Same and one Extension trial where the novel animal, and naturally occurring animal were the target. Infants' performance did not differ from chance on either Novel Same (M = .52), Novel Extension (M = .44), Naturally Occurring Same (M = .51) or Naturally Occurring Extension (M = .50) trials. Thus, infants did not learn or generalize the animal-sound associations for either the novel animal category, or the naturally occurring animal category. Together, our findings suggest that at 11-months of age, categorization training does not facilitate infants' ability to learn or generalize a novel animal-sound association, when familiarized with a single exemplar. Furthermore, the results of Study 2 indicate that the demands of learning a novel animal-sound association may have disrupted infants' associations of naturally occurring animals and their characteristic sound properties.

P1-F-148 Infants Individuate Objects with Distinct Prior Event Roles

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Findings from many studies have shown that young infants can use various types of categorical descriptors (e.g., ontological, linguistic, and functional) to individuate objects. Thus, after watching two categorically-distinct objects emerge in alternation from behind a screen, infants detect a violation if the screen is lowered to reveal only one of the objects. Here we examined whether infants might be able to use another type of categorical descriptors, event roles, to individuate objects. In Experiment 1, 13-month-olds were assigned to a different-objects or a same-object condition. Infants in the different-objects condition received a test trial in which two cylinders that differed only in pattern and color (one orange and striped; the other blue and starred) emerged in alternation from behind a screen. Next, the screen was lowered to reveal only one cylinder (prior research indicated that infants this age do not correctly individuate two objects that differ only in their featural properties). Prior to the test trial, however, infants received two familiarization trials in which the cylinders played distinct roles in support events. In one trial, one cylinder (e.g., the orange one) was placed on top of a star-shaped box and thus played the supportee role. In the other trial, a rectangular box was placed on top of the other cylinder

(e.g., the blue one) and thus played the support role. Of interest was whether infants would use these distinct prior roles -supportee, support--to individuate the two cylinders in test. Infants in the same-object condition received similar familiarization trials except that the same cylinder (e.g., the orange one) emerged on either side of the screen in test. When the screen was lowered to reveal only one cylinder, infants in the different-objects condition looked significantly longer than did infants in the same-object condition, suggesting that they could use the cylinders' distinct prior event roles to individuate them. In control Experiment 2, both cylinders played identical roles (e.g., both served as supports for their respective boxes) in the familiarization trials, and infants in the different-objects and same-object conditions now looked equally at the final display. Experiment 3 examined whether infants could individuate the two cylinders if they played similar but successive roles relative to the same box (e.g., the orange cylinder served as a support for the star-shaped box in the first familiarization trial, and then the blue cylinder did so in the second familiarization trial). As in Experiment 1, infants in the different-objects condition looked significantly longer at the final display than did infants in the same-object condition, suggesting that they were able to use the cylinders' successive event roles to individuate them. Our results thus show that 13-month-old infants can successfully individuate two objects that differ only in their featural properties if the objects serve distinct roles in previous events (e.g., supportee vs. support, or first to support an object vs. last to support that object). These results add to a growing body of findings that highlight the crucial role of categorical information in infants' event representations.

P1-F-149 Adoptees Psychological Adjustment and Parental Multicultural Competency in Ethiopian Adoptive Families

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Multicultural competency among cross-cultural adoptive families starts with parents' cultural awareness, knowledge and skills, proceeds in and through their parenting, and is revealed in the general formation of their family system. Based on this conceptualization, this study examined the relationship between psychological adjustment and multicultural parenting competence in Ethiopian adoptive families. Participants included 25 American parents who adopted a total of 35 Ethiopian children. Adoptive parents completed an online survey concerning their own adjustment to adoption and their own multicultural competence; they also reported on their adopted children's psychological adjustment by

completing the Child Behavioral Check List (Achenbach & Rescorla, 2000). The correlational analyses of the study show that perception of lower level of adoptee's adjustment problems was found to be related to higher levels of parental cultural competency. Results highlight the importance of parental cultural competency in building positive relationships between adoptees and their adoptive families.

P1-F-150 Electrophysiological Evidence for the Emerging Sense of Agency in Early Infancy

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The emergence of a sense of agency is a crucial milestone of early cognitive development. Experiencing a sense of agency implies having a causal model of one's actions and their consequences. In the current experiment, we tested whether infants can build a model of causal action-effect relations as shown by their ability to predict the consequences of their actions. To this end, we used the mobile paradigm in which an infant's limb is tethered to an overhead mobile such that when the infant moves a movement of the mobile is triggered. We focused on indicators of a violation of their expectation when the action-effect ceased to exist. We hypothesized that if infants built a causal model, we would observe a violation of expectation in the form of a mismatch negativity (MMN; Garrido, Kilner, Stephan & Friston, 2009) event-related potential (ERP) locked to the moment that the infant would expect the omitted effect. Moreover, we expected to find an extinction burst. i.e., an additional increase in movement frequency after the action-effect contingency was discontinued. Recent research suggests that such an extinction burst may serve as a behavioral indicator of a sense of agency (Zaadnoordijk, Otworowska, Kwisthout, Hunnius & van Rooij, 2016). Three- to 4.5-month-old infants were tested in a computerized version of the mobile paradigm during which we recorded neural (EEG) and movement measures. As a group, infants (N=22) did not show a significant MMN following the omission of the effect ($t(21)=-1.05$, $p=.85$, one-tailed). Based on previous research into mismatch negativity responses in this age group (Trainor et al., 2003), we split the infants into two groups based on the direction of the deflection of the mean amplitude. Only the negative deflection group displayed the morphology of an ERP within the time window of interest, suggesting a violation of expectation. The positive deflection group did not show an ERP at all, indicating no violation of expectation (Figure 1). We then examined the behavioral patterns (N=40), which showed a significant linear increase

of movement frequency over time when the effect followed the action (B=0.64, SE=0.20, t(199.41)=3.30 p<.01) and a significant quadratic curve in the movement frequency, i.e., an extinction burst, when the effect was omitted (B=-0.20, SE=0.10, t(493.87)=-2.00, p=.05). Crucially, the group of infants who showed an MMN displayed significantly more limb specificity during the extinction burst -- i.e., the extinction burst was more pronounced for the arm that triggered the effect -- than the other group (B=4.65, SE</I>=0.98, t(1203.40)=4.75, p<.001; see Figure 1). These data suggest that the infants who experienced a violation of expectation were also those with a better model of which limb caused the effect. Moreover, a marginally significant effect (B=0.24, SE=0.13, t(472.45)=1.88, p=.06) was observed in the steepness of increase in movement frequency when the action was followed by an effect. Our neurobehavioral analyses demonstrate that 3- to 4.5-month-old infants are starting to accurately detect the causal relation between their actions and the consequences. As such, we provide the first electrophysiological evidence of the emergence of a sense of agency.

P1-F-151 Did you expect that? 12-month-olds discriminate familiar and unusual action outcomes without context information

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Imitation is an important social learning mechanism for young infants exploring the world (Jones, 2009). Interestingly, infants do not imitate every action they observe. Fourteen-month-olds predominantly imitated an unusual and unexpected action (turning on a lamp with one's forehead) when the model's hands were free compared to when the model's hands were occupied (Gergely et al., 2002). There are many different theoretical explanations for selective imitation differing with regard to the assumed level of infants' cognitive abilities. However, only one past study has investigated neural correlates of infants' underlying action understanding using event-related potentials (ERPs; Langeloh et al., in preparation). In this study, 12- to 14-month-olds allocated increased attention towards an unusual action (head touch) compared to a familiar action (hand touch) indicated by increased Negative Central (Nc) amplitude and an N400-like component in response to the unexpected action outcome indicating violation of semantic expectation. Importantly, in this study infants received information on action context and action initiation before observing action outcomes. In the present ERP study, we further explored

neural mechanisms underlying infants' selective imitation: We aimed to investigate whether 12-month-olds need information on action context and action initiation to evaluate action outcomes semantically. Thus, we only presented pictures depicting action outcomes (hand touch vs. head touch). Twelve-month-old infants (N = 20, 10 girls, Mage = 12 months 10 days, data collection is ongoing) watched action outcomes of adult models either touching an object with their head or with their hand (Figure 1). We assumed that infants hold expectations on how a person normally touches an object leading to violation of expectation (VOE) in response to the unusual head touch. Comparable to our previous study, analyses revealed an increased Nc amplitude (400-600 ms) across an average of central channels (C3,Cz,C4) in response to the head touch (M = -18.13µV, SD = 11.18) compared to the hand touch (M = -11.88µV, SD = 12.10), t(19) = -2.667, p = .015, d = 0.62 (Figure 2). Thus, infants discriminated head and hand outcomes with differences in the allocation of attention. The increased Nc for the unexpected action outcome may illustrate an orienting response reflecting mismatch detection. However, we did not observe an N400-like component. This is in line with the fact that no semantic expectation could be built up as we only presented action outcomes and no context information. In sum, neural correlates indicating VOE on a semantic level were not found in this study when only presenting photos of action conclusions. However, we showed that the observation of an unusual action outcome increases attention. These differences in attentional processing between action outcomes might have influenced imitative behavior in previous studies. For a broader developmental perspective, results will be embedded in our previous research with different age groups (9- and 12- to 14-month-olds) and theoretical implications will be discussed accordingly.

P1-F-152 The Early Childhood Inhibitory Touchscreen Task: A New Measure of Inhibitory Control for Toddlers

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Despite inhibitory control (IC) skills being found in children as young as 3 years of age, research into the earliest development of IC in the toddler years has been limited by a lack of suitable tasks. Tasks used to assess IC in early childhood typically differ substantially in design at each age, making comparisons problematic, and many have high working memory and language demands, making them too difficult for toddlers. A simple

measure of inhibitory control that remains structurally similar across age is therefore needed. The current study was a first investigation of the newly-developed Early Childhood Inhibitory Touchscreen Task (ECITT). ECITT is a simple response inhibition task that is easy for toddlers to understand. Participants are presented with two blue buttons on a tablet computer; one of the buttons has a smiley on it. The instruction is simply: "Press the happy face". The smiley is in one location (e.g., at the top of the screen) on 75% of trials (prepotent condition) and in the other location (e.g., at the bottom of the screen) on 25% of trials (inhibitory condition). The hypothesis is that inhibitory control is needed to overcome the more habitual response when the smiley is in the less frequent location. A version specifically developed for toddlers includes small animations as a reward for correct responses. The task is illustrated in Fig. 1. In two independent samples, we investigated the validity of this new task. In Study 1, 2-year-olds (N = 14), 2.5-year-olds (N = 40), 6-9-year-olds (N = 27), young adults (18-30 years, N = 17) and older adults (> 60 years, N = 20) performed the task in a controlled lab-based setting. As predicted, children committed more errors in the inhibitory condition compared to adults, and toddlers performed particularly poorly in terms of inhibitory control, despite maintaining high accuracy on the prepotent trials, see Fig. 2. We also found a significant correlation between performance on ECITT and performance on a classic IC task, the Stop-signal task (Logan & Cowan, 1984), in older children and adults ($r = .34$, $p < .01$, controlling for age), indicating that participants who took longer to respond to the stop-signal made more errors on inhibitory, relative to prepotent, trials in ECITT. This evidence supports ECITT as an inhibitory control task. Study 2 involved testing participants of all ages in a more naturalistic setting - at public engagement events. One hundred and twenty-one participants ranging in age from 17 months to 71 years were tested on a single block of ECITT (32 trials). Results demonstrated a main effect of condition across ages, but toddlers and young children (17 - 45 months) performed significantly poorer on inhibitory trials relative to prepotent trials compared to older children and adults (all ps < .05), replicating the effects found in Study 1. These findings suggest that ECITT not only measures inhibitory control across childhood and adulthood, but also extends the assessment of this key cognitive function into toddlerhood.

P1-F-153 Socioeconomic Status and Cognitive Development in Infancy

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It has been proposed that effortful control mediates a wide range of negative outcomes associated with low-socioeconomic status (SES; Lengua, 2012). One critical component of effortful control is attentional control which has been found to vary systematically across individuals within the first three months of life (Libertus & Needham, 2014). However, it is unknown whether SES relates to attentional control early in life. We address this issue in the current study. Retrospective data analyses were conducted to first determine if the face/object preference paradigm is sensitive to differences in attentional control pertaining to SES, and second to determine if the relationship between SES and attentional control extends to preferences between multiple social stimuli. In Experiment 1, thirty-five 6.5-month-old infants (M = 195.97 days, SD = 8.32) were presented with displays containing a face on one side and an object on the other. Displaying a face over object preference requires inhibiting attention to the object (more salient based on bottom-up image processing) to attend to the face (more salient based on top-down processes). A moderate to large positive association was found between estimated family income and infants face preference scores, $r\ (33) = .41$, $p = .01$. Furthermore, the mean estimated family income for infants displaying a face preference was approximately $20,000 higher than that of the infants who displayed an object preference, $t(33) = 2.85$, $p = .007$, $d = 1.02$, see figure 1. The results of this experiment demonstrate that SES is associated with individual differences in attentional control early in life. In Experiment 2, we examined whether the association between SES and cognitive performance observed in Experiment 1 generalized to preferences within social stimuli. The increased sample size in this study also allowed us to control for the effects of race, gender, and age. One hundred and twenty six infants at 3.5 (n = 53; M = 102.11 days, SD = 7.97), 5 (n = 27; M = 149.41 days, SD = 4.93), or 6.5 (n = 46; M = 195.02 days, SD = 7.87) months of age completed an intermodal matching task in which two images of bodies, one happy one angry, were presented simultaneously on the screen while a happy or angry vocalization played. The dependent measure was the proportion of time the infants attended to the body that matched the vocalization that was playing. Estimated family income was found to significantly predict infants' matching scores above and beyond the effects of age, gender and race, $\beta = .19$, $t(115) = 2.01$, $p < .05$, see table 1. The results of Experiment 2 not only document SES related deficits in attentional control in the context of a more complex situation, namely a choice between social stimuli, but also suggest that such deficits may be manifesting as early as 3.5 months of age. The results of these experiments add to our understanding of the emergence of attentional control deficits related to SES, and theory suggests that such deficits have significant implications for future developmental outcomes (Lengua, 2012).

P1-F-154 Infants recognize the counting routine as numerically relevant

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Children typically start reciting their language's count sequence at around age 2.5. Initially these counting words are meaningless; it takes several years for children to gradually learn their meanings (Wynn, 1992). By around 4, children have mapped count words to approximate quantities (e.g., knowing that "nine" is more than "five" even before knowing these words' precise meanings). However, before children can map specific number words to the corresponding numerical representations, they must first identify both of them are relevant to quantities. When do children first recognize that counting is "about" quantities? Here in 5 experiments we asked whether, long before learning the meanings of number words, infants recognize the counting routine as numerically relevant. We used a manual search task that has been shown by many previous studies to fail to evoke approximate numerical representations. Our question was whether adding counting to the task would trigger infants to deploy their approximate number representations. If so, this would suggest that the counting sequence already has been identified with numerical content, long before children fully understand how counting works. We measured 18-month-old infants' ability to concurrently represent four objects hidden in a box. In previous studies with this task, infants successfully represent one, two, and three hidden objects, but not four (e.g., Barner et al., 2007). In Experiment 1, before objects were hidden infants either saw them individually labelled without counting ("this", "this", "this", "this"), or saw objects counted ("one", "two", "three", "four"). We found that infants failed to remember four objects in the no-counting condition, and succeeded in the counting condition (all results in Figure 1). Next we asked whether infants' familiarity with specific count words was required for them to benefit from counting. In Experiment 2 we found that infants remembered the four-object arrays even after observing counting in an unfamiliar language (German: "eins, zwei, drei, vier"). However, Experiment 3 revealed that infants' counting benefit required count words to obey standard counting principles including stable ordering (Gelman & Gallistel, 1978)-- infants did not benefit from observing scrambled English counting prior to object hiding. Lastly we asked whether counting helps infants form precise representations of the individual objects in the array, or whether it instead encourages infants represent the array's approximate cardinality. In Experiment 4 we found that when four counted objects were hidden and infants retrieved three of them, they failed to continue searching for the missing object. In Experiment 5 we found that when six counted objects were hidden and infants retrieved four of them, they successfully continued searching for the missing objects. That infants' performance

was ratio-driven (success with 6:4 and 4:2 objects, failure with 4:3 objects) suggests that observing counting did not increase infants' ability to remember each of the precise individuals in the hiding array, but instead allowed them to represent the array's approximate cardinality. Together, these results show that observing counting encouraged infants to represent the numeric properties of an array. Hence 18-month old infants already recognize counting as numerically relevant.

P1-F-155 All for one and one for all: A Free Operant Test of the Ideal Free Distribution in Preschoolers

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Ideal free distribution (IDF) theory predicts the behavior of groups of foragers when presented with reward potential (Fretwell & Lucas, 1970). IDF asserts that the number of individuals in two different reward areas is proportional to the amount of reward distributed in each area, a strategy that under certain conditions, will maximize maximize reward at the group level. Harper (1982) tested mallard ducks in a naturalistic setting by offering food morsels at different rates at two different locations on a pond. As predicted by the IDF, the number of ducks at each location was proportional to the amount of food being distributed. Madden et al. (2002) tested human adults in an analogous free-operant procedure, and found they also distributed themselves in proportion to the amount of reward available at two different sites. We explored whether the IDF also characterizes group foraging behavior early in human development by testing young children (2.5-5 years) in a free operant foraging procedure. Sixteen children (5 male) participated in procedure modeled after Madden et al.'s (2002) task. Participants moved freely inside a testing area divided into two colored end zones (red and yellow, each 4ft x 9ft), separated by a blue neutral zone (2ft x 9ft). Computers in each zone signaled a reward at various rates (1:1, 2:1, or 5:1, twice each in separate testing sessions) on a variable interval schedule. Twenty pennies were divided amongst all participants within a zone whenever its bell rang. The color (red or yellow) representing the "rich" and "lean" zones was counterbalanced across sessions. As motivation to maximize reward, the child with the most pennies at each session's end won a prize. Video recorded sessions were sampled every 10 sec (6 samples/min) to determine the number of children in each zone (Red, Yellow, and Blue/Neutral). Figure 1 shows the observed proportion of participants in Red to the total number of participants minus those in the neutral zone (Red + Yellow - Blue) against the expected ratio. In all sessions, observed ratios stabilized near the expected

ratio predicted by the IDF. In Figure 2, the ratio of the average number of participants (NYellow/NRed) was plotted against the observed reward ratio for each zone (RYellow/RRed). The line of best fit had a regression coefficient of 0.93, confirming that children's group behavior conformed to IDF, which predicts a slope of 1 and an intercept of 0. Interestingly, individual children generally did not themselves exhibit matching behavior. On average, only 13%, 31%, and 46% of children matched reward ratios in 1:1, 2:1, and 5:1 sessions, respectively. And, only 2/16 children showed matching in >50% of sessions, suggesting the group level behavior was not a mere reflection of individual matching (Herrnstein, 1961). These data suggest that the IDF characterizes group foraging behavior even early in human development, and that the ability for group members to distribute themselves according to the IDF is an emergent, group-level phenomenon. These findings have implications for understanding the mechanisms underlying cooperative group behavior and the development of social cognition, more generally.

P1-F-156 Cumulative prenatal risk and physical aggression during the first years of life: the role of inhibitory control

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Abstract Objectives. Several maternal risk factors have consistently been related to the development of physical aggression in toddlerhood (Carneiro, Dias & Soares, 2016), such as low socioeconomic status (Garratt, Chandola, Purdam & Wood, 2017) and substance use during pregnancy (LaGasse et al., 2012). It has been suggested that suboptimal cognitive development, such as a lack of inhibitory control, might explain associations between risk and physical aggression (Hughes and Ensor, 2008). This study examined whether inhibitory control mediated the relation between prenatal cumulative risk and aggression in a sample of toddlers. As previous research has shown that girls have better inhibitory control and show less aggression compared to boys, it was also examined whether gender moderated the possible mediation effect of inhibitory control (as shown in Figure 1). Methods. The sample consisted of 161 mother-child dyads (83 boys, 78 girls). A cumulative maternal risk score was created by summing a number of well-established risk factors present during pregnancy (World Health Organization, 2005). At 12 months, child's inhibitory control was measured using an adapted version of the Don't task (Kochanska & Aksan 1995; Kochanska, Tjebkes & Forman, 1998). Mother was instructed to prohibit her child from touching an attractive toy, using words and sentences she would

also use in daily settings. Physical aggression was assessed through maternal reports using the Physical Aggression Scale for Early Childhood (PASEC; Alink et al., 2006) at 12 and 20 months of age. Results. Results showed that higher cumulative prenatal risk was associated with more physical aggression in young children. In addition, inhibitory control mediated this association at both 12 and 20 months: higher cumulative risk was related to lower inhibitory control, which in turn led to higher levels of physical aggression. At 20 months, gender moderated the mediation effect: the mediating role of inhibitory control in the risk-aggression relation was only found for girls, not for boys. Conclusion These results suggest that even before two years of age, inhibitory control is an important construct involved in the relation between prenatal cumulative risk and physical aggression. Because girls develop inhibitory control earlier than boys, inhibitory control may be particularly important for girls in relation to aggression during toddlerhood. The results of this study implicate that interventions aimed to reduce aggressive behavior should focus on both maternal factors, as well as child's inhibitory control, since both levels are important constructs related to physical aggression.

P1-F-157 Abstract Representations in the Infant Brain

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As humans, our daily inner life consists in constantly forming and manipulating abstract mental representations. Those everyday computations are highly supported by the use of various symbolic systems such as language, mathematics or music in which an arbitrary signal can stand for a given concept. However, it remains poorly understood whether very young infants, well before language proficiency, readily demonstrate similar abilities for re-describing their environment into mental representations, encoded as variables that are available for further mental operations. We explored 5-month-olds' abilities for building and concurrently monitoring several abstract representations. We used a pairing task in order to test the encoding of abstract auditory patterns (AAB, ABA or ABB) as stable mental representations. Infants were first presented with tri-syllabic words instantiating two of the three repetition-based patterns, and each pattern was systematically followed by a specific arbitrary sensory label 1 second later. Infants were thereafter introduced to some incongruent pairings while they were recorded with high-density electroencephalography (EEG). Classical event-related potentials (ERP) comparing brain responses to the congruent and incongruent visual labels revealed a late surprise response elicited by incongruent pairings. A frequency tagging approach additionally

revealed that early visual activations to the label were also modulated by pattern-label congruency, with stronger activity in response to congruent pairings. Finally, inspection of the silent period between the tri-syllabic word and the following label revealed the build-up of anticipatory activity before the occurrence of the label. Altogether, these three neural responses demonstrate that abstract patterns can be captured by the infant brain and encoded as unitary mental representations, which could be paired with the following label. These results also evidenced a sophisticated series of neural computations, showing that, although still immature, the infant brain relies on a vast network of connections to process and transfer complex representations between remote brain modules.

P1-F-158 Do Infants Understand Moral Obligations?

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Recent research indicates that infants expect individuals to help ingroup members in need of instrumental assistance: They detect a violation when an individual chooses to ignore, as opposed to help, an ingroup member. In contrast, infants hold no particular expectation about whether individuals should help outgroup members: They tend to look equally whether an individual chooses to help, ignore, or hinder an outgroup member. These results raise important questions concerning the nature of infants' expectation about the provision of help to ingroup members. One hypothesis is that this expectation simply reflects a behavioral regularity infants have detected in their social environments (regularity view). Another hypothesis is that this expectation stems from infants' belief that individuals have a moral obligation or duty to help ingroup members in need (obligation view). To evaluate these two hypotheses, we showed infants two scenarios in which a character needed instrumental assistance and was helped in exactly the same way by either an ingroup or an outgroup helper. Next, infants received a preferential-looking trial in which the two helpers stood side by side, and infants' looking times at each helper were measured. Evidence that infants preferred the outgroup helper would be difficult for the regularity view to explain, but would be easy for the obligation view to explain. Specifically, infants could reason that the outgroup helper was not obligated to help, so her action revealed a kind disposition, whereas the ingroup helper was obligated to help, so her action yielded little information about her disposition. In our first experiment, 18-month-olds were first introduced to two groups of animated puppets, frogs (F1, F2) and owls (O1, O2). Next, one of the puppets (e.g., F2) stacked discs to build a tower, while the other puppets watched. Infants then received two test trials. In the ingroup-helps event,

only F2 was present initially and she again began to build her tower. Midway through, she was joined by F1. When F2 couldn't reach the last disc for her tower, F1 helped her by bringing the disc closer. The outgroup-helps event was identical except that O1 joined and helped F2. In the preferential-looking trial, F1 and O1 tilted briefly while an experimenter said "Watch this!" to draw infants' attention, then both puppets paused. Infants' preferential looking behavior toward F1 and O1 was coded offline. Confirming prior results, infants looked equally at the ingroup- and outgroup-helps events. Nevertheless, infants looked significantly longer at the outgroup than at the ingroup helper, suggesting a preference for the helper who performed a supererogatory act over a helper who performed a dutiful act. A control experiment provided additional support for this conclusion: When F2 did not need help in the test trials and F1 and O1 simply greeted her, infants did not look preferentially at the outgroup protagonist. Together, these results suggest that infants do perceive helping ingroup members in need as a moral obligation. Moreover, they distinguish between supererogatory and dutiful actions, and prefer individuals who perform the former over the latter.

P1-F-159 Cortisol reactivity to stress is negatively associated with development and adaptive behavior in healthy infants

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From childhood to late adulthood, modulation of stress reactivity has a task-dependent impact on cognition. Furthermore, in infants, exposure to stress has been shown to affect behavioral flexibility (Seehagen et al., 2015). Although both a facilitating and impairing influence of stress reactivity on aspects of general and adaptive functioning has been documented in school-aged children (Boyce & Ellis, 2005; Obradović et al., 2010; Sandi, 2013), the effect of stress reactivity on general cognition and adaptive behaviour in infants is less documented. The aim of our study was to examine the link between stress reactivity and day-to-day functioning in infants. We hypothesized that stress reactivity is negatively associated with development and adaptive behavior. Twenty-two infants (12 males) between the ages of 6 and 28 months were evaluated. Stress reactivity was measured through free salivary cortisol in response to a stressor (i.e. electrode placement for an electroencephalography exam). Saliva samples were collected before arriving in the exam room (M = 7.47 mins before the stressor), and 20 and 45 mins after the stressor. Cortisol levels were determined by radioimmunoassay and stress reactivity was assessed by

calculating the area under the curve with respect to ground. Developmental domains (i.e. cognition, language, motor) were assessed using the Bayley Scales of Infant and Toddler Development, Third Edition during the same visit, but following cortisol recovery (i.e. over 45 mins after the stressor). Day-to-day adaptive behaviors were assessed using the Adaptive Behavior Assessment System, Second Edition, completed by the mother. Pearson bivariate correlation coefficients were computed to assess the relationship between salivary cortisol reactivity to stress, and developmental scaled scores and adaptive behavior composite scores. Significant negative correlations were found between free salivary cortisol and scores in three developmental domains, being receptive language [r=-.429, n= 22, p=0.046], gross [r=-.447, n= 22, p=0.037] and fine motor skills [r=-.478, n= 22, p=0.025]. Negative relationships were also found with all domains of adaptive behavior. Indeed, there were significant correlations between free salivary cortisol and scores in the general domain [r=-.701, n= 19, p=0.001], the conceptual domain [r=-.552, n= 18, p=0.018], the social domain [r=-.616, n= 18, p=0.006] and the practical domain [r=-.820, n= 15, p=0.0001]. Our results suggest that, in healthy infants, higher levels of cortisol reactivity to stress is associated with poorer receptive language and motor skills, and with the presence of less adaptive behavior in all domains. Despite some limitations to our study, such as a small sample size which could have led to false negatives and rendered us unable to look at potential covariates (e.g. gender), our results are an important addition to a strong body of literature supporting the impact of stress reactivity on general functioning later in the lifespan. Importantly, we show that relations between development or adaptation and exaggerated stress reactivity are observable early on in childhood. As both development and adaptive behavior are the base of infants coping with demands in their environment, early childhood interventions on stress reactivity should be investigated in future studies.

P1-F-160 The role of disjunctive inferences in search: a gaze-contingent paradigm with 10-month-old infants

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Studies exploring search strategies in preschoolers suggested that in the process of eliminating possible locations they proceed deductively representing the available choice alternatives in terms of disjunctions (A or B, not A, therefore B). In a comparative study involving preschool-aged children and dogs, Watson et al. (2001) proposed that these abilities are present only in children: when a target item was hidden in one of three

possible locations the searching time decreased as alternatives were eliminated, specially it was the shortest when children could infer the location of a target with certainty. In contrast, however, dogs displayed a prolonged searching time as they progressed from one alternative to the other. Disjunctions endowed children to represent a set of mutually exclusive possibilities and determine the valid inferences that can be performed when alternatives are eliminated. Thus, the search-time pattern observed in preschool-aged children (specifically, that the more choice alternative were eliminated the faster the search became) could be considered as a marker of disjunctive inferences. It is not yet known, however, whether logical connectives are available early in development. According to one possibility, in order to reason deductively children need first to master the verbal representation of logical connectives. According to another possibility such abilities might not depend on language and might be present already in pre-linguistic thought. In order to disentangle between these scenarios we tested pre-linguistic infants and explored whether they possess the representational resources to reason using disjunctive syllogisms. To address this question, in our main experiment we developed an interactive eye-tracking paradigm involving 10-month-old infants. We measured whether their searching behavior (as reflected by their eye movements) would reflect similar patterns as the manual search observed in preschoolers. In Experiment 1 the participants saw tree cups on a computer screen positioned at equal distance from each other. Infants could verify the content of a cup by looking at the corresponding region of interest (i.e. cup A, B and C). In each trial one of the cups contained an interesting object while the others were empty. The study was designed in such a way that at each stage of verification they had equal chance to find the rewarding object. Infants could verify the cups one by one and a trial ended if the target object was found. Of special interest were those trials where infants needed to verify all tree possibilities in order to identify the final location of the object. We collected the temporal parameters of this search process, specifically we measured the speed of the gaze-shift from one location to the other. In contrast to preschool-aged children, 10-month-old infants were slower in verifying a third possibility in comparison to the time needed to check the preceding locations (even though the third location contained the object with 100% certainty). Experiment 2 and 3 tested the role of two training interventions in order to minimize instances of redundant search. This training protocol affected the latency of verification but did not match a pattern produced by preschoolers.

P1-F-161 Infants' belief congruent anticipatory looks are not due to memory interference processes

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Several studies on anticipatory looks suggest that, by the second year, infants can reason about others' false beliefs (see Gliga et al., 2014; Grosse Wiesmann et al., 2016; Low, 2010; Meristo et al., 2012; Senju et al., 2011; Surian & Geraci, 2012; Thoermer et al., 2012; Wang & Leslie, 2016). However, Heyes (2014) argued that these findings may be due to retroactive interference memory processes. In three experiments, here we take up this challenge and investigate the domain-specificity of mechanisms underpinning looking behavior in 15- and 20-month-olds. Participants were presented with animation events in which an agent, or a hand holding an inert triangle, followed a disk through an inverted Y-shaped tube (similar to Surian & Geraci, 2012). In familiarization events, the disk moved through the tube, going in and out. Participants were then tested in the Agent or the Inert object condition (see Figure 1). In the Agent condition, an Agent-triangle chased the disk in the upper part of the screen. Then, the disk moved through the tube and hided in a box positioned at the end of one of the two lower exit points, while the main character remained above, 'looking' at the motion of the disk. The character then left the scene, and the disk moved to another box, located at the opposite side. Finally, the character entered again the scene and it went into the tube. Participants' anticipatory looks were recorded using a Tobii eye-tracker. In the Inert object condition, the Agent-triangle was replaced by a hand holding an inert triangle. The familiarization phase was identical to the other condition, whereas in the test phase the hand dropped the inert triangle into the tube. Infants at 20 months showed anticipatory looking times that were consistent with a rich, domain-specific account of the underpinning processes: they looked longer at belief congruent locations in the Agent condition ($p = 0.012$, two tails), but they looked equally long at the two locations in the Inert object control condition. Younger infants looked equally long at belief congruent and incongruent locations. Converging results were also found when we looked at the number of first anticipatory looks. Overall, these results help to make sense of previous findings in the literature on early false belief understanding. They are difficult to explain away with reference to domain general memory limitations, as proposed by Heyes, and support the idea that, by 20 months, infants possess a metarepresentational competence that guides their anticipatory looks.

P1-F-162 Infants' fine motor skills predict children's spatial and math skill performance at age 5

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Children's early spatial skills are foundational to later STEM performance and participation in STEM disciplines. By 1st grade children vary substantially in these skills and differences persist over time, sparking questions about the sources of individual differences in infancy. When in development do individual differences emerge? Are spatial skills in infancy measurable? Are they stable into childhood? We focused on 2-year old infants' fine motor spatial actions--those that required infants to spatially manipulate and adjust the orientations of their hands and objects to complete a task. We asked whether these early object-directed actions contribute to later differences in STEM-related performance. Infants' ability to apply fine motor skills to small objects with accuracy may be an important indicator of early spatial skill. Children were longitudinally followed to 5 years of age, when they were tested on a battery of cognitive measures (math, spatial, and literacy). We hypothesized that infant fine-motor spatial skills would predict later math and spatial performance, but not literacy outcomes. Participants were 157 toddlers (51% female) (M = 24.63 mos, SD = 2.29) from diverse ethnic backgrounds (Mexican, Dominican, African American) in a large, densely populated urban area, who were tested in their homes on problems that required infants to carry out and/or imitate sequences of fine-motor actions to complete spatial tasks. All problems used a set of small, standard toys and common objects. For example, infants were prompted to place pennies into slots of different orientations, stack blocks, build towers, screw and unscrew nuts and bolts, and string beads. Materials and items were drawn from the Mullen Scales of Early Learning (Mullen, 1995). At age 5, participants completed the WPPSI Block Design (Wechsler, 2002) and the Applied Problems and Letter-Word Identification subtests of the Woodcock Johnson (Woodcock et al., 2007) to assess spatial cognition, math ability, and early literacy skills, respectively. Analyses controlled for infant age at assessment, sex, infant expressive vocabulary, age 5 expressive vocabulary, PreK attendance, and maternal years of education. Infants varied substantially in their performance on spatial items, ranging from 16 to 31 correct. Notably, individual differences revealed specificity in associations over time (Table 1). As hypothesized, fine-motor spatial skills in infancy predicted spatial and math performance at age 5 years, but not later literacy performance. In ongoing analyses we are investigating the precise fine-motor spatial problems that are most predictive of later STEM performance, and examining the sources of variation in those skills by coding infants' toys and play activities at home (e.g., access to nesting cups, puzzles, blocks, shape-sorters, and so forth).

P1-F-163 Acquiring a proper name via the speaker's false belief

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Proper names pick out particular individuals and are learned through specific acts of labeling. Suppose a speaker has a false belief about the identity of a dog currently in a box and mislabels it with her pet dog's name. Will a young child assume that the dog actually in the box at that moment is named or will the child correct for the speaker's false belief and learn the name of the speaker's intended referent? We presented 36-month-olds with a narrated, illustrated story in which Sally puts one of two identical dogs in a box and leaves. In her absence, this dog jumps out of the box and leaves the scene; the other dog then jumps into the box. Sally returns with her friend, points to the box, and says, "That's Fido in the box. I put Fido in the box for sleep"; they then leave. In the test scene, the first dog returns and the two dogs are presented side by side. Subjects are asked to point to Fido. Initial results are suggestive: out of 20 three-year-olds (mean = 41, SD = 3.41; range = 36-47), 15 pointed to the correct dog--the speaker's intended referent (Binomial p=.04, two-tailed; BF=3.2 in favor of H1). Because children could have tracked the referent through Sally's description, "I put Fido in the box for sleep", we conducted the experiment on a new group of children, omitting this description from the script. Hence, in the naming-scene, Sally says, "That's Fido in the box!" and then leaves. In addition to this modification, we included the true-belief (TB) condition in which Sally returns to the room before the dogs change their initial places; hence her intended referent is the same as the actual referent. Out of 15 three-year-olds in the FB condition (mean = 41 months, SD = 4.42; range = 36-47), 12 pointed to the correct dog--the speaker's intended referent (Binomial p=.035, two-tailed; BF=4.50 in favor of H1). In the TB condition, 9 out of 10 three-year olds (mean = 41 months, SD = 4.43; range = 36-47 months) pointed to the correct dog--the speaker's actual referent (Binomial p=.02, two-tailed, BF=9.31 in favor of H1). Hence, three-year-olds appear to correct for the speaker's false-belief about identity in a labeling task. Early theory of mind (ToM) may sometimes be able to represent false beliefs about object identities, suggesting a strong continuity of competence with later ToM. Speaker's intent may override stimulus-world associations in early world learning. Currently, we are preparing a pre-registered follow-up study that will extend these findings to 30- to 36-month-olds.

P1-F-164 Developments in object individuation during the second year of life: Evidence from novel preferential-reaching tasks

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Prior research has revealed important limitations in infants' ability to individuate objects. In manual-search tasks, for example, 12-month-olds first see two objects being removed and replaced alternately from inside a box. Next, infants are allowed to search the box. Infants show successful individuation (as indexed by longer search times) when the two objects belong to different categories (e.g., bottle, bunny), but not when they differ only in their featural properties (e.g., two different bunnies). Here, we explored developments in 16--20-month-old infants' ability to individuate objects, using novel preferential-reaching tasks. Specifically, we examined whether infants (1) would be able to individuate two objects from the same category (e.g., two different bunnies), (2) would do so even if presented with two sets of objects in two different boxes, and (3) would do so whether the objects were revealed one box at a time, or alternately between the two boxes. In Experiment 1, infants watched as an experimenter lifted and lowered two objects, one at a time, from each of two boxes. The different-objects box contained two objects with different featural properties (e.g., a striped bunny and a dotted bunny); the same-object box contained two identical objects (e.g., checkered bottles). The objects were revealed, one box at a time (e.g., box A: bunny-1, bunny-2; box B: bottle-1, bottle-1). Next, the experimenter removed one object from each box (i.e., a bunny and a bottle), and then allowed infants to reach for one of the boxes. We reasoned that if infants (a) correctly individuated the two featurally distinct objects, (b) assumed that the two identical objects were the same object, and (c) updated their representation of the contents of each box when objects were removed, then they should reach preferentially for the different-objects box (which should still contain one object) over the identical-objects box (which should now be empty). Indeed, 25/32 infants (13/16 at 16--18 months and 12/16 at 19--20 months) reached for the different-objects box, $p = 0.001$, suggesting that they correctly individuated and tracked the contents of each box. Experiment 2 was similar except that objects were revealed alternately across the two boxes (e.g., box A: bunny-1, box B: bottle-1, box A: bunny-2, box B: bottle-1). Performance varied by age: 12/16 infants ages 19--20 months reached for the different-objects box, $p = 0.038$, whereas only 6/16 infants ages 16--18 months did so, $p = 0.895$. Experiment 3 confirmed, using a more challenging procedure, that infants ages 19--20-months could individuate and track the contents of the two boxes even when shown in alternation: 12/16 infants again reached for the different-objects box, $p = 0.038$. Thus, by 16--18 months of age, infants can individuate objects that differ only in featural properties, and they can do so even when shown two sets of objects, one set at a time. By 19--20 months, infants succeed even if the two sets are revealed in alternation. More generally, our preferential-reaching tasks provide a

simple and powerful tool for exploring developments in infants' ability to individuate and track objects.

P1-F-165 Do Infants Selectively Imitate Surprising Individuals?

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Previous studies have demonstrated that infants learn more effectively about and prefer to explore objects that violate their expectations over objects that accord with their expectations. For example, infants preferentially attend to and learn about a ball that is revealed in a different location from where it was hidden, relative to a ball that was revealed in its original hiding location (Stahl & Feigenson, 2015). However, it is unknown whether infants would also preferentially learn from the individual who produced the surprising outcome, relative to an individual who produced a non-surprising outcome. Infants are adept at selecting individuals from whom to learn. For instance, they will preferentially imitate an unconventional, inefficient action (using one's head, rather than one's hands, to activate a toy) if that action was produced by an individual that demonstrates competence, but they will not do so if that action was demonstrated by someone incompetent (Zmyj et al., 2010). Similarly, infants will selectively imitate an individual who speaks their native language but not a foreign language (Buttelmann et al., 2013). In the current study, we asked whether infants would also selectively imitate individuals who produce surprising outcomes, relative to individuals who produce non-surprising outcomes. Infants (N=16) between 13 and 17 months watched an experimenter produce either a non-surprising or a surprising outcome. The experimenter sat across from the infant and placed two identical opaque screens on the table. She then presented infants with a ball and hid it behind the left-hand screen. For half the infants, she lifted the screens to reveal a non-surprising outcome, in which the ball appeared in the expected location behind the left-hand screen. For the other half of infants, she lifted the screens to reveal a surprising outcome, in which the ball appeared behind the right-hand screen, appearing as though it teleported. Next, the experimenter showed all infants that her hands were free by waving with both hands, then placing her hands flat on the table. She then bent over and used her forehead to turn on a toy that lit up when pushed. She demonstrated this head-touch action four times. She then presented infants with the toy to freely explore for 90s. Current results demonstrate that infants in each group were equally interested in the toy ($p>.05$), and that all infants used their hands at least once to activate the toy. However, the critical measure of selective imitation was whether infants

also used their head to activate the toy, despite that action being unconventional and less efficient than using their hands. Of the infants who saw the experimenter produce a non-surprising outcome, only 1 out of 8 used their head to activate the toy. In contrast, of the infants who saw the experimenter produce a surprising outcome, 6 out of 8 used their head to activate the toy (Fisher's exact test, $p<.05$). Therefore, infants not only prefer to learn about objects that behave surprisingly (Stahl & Feigenson, 2015), but they also prefer to learn from individuals who produce those surprising outcomes.

P1-F-166 Perceptual narrowing in face and speech processing

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The development in face and speech processing during the first year of life is characterized by perceptual narrowing which refers to the fast attunement of discriminatory abilities to stimuli that infants encounter in their everyday lives along with declining discrimination for stimuli not relevant in the environment. These parallels in infants' development of face and speech processing led to the hypothesis that perceptual narrowing is induced by a domain-general process. This hypothesis, however, has not been tested so far, as face and speech processing has almost always been investigated separately. Therefore, we aimed at investigating the narrowing processes for face and speech stimuli within the same infants at 6 and 9 months of age. We longitudinally tested 31 6- and 9-month-old Caucasian infants with a face and speech task (data collection is still ongoing). In the face task, infants were habituated to an Asian or Caucasian female face. At test, a new Asian or Caucasian face was presented. Infants' face discrimination was indicated by longer looking times to the novel face compared to the habituation face. In the speech task, we measured infants' looking times at a display showing a checkerboard while tones were presented. We habituated the infants to a rising tone and tested them with a mid-level tone from Cantonese instantiated on a CV-syllable. Speech discrimination was indicated by longer looking times to the novel than the habituation tone. The separate analyses of the tasks showed that in the face task infants' preference scores for the Caucasian faces remained over 50% at both ages (57% and 56%) while they decreased for the Asian faces (55% to 46%). In the speech task, the preference scores at 6 months decreased from 60% to 53% at 9 months. So far, the statistical tests only marginally reached significance, but we expect significant effects with an increased sample size. Regarding a joint analysis of the tasks, an ANOVA with the repeated factors faces (preference score for the Asian face with 6 and 9 month) and speech (preference

score for the novel tone at 6 and 9 months) revealed a significant factor of faces, $F(1, 12) = 7.09$, $p < .02$, indicating that the decline in face discrimination at 9 months was significantly stronger than the decline in tone discrimination at 9 months. The corresponding ANOVA in which we submitted the preference scores for the Caucasian faces and those for the novel tones, did not show any significant effects. Our separate analyses of the face and speech tasks seem to confirm previous results on parallels in perceptual narrowing for face and speech discrimination between 6 and 9 months of age. The joint analysis of the face and speech data of the same individuals, however, suggested differences in the narrowing process of face and tone stimuli, especially with regard to the strength of the narrowing processes. The narrowing process seems stronger for faces than tones. Domain-general compared to domain-specific effects of the narrowing processes will be discussed.

P1-F-167 Probing Communication-Induced Memory Biases in Preverbal Infants: Two Replication Attempts of Yoon, Johnson and Csibra (2008)

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In a seminal study, Yoon, Johnson and Csibra [PNAS, 105, 36 (2008)] showed that nine-month-old infants retained qualitatively different information about novel objects in communicative and non-communicative contexts. In a communicative context, the infants encoded the identity of novel objects at the expense of encoding their location, which was preferentially retained in non-communicative contexts. This result has not yet been replicated. Here we attempted two replications, while also including a measure of eye-tracking to obtain more detail of infants' attention allocation during stimulus presentation. Experiment 1 was designed following the methods described in the original paper. After discussion with one of the original authors, some key changes were made to the methodology in Experiment 2. Neither experiment replicated the results of the original study, with Bayes Factor Analysis suggesting moderate support for the null hypothesis. Both experiments found differential attention allocation in communicative and non-communicative contexts, with more looking to the face in communicative than non-communicative contexts, and more looking to the hand in non-communicative than communicative contexts. High and low level accounts of these attentional differences are discussed.

P1-F-168 Flaps in 'First Words' Picture Books Hinder Toddlers from Learning New Words

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Objective: Educational picture books for toddlers often have manipulative features (e.g., lift-the-flap) to encourage interaction. However, such features may actually discourage learning by distracting children from book content, or by making the book more like a 3D toy than a 2D source of information about real-world referents (e.g., Tare et al., 2010). Surprisingly little research examines how tactile features in symbolic media affect early learning, despite toddlers' widespread exposure to them in picture books and now touchscreens. This study therefore tested how flaps in a commercial 'first words' picture book affected 2-year-olds' learning of new words for unfamiliar foods. Methods: Thirty-two 2-year-olds were pre-tested for knowledge of 7 target foods by parents' reports of food words their child understood (Word List), and children's accuracy at pointing out the named target's photo (Figure 1; Picture Identification). Children were credited with knowing the word if they were correct in both pre-tests. Sixteen children then saw the Flap book and 16 saw the No-flap book (identical except the flaps were sealed shut) while the researcher described and labelled each target 6 times during picture-book readings. Finally, children were post-tested with Picture stimulus recognition trials of pointing out the target photo and Object stimulus extension trials of pointing out the target fake-food replica. Each trial was scored 1 or 0 for whether the child chose the target or not. For the words that children did not know before the book reading, post-test proportional scores were analyzed with a 2 Group (Flap/No-Flap) x 2 Stimulus (Picture/Object) ANOVA and t tests against chance. Results: Before they saw the book, the two groups had equivalent knowledge of the 7 target words. Children were unfamiliar with 3.88 (SD = 2.00) target words in the Flap group and 3.38 (SD = 2.22) words in the No-Flap group, $t(30) = .51$, according to pre-test scores averaged across Word Lists and Picture Identification. After they saw the book, however, the No-Flap group outperformed the Flap group, according to a main effect of Group, $F(1, 27) = 8.22$, $p = .008$, $\eta 2 = .23$ (Figure 2). There was no main effect of Stimulus, $F(1, 27) = .10$, or Group x Stimulus interaction, $F(1, 27) = .31$. The No-flap group also exceeded chance for Picture Recognition, $t(15) = 3.13$, $p = .007$, $d = .76$, and Object Extension, $t(15) = 3.48$, $p = .003$, $d = .85$. However, the Flap group performed at chance for Picture Recognition, $t(15) = .09$, and Object Extension $t(15) = 1.75$. Conclusion: Thus, 2-year-olds were half as likely to learn new words from a commercial 'first words' book with flaps than one without. These findings support dual-representation arguments that a symbol's concreteness interferes with toddlers' representation of its

abstract referent, and cognitive-load arguments that manipulative features distract attention from book content (e.g., Tare et al., 2010). This work contributes new evidence to the sparse literature examining how tactile features affect toddlers' learning from symbolic media, and highlights the need for future comparisons of toddlers' learning from traditional print media versus digital media.

P1-F-169 Do infants understand the true size of familiar objects?

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Much research on cognitive developmental psychology centers on the question when and how infants acquire knowledge about the real world. One question of this kind is when children learn about the true size of objects. Interestingly, although even newborns (Slater, Mattock & Braun, 1990) and young infants (Granrud, 2006) are able to perceive the real size of an object as constant across different distances, 18- to 30-month-olds still show scale errors by trying to sit in miniature cars or on miniature chairs. Nevertheless, 18- to 30-month-old children are able to select the larger object when offered miniature and true-sized familiar objects (DeLoache, Uttal & Rosengren, 2004). Here we asked when infants start to acquire knowledge about the true size of an object and how this affects infants' visual preferences? Sixty-five 7- and 12-month-old infants were presented with two types of highly familiar objects, pacifiers and sippy cups. The stimuli were 3D-printed objects shown in their true size and in unusual sizes. Unusual-sized objects were 50% larger than the true size, referred as the maxi-sized-object, or 50% smaller, referred as the mini-sized-object. In a preferential looking paradigm, objects were presented simultaneously in pairs, either the true-sized and maxi-sized object or the true-sized and mini-sized object together. Infants of all age groups saw each combination twice. Our dependent variables were the initial look and the overall looking durations towards an object. Infants of both age groups initially looked towards the larger object within the pair [$t(63) = 5.85$, $p < .001$, $d = -1.24$]. That is, they initially looked at the maxi-sized object in true-maxi pairings and the true-sized object in true-mini pairings. However, regarding the total looking duration, we found a significant size preference by age interaction [$F(1,61) = 5.98$; $p = .017$, $\eta2 = .09$]. Only the 12-months-olds looked longer at the maxi- and mini-sized objects [$F(1,33) = 28.67$, $p < .001$, partial $\eta2 = .47$] compared to the true-sized objects. The 7-month-olds showed no difference in looking durations between the true- and maxi- or mini-sized objects [$F(1,28) = 2.16$, $p = .153$, partial $\eta2 = .07$]. In sum, as indicated by the initial look, both 7- and 12-month-olds are able to successfully

discriminate between larger and smaller objects based on their physical size. However, as indicated by their longer looking durations towards the maxi- and mini-sized objects compared to the true-sized object, only the 12-month-olds seem to have a notion of the true size of a familiar object. Future research should examine infants' manual preferences to determine whether they also act differently toward true-sized objects than maxi- and mini-sized objects.

P1-F-170 Infants Understand Helping as Reducing a Helpee's Action Costs

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From a young age, infants show a preference for helpful characters. This evaluative behavior is thought to reflect an early understanding of the act of helping; however, to date, not much is known about what this helping concept precisely entails. Prior research indicates that preverbal infants attribute to a helper the goal of bringing about a helpee's goal: they prefer intentional over accidental (Woo et al., 2017) and knowledgeable over ignorant helpers (Hamlin et al., 2013), and expect helpers to help a character in need rather than one who can achieve the goal by himself (Köster et al., 2016). However, helping can also be understood as an action aimed not just at completing the helpee's goal, but at reducing the action costs incurred to realize her goal. Indeed, most everyday helping acts (e.g., holding the door for someone) are like this: they simply make the helpee's action easier. In this study, we investigated whether 12-month-olds (n = 24) expect a helper to act in a way that minimizes the helpee's action costs. In a violation-of-expectation paradigm, infants were familiarized with an agent approaching a goal object that could be reached through two paths of different length, the shorter of which was blocked by an obstacle. In half of the familiarization trials, the agent took the longer path; in the other half, the agent was assisted by a helper who removed the obstacle and thus allowed the agent to reach the goal via the shorter path. At test, infants were presented with two test events: the helper provided the helpee access to the goal via the shorter (consistent test) or longer path (inconsistent test). If infants understand that the goal of the helper's action during familiarization is to reduce the helpee's action costs, they should look longer at the inconsistent test event. An ANOVA on the log-transformed looking times revealed no main effect of Test Outcome, but a significant interaction of Test Outcome x Order of test trials ($F = 7.612$, $p = .012$). Infants who were presented with the inconsistent test event first looked longer at the inconsistent outcome ($M_{eff} = 16.06$, $SD = 10.01$; $M_{ineff} = 23.24$, $SD = 12.61$; $t(11) = 3.089$, $p = .01$), whereas infants who saw the consistent outcome

first did not distinguish between test events (M_eff = 19.5, SD = 13.9; M_ineff = 18.26, SD = 14.22; t(11) = .917, p = .379). This suggests that, beyond the expected effect of Test Outcome, an additive Order effect also influenced looking times, making infants look longer at the first test trial. To our knowledge, this is the first study to investigate whether preverbal infants expect helpers to minimize the action costs that helpees incur to fulfill their goal. While it has been previously demonstrated that 14-month-olds expect agents to behave in a jointly efficient manner towards shared goals (Mascaro & Csibra, 2014), the present research also indicates that infants may attribute to helpers the goal of reducing a helpee's action costs.

P1-F-171 Beginnings of Grammar: Domain-generality of Phrase Structure Learning in Infancy

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When infants begin to acquire grammatical patterns of their native language, they learn that words are grouped into categories and organized according to hierarchical structures. They also learn that word classes comprise more than one lexical item (e.g., English determiners could be a or the), and that the presence of a member of a class predicts the presence of a member of another word class, a key statistical cue to discover linguistic phrase structure. Previous evidence showed that 12-month-olds learn phrase structure from artificial languages (Saffran et al., 2008), leaving open the domain-specificity of this process. The current study investigates the extent to which infants can track phrase structure from nonlinguistic materials, which were designed to be nonlinguistic analogues of the languages used in Saffran et al. (2008, Experiment 1). Stimuli consisted of sentences produced using a set of 5 nonlinguistic sounds taken from the pool of Mac Alert sounds (Mac OS Sierra, 10.12.5). Sounds were clearly discriminable from one another (Glass, Basso, Hero, Ping, Sosumi), and were intended to correspond to words in a linguistic grammar. We used Headturn Preference to assess learning. A group of 12.9-month-old infants was familiarized with an artificial language formed by sounds, whose ordering was determined by predictive dependencies (P-Grammar); the presence of a given sound predicted the presence of another sound within the same string, and sound strings were embedded into other sound strings conferring hierarchical organization to the grammar (Figure 1). A second group of infants of the same age was familiarized with a language that did not comprise such statistical dependencies between elements (NP-Grammar; Figure 1). Each grammar generates 8 strings, ranging from 3 to

6 sounds per string (e.g., ACF, ADCGF, ADCFCG, DCGF). At test, all infants heard grammatical vs. novel ungrammatical strings. Four grammatical strings were selected from the pool of familiarization sentences and were grammatical (matched with the exposure language) in both conditions. Four ungrammatical strings were instead formed by familiar sounds re-combined into novel (illegal) strings that broke the patterns shared among grammars (e.g., strings did not contain an A-Phrase). Looking time measures revealed a preference for ungrammatical over grammatical strings after exposure to P-Grammar ($t(26)=2.45$, $p=.021$, Cohen's $d=.47$) but not to NP-Grammar ($t(29)=.005$, $p=.995$; Table 1). Results showed that only infants familiarized to the P-Grammar were able to discriminate between test strings that followed the familiar pattern from test strings that broke that pattern, in line with what found with linguistic materials (Saffran et al., 2008), and in different age ranges (Saffran, 2001; Saffran, 2002) and species (Abe & Watanabe, 2011; Wilson et al., 2013). This evidence suggests that predictive dependencies may facilitate learning of phrase structure also in non-linguistic inputs, and represents a promising starting point towards the discovery of the nature of the learning processes underlying grammar acquisition.

P1-F-172 Pupilary response in an auditory oddball task varies with temperamental style

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Research has revealed certain aspects of infant temperament are remarkably stable (e.g., Fox, Henderson, Rubin, Calkins, & Schmidt, 2001), and may be related to individual differences in novelty detection, and perception (Marshall, Reeb, & Fox, 2009). For example, research using auditory "oddball" tasks suggests that individual differences in temperament may influence low-level attentional responses during a passive listening task. In these tasks, infants are presented with a series of tones, punctuated by less-frequent "oddball" tones. Attentional responses are typically assessed using EEG, and large neural responses to the auditory "oddball" is generally associated with greater activation in frontal cortical areas. These attention responses vary as a function of temperamental style, and are typically greater for infants who are high in negative reactivity (Marshall et al., 2009). Given that arousal responses typically associated with auditory oddball tasks are likely to elicit activation of the locus coeruleus norepinephrine system (e.g., Columbo, 2001), it is possible that strong novelty detection will elicit pupillary changes. Thus, we examined pupillary changes during a standard auditory oddball task,

while infants passively viewed a silent movie. The goals of this project were twofold: First, to determine if novelty detection during an auditory oddball task produced detectible changes in pupil dilation, and second, to see if the strength of these pupil responses varied as a function of temperamental style. We tested 41 8-month old infants in a classic auditory odd-ball task. A Tobii TX300 eyetracker was used to capture pupil diameter continuously (300Hz) while infants passively viewed a silent movie (Elmo's World). During the viewing, infants heard a stream comprised of up to 375 1000Hz and 1100Hz tones. Each tone lasted for 150ms, and was followed by 850ms of silence. One of the tones occurred frequently (~80%) and the other infrequently (~20%). Parents additionally completed the Revised Infant Behavior Questionnaire (IBQ-R), and responses were used to calculate three temperament scales: Surgency (extroversion and high sensory perception), Orienting and Reactivity (attention and emotional regulation), and Negative Affectivity (distress, fear, and sadness, Gartstein & Rothbart, 2003). Though overall pupil dilations in response to the deviant tone did not differ from the standard tone, we did see a significant differences in pupil reactivity as a function of temperamental style. Specifically, preliminary results suggest pupil change from baseline was marginally greater for High Surgency infants than for Low Surgency infants, $F(1,38)=4.019$, $p=.052$ (Fig 1). Moreover, one-sample t-tests comparing pupil change from baseline to zero revealed a significant change from baseline for the High Surgency infants in response to the standard tones, $t(20)=-2.55$, $p=.019$, as well as a marginal effect in response to the deviant tones, $t(20)=-1.735$, $p=.098$, which may be suggestive of overall high pupil reactivity to stimuli in infants who are higher in surgency. Interestingly, Low Surgency infant responses to standard and deviant tones didn't differ from baseline, suggesting high levels of surgency are related to strong novelty responses. These findings demonstrate the utility of pupilometry as a marker of novelty detection, and underscore the relationship between physiological reactivity and temperament.

P1-F-173 Development of high-risk preterm and full-term infants: a prospective longitudinal study

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Preterm birth (< 37 weeks of gestational age) presents several risks for child development. However, development outcomes are heterogeneous in this vulnerable population. Regarding the implementation of preventive strategies of problems in the course of development, it is necessary to advance on the understanding of the longitudinal impact

of other clinical risks associated with premature birth. The aim of the present study was to examine the evolution of the developmental outcomes (cognitive, language, motor, and social-emotional) of preterm infants with high neonatal clinical risk and of full-term infants with no biological vulnerability at birth, at 6-8 to 12-15 months of age. High neonatal clinical risk included central nervous system deficiencies, such as intracranial hemorrhage and leukomalacia, pulmonary bronchodysplasia, septicemia, and retinopathy of prematurity. The sample consisted of 90 infants (58% girls) divided by gestational age: 30 preterm infants with very low birth weight ≤ 1,500g (PT; 67% girls) and 60 full-term infants (FT; 53% girls), followed in two phases (6-8 to 12-15 months of age); both groups were from low-income families in a developing country. All children were born in the same hospital complex in the Southeast of Brazil. The preterm infants were admitted in the Neonatal Intensive Care Unit and attended to a multidisciplinary follow-up program (including physicians, psychologists, physiotherapists, occupational therapists, speech therapists) after the hospital discharge. The development of the infants was evaluated by Bayley Scales of Infant and Toddler Development, 3rd Ed. (BSDI-III). The statistical descriptive analysis and the within-groups comparison (paired t-test) were performed (SPSS, version 23.0, Il Chicago, USA). The level of significance was $p < 0.05$. As expected, the groups showed statistical significant differences in relation to the perinatal and neonatal characteristics of gestational age (PT, mean = 28 weeks [± 1.5]; FT, mean = 39 weeks [± 1.4]; $p < 0.0001$) and birth weight (PT, mean = 1,077g [± 242]; FT, mean = 3,340g [± 476]; $p < 0.0001$). Regarding the development characteristics, both groups presented average scores (80-119 points) in all scales of BSDI-III, in the two phases. However, there was a statistical significant difference within-groups, showing a decrease of mean scores in the 12-15 months phase, in both groups, specifically in the language scale (PT, mean = 109 [6-8 months] and mean = 95 [12-15 months], $p < 0.0001$; FT, mean = 118 [6-8 months] and mean = 107, $p < 0.0001$). It is important to note that language was the only scale that had a development decrease both in PT and in FT groups, suggesting a possible loss of development potential, regardless of the issue of prematurity, even in preterm infants with high neonatal risk. In conclusion, the follow-up program that the preterm infants attended may have been a protective factor, promoting the normal developmental condition for these infants and emphasizing the importance of clinical and educational support in the developmental trajectory.

P1-F-174 Do social factors predict performance on spontaneous-response false-belief tasks? Evidence from toddlers

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Infants' successful performance on spontaneous-response tasks suggests that false-belief understanding emerges during the first years of life. What factors influence individual differences in this early understanding? One recent study found that parental use of mental-state language (e.g., think, know) predicted 2.5-year-olds' performance in an anticipatory-looking task (Roby & Scott, 2015). This suggests that toddlers' performance on spontaneous-response tasks is related to at least one of the social factors that predicts preschooler's performance on elicited-response false-belief tasks (e.g., Ruffman et al., 2002). The present study sought to replicate this novel finding and examine whether a second factor that predicts preschooler's elicited-response performance, children's personal use of mental-state language (e.g. Ensor & Hughes, 2008), also predicts toddlers' spontaneous-response performance. Children (33-39 months; M = 36 months) completed the anticipatory-looking false-belief task from Low (2010) in which they heard a change-of-location false-belief story enacted with props. Children faced a house that had two slides protruding from the left (red) and right (green) sides (Fig-1). A red and green box sat near each slide opening. The experimenter introduced a character named Liam and demonstrated that when Liam wanted to look in the green box, he would go down the green slide, and that when he wanted to look in the red box, he would go down the red slide. Children were then asked two practice questions, one for each slide, "Which slide will Liam come down if he wants to look in the red/green box?" (order of questions counter-balanced) to ensure they understood how Liam used the slides. Next, Liam hid a toy in the green box (color counterbalanced) and then left. While Liam was gone, his sister Sophia moved Liam's toy from the green to the red box and then left. In the test trial, children were told that Liam wanted to play with his toy. The experimenter then delivered an anticipatory-looking prompt: she looked down, avoiding eye contact with the children, and wondered aloud to herself, "I wonder which slide Liam will come down to look for his toy?" We coded children's anticipatory looking during the 4s following the prompt. If children correctly attributed to Liam a false belief about the toy's location, then they should look longer at the green box (belief-consistent location) rather than the red box (belief-inconsistent location). We calculated children's anticipatory-looking difference score: looking time to belief-consistent location - looking time to belief-inconsistent location. To measure mental-state language, parent-child dyads looked at a picture book containing photos of people (Taumoepeau & Ruffman, 2006). We calculated the percentage of parent and child utterances containing mental-state terms. Preliminary results indicate that parental mental-state language was significantly positively correlated with children's anticipatory-looking difference scores, $r = .40$, $p = .018$. Controlling for parental mental-state language, children's mental-state language was marginally

positively correlated with their anticipatory-looking difference scores, r = .33, p = .073. These results replicate and extend the results of Roby and Scott (2015). Together these findings suggest that a variety of social factors facilitate false-belief performance from an early age.

G: Social Development

P1-G-175 The origin of bonding through shared experience: toddlers and great apes approach faster after watching a video in joint attention

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Human sociality is different from that of our closest evolutionary relatives, the great apes. Not only do we have larger social networks, but we also seem to have unique ways of connecting to each other. Humans engage in a variety of social bonding activities that do not require physical interaction, such as playing games or dancing. Successful engagement in such activities requires joint attention, a referential triangle in which two individuals realize they are attending the same stimulus. Research on adults has supported the hypothesis that joint attention based interactions establish feelings of closeness between individuals. Yet, the question remains how fundamental and uniquely human the capacity to connect with others through joint attention is. Does this social dynamic emerge early in ontogeny? And can we find this way of establishing a 'we' in other species as well? To answer these questions, we conducted a comparative experiment with a group of 30 month olds (between subjects) and a group of chimpanzees and bonobos (within subjects). We expected that 30 month olds, but not great apes would change their behavior to a partner after jointly attending a stimulus with them. In this study, both the children and the apes were let into a room and sat down in front of a screen. An experimenter came in and sat down next to the subject, after which a silent video containing animal behavior started. In the joint attention condition, both the subject and the experimenter watched the video together. In the disjoint attention condition, the screen was not visible to the experimenter due to a cardboard divider placed next to the screen (human subjects) or because the screen was turned away from the experimenter (ape subjects). Instead of watching the video, the experimenter in the disjoint condition read a book (human subjects) or information on a clipboard (ape subjects). After the video, the experimenter moved to the other side of the room. For human subjects, the experimenter then offered a stuffed animal (0-30 seconds), toy truck with blocks (30-60 seconds) and a marble run (60-90 seconds) to the child. For ape subjects, the experimenter

looked at them (0-30 seconds), rattled the mesh (30-60 seconds) and rattled the mesh while calling their name (60-90 seconds). For all subjects, we measured the time they took to approach the experimenter. Our preliminary data suggests that, in line with our hypothesis, the 30 month olds in the joint attention condition approached faster than in the disjoint attention condition. Moreover, to our surprise, the (finalized) ape data shows that chimpanzees and bonobos also approached faster in the joint attention condition than in the disjoint attention condition. These results suggest that (1) connecting through shared experiences is a social dynamic that emerges early in ontogeny and (2) this dynamic also seems to be present, at least to some degree, in great apes. These results shed a new light on the way through which infants start forming their social networks, and how these processes have developed over our evolutionary history.

P1-G-176 Parenting behavior and regulatory skills in toddlerhood predict childhood weight outcomes

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Due to the high prevalence of obesity among young children, it is critical to understand factors contributing to weight gain in early life. Both parent-child interactions during feeding and poor child regulation have been linked to obesity (Anzman-Frasca et al., 2012; Skouteris et al., 2012). However, there is limited research examining whether parent-child interactions outside of a feeding context contribute to weight gain, and if this association varies based on children's early regulatory abilities. The present study investigates interactions between maternal interactive behaviors and toddler regulation at 18 months predicting child BMI at 4.5 years. Infant-mother dyads (n = 108) participated in laboratory visits when the child was 18 months and 4.5 years of age. At 18 months, dyads participated in free play and clean-up tasks. Mothers played with their toddlers and a basket of toys. Afterward, mothers prompted their child to return the toys to the basket. Two types of maternal interactive behaviors were coded during each task: positive responsiveness (i.e., combination of positive affect and responsiveness to the child's behaviors) and gentle control (i.e., behaviors to change/redirect the child's behavior). Toddler regulation was assessed separately in three ways. First, an experimenter instructed the toddlers not to touch a wind-up toy during three trials (5s, 10s, 15s). Latencies to touch the toy were coded and z-scores were averaged. Second, two experimenters independently rated the toddlers' behavior across the visit using the Infant Behavior Record (IBR) (Stifter et al.,

2008). Three items measuring regulation components (attention span, object orientation, and compliance) were averaged for each toddler. Third, mothers completed the Early Childhood Behavior Questionnaire (Putnam et al., 2006), which includes an effortful control superfactor. A final regulation composite was created by averaging the z-scores for each regulation measure. Finally, child and mother length/height and weight measurements were recorded at both visits and used to calculate child BMI z-scores (BMIZ) and maternal BMI, respectively. After controlling for maternal education, BMI, and toddler weight status, two significant interactions emerged between maternal interactive behaviors and toddler regulation predicting BMIZ at 4.5 years. First, an interaction of positive responsiveness during free play and toddler regulation demonstrated that lower positive responsiveness significantly related to greater child BMIZ for toddlers with low regulation (See Figure 1). Second, an interaction of gentle control during clean-up and toddler regulation indicated that greater gentle control was associated with greater BMIZ for well-regulated toddlers, but lower BMIZ for toddlers with lower regulatory abilities (See Figure 2). No significant main effects emerged for maternal interactive behaviors or toddler regulation. These results suggest that associations between maternal behaviors and child BMIZ may depend on toddlers' emerging regulatory abilities. Maternal responsiveness during free play and gentle control during clean-up appear to protect against weight gain, especially for toddlers with lower regulatory abilities. However, greater levels of gentle control may have adverse effects on BMI for well-regulated toddlers. These results suggest that both parenting and toddler regulation, examined outside feeding contexts, have important implications for childhood obesity.

P1-G-177 Implicit Construction of Gender in Parental Descriptions of Their Infant Children

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Although children do not definitively understand their own gender until about two-and-a half years of age, parents begin socializing their children in gender-normative ways even before they are born, from what they decide to name their baby to the color they paint their nursery (Kane, 2006; Martin & Ruble, 2004). Deeply-rooted societal beliefs about gender continue to dictate choices parents make for their children throughout childhood, and influence behavioral expectations they will hold for them as they grow up (Martin & Ruble, 2004). Even as modern-day parents insist they raise their children free from gender-normative confines, it is possible gender stereotypes are so pervasive they remain present

in implicit behaviors (Freeman, 2007). Small variations in language on account of implicit stereotypes can strengthen their relevance both within the person speaking (here, parents) and the person listening (their child) (Beukeboom, 2014). For toddlers who are just beginning to undergo the process of gender-identification, the implicit communication of gender-based stereotypes can limit their early gender expression and inhibit their behavioral futurities as they attempt to correctly perform their newfound gender (Freeman, 2007). This study explores the extent to which parents implicitly construct gender in stereotypical ways in descriptions of their infant children, as well as how this narrative gendering varies as a function of the child's and/or the parent's gender. The study also explores correlations between the way parents implicitly gender their children and their explicit gender-stereotypic parenting beliefs (Rubin, Provenzano, & Luria, 1974). Data were collected from 258 first-time parents in the New York City area. Both parents were asked to speak for 5 minutes, describing their child's personality at 4, 14, and 24 months. Transcriptions of the speech samples were coded for all descriptive language used (e.g., funny, cute, a joy), which were then scored by a separate sample on its societal gender connotation (i.e., the extent to which the word is generally considered to be masculine or feminine). Each speech sample was then assigned a "gender construction score" based on an aggregate of gender-connotation scores of the descriptive words used. Additionally, parents completed a 27-item measure of explicit gender-based parenting beliefs, the Child Gender Socialization Scale (Blakemore & Hill, 2008). Exploratory factor analysis using preliminary data with N=132 parents (73 moms) replicate findings that items load onto 6 factors (generic play, hyperfeminine activities, violent activities, household chores, discouraging cross-gender behavior, and encouraging education about domesticity). Independent samples t-tests reveal that parents' opinions vary by both child's and parent's gender (e.g., dads are more likely to discourage other-gendered behaviors than are moms, $t(120)=-2.36$, $p=.02$). Implicit and explicit gendered attitudes will also be compared, and growth trajectories of implicit attitudes from infancy through toddlerhood will be explored. If parents are to truly provide equal opportunities for their sons and daughters, it is important to understand the ways they perpetuate stereotypical gendering from such an early age.

P1-G-178 A longitudinal study of the relations between infants social understanding and orientation and later instrumental helping behavior

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A growing literature demonstrates that even very young children engage in prosocial behavior (Vaish & Tomasello, 2014). For example, toddlers intervene to assist others in carrying out their goals, described as instrumental helping (Warneken & Tomasello, 2006, 2007). Little is known, however, about what factors may underpin and explain individual differences in children's emerging prosocial behavior. To explore this question, the present study examines longitudinal relations between several foundational social-cognitive constructs in infancy and instrumental helping in the toddler years. One key requirement of instrumental helping behavior is the ability to identify the goals of the person in need. This ability to make inferences about others' intentions emerges during the first year of life (Brandone & Wellman, 2009) and may underpin later instrumental helping behavior. Infants who are better at inferring others' intentions may be more likely to engage in instrumental helping behaviors because they more readily recognize when others are attempting to carry out goals and when they need assistance to do so. Here we explore this hypothesis by examining whether the ability to interpret an ongoing intentional action in infancy predicts instrumental helping behavior in the toddler years. We also examined several additional potential predictors of instrumental helping behavior. First, given that prosocial behavior requires coordinating one's own attention and actions with those of a social partner, we explored relations between coordinated joint engagement and joint attention in infancy and later instrumental helping behavior. Second, we explored the contributions of individual differences in temperament for later prosocial behavior. Participants included 90 7.5- to 12-month-old infants who later returned to the lab at 18-24 months of age. At Time 1, infants completed measures of intention understanding, coordinated joint engagement, joint attention, and temperament. Intention understanding was assessed via an experimental measure of infants' ability to visually predict the goal of an intentional reaching action (Brandone et al., 2014). Coordinated joint engagement was assessed during a brief play session with a researcher and some toys. Sessions were coded for active gaze shifts between an object, the experimenter, and the same object (Bakeman & Adamson, 1984). Joint attention was assessed via structured tests of infants' ability to follow a researcher's gaze and point (Carpenter et al., 1998). Finally, temperament was assessed via parent-report on the Infant Behavior Questionnaire-Revised (Garstein & Rothbart, 2003). At Time 2, instrumental helping behavior was assessed via four tasks in which a researcher ostensibly needed help to complete a task (e.g., retrieve a dropped crayon; Warneken & Tomasello, 2006). Preliminary results from a subset of 30 infants suggest that early intention understanding may not be related to later instrumental helping behavior. Initial analyses also indicate that neither coordinated joint engagement nor joint attention in infancy were related to

later instrumental helping. However, the Surgency/Extraversion dimension of infant temperament emerged as positively related to later prosocial behavior ($p = .042$). Together, these findings begin to shed light on the social-cognitive and dispositional predictors of instrumental helping behavior in the toddler years.

P1-G-179 A cross-cultural examination of life satisfaction among mothers of infants: The role of social status

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Satisfaction with life is an important component of overall well-being, as it has been shown to be linked to both mental and physical health risks (Strine et al., 2008). While issues related to health and well-being are often attributed to biological or psychological causes, recent research suggests that the social component of these conditions may be just as important. One social factor that may play a role in an individual's health and well-being is perceived social status, or how an individual sees him or herself in relation to others in society (Green, 2010). Perceived social status has specifically been linked to life satisfaction - even when controlling for more objective measures of socioeconomic status (e.g., income; Collins & Goldman, 2008). For example, one study conducted in the UK found lower perceived social status to be related to lower life satisfaction (Bannink, Pearce, & Hope, 2016). Another study in Germany found strong associations between low social status, poor health outcomes, and low life satisfaction (Laubach et al., 2000). While more recent work has been done to explore the social components of life satisfaction, little has been done to highlight this relationship in first-time mothers. Our study not only focuses on a sample of first-time mothers, but includes mothers from three different countries to allow for an innovative, cross-cultural perspective. In an international, longitudinal study, 395 first-time mothers of 14-month old infants were asked to rank themselves by social status in terms of their perceived position on a ladder, with 1 being the lowest rung/lowest status and 10 being the highest rung/highest status (Adler & Stewart, 2007). Life satisfaction was measured to evaluate subjective well-being, using five items of the Satisfaction with Life Scale (Diener et al., 1985). Across England (N=188), the Netherlands (N=117), and the United States (N=90), a main effect of perceived social status on life satisfaction was found, such that mothers who rated themselves as higher on the social status ladder were more likely to be satisfied with life. Additionally, an interaction effect was identified between social status and country, such that the association between perceived social status and life satisfaction was significantly stronger for US parents than

it was for UK and Dutch parents (see Table 1 and Figure 1). Our results suggest that not only might social factors play a role in overall well-being, but the role may vary depending on cultural context. At time of presentation, we plan to leverage additional time points of this study to investigate this relationship over time, and investigate the possible implications of decreased life satisfaction on infant development.

P1-G-180 Norms with affect: Children and adults show greater physiological arousal to moral than conventional transgressions

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By age 3 years, children differentiate moral from conventional norms. They state, for instance, that moral but not conventional norms generalize across contexts and are authority-independent (Smetana et al., 2014). However, less is known about the mechanisms driving this differentiation. We asked whether children focus differently on the transgressor and the victim during moral versus conventional transgressions, and whether they show greater physiological/internal arousal (measured via changes in pupil dilation) during moral transgressions. In a between-subjects design, 3-year-olds (n = 32), 4-year-olds (n = 34), and undergraduate students (n = 64) watched a video of either a moral norm violation (e.g., destroying another person's artwork; Figure 1a) or a conventional norm violation (e.g., playing a game wrong; Figure 1b). Crucially, the final scene of both videos was identical, but based on what had previously transpired, this final scene represented either a moral or a conventional transgression. Participants of all age groups looked significantly more at the victim during the moral than the conventional transgression, $F(1, 124) = 6.19$, $p = .014$. Thus, the victim of a moral transgression drew more attention than the bystander witnessing a conventional transgression. With regard to our central question concerning arousal, we measured participants' pupil dilation during the first 2 seconds of each transgression. As predicted, we found that across all age groups, participants in the moral condition ($M = .10$, $SD = .15$) showed greater pupil dilation than participants in the conventional condition ($M = .01$, $SD = .14$), $F(1,112) = 11.50$, $p = .001$ (Figure 2). We also found a main effect of age, such that adults showed less change in pupil size than 3- and 4-year-olds, $F(2,112) = 3.36$, $p = .038$. This is the first evidence that differences in affective arousal contribute to the distinction that even young children draw between moral and conventional rules.

P1-G-181 Linguistic and Social Factors Affecting 19-Month-Olds' Understanding of Possession

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Previous research has demonstrated that preschoolers have understandings about the abstract concept of ownership as well as perceivable possessions (e.g., Friedman & Neary, 2008). Because of young children's experiences with their own and their siblings' toys, younger, two-year-olds may also understand object possession (e.g., Allen, 1995; Fasig, 2000; Ross, 1996; Ross, Tesla, Kenyon, & Lollis, 1990). The present study thus examines whether infants can infer possession from an experimenter's actions and her explicit claim "It's mine!" Nineteen-month-olds are tested because of the language element. To assess language development, parents check on the Level-II short form MacArthur Communicative Development Inventories (Fenson et al., 2000) how many words their infant can produce. Given the potential links between infants' experiences with own toys and siblings, we also ask parents whether or not the infant has any toy(s) he or she is attached to and whether or not the infant has any (older) siblings.
 In a violation-of-expectation looking time task, infants first watch three familiarization events. In each event, an agent who sits across a stage from the infant, turns to look at the only toy present on the stage. She says in infant-directed speech: "It's mine!" and then reaches for and grasps the toy (toy-A). During test, toy-A's position is changed and a new toy, toy-B is put in toy-A's original location. The experimenter silently reaches for and grasps toy-A (old-toy event) or toy-B (new-toy event). In previous work on infants' understanding about others' goals and preferences (for a review, see Baillargeon, Scott, & Bian, 2016), if an experimenter is only faced with one toy initially, then after a new toy is introduced, infants accept that she can choose either one of the two toys. Consistent with these results, in our experiment, infants do not differentiate between the old-toy and the new-toy events during test.
 When we perform a median split on the group based on infants' productive vocabularies, however, infants with vocabularies above the median (N = 16) look longer at the new-toy than at the old-toy test event, $F(1, 30) = 3.63$, $p = .066$, suggesting the link between language development and infants' expectation that the experimenter should always stick to her own toy.
 In addition, when the group is divided into two subgroups based on whether or not infants have toy(s) they are attached to, infants who have attached toy(s) based on parental reports (N = 14) also look marginally significantly longer at the new-toy than at the old-toy test event. These two subgroups do not differ in the numbers of infants with productive vocabularies above or below the median, $\chi2(1) = 1$, $p > .250$. If the looking time results held with a full sample,

it would suggest that infants' relationships with their own toys affect how they come to construe others' possession of objects. Interestingly, whether or not infants have older siblings does not influence their looking patterns.
 In sum, the present study provides tentative evidence that linguistic and social factors affect infants' understanding about possession, shown by others' actions and claims.

P1-G-182 Biological Stress and Socioeconomic Status Correlate with School Readiness in Preschool Children

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Early experiences can profoundly impact students' learning trajectories (High, 2008). Moreover, impoverished and less educated backgrounds increase the likelihood of poor school readiness (Reardon, 2013). Although overall socioeconomic status is associated with school readiness, many risk factors tend to co-occur in lower income households, and less is known about what specific aspects of early life stress are linked to school readiness. Methods: The current study examined how cumulative biological and parent-reported stress, income, and parent education correlated with school readiness in 3.5-year-olds (N=75, 36 girls). We measured school readiness through the Bracken School Readiness Assessment, parents' perceived stress through the Parenting Stress Index 4th Edition, and cumulative biological stress by assaying parent and child hair samples for the stress hormone cortisol. To assess socioeconomic status, we evaluated income-to-needs ratios and parent education levels. Results: Parent ($r=-.286$, $p=.038$) and child ($r=-.517$, $p<.001$) hair cortisol both were negatively correlated with school readiness, such that higher hair cortisol in both parents and children was associated with lower school readiness. Parents' perceived stress and income-to-needs ratio were not significantly related to school readiness. Children who had parents with at least a four-year college degree obtained higher school readiness scores ($t(73)=-3.489$, $p=-.001$). Discussion: Results suggest that chronic biological stress, as indexed by hair cortisol, is implicated in school readiness even before the beginning of a formal education; chronic early adversity takes a physiological toll and may play a role in cognitive development in children. Furthermore, as higher parent and child hair cortisol were associated with lower school readiness, while parents' perceived stress was not, it seems likely that cumulative biological stress and perceived stress operate as distinct mechanisms. In the current sample, parent education was linked to school readiness while income-to-needs ratio was not, indicating that these dimensions of socioeconomic status may relate differentially to

school readiness. In preschool, the dissemination of knowledge by parents may be more influential for school readiness than income-related factors such as literacy resources in the home. Parents who are more educated may be prioritizing education and exposing their children to more knowledge. Children from less educated families may be at more risk of lower school readiness regardless of household income. Ultimately, results from this study contribute to a growing body of knowledge that will identify children at risk for academic difficulty at school entry. While the current study indexed cumulative biological stress from hair cortisol, future research should investigate the relationship between day-to-day rhythms of biological stress, as indexed by diurnal salivary cortisol, and school readiness to more thoroughly understand the link between biological stress and school readiness. The current findings underscore the importance of measuring multiple dimensions of both stress and socioeconomic status to clarify the specific processes and risk factors underlying school readiness.

P1-G-183 Communicative function of singing to infant

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It is well known that parents frequently sing songs to their infant during natural interactions such as soothing and playtime (Trehub, Unyk, & Trainor, 1993). It was also reported that the affective nature of these songs has an effect on infants' behavioral responses (Volkova, Trehub, & Schellenberg, 2006, Tsang & Conrad, 2010). Thus, singing can be communicative to infants. However, it remains unclear whether infants are sensitive to visual and communicative functions of singing above and beyond the auditory aspects of singing. In the present paper, we address this question by examining whether infants would prefer watching a singing person over a still face presented along with a song, and whether they respond differently when the singers' gaze is directed to them or not. Three Japanese women were filmed while singing 3 traditional Japanese children's songs during approximately 15 s. They were recorded once, while they gazed directly into the camera (direct gaze condition), and a second time, while they looked 45 degrees away from the camera (avert gaze condition). As a control, still movies were created by replacing the still photographs of the same women with the dynamic movie. A trial consisted of a familiarization phase during which one of the movies was presented, followed by a test phase during which infants were presented with two side-by-side still photographs (without sounds, for 15 s) corresponding to the familiar face (seen during the familiarization) versus a novel face (see. Figure 1) . Each infant was given 12 trials, such

that the order of familiarization stimuli and the side at which the familiar face appeared were counterbalanced. Infants' looking times, both during the familiarization and test phases, were measured by Tobii T60XL eye tracker. Forty-five 5-month-old infants and 53 twelve-month-old infants were tested. During the familiarization phase, both groups of infants looked significantly longer at the movie of a women singing than the still photograph presented with song (5m: $F(1, 44) = 17.87$, $p < .01$, 12m: $F(1, 52) = 24.64$, $p < .01$), showing that infants preferred the dynamic movie of singing over the still photo with the same singing voice. During the test phase, 12-month-old infants looked significantly longer at the familiar face than the novel face, only when they were presented in dynamic movies with direct gaze, as shown in Figure 2 ($F(1,52) = 4.29$, $p < .05$). Five-month-olds did not show any preference in any of the conditions. The results suggest that by 12 months, infants are sensitive to the act of singing itself above and beyond the auditory property of the songs and that their preference to the familiar face was specific to the person's gaze, indicating that infants are able to discern the communicative signals of songs by this age. At the same time, 5-month-olds did not show any signs of sensitivity to these factors. This indicates that the sensitivity to these signals emerge developmentally between 5 and 12 months of age.

P1-G-184 Prenatal Exposure to Maternal Stress and Household Chaos as Interacting Predictors of Toddlers' Behavior Problems

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Prenatal exposure to maternal stress is associated with behavioral and emotional difficulties in early childhood (Van den Bergh et al., 2017). However, there are inconsistent findings regarding specific behavioral difficulties, including findings that prenatal stress is associated with internalizing problems (Robinson et al., 2008), externalizing problems (Gutteling et al., 2005), or both (Park et al., 2014). Moderate levels of prenatal stress may even result in improvement in behavioral control (Rothenberg et al., 2011). Based on these conflicting results, it is important to consider additional factors in the development of child behavior, including the home environment. Specifically, household chaos predicts behavioral problems in young children (Coldwell, Pike, & Dunn, 2006). The current study examined prenatal stress, household chaos, and their interplay as predictors of toddlers' behavior problems. Maternal stress during pregnancy was hypothesized to be associated with increases in behavioral problems. Further, household chaos was expected to

moderate the association between maternal stress and behavior problems, such that lower household chaos would buffer the association between prenatal stress and toddler behavior problems. Participants consisted of 78 at risk, low-income mothers-child dyads recruited in Detroit, MI as part of a larger study on child social, emotional, and cognitive development. The mothers ranged in age from 18 to 40 (M = 25.27) years at the time of their child's birth. 86.5% of participants were African-American and 6.3% were Caucasian. During pregnancy, mothers completed the Perceived Stress Scale (PSST; Cohen, Kamark, & Mermelstein, 1983), a self-report scale to measure their perception of stress. This measure was administered while the mother was between 20 and 40 weeks pregnant. When children turned 36 months, a true/false version of The Confusion, Hubbub, and Order Scale (CHAOS; Matheny, Wachs, Ludwig, & Phillips, 1995) was administered to mothers to assess household chaos. Additionally, the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001) was administered to mothers at 36 months to assess toddler internalizing and externalizing behavior problems. The above hypotheses were partially supported. After controlling for child sex, gestational age at birth, birth weight, and maternal anxiety scores at 36 months, household chaos was the only significant predictor of externalizing problems, $\beta = 0.26$, $p < .05$. Regarding internalizing behavior, there was a significant interaction between prenatal stress and household chaos, $\beta = 0.22$, $p < .05$ (see Figure 1). Maternal stress during pregnancy was associated with increased internalizing behaviors in more chaotic homes ($\beta = 0.42$, $p < .05$), but not in less chaotic homes ($\beta = -0.07$, $p > .05$). Less chaotic home environments buffered the association between maternal stress during pregnancy and toddler internalizing problems. These findings support the importance of understanding the roles of maternal stress and the home environment in the development of internalizing behavior problems in early childhood. It may be useful to consider early home experiences when working with children who display internalizing behaviors.

P1-G-185 Shuar infants' behavior towards plants and other objects

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Recent work has shown that 8- to 18-month-old infants treat plants differently than other types of entities. Specifically, infants (i) are reluctant to touch plants compared to novel artifacts, familiar artifacts, and other natural kinds (stones and shells), and (ii) differentially seek out social information when confronted with plants compared to these other object types (Elsner & Wertz, under revision; Wertz & Wynn, 2014). These results suggest that

infants possess a collection of behavioral avoidance strategies and selective social learning rules that enable the acquisition of information about this critical aspect of the natural world over the course of ontogeny. However, the infant samples tested so far to address these questions are decidedly WEIRD (Western, Educated, Industrialized, Rich, and Democratic; Henrich et al., 2010). Specifically, the infants were tested in a mid-sized city in the US and a large metropolitan area in Germany. These infants have some exposure to plants, but their interactions with the natural world are very different than infants growing up in non-WEIRD societies. Therefore, to examine whether differences in exposure to and interaction with plants in daily life impact infants' responses to plants, we tested Shuar infants' behavior towards plants and other object types. The Shuar are an indigenous Amazonian society in southeastern Ecuador. Our sample consisted of 52 infants and toddlers from four small rural Shuar villages (7- to 36-month-olds). Children in these villages have substantial exposure to and experience with plants. Shuar participants were tested using a paradigm adapted from Wertz & Wynn (2014) to assess whether they also exhibit a reluctance to touch and increased social information seeking when confronted with plants. The stimulus set consisted of four real plants (two plants that grow wild in the surrounding jungle and two domesticated plants found around Shuar homes), two artificial plants, two novel manmade objects (matched to shape and color features of plants), two familiar manmade objects (cooking pot, spoon), and two naturally occurring objects (stones). An experimenter placed each stimulus object in front of the participant one at a time in a randomized order for 10 seconds; infants' touch behavior and looking behavior are subsequently coded from videos of the sessions. Video coding is ongoing, therefore we report here only a preliminary analysis of the touch data for half of the sample (N = 21). A repeated-measures ANOVA on participants' latency to touch plants shows a main effect of Object Type ($F(5,20) = 9.50$, $p > .001$, Partial Eta2 = .32; see Figure 1). Shuar infants and toddlers in the first half of the sample take longer to touch all three types of plants (wild, domestic, and artificial) compared to familiar artifacts and other naturally-occurring entities (p's < .005). Shuar infants also take longer to touch the novel artifacts than familiar artifacts or other natural kinds (p's < .009), but still take marginally longer to touch artificial plants than these novel artifacts ($p = .087$). These initial results suggest informative similarities and differences between the Shuar and WEIRD infants.

P1-G-186 Examining infants' expectations surrounding cooperation between a human and a robot

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Cooperation is fundamental to human society; from everyday interactions in which we must coordinate our actions with another to attain a common goal to the critical role that cooperation plays in the transmission and existence of culture over time (Tomasello, 1999; Tomasello, Kruger, & Ratner, 1993). Research has revealed that the ability to engage in (e.g., Brownell & Carriger, 1990; Warneken & Tomasello, 2007; Warneken, Chen & Tomasello, 2006) and understand cooperation (e.g., Henderson & Woodward, 2011; Henderson, Wang, Matz & Woodward, 2013; Warneken & Tomasello, 2007; Warneken et al., 2006) emerges in the first two years of life. Although much is now known about the developmental trajectory of cooperation in infancy, the majority of this research has been concerned with cooperative activities between humans. Which raises the question of whether cooperation could be present between human and non-human agents and how infants might regard these interactions. To begin to investigate this question, we presented 14-month-old infants with a cooperative exchange between a human agent and a non-human agent (i.e., a robot). Fourteen-month-old infants (n = 16) were habituated to a cooperative event in which a human and a robot retrieved resources (i.e., six cherries) from inside a plastic box (stimuli adapted from Henderson & Woodward, 2011). Infants were randomly assigned to one of two conditions; infants watched either the human open the box or the robot open the box. All infants were then shown two test events in which the resources were shared either equally or unequally between the partners. We hypothesized that if infants perceive the two agents (human and robot) as cooperating, then infants would look longer towards trials in which the cooperatively earned resources were not equally divided. Surprisingly, our preliminary data suggest that infants who watched the robot open the box and the human retrieve the resources showed a tendency to look longer towards the test trial in which the resources were distributed equally between the agents (data collection remains ongoing). Infants' perceptions of interactions involving non-human agents may help to shed light on how infants develop their early emerging expectations of cooperation.

P1-G-187 Infants' understanding of multiple agents' goal-pursuit in cooperative vs competitive context

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Human infants are sensitive to the efficiency of goal-directed actions (Gergely et al., 1995; Skerry, Carey, & Spelke, 2013), as well as others' intentions and beliefs already in their first year of life. Despite the progress in the field it is not yet known whether this early preparedness to track others' intention and the efficiency of the actions also involves the ability to represent interactive goal-directed events - when more than one agent pursue the same objective - within a teleological framework. We tested these questions in a series of studies using video animations depicting complex chasing events. These events involved three agents: two chasers and one chasee. In the first study, two groups (N=24 in each group) of 13-month-old infants were presented with one of two types of interaction patterns between the chasers representing either cooperative or competitive scenarios. In the cooperative condition the chasers' goal-pursuit exhibited cues of coordination, communication and joint efficiency. In the competitive condition chasers engaged in hindering each other in order to prevent the opponent from attaining the goal first. During the test phase both groups were presented with either of two kinds of outcome displays. Infants saw the chasers achieve their goal - catching the prey - and distribute the reward either equally (e.g. sharing the 'prey' by eating it up together) or unequally (e.g. one of the agents ate the 'prey' alone without sharing with the other). Infants reacted with longer looking time to scenarios where cooperative events were followed by unequal sharing. Thus, they linked cooperation with fair distribution of the gained resources. On the opposite, when agents demonstrated cues of competition, infants did not expect equal sharing. We replicated and extended these results in another set of studies of the similar design but a different setup and different behavioural cues. If social relations interpreted in terms of cooperation and competition has such a great predictive power over the protagonists subsequent attitude toward each other, then one would expect that the cognitive system responsible for this competence allows a great flexibility in categorizing interactions. In the second experiment we tested two more groups (N=24 in each group) of the infants of the same age. Similar to previous study, each group saw either cooperative or competitive pattern of interaction between the agents. However, we narrowed down the cues of cooperation to only one - joint instrumental action, and contrasted it to individual competitive action. The test phase was identical to the first study. Consistent with our predictions and similar to the previous study, infants showed the same looking pattern: they reacted with longer looking time to scenarios where cooperative events were followed by not sharing; in contrast, when agents demonstrated cues of competition, infants did not expect equal sharing. These results suggest that even at the age of 13 months infants are able to categorize cooperative vs competitive types of interactions between the agents, and this

categorization leads them to differential expectations about agents' subsequent sharing behavior.

P1-G-188 Should we consider infant clarity of cues when promoting responsive feeding?

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Rapid weight gain during infancy has been recognized as a prime target for prevention and intervention efforts and bottle-feeding has been highlighted as one of the strongest modifiable predictors of risk for rapid weight gain during the postpartum period, regardless of whether expressed breast milk or formula is in the bottle. Current recommendations and prevention programs aimed at reducing risk for rapid weight gain and obesity during early childhood have predominately focused on promoting responsive bottle-feeding practices. However, previous research examining responsive feeding has taken a mother-centric approach, focusing on relating mothers' feeding practices and styles to infant outcomes without adequate consideration of how infant behaviors - such as ability to effectively communicate satiation - may influence feeding interactions and influence mothers' abilities to adhere to a responsive feeding style. To this end, the objective of the present research was to examine associations between infant clarity of cues, responsive feeding, bottle-feeding, and weight gain during early infancy. Mothers (n=86) with 0-29-week-old infants completed demographic and infant feeding questionnaires, and reported infant birth weight and length. During a laboratory visit, infants were weighted and measured by trained research assistants; weights and lengths were standardized to weight-for-length z-scores (WLZ) using the WHO Growth Standards. Dyads were video-recorded while feeding their infants under typical feeding conditions; videos were later coded by two coders trained in the Nursing Child Assessment Feeding Scale (Sumner & Spitz, 1994). Infants were 15.5±7.6 weeks of age, 54% of mothers were primiparious, and 56% of dyads were non-Hispanic White. Forty-one percent of infants were bottle-fed at a low intensity (<20% of daily feedings), 20% of infants were bottle-fed at a moderate intensity (20-80% of daily feedings) and 39% of infants were bottle-fed at a high intensity (>80% of daily feedings). Infants who were bottle-fed at a high intensity had significantly greater change in WLZ from birth to study (ΔWLZ=1.34±0.32) compared to infants bottle-fed at a low (ΔWLZ=0.57±0.32) or moderate (ΔWLZ=0.46±0.46) intensities (p=.03). Across all bottle-feeding intensity groups, infant clarity of cues was a significant predictor of mothers' observed (p<.001) and self-reported (p=.04) levels of

responsive feeding, but mothers' observed or self-reported reported levels of responsive feeding were not associated with WLZ change and was not modified by infant clarity of cues. However, when results were considered by bottle-feeding intensity, interactions between infant clarity of cues and maternal sensitivity to infant cues were significant for infants receiving bottles at low and medium intensities ($p<.001$). For these infants, maternal sensitivity to infant cues was only associated with slower weight gain when infants had greater clarity of cues. For infants receiving bottles at a high intensity, only infant clarity of cues predicted WLZ change ($p=.01$), with greater clarity of cues associated with lower WLZ change. In conclusion, efforts to promote responsive feeding may need to also consider what the infant "brings to the table" and further research is needed to understand mechanisms underlying associations between feeding mode, responsive feeding, and infant clarity of cues.

P1-G-189 Facial mimicry in three-year-old children and its modulation by attachment security

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The goal of this study was to study the emergence and the modulation of facial mimicry in young children. Facial mimicry is conceived as the nonconscious tendency to mimic one's facial expression. While scholars acknowledge the social function of mimicry("social glue"), very little is known about its development and sensitivity to social dynamics during early development, such as affiliation-driven objectives. Pioneering work by van Schaik and colleagues shows that 3½-year-olds display behavioral mimicry, yet not sensitively to the social manipulation prompting affiliation. Likewise, 4- to 6-year-olds display selective behavioral mimicry, whereas 3-year-olds mimic indiscriminately. The question is whether mimicry becomes increasingly socially sensitive across development or previous paradigms were ineffective to capture the phenomenon in the youngsters. In adults, attachment security moderates affiliation motivation and also the expression of mimicry. Furthermore, attachment patterns influence the mimicry responses to negatively valenced stimuli differently during the conscious, compared to automatic processing phase. To tackle this issue, the current study investigated the relation between interindividual differences in the intrinsic drive to seek affiliation and facial mimicry differences in 3-year-olds. Accordingly, we tested the modulation of facial mimicry in 3-year-olds by attachment security, during the automatic and the conscious phase of processing, namely rapid and delayed facial mimicry, respectively. Subtle muscle activation of the

zygomaticus and the corrugator muscles in response to facial expressions was measured using electromyography (EMG), as it occurs during frowns or smiles, in response to sad and happy pictures, respectively. First evidence for the feasibility of EMG measures of facial mimicry, in 3-year-olds has been recently provided by Geangu and colleagues. Attachment security was assessed with two instruments: the Attachment Q-Sort during 90 minutes home observations, and the Attachment insecurity screening instrument. Eighty-two children were tested and 42 (25 girls; mean age 2.93) were included in the final analyses. Repeated measures ANOVA yielded a non significant muscle X condition X phase X attachment interaction. Yet it emerged a significant muscle x condition interaction and a significant main effect of attachment. Exploratory analyses showed that secure children mimicked exclusively happy stimuli, whereas insecure children (avoidant and ambivalent) mimicked exclusively sad pictures. Interestingly regression analyses yielded opposite patterns of mimicry for avoidant and ambivalent: higher ambivalent attachment scores predicted more mimicry, whereas avoidant attachment scores predicted less mimicry for sad stimuli.Our findings help unraveling the development of social mimicry in early childhood as well as the pivotal motivational processes underlying the intrinsic drive for affiliation in young children. Results show that attachment patterns have a great influence on facial mimicry responses, dependent on the emotional valence of the stimuli. The current study discusses the effects of early attachment relationships on the emergence of social mimicry in relation to emotional processes.

P1-G-190 Do infants infer both affiliation and disaffiliation from observing others? movement synchrony?

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Background & Aims: Similarity in the timing of actions is an important component of bonded social interactions. Mounting research shows that starting from 12 months, moving synchronously to the same rhythm with others facilitates affiliation (Tuncgenc, Fawcett & Cohen, 2015) and helping (Trainor & Cirelli, 2015). One recent study showed that infants associate movement synchrony with affiliation even when they are not involved in the movement themselves; 15-month-olds inferred affiliation among those who moved synchronously compared to those who moved non-synchronously (Tuncgenc & Fawcett, 2017). Investigating infants' third-party inferences is important as social development is facilitated by learning from others' interactions. Although the link between synchronous movements and affiliation seems robust, little is known about

whether non-synchrony is linked with disaffiliation. The current study explores this question by adapting Tuncgenc and Fawcett's (2017) paradigm. Method: Forty 15-month-olds will be recruited. The preliminary data reported is collected from 22 infants. The infants watched a short video that featured three toy characters (Figure 1). In the Movement Phase of the video, the two side characters moved either synchronously or non-synchronously with the central character in turns. In the Talking Phase, the central character said either "I like you!"(affiliation condition-AC) or "I don't like you!"(disaffiliation condition-DC), after which both side characters were highlighted simultaneously. Using Tobii eye-tracking, we examined which side character (synchronous vs non-synchronous) infants tended to look at following the central character's affiliation/disaffiliation statement. In alternating blocks, infants observed both AC and DC (counterbalanced): e.g., Bears-AC, Dogs-DC, Bears-DC, Dogs-AC. Results: Our preliminary data has not yielded statistically significant results; we thus present only descriptive statistics here (means and 95% confidence intervals). Over the four trials, infants looked somewhat more at the synchronous than the non-synchronous character in DC (Msync-nonsync= 0.06s, CI[-0.33, 0.54]) and more at the non-synchronous character in AC (Msync-nonsync= -0.07s, CI[-0.80, 0.66]). Although this pattern seems contrary to our initial hypothesis, a more careful investigation reveals a different pattern for Trial 1: More in line with our hypothesis, infants looked at the synchronous character more than the non-synchronous character in AC (Msync-nonsync= 0.16s, CI[-0.20, 0.51]) and in DC (Msync-nonsync= 0.10s, CI[-0.33, 0.54]), with this trend being stronger in AC. Importantly, the mean difference observed in the AC of Trial 1 was similar to that observed in Tuncgenc and Fawcett (2017; i.e., Msync-nonsync= 0.19s). Discussion: It is not yet clear why the results are showing a different pattern than we had expected. It might be a result of the study being underpowered with only half the data collected. Alternatively, the design including both affiliation and disaffiliation trials could be confusing, in which case a between-subjects design will be considered in pursuing data collection. Examining infants' affiliation and disaffiliation inferences based on movement synchrony is important for understanding how infants obtain social information from observing others' movements. Our findings also contribute insights into the replicability of existing findings in infancy research.

P1-G-191 Investigating social interaction behavior in 7- to 11-month-old infants

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Around 9 months of age, infants show a great qualitative change concerning their active social interaction behavior (Tomasello, 1999). One central developmental change is the emerging engagement in triadic interactions, referred to as joint attention: Infants do not only interact in dyads with objects or persons, but rather begin to share their attention with a social partner towards an object of mutual interest (Tomasello, Carpenter, Call, Behne, & Moll, 2005). In the current study, we intended to replicate the robust finding of previous research, showing an increase in social interaction behavior after 9 months of age. Infants from two age groups participated in the currently ongoing study: one group consisting of infants between 7 and 8.5 of age (n = 10; data collection currently ongoing; 4 females; mean age = 232.9 days, SD = 12.62 days) and one group consisting of infants between 9.5 and 11 months of age (n = 20; 10 females; mean age = 315.5 days; SD = 10.23 days). To investigate infants' level of active social engagement, we coded their looking behavior during a 5-minute free play session with their parent. For this purpose, we developed a coding scheme according to which four infant behaviors were coded in 5-second intervals: general looking at parent, looking at parents' face, eye contact between parent and infant, and joint attention looks between infant, parent, and an object of mutual interest. We hypothesized that if infants' social behavior increases after 9 months of age, the level of social engagement should be higher in the older compared to the younger sample. Preliminary results suggest higher levels of active social engagement in infants older than 9 months compared to infants younger than 9 months (p = .009). Our findings are in line with previous studies suggesting a decisive change concerning infants' social engagement between 7 and 11 months of age. On the poster, methodological challanges concerning the investigation of infant joint attention behaviour during free play will be discussed.

P1-G-192 Parent's Beliefs in Their Toddler's Ability to Self-Regulate Food Intake

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Most infants and toddlers have the nascent ability to self-regulate their energy intake (they eat when hungry and stop when full; Birch & Deysher, 1986), but parents may not recognize this in their children. This is problematic because previous research indicates that parents of infants 2-weeks to 6-months-old (Gross et al., 2011) and children ages 3- to 9-years old (Tan & Holub, 2011) who do not believe their child can self-regulate their food intake use more obesogenic feeding practices. However, research has yet to examine whether parents believe 12- to 36-month old children have the ability to self-regulate

their energy intake. This is a developmental period in which self-feeding abilities are developing (Daniels et al., 2009) and sets the stage for whether parents will provide children autonomy within the parent-child feeding relationship. The current study first examined whether parents believe toddlers can self-regulate their energy intake. Second, the study examined child and parent characteristics that might be related to parental perceptions of toddlers' energy regulation abilities during this crucial developmental period. Parents of 106 children 12- to 36-months old (43% girls, 75% white) reported on their toddler's energy regulation abilities, child characteristics (age, weight status, temperament, eating behaviors) and parental characteristics (mental health concerns). The mean score across energy regulation items was 3.8 (SD= .84; Range: 1.5 - 5.0) out of 5. A one sample t-test was conducted against a score of 4 (which would mean parents reported agreeing that children demonstrated the ability to regulate their energy intake). Results suggest that most parents in this sample do not believe children can regulate their energy intake, $t(101) = 9.32$, $p < .001$. There were no child gender differences in parents' beliefs in their toddler's energy regulation, $t(100) = .26$, $p = .80$. Correlational analyses suggest that beliefs about toddler's energy regulation are not related to child age or weight status (weight-for-length z-scores), but are related to children's temperament (Table 1). Children with more negativity and less effortful control were rated as worse at energy regulation. Children who were rated as fussier eaters, high in food responsiveness, high in desire to drink, or high in emotional overeating were also rated worse on energy regulation abilities. Parents who reported more parental depression, anxiety, or obsessive compulsive symptoms were also more likely to report that children could not self-regulate their energy intake. A hierarchical linear regression was conducted to see the relative importance of these predictors. The only step that was significant included child characteristics as predictors, $\Delta F (7, 89) = 8.79$, $p < .001$, $\Delta R2 = .41$. Child effortful control, food fussiness, and food responsiveness were the only significant univariate predictors. The current study was the first to examine parent's beliefs about their toddler's energy regulation abilities, bridging the gap between pediatrics and developmental science research. Results indicate that children's behavior inside (fussiness, responsiveness to food) and outside of the feeding domain (effortful control), can influence parental beliefs about children's self-regulation abilities and in the long-term may undermine the feeding relationship.

P1-G-193 Young children negatively evaluate people who do not help, even when helping is challenging

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Moral theories support judgments about the rightness of actions and the goodness of actors. Children's moral theories are rooted in social evaluations that appear early in development (Van de Vondervoort, 2017). Even infants avoid agents who actively hinder others or behave with harmful intent (Hamlin, 2007; 2015). But morality involves more than positively evaluating good actions and negatively evaluating bad actions. When someone is in need, providing help may be seen as obligatory, and inaction itself deemed impermissible. At what age do young children view helping as obligatory? To answer this question, we investigated how young children evaluate a person who is unresponsive to another person's need. In Study 1, three- to six-year-olds (N = 128) viewed two videos each. In the Helpful condition, they saw one actor help another access an out-of-reach object; in the Unhelpful condition, they saw her observe the other's reach but do nothing. Participants also viewed a baseline, no-help-needed video, with new actors whose movements matched those in the main video. From 4 years, children increasingly rated the helpful actor as nicer, and the unhelpful actor as less nice, than each condition's baseline actor; 2(Condition) x 2(Actor) x 4(Age) interaction, $F(3, 120) = 4.23$, $p = .007$. By 5, children's play preferences between actors followed the direction of these ratings ($p = .021$ and .021, respectively). In Study 2, we asked whether children are more accepting of inaction when it would be physically challenging for a person to help. Four-to-six-year-olds (n = 48) saw two videos each. In both videos, a character failed to provide help in the same manner as Study 1. In the Blocked condition, the focal actor was surrounded by a gate that limited her ability to provide help. In the Unblocked condition's video, the focal character had a gate nearby but it did not similarly constrain her movement. Overall, children did not view one actor as nicer than the other $F(1, 45) = 1.66$, $p = .205$, and this tendency did not vary across the age groups we tested, 2(Actor) x 3(Age) interaction, $F(2, 45) = .861$, $p = .43$. Children's play preferences also did not favor either actor (all p's n.s.) Overall, these studies highlight an important gap between the morally-relevant computations underlying infants' social evaluations and the moral theories that emerge later in development: Only by their 4th birthdays do children evaluate people according to whether they have upheld a general obligation to act prosocially toward others. Further, children's apparent disregard of the physical challenges that could explain unhelpful inaction suggests additional developments in their moral reasoning; this poster will also report an in-progress study examining this issue with a different procedure.

P1-G-194 Does the valence of prior behavior influence infants' agency attribution and action predictions?

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A crucial skill for young individual to thrive in the world is to differentiate entities whose actions are driven by mental states (agents) from entities whose actions are governed by external physical laws (non-agents). This ability enables individuals to identify potential social partners, predict others' actions, and generate appropriate responses. Past research shows that infants tend to over-attribute agency to non-human entities that look like agents (e.g., having eyes), move like agents (showing self-propelled movement), and act like agents (e.g., performing different actions to achieve the same outcome) (e.g., Biro & Leslie, 2007; Premack, 1990). In addition, recent evidence suggests that infants are more likely to attribute agency to objects that cause negative versus positive outcomes (Hamlin & Baron, 2014). The current study follows up on this line of research and examines whether infants' reasoning about agency and predictions of goal-directed actions are influenced by the valence of the object's prior behaviors. Participants (mean age = 13 months) are randomly assigned to four conditions in which an agent (a mechanical claw with eyes) or a non-agent (a mechanical claw without eyes) causes either a positive or a negative outcome. Throughout the study, infants' eye gaze is measured using an SMI REDm250 eye-tracker. The study begins with two familiarization events ("opening a box" scenario; Hamlin & Wynn, 2011), in which a mechanical claw either opens a box to help an animal puppet retrieve an attractive toy (positive outcome) or closes a box to prevent the puppet from getting the toy (negative outcome). Afterwards, infants' tendency to attribute agency to the claw is tested in five trials using a predictive looking paradigm (Adam, Reitenbach, & Elsner, 2017; Cannon & Woodward, 2012). In each trial, infants view the claw repeatedly reach and grab one of two toys (a rubber duck or a ball). Then the toys switch places, and the claw makes an incomplete reach between the toys. We reason that if infants attribute agency to the claw, they will show two eye-movement patterns: First, they will learn to look to the previously grabbed toy before the claw actually arrives there. Second, after the toys switch places, infants will still predictively look to the previously grabbed toy in a new location as opposed to the untouched toy in the old location. Given that infants show anticipatory looking for mechanical claws that demonstrate agency cues (Adam, Reitenbach, & Elsner, 2017), and that having eyes and causing negative outcomes are stronger cues to agency than having no eyes and causing positive outcomes, respectively, we predict that infants are most likely to show anticipatory looking for mechanical claws that have eyes and cause negative outcomes

(two strong agency cues) and least likely to show anticipatory looking for mechanical claws that have no eyes and cause positive outcomes (no strong agency cues). The data collection of the project is well underway and will be complete well in advance of the conference date. The findings of the study will shed light on how infants represent agency and understand others' mental states.

P1-G-195 Early experiences of sensitive maternal care predict infant health

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BACKGROUND: According to the developmental origins of health and disease (DOHaD) model, the first 1,000 days of life represent a period of increased vulnerability and plasticity in which environmental factors have lasting impacts on biological systems that contribute to later health (Barker, 2004). A growing body of research suggests that early experiences with parents may have important implications for children's health. In particular, early caregiving adversity--such as parental abuse and neglect--has been linked to child inflammation, abnormal brain development, and risk for cardiovascular and metabolic diseases (e.g., Miller et al., 2011; Shonkoff, 2016). Less is known, however, about how positive parenting may contribute to child health, especially in the first 1,000 days of life. Also unknown is whether the findings reported in high-risk families replicate in community samples, given that a large proportion of children receiving pediatric care are not high-risk. Thus, this study goes "beyond early adversity" to ask: Does the quality of parental care predict infant health in the first year of life in a community sample? METHOD: Participants were 187 healthy mothers and their full-term infants (86 girls), followed from birth to age 1. Mothers' behavior was observed in a naturalistic setting (home bathing session) when infants were 5 weeks old. Two trained, independent coders rated mothers' sensitivity and cooperation on a widely used, well-validated measure of maternal care (Ainsworth, 1969); inter-observer reliability was strong (intraclass correlations ≥ .94). Sensitivity and cooperation scores were combined into a composite reflecting overall quality of maternal care. Every month for the first 12 months of the child's life, mothers completed structured interviews about their infants' health symptoms, as well as prescribed antibiotic use (12 total assessments). Infant health symptoms were categorized into four non-overlapping domains according to established criteria from the International Classification of Primary Care: respiratory, digestive, skin, and general illnesses and symptoms (Lamberts & Wood, 1987; Soler et al., 2008). RESULTS: For each health domain, a hierarchical multiple regression was conducted, controlling for health-

related covariates that explained at least 1% of the variance. Results are displayed in Table 1. Higher quality maternal care predicted reduced rates of respiratory illnesses, ß= -.16, p=.015, ΔR^2=.03, and skin illnesses, ß= -.19, p=.007, ΔR^2=.04, and marginally lower prescribed antibiotic use, ß= -.13, p=.083, ΔR^2=.02. Effect sizes were small. Maternal behavior was unrelated to digestive and general illnesses, p's>.05. CONCLUSIONS: Quality of maternal care, even in the absence of adversity, may have implications for the developmental origins of health and disease. Although ample research has documented the negative health consequences of low-quality parenting, this study is among the few to show a potential contribution of positive parenting to child health in a community sample. Results suggest that parenting may be an important point of entrée for early prevention and intervention to support children's health (Britto et al., 2017; Hagan, Shaw, & Duncan, 2008; Perrin, Leslie, & Boat, 2016; Richter et al., 2017).

P1-G-196 Individual differences in response to joint attention in the first year of life relate to familial history of ASD

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Background: Triadic joint attention, or the ability to coordinate attention to objects in the distal visual field with another, is a critical milestone in infant social development. Responding to joint attention (RJA) emerges around 9 months of age and refers to an infant's ability to respond to a bid from another to share joint visual attention on an object (Carpenter et al., 1998). Developmental deficits in joint attention constitute a core feature of autism spectrum disorder (ASD), a highly heritable neurodevelopmental disorder characterized by impaired social communication beginning in early childhood (Charman, 2003; Mundy et al., 1986). Objective: We sought to determine whether RJA varies as a function of autism risk in n = 120 infants (n = 80 high-risk infant siblings of children with autism; n = 40 low-risk infants with no family history of autism) between 9 and 15 months of age. Method: As part of the ACE IBIS network, the present study examines RJA using the Dimensional Joint Attention Assessment (DJAA; Elison et al., 2013). This measure characterizes individual differences in infants' abilities to respond to joint attention using 4 series of hierarchically ordered joint attention bids that vary in cue redundancy. Average individual scores range from 1-4 with higher scores reflecting the ability to respond to

more subtle, less redundant bids for joint attention (i.e., response to gaze shift and head turn cues only). The DJAA was administered in a naturalistic, play-based setting during 163 assessments of infants at 9, 12, and 15 months of age. Average DJAA scores were compared between 51 assessments of low-risk (LR) infants with no familial history of ASD and 112 assessments of high-risk (HR) infant siblings of children with ASD. Results: Average DJAA scores are normally distributed in both LR and HR samples (Figure 1), reflecting the dimensionality of DJAA performance within this age range. A linear mixed effects model found that risk status significantly predicts DJAA scores ($X^2(1)=4.2382, p=0.039$), controlling for the effects of sex and age. On average, HR infants score 0.368 points lower on the DJAA than their LR counterparts, suggesting familial risk for ASD may confer deficits in social communication beginning in the first year of life. A linear mixed effects model including a risk-by-age interaction explains marginally more variance in DJAA scores ($X^2(1)=3.1782, p=0.075$) (Figure 2). Conclusion: Individual differences in RJA during the first year of life vary as a function of familial risk of ASD. Future analyses will examine DJAA patterns in infants later diagnosed with ASD compared to those at high-risk for the disorder who did not receive a diagnosis, to determine whether the observed group difference is driven by HR-ASD cases or is a robust familial risk marker. Additionally, we will examine associations between the DJAA and other outcome measures such as language development and adaptive behavior level. Identifying whether RJA performance differentiates HR infants who subsequently develop ASD has important implications for both early identification efforts and interventions that target early emerging social-cognitive skills.

P1-G-197 Do infants prefer prosocial others? A direct replication of Hamlin & Wynn (2011)

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Within the last five years, social sciences, especially psychology, have seen problems with replicability and reproducibility (OSC, 2015). A growing body of evidence suggests that low powered studies, undisclosed statistical flexibility and lack of pre-specified study standards are all contributing factors to a low rate of replicability (Frank et al., 2017). Within the realm of infant social evaluation, a topic of both theoretical interest and empirical controversy, both replications and non-replications exist (Steckler, Woo & Hamlin, 2017; Salvadori et al., 2015). Given this, and the movement toward replication in psychology in general, this poster will present results from a pre-registered direct

replication of Hamlin & Wynn's (2011) "box scenario," which examines whether preverbal infants prefer prosocial to antisocial others. We are in the process of directly replicating the box-opening act from Experiment 1 of Hamlin and Wynn's (2011) study. We have chosen to increase the sample size to 32 infants instead of 16 to better power this study. Infants watch a puppet show that involves three puppet characters: a prosocial dog ("the Helper"), an antisocial dog ("the Hinderer"), and the protagonist, a horse. The scene begins with the "Helper" and "Hinderer" puppets sitting in the far corners of the stage. In the centre of the stage is a clear plastic box and inside the box is a brightly coloured rattle. The horse appears on the stage through the centre of the back curtain, runs over to the side of the box and leans down twice to peers into the box, each time popping back up with excitement. The horse then jumps on top of the box and attempts to open the box, but fails because the lid is too heavy. On the final attempt, the "Helper" or "Hinderer" will run to the box. In the prosocial event, the "Helper" jumps on top and assists the horse by pulling the lid open. On the other hand, in the antisocial event, the "Hinderer" jumps on top of the box and slamming it shut keeping the horse from getting the toy. The prosocial and antisocial events will be presented in alternation until the infant is habituated (minimum of six and maximum of 14). After watching the show, the infant is presented with the "Helper" and "Hinderer" and asked to pick between them. Choice is recorded if the baby looks at the puppet first and then touches it. We have tested 16 infants thus far and 10 of them have chosen the prosocial puppet. We are confident that we will finish testing our sample of 32 infants before the ICIS conference. Our findings will add to the scientific understanding of infant social evaluation and provide an important opportunity to add to the replicability movement, thereby helping foster a more robust science and better confidence in our results. [Word Count= 465]

P1-G-198 Old Roads, New Paths: Mens Childhood Relationships with Their Fathers and Their Current Parenting

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Research has long supported the assertion that adults' experiences with their parents during childhood influence their later parenting; referred as "intergenerational transmission of parenting" (Main, Kaplan & Cassidy, 1985; van IJzendoorn, 1992), however two gaps persist. First, research on attachment and parenting has been based historically on women's relationships with their mothers (Main et al., 1985), only a handful of investigators tested intergenerational links between men's childhood relationships and

their current parenting within low-income samples of men, and findings have been inconsistent (Shannon, Tamis-LeMonda & Margolin, 2005). Second, research has moved beyond the assumption that early attachment histories are linearly linked to current parenting. Rather, intergenerational models of parenting allow for flexibility and adaptations in IWM over time by considering attachment within broader contexts (Berlin, Cassidy & Appleyard, 2008). Objectives. To address these gaps, our first objective documented patterns of association between men's childhood relationships with their fathers and their current fathering with low-income ethnically/racially diverse men. Our second objective examined individual and broader contextual factors that might explain different patterns of association from men's childhood relationships to current fathering (Cabrera, Fitzgerald, Bradley & Roggman, 2007). Specifically, we examined men's childhood relationships with their fathers, the father-mother relationship, and men's psychological functioning and resources in relation to their fathering. Method. The study included 501 ethnically/racially diverse low-income men from the National Early Head Start Research & Evaluation study. Men reported their experiences of acceptance/rejection from their fathers using the PARQ (Rohner, 1986), their involvement in caregiving and social-didactic activities with their 2-year-old children and their depressive symptoms, education and income. Results. Cluster analysis yielded a nine-cluster solution (Table 1): 3 groups of men reported high father acceptance, 3 groups reported high father rejection, and 3 groups reported having disengaged fathers. Within each of these reported experiences, men displayed different patterns of involvement with their children (high, moderate, low). Men's relationships with their children's mothers, depression, income and education predicted cluster-group (Table 2 for ANOVAs). Conclusion. Findings indicate that low-income men's perceptions of acceptance/rejection experiences with their fathers are related in complex ways to their own fathering. Men's perceptions of their fathers as accepting may be a protective factor encouraging positive involvement with their children when they maintain residence and agreeable relationships with their children's mothers, and when they are not subject to risk factors such as depression, low education, and extreme poverty. Similarly, men's perceptions of their fathers as rejecting or disengaged may motivate them to parent their own children differently and to be highly involved in their children's lives. Again, however, this pattern is more likely to emerge when men reside with their children and maintain positive relationships with their children's mothers. Our study indicates the need for closer examination of men's perceptions of their childhoods, relationships with their children's mothers, depression, resources and parenting over time.

P1-G-199 The importance of cultural context in research on developmental milestones

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The purpose of this study is to understand the cultural structuring of universal developmental tasks. Chinese mothers were asked to complete the Infant Feeding Attitude Scale (IIFAS), the Brief Infant Sleep Questionnaire (BISQ), and the short version of the Individualism-Collectivism Scale. Structural Equation Modeling (SEM) was used to determine the relationship between cultural orientation, infant feeding practices, infant feeding attitudes, and sleep arrangements and concerns. Results suggest that cultural beliefs and childrearing practices around developmental milestones such as sleeping through the night alone and weaning from the breast or bottle are systematically related. The results will be discussed in light of how public health messaging must be sensitive to cultural context.

P1-G-200 How do 2-year-old infants respond to unreliable informants?

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Infants are sensitive to false testimony at an early age. Around 16 months, they show increased attention when an informant mislabels a familiar object; already around 24 months they start correcting mislabeling adults. Around 4 years of age, children selectively learn from informants with a reliable track record, and even toddlers learn more when information is provided by a previously reliable speaker. But to what extent do toddlers employ the same strategies as preschoolers? We know that preschoolers track the past reliability of specific individuals, but do toddlers do the same or do they simply learn less in 'odd' situations. Studies that investigated selective social learning in young infants typically used paradigms with a single reliable or unreliable informant, possibly to reduce cognitive load. However, infants reduced learning from an unreliable informant in such situations could simply stem from confusion about the situation. Additionally, recent studies show that the availability of better alternatives during the acquisition of information is a crucial determinant of whether or not children learn from unreliable informants. When novel information offered by an unreliable informant is not contradicted by a more reliable source, children at 4 years appear to trust that informant

by default despite her prior unreliability. Is the availability of better alternatives during the acquisition equally crucial for how infants respond to unreliable informants? In order to keep the cognitive load low and at the same time be able to confront infants with both a reliable and an unreliable informant to exclude confusion about the situation as an alternative explanation, we used an eye-tracking paradigm that has been validated with 5-year-old children. We investigated how infants react to unreliable informants when they offer uncontested information (Study 1+2) or information that conflicts with that of a more reliable informant (Study 3). In our first study, 24-month-old infants (N=32) did not learn from either informant, however they used information from both to the same degree in a disambiguation task. They expected an unfamiliar label to refer to an unfamiliar object rather than to an object that had been labelled by the reliable or unreliable informant. In our second study, we increased the training and simplified the test trials, but still presented infants (N=32) with a reliable and an unreliable informant offering non-conflicting information. We found that they learned from both the reliable and the unreliable informant, as they looked significantly more towards the target after hearing the label used by either informant compared to during a baseline window before label onset. We did not find any differences in how they learned from either informant; a time-course analysis suggests that the looking behavior was the same in both conditions. This shows that when confronted with non-conflicting information, infants - just like preschoolers - learn from both reliable and unreliable informants. We are currently conducting a third eye-tracking study, where we confront 24-month-old infants with both a reliable and an unreliable informant who offer contradictory information. The data collection for this study is ongoing.

P1-G-201 The Association Between Maternal History of Childhood Maltreatment and Later Parenting Outcomes: A Meta-Analysis

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Childhood relational trauma experiences (CRTE) can be defined as experiencing abuse and/or neglect before reaching 18 years of age. It is now generally accepted that CRTE not only may have deleterious effects throughout the lifespan of an individual by predisposing them to different mental health outcomes such as depression, anxiety, conduct disorder and high levels of stress, but they may also exert an impact on their children. The transmission of the effects of CRTE to children has been observed with

mothers coming from high-risk circumstances (Madigan et al., 2014). One hypothesis to account for this association is that it is mediated by maternal behaviour towards her child. In the context of their own adjustment difficulties, mothers exposed to CRTE have fewer resources to cope with the challenges of childrearing and may adopt parenting behaviours that may make their children at greater risk of experiencing developmental difficulties. However, studies examining the association between CRTE and later parenting outcomes have yielded mixed results. Objectives: The aim of this study is to conduct a meta-analysis between CRTE and parenting outcomes of mothers of 0-to-5-year-old children. Several potential moderators of this link are also examined such as the type of CRTE experienced by the mother, the type of parenting outcomes measured, the age of the child and of the mother and the presence of different risk factors (poverty, teen motherhood). Methods: A systematic search of the literature was performed (PsycINFO, MEDLINE, Embase and Francis) using search terms related to CRTE and parenting. Reference lists from articles related to the topic were also examined. A total of 33 studies corresponding to the following criteria were retained: 1) there was an assessment of maternal CRTE; 2) there was a measure of the mothers' parenting behaviour towards their 0-to-5-year-old child; 3) papers were published in French or in English in peer-reviewed journals between 1980 and 2017. Results: Preliminary results show a small, significant association between maternal CRTE and parenting outcomes ($r = -.13$, $p < .05$; 95% CI: -.16, -.10). Two moderating effects were found. First, parenting difficulties were greater for victims of emotional and physical abuse and neglect ($r = -.19$, $p < .001$, $k = 51$) than for sexual abuse victims ($r = -.09$, $p < .000$, $k = 37$; $Q' = 10.47$, $p < .001$). Second, the type of parenting outcome measured also moderates the link between CRTE and parenting ($Q' = 19.60$, $p < .001$). CRTE appears to be more correlated to the quality of the parent-child interactions ($r = -.33$, $p < .01$, $k = 9$) than to the occurrence of poor parenting behaviour ($r = .12$, $p < .000$, $k = 46$; $Q' = 4.18$, $p < .05$). Discussion: Results confirm a significant association between maternal CRTE and their parenting of their 0-to-5-year-old children. Discussion focuses on the relatively low effect size found between CRTE and later parenting difficulties. Specific methodological and conceptual issues are raised, where factors that may change positively or negatively the impact of maternal developmental history on parenting are identified. The pertinence of integrating both resilience-based, as well as pathology-based, processes is addressed.

P1-G-202 Maternal Gatekeeping, Parenting Self-Efficacy, and Caregiving Behaviors in Mexican American Mothers and Fathers

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Culture influences how mothers and fathers raise their children and which caregiving behaviors are emphasized (Bornstein & Cote, 2001). Level of acculturation can likewise regulate thinking and behavior toward providing care and protection for infants (George & Solomon, 2008). Social persuasions are also significant in the development of self-efficacy; positive persuasions can encourage and empower, whereas negative persuasions can deflate and weaken self-efficacy (Bandura, 1997). Maternal gatekeeping can similarly influence fathers' self-efficacy as a parent; mothers can open the gate with support and encouragement (Schoppe-Sullivan et al., 2008) or close the gate with criticism or control (Fagan & Cherson, 2017). The purpose of this study is to examine the relationship between culture, maternal gatekeeping, self-efficacy in parenting, and caregiving behaviors in Mexican American mothers and fathers with a toddler. Participants were 27 Mexican-American mothers, fathers, and 12- to 18-month-old child (median age = 14 months). A majority of the mothers and fathers were married (74%) or living together (11%) and all of the toddlers (16 boys and 11 girls) were born in the United States. More demographic characteristics are presented in Table 1. Mothers and fathers were videotaped while playing together with their child for 10 minutes in structured and unstructured tasks with novel toys (McHale, 1995). Mothers were coded for facilitation and negative control (Altenburger, 2012). The parents were also videotaped on separate visits with their child in Smith and Pederson's (1988) competing demands task and coded for sensitivity (Ainsworth et al., 1974) followed by the Rothbaum and Schneider-Rosen's (1991) procedure that was coded for intrusiveness and disengagement (NICHD SECCYD, 1992). Each parent completed the Acculturation Rating Scale for Mexican Americans-II (ARSMA-II; Cuéllar, Arnold, & Maldonado, 1995) to assess acculturation by measuring orientation towards Anglo and Mexican cultures. The demographics portion of the questionnaire was used to assess generation level. Mothers and fathers completed the Maternal Self-Efficacy Scale (MEQ; Teti & Gelfand, 1991) to assess their perceived ability to perform effectively as a parent. For fathers, parenting self-efficacy was significantly correlated with disengagement. Confidence in the ability to parent may have led fathers to allow their toddler to play by themselves until it was necessary to provide protection. Facilitation was significantly correlated with intrusiveness. Fathers may be overly excited by mothers' encouragement to interact with their child making his caregiving abrupt and forceful. Mexican orientation was negatively correlated with facilitation. This finding indicates that mothers opened the gate to father-child interactions less when fathers were more Mexican-oriented. For mothers, Mexican orientation was negatively correlated with disengagement and marginally related to sensitivity in caregiving. These findings indicate that the more Mexican-oriented the mother, the more sensitive and less disengaged she

was in mother-child interactions. Maternal gatekeeping was unrelated to parental self-efficacy for both mothers and fathers in this sample indicating that parenting self-efficacy is not the mechanism through which gatekeeping influences caregiving as suggested by McNeil and Schoppe-Sullivan (2017).

P1-G-203 Maternal Sensitivity and Infants? Mother-Directed Gaze at Six Months of Age

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Background Parent-infant relationships provide an important context for children's early development across numerous domains. Of particular importance is infants' ability to use parents as a means for regulating emotion in the face of stress. During the first year of life, parents act as the primary source of emotion regulatory support, as infants progressively develop self-regulatory abilities (Calkins, 2011; Sameroff, 2010). However, co-regulation requires mutually-engaged interaction between infants and parents (Tronick, 1989), and low parental sensitivity may result in infants' inability to use them as a source of emotional support. The current study examined maternal sensitivity and infants' regulatory behavior, specifically mother-directed gaze during a stress-inducing interaction, in order better understand these mutual co-regulatory processes. We hypothesized that maternal sensitivity would be positively associated with mother-directed gaze. Method Participants were 222 mothers with varying depression and anxiety diagnosis histories and their infants. Eighty-seven (39%) mothers had a current diagnosis of depression or anxiety, 64 (29%) had a past diagnosis, and 71 (32%) had no history of depression or anxiety. Eighty-four percent of mothers were white, 12% were black, 9% were Hispanic, 5% were Asian, and 2% were Native American. The sample was highly educated, with 45% having postgraduate degrees, 30% having four-year college degrees, and 25% having less than four years of college. Mothers completed a baseline lab visit in the 3rd trimester, monthly phone interviews, and 3 lab visits with their infants at 2, 6 and 12 months postpartum. Throughout the first year, mothers reported monthly on their depressive symptoms using the Edinburgh Postnatal Depression Scale (EPDS; Cox, Holden, & Sagovsky, 1987). At 12 months, dyads completed the Strange Situation Paradigm, which was coded by trained observers to assess attachment security (Ainsworth, Blehar, Waters, & Wall, 1978). Results and Discussion Univariate repeated

measures ANCOVA analyses were conducted to assess the association between maternal sensitivity and infants' mother-directed gaze during each episode of FFSFP at 6 months. Child sex was included as a moderator in order to examine sex differences in this association. Covariates included child race, family income-to-needs ratio, and maternal education level. Results indicated a sensitivity x child sex x episode interaction, in which maternal sensitivity and mother-directed gaze were significantly negatively related among girls, but not boys. As illustrated by Figure 1, probing the interaction showed that girls with more sensitive mothers engaged in more mother-directed gaze during the still-face episode than girls with less sensitive mothers, $p = .02$. These preliminary findings suggest that during an emotionally and physiologically distressing task (i.e., the still-face episode, in which mothers instructed to be nonresponsive), girls of less sensitive mothers spend less time looking to their mothers for support. It is possible that these infants learn not use their less sensitive mothers for support, but rather engage in self-soothing, over the course of repeated interactions during their first six months of life. Examining such parenting mechanisms prospectively is critical for understanding infants' use of their mothers for help regulating emotions.

P1-G-204 Infancy predictors of triadic family interactions: Maternal and paternal mind-mindedness and mutually responsive orientation

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Family-systems theory (Minuchin, 1985) emphasizes the importance of examining different family sub-systems and their inter-relations when studying family influences on infant development. Consistent with this perspective, the quality of triadic (mother-father-child) interactions has been shown to provide a unique contribution to child outcomes, beyond dyadic (mother-child, father-child) relationships (Karreman et al., 2008). However, little is known about the predictors of these triadic interactions. Empirical evidence suggests that higher parental mentalization capacity during parent-toddler interactions is associated with higher levels of cooperation and co-parenting in triadic interactions (Marcu et al., 2016). Accordingly, one of the central indicators of parental mentalization during infancy, namely mind-mindedness (caregivers' tendency to consider their infant as an individual with a mind of his/her own; Meins, 1997), might be expected to predict the later quality of triadic family interactions. In addition, dyadic and triadic family subsystems have been found to be interrelated (Murphy et al., 2017); thus, the early quality of dyadic parent-infant interactions might constitute another developmental antecedent of the

quality of triadic family interactions. This study's aim was to investigate the contributions of mothers' and fathers' mind-mindedness, as well as their respective quality of dyadic interaction with their infant, to the prediction of the quality of mother-father-child triadic interactions at preschool age. 46 families (23 boys and 23 girls) drawn from a community sample participated in three visits over five years. Maternal and paternal mind-mindedness were assessed with the Meins et al. (2001) coding system at 12 months and 18 months, respectively, based on 10-minute sequences of parent-infant free play. Mother-infant and father-infant dyadic interactions were rated with the Mutually Responsive Orientation scale (MRO; Aksan et al., 2006) at 18 months during two separate 10-minute unstructured parent-infant interactions. Finally, triadic interactions were assessed at age 6 with the Family Alliance Assessment scale (Favez et al., 2011) based on a 15-minute joint mother-father-child play. All interactions were videotaped and rated by independent teams of trained assistants, and measures showed excellent inter-rater reliability (ICC = .80 to .96). Table 1 presents the correlations between study variables. Next, the quality of triadic interactions was regressed on all four infancy parenting predictors, namely maternal and paternal mind-mindedness and mutually responsive orientation. Results indicated that MRO-father had a unique and substantial contribution (ß = .45, p = .005) to the quality of triadic interactions five years later, beyond paternal mind-mindedness and maternal contributions. These results support family-systems theory, highlighting the interdependence of dyadic and triadic subsystems. They are also in line with previous studies emphasizing the important and unique role that fathers play, especially during the infancy-to-toddlerhood period and in play contexts (Grossmann et al., 2002; Tamis-LeMonda et al., 2004). Overall, this study reiterates the importance of the emotional quality of father-infant interactions for family life.

P1-G-205 From Feelings to Actions: Emotion Understanding and Prosocial Behavior in Toddlers

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Prosocial behavior can be seen as early as 14 months (Warneken & Tomasello, 2009). Some scholars contend that the emergence of prosocial behavior is tied to empathetic concern and understanding others' emotions (Hoffman, 2000).Research demonstrates that 11-28-month old infants can understand and interpret emotions before they can articulate them (Chiarella & Poulin-Dubois, 2013; Vallotton, 2008); helping behavior relates to emotion word comprehension in 18-20-month olds (Newton, Goodman &

Thompson, 2014); and concerned looks toward a victim of harm relate to helping behavior in 18-25-month olds (Vaish, Carpenter, & Tomasello, 2009). The current study explores relations between emotion understanding and emerging helping behavior in younger toddlers, and employs a nonverbal looking time procedure to assess emotion understanding at preverbal ages. 55 toddlers (14 - 23 months; M=16.38) completed an emotion understanding procedure followed by a helping task. For emotion understanding children were assigned to a happy (N=29) or sad condition (N=26). They watched 4 video vignettes (adapted from Denham, 1986; Hamlin & Wynn, 2011). Each vignette was repeated three times and was accompanied by a standard sound, identical across trials and conditions. In the first trial an experimenter (E) hurt herself (sad) or played by herself (happy). The three subsequent trials depicted happy or sad social interactions: E1 hugged (happy) or hit (sad) E2; E1 played ball with E2 (happy) or stole a ball from E2 (sad); E1 helped (happy) or hindered (sad) E2 as she tried to open a box to retrieve a toy. Experimenters' faces were obscured to conceal facial cues. Each trial ended with a blank screen accompanied by still photos of a happy and a sad female face, one on each side of the monitor. Looking time to each face was coded from the videos. In the instrumental helping task, E "accidentally" dropped a set of sticks and indicated her need for help using a series of 4 increasingly explicit cues. Helping was coded on a scale of 1 (helped after the first cue) to 5 (did not help). Regardless of condition, toddlers looked longer at the sad face than the happy face (t=4.52 p=.00). However, when grouped by age, older toddlers (>18 months, N=9, data collection ongoing) looked slightly longer at the face that was congruent with the vignette emotion (see Figure 1). Among younger toddlers (<17 months, N=46), the proportion of congruent looking was positively correlated with helping scores (r=3.21, p=.03) such that toddlers who looked longer at the face that corresponded to the vignette emotion helped less readily, likely driven by the sad-face looking bias. Among older toddlers, emotion-congruent looking was negatively related to helping scores (r= -.35, ns), indicating that older toddlers who exhibited looking appropriate to the emotion depicted in the vignettes tended to help more readily. Discussion will focus on the negativity bias in younger toddlers; growth of emotion understanding over the second year; and relations between emotion understanding and prosocial behavior in young children.

P1-G-206 New technology provides insight into early childhood interaction patterns in the classroom

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Background: A growing body of research captures the behaviors of individuals in real time to gain deeper insight into the dynamics of social behavior (Castellano, 2009; Lazer, 2009; Barthélemy, 2011; Holme, 2012; Palla, 2007; Sekara, 2016). Yet continuous measurements of children's group interactions in physical space are rare. Observations made by human observers are limited in the quantity of information that can be derived and occur in a sequential fashion in which only the interaction partners of an individual child can be assessed in any given moment. For example, when observing children in a classroom, manual coding of behavior cannot occur for all students simultaneously, but rather must be conducted at the level of the individual, with each student observed in sequence. Here we demonstrate how social ties within the classroom can be investigated by modeling automated continuous measurements of children's location and movement. We also examine whether and how the dynamics of classroom interactions are influenced by gender. Method: Using radio frequency measurements from a commercial system (Ubisense), we analyzed children's real-time location and movement in a kindergarten classroom during three 50-minute observations over the course of ten days. Participants included 16 children (Mage = 61.8 months, SD = 8.1 months). To allow for real-time location detection, all children wore an Ubisense sensor tag on their wrists. Observations took place during free play after children arrived at school, and teachers were instructed to avoid interfering with children's activities. Results: Based on the continuous capture of children's social behavior, we calculated a radial distribution function. This allowed for principled determination of times when children were in social contact by estimating when social affinity occurred at greater than chance levels. This social affinity range (one-meter) was used to assess each child's social contact with each other child. Total pairwise durations of social contact were then used to conduct network analyses, providing an overview of a web of social contacts in the classroom (Figure 1). These network analyses revealed male and female cliques with limited gender integration. We also examined transitivity of social contacts, that is, the degree to which having a mutual friend increased the likelihood that two children would befriend one another. All-female triplets (i.e., triads of girls) displayed somewhat greater transitivity than all-male triplets and consistently greater transitivity than hybrid (i.e., gender-integrated) triplets (Figure 2). Hence, all-female groups were more likely to spread their social ties within the group (suggesting higher levels of social influence) than all-boy or mixed groups. Conclusion: Commercial systems for tracking children's real-time location and movement can be modeled to understand classroom social interactions. This proof-of-principle study provides strong evidence that the application of this technology allows for a more comprehensive and detailed examination young children's development of group interactions.

P1-G-207 The roles of competition and cooperation in infants' social group affiliations

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Young children favor similar others, both those who share trivial but non-arbitrary attributes with them (e.g. a shared food or toy preference; Fawcett & Markson, 2010), and those whose similarity is arbitrary (e.g., color of an assigned T-shirt; Patterson & Bigler, 2006; Dunham, Baron, & Carey, 2011). A recent study found that infants, in contrast, exhibited the first pattern but not the second: They preferred individuals who shared their preference in mitten color, but showed no preference for individuals arbitrarily given the same-colored mittens as themselves (Mahajan & Wynn, 2012, henceforth M&W). This suggests that a preference for those sharing arbitrary features with oneself may be acquired in the first few years through cultural exposure and learning. An alternative possibility, however, is that infants are less attentive to arbitrary features than are older children, but that there may be conditions under which a preference for those with arbitrary similarities can be elicited. Competitive contexts increase adults' sensitivity to group distinctions and heighten own-group favoritism (e.g., Spielman, 2000). Experiment 1 asked whether a competitive interaction could induce in infants a preference for individuals sharing an arbitrary similarity. Sixteen 11.5-month-old infants were present two colors of scarves and mittens; the experimenter arbitrarily dressed the infants in one color, and then dressed two puppets, one in each color. Infants then observed a 15s video interaction in which the two puppets, wearing their colored clothing, competitively struggled for possession of a box. Infants were then encouraged to choose one of the two puppets. As competition engages cognitive systems for detecting and reasoning about coalitions and alliances and increases in-group allegiance, if these systems are online in infancy this manipulation might lead them to prefer the arbitrarily-similar puppet. Indeed, this is what we found; infants significantly chose the puppet wearing the same-color clothes as them ($p < .05$). While intergroup competition increases sensitivity to group distinctions and ingroup favoritism, intergroup cooperation has the opposite effect (e.g., Gaertner, Mann, Dovidio, Murrell, & Pomare, 1990). Accordingly, Experiment 2 asks whether seeing a cooperative intergroup interaction reduces infants' preference for those with non-arbitrary similarities. Here, 11.5-month-old infants choose their preferred color of scarves & mittens; the two puppets also each actively choose a color (one chooses the same as the infant; the other, the other color). Infants then see a 15s

video interaction in which the two puppets work together, successfully moving a box. If cooperation across groups reduces the significance of the group distinction for infants, this should reduce or eliminate their preference for the puppet sharing their color preference. Preliminary results (14 infants tested to date of a total sample of 16) support this hypothesis: Infants show no preference for one puppet over the other ($p > .2$). These results highlight the significance of cooperation and competition as cues to meaningful social group alliances and boundaries, and show that infants are sensitive to these cues in the first year of life.

P1-G-208 How does affective touch modulate arousal states? An investigation in early development

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The sense of touch plays a key role in an infant's life, most of the interactions with a caregiver, regardless of the purpose, are indeed mediated by interpersonal touch. Despite being ever-present, however we know far less about how infants process tactile compared to, say visual or auditory stimuli. Specifically, we are interested in whether infants process differentially touches with an affective valence from touches that subserve different functions. The aim of the present study is to investigate how affective touch affects arousal states in young infants. Animal and human studies suggest that touch modulates arousal states. Heart rate is a marker of arousal states, and heart rate deceleration is associated with lower arousal (Olbrich et al., 2011). In a recent work, heart rate decelerations were observed in 9-month-old infants when they experienced affective touch (slow stroking) but not when they experienced non-affective touch (very slow or very fast stroking) (Fairhurst et al.,2014). We tested 45 1-3 months-old infants to investigate if these effects are observed at an earlier time in life. The choice of this age group was also motivated by animal work that identified early infancy as a critical period for touch to elicit its effects on a number of measures, including response to stress and emotional reactivity, later in life. In this experiment, each infant received both slow (5cm/s) and fast (30cm/s) touch (administered via a soft brush). Experimental trials are 10seconds long and are interleaved with baseline trials, with no tactile stimulation, of 20 seconds. During the experiment infants were seated in a carseat and watched a colourful screensaver. We hypothesised that if affective touch represents for young infants such an important signal (as suggested by animal models), they will discriminate between the two stimuli at the physiological level showing decreased arousal in response to the affective (slow) touch. In order to

investigate both orienting (heart rate decrease that follows the beginning of the stimulation) and sustained responses (sustained heart rate decrease throughout the stimulation) to our stimuli we separately looked at responses during the first and during the second half of stimulation.We didn't find a main effect of touch type($F(1,43)=.33, p=.564$), but we found a main effect of time on the heart rate response($F(1,43)=20.30, p<.001$). These results support an early orienting response to both stimuli and a lack of a sustained response suggesting a)no discrimination between the stimuli and b)no further processing of either stimuli.Since it could be argued that infants are normally stroked with hands and not with brushes, the lack of the hypothesised response could be ascribable to the stimuli used. In order to investigate this possibility, we analysed data from two previous experiments that we conducted with5mo infants using fNIRS. In these experiments, we contrasted hand stroking to stroking with a spoon (exp1,n=27) or with a toothbrush (exp2,n=23). We extracted heart rate data from the fNIRS signal and performed the same analysis as for the brush study.Once again results are puzzling and in this case show that there is no response to the stimulation with the hand in both experiments while there is an orienting response to the most novel stimulus, the toothbrush. From our work, it emerges a difficulty to isolate a response unique to affective touch, at the heart rate level, in the these two age-groups.

P1-G-209 Controlling Parenting and Toddler's Noncompliance: An Observational Study

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The parent-child relationship can be gratifying. However, parental discipline can be especially challenging for both parent and child during toddlerhood, as children become increasingly capable to initiate and regulate their behavior (Maccoby, 1984; Nelson et al., 2014). Controlling parenting (CP) discipline is defined as tactics characterized by pressure and intrusion to control children's thoughts, feelings, and behavior in order to meet parental expectations (Grolnick & Pomerantz, 2009). It fosters children's overcontrolled regulation, thwarts rule internalization processes, and is a well-known risk factor for children's psychosocial adjustment (Baumrind et al., 2010; Joussemet et al., 2005; Laurin & Joussemet, 2017). Soenens and Vansteekiste (2010) argue that the type of parental pressure felt by the child and which motivates their behavior can be categorized as either external (threats, punishment and physical force) or internal (criticism, bribes and love withdrawal) types of CP. We hypothesize that these may elicit differential types of child

noncompliance. Indeed, according to Kochanska and Aksan (1995), children may ignore the parental agenda (passive noncompliance), they may openly dispute the directives (overt resistance), or they may angrily reject parental demands (defiance). Researchers investigating CP usually fail to assess the unique contributions of external and internal CP to various indices of child noncompliance in toddlerhood. This is a significant oversight, as children may react differently to the type of CP used by parents (Soenens & Vansteenkiste, 2010). Therefore, this study's objective was to examine whether external and internal CP in socialization contexts predicted toddler's passive, defiant or overt resistance noncompliance, after controlling for child temperament and family income. When toddlers were 2- and 3.5-year-old (T1 and T2), 76 parent-child dyads were videotaped during two laboratory visits, in which a request and prohibition task were performed ("Do" & "Don't"; Kochanska & Aksan, 1995). Primary caregivers' external and internal CP was coded at T1 (Laurin & Joussemet, 2017), and also filled-out socio-demographic and child temperament questionnaires (ECBQ; Putnam et al., 2006). Although both CP indices were moderately associated ($r=.36, p<.00$), they showed distinct relations to children's subsequent noncompliance in the "Don't;" context. Hierarchical regression analyses indicated that external CP at T1 predicted changes in child passive noncompliance at T2, controlling for child effortful control and passive noncompliance at T1 ($\beta=.36, p=.001$), explaining 13% of the variance in changes in children's passive noncompliance from T1 to T2 ($R2=.13$). Internal CP at T1 predicted changes in overt resistance at T2, controlling for family income and overt resistance in T1 ($\beta=.23, p=.03$), explaining 7% of the variance in changes in children's overt resistance from T1 to T2 ($R2=.07$). These results suggest that when parents use external CP to prohibit their toddlers from behaving in a certain way at 2-years-old, children are more likely to not comply by ignoring parental discipline at 3.5-years-old. Similarly, when parents use internal CP at 2-years-old, children are more likely to refuse compliance by calmly, openly rejecting parental demands. These results not only provide further support for dividing internal from external CP, but they also shed light on their respective influence on child socialization

P1-G-210 Mimicry of linguistic in-group members is modulated by the development of a sense of self: an EMG study with 18-month-olds

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Mimicry, the tendency to spontaneously copy others' behaviour, is thought to play an important role in social interaction. For example, adults mimic the postures of in-group more than out-group others, suggesting an affiliative role for mimicry(Chartrand & Lakin, 2013). Little is known about the development of mimicry, but it is plausible that group effects on mimicry are modulated by self-other comparison, a process that should depend on a sense of self(Prinz, 2012). One of the first aspects in the context of a sense of self that is thought to arise, is physical self-awareness, that begins to emerge at around 18 months of age. This aspect is usually tested with the mirror self-recognition task (MSR)(Amsterdam, 1972). Here we sought to explore whether facial mimicry of a linguistic in- and out-group model is modulated by developing self-awareness, by asking whether 18-month-olds who have already achieved self-awareness based on MSR exhibit greater facial mimicry of the in-group than out-group model compared to infants who do not pass the MSR. 38 18-month-old infants were tested with MSR, and we coded for behaviours in front of the mirror and percentage of looking time (%LT) at the mirror before and after a red mark was placed. Afterwards, they were presented with videos of a Native and a Foreign model performing mouth and eyebrow actions, while we measured activation of the infants' corresponding facial muscles using electromyography (EMG). After normalising the muscle activity within each participant and each muscle group to allow for meaningful comparison between regions, we calculated a mimicry score per trial, per condition, by subtracting EMG activity over the non-corresponding muscle region from EMG activity over the corresponding muscle region. Using the coding scheme from the original MSR study, 17 participants were classified as 'recognisers'(Rs) and 21 as 'non-recognizers'(NRs). The Rs showed higher %LT after the mark was placed on their cheek, $t(37)=2.78$, $p=0.006$, but there was no difference in %LT before mark placement between the two groups $t(37),=0.335$, $p=0.739$, indicating equivalent attentiveness in both groups. A repeated measures analysis on the Mimicry scores (activation over the corresponding muscle region minus activation over the non-corresponding muscle region) with Group (Native vs. Foreign speaker) and Action type (Mouth vs. Eyebrow) as within-subject factors, and MSR as a between-subjects factor revealed a significant main effect of Group, $F(1,36)=5.36$, $p=0.026$, and a marginally significant interaction between Group and MSR, $F(1,36)=4.021$, $p=0.053$. A post-hoc paired t-test revealed a significant difference between mimicry on Native (N) and Foreign (F) trials in Rs, $t(16)=2.24$, $p=0.039$, but not in NRs, $t(20)=0.235$, $p=0.817$(see figure 1). The number of valid EMG trials included was not different between Rs and NRs neither for the Native, $t(33)=0.228$, $p=0.821$, nor the Foreign condition, $t(33)=0.985$, $p=0.332$. 18-month-olds copied more actions performed by the in-group than the out-group model. However, that this effect was only statistically significant in the group of infants who exhibited MSR suggests a fundamental role played

by self-awareness in the modulation of mimicry. We propose that the emergence of self-awareness may permit self-other comparison, which may change infants' perception of the linguistic in-group member and, as in adults, modulate mimicry of the in-group model.

P1-G-211 Selective facial mimicry of minimal in-group members in toddlerhood

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Humans have a strong tendency to divide people into social groups, and to prefer those who share their group membership. For example, previous studies have shown that we evaluate more favourably, and are more willing to share resources with people who belong to our group (Locksley et al., 1980), presumably as part of a broader desire to affiliate with in-group members. These effects are present even when the cues to group membership are arbitrary, such as t-shirt colour or performance on a simple test (Tafjel et al., 1971). Mimicry, the unconscious tendency to copy others' actions, has been suggested to be one of the tools by which we enhance social affiliation, and previous studies have shown that adults and 4-, but not 3-year-old children will selectively mimic in-group members in a minimal group paradigm (e.g. van Schaick et al., 2016). Here we investigated whether arbitrary cues to group membership lead to selective mimicry in younger children if we use a more sensitive measure of mimicry. Sixteen 30-month-olds were randomly allocated to the green or red group as indicated by their t-shirt colour. Hereafter the toddlers observed videos of facial actions (e.g. mouth opening and eyebrow raising) performed by models who were either in their in- or out-group (based on their t-shirt colour), while we measured activation of their mouth and eyebrow muscle regions using electromyography (EMG) to obtain an index of mimicry. To validate whether our procedure elicited in-group preferences, toddlers were encouraged to choose between the two models by pointing at the model that they liked best at the end of the session. 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). A repeated measures analysis on the Mimicry scores with Group (In- vs. Out-group), and Action type (Eyebrow vs. Mouth actions) as within subject factors, and the toddlers' preference during the choice task (In- or Out-group member) as a between subjects factor, demonstrated a marginally significant main effect of Group, $F (1, 14) = 3.75$, $p = .073$, $\eta p2 = .211$, and a

significant interaction between Choice and Group, F (1, 14) = 9.32, p = .009, ηp2 = .400. As can be seen in Figure 1, only those toddlers who showed a preference for the in-group member during the choice task showed significantly greater mimicry of facial actions performed by the in- compared to the out-group member. These preliminary findings suggest that the tendency to selectively mimic minimal in-group members is present from at least 30-months of age. Data collected from the same participants on the same task at 24-months of age, as well as simultaneously recorded functional near-infrared spectroscopy data will also be presented, allowing us to explore the development of, and cognitive mechanisms underlying, the selective mimicry of in-group members in toddlerhood.

H: Emotional Development

P1-H-212 Clustering Infant Communication: Carving Nature at its Joints

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We present a novel approach to understanding types of infants based on microanalysis of infant communication behavior during mother-infant face-to-face interaction. By classifying infants into types (clusters), which generated unique behavioral profiles, and which predicted outcomes, we "carved nature at its joints." Clustering infants may allow us to identify novel markers of infant risk. Prior studies of mother-infant interaction have tended to use a variable-centered approach, meaning that the measured constructs, represented as the independent and dependent variables and their associations, are treated as universal and applicable to all participants of the study population. In contrast, this study uses a person-centered approach, which strives to identify behavioral profiles that apply to persons within a specific study subpopulation, but not necessarily in other subpopulations. We tested whether there are clusters of infants who show similar patterns of behavior across four communication variables: infant attention, facial affect, vocal affect, and head orientation. We videotaped (split-screen) mothers and infants of a large community sample (N=132) in face-to-face interaction and coded infant behavior on a 1-second time-base. K-means clustering was used to classify infants into 10 groups, based on variation in predictability of the infant's own moment-by-moment stream of communication behaviors (time-series autocorrelation function from t-1 to t0) and the

grand mean of the time-series (intercept). Clustering infants yielded comprehensible behavioral profiles. These clusters were differentially related to psychosocial variables: 4-month infant temperament (Carey & McDevitt, 1978), 4-month maternal anxiety (Spielberger/State), and 12-month infant-mother attachment (Ainsworth Strange-Situation paradigm). Problematic behavioral profiles were identified in Clusters 1 and 10. Infants in Cluster 1 were the most affectively distressed, and they vacillated between head orientations of enface and arch (the most extreme form of head aversion). Infants of Cluster 10 were inscrutable, with a profile of looking away, orienting away, being vocally silent and facially neutral. These two clusters were associated with outcomes known to be risk factors in development. Infants in Cluster 1 had the highest degree of 12-month disorganized attachment. Infants in Cluster 10 had the highest degree of 4-month difficult temperament. Three other clusters were associated with attachment resistance in the attachment assessment (Clusters 2, 3, 5), and Cluster 2 was also associated with 4-month maternal anxiety. Positive behavioral profiles were identified in three Clusters (6, 7, 9) who were similar in the highest use of extreme positive/engaged codes in all dimensions: attention, affect and orientation. Thus, our clustering approach enabled us to "carve nature at its joints," providing a classification scheme that predicted psychosocial outcomes. Strikingly, forms of infant head aversion were salient in four (of five) risk clusters, but head orientation is an oft neglected behavior in infant research. Our approach allowed us to discern problematic infant behavioral profiles that we cannot easily observe with the naked eye. These profiles may function as markers of later psychosocial difficulties, thereby providing targets for dyadic-behavioral treatment as early as 4-months of age.

P1-H-213 Maternal attributions of infant behavior and parenting in toddlerhood predict teacher-rated internalizing problems in childhood

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Social information processing theories of parenting posit that parents' beliefs and attributions about their children's behaviors contribute to how parents interact with their children, but these processes and their consequences are not well understood in infancy. The purpose of this study was to examine the associations between negative parenting attributions in infancy, harsh-intrusive parenting in toddlerhood, and children's internalizing problems in early childhood. Negative parental attributions are those in

which parents see their child's problem behavior as intentional, pervasive, and stable (Williamson & Johnston, 2015). While such attributions have been found to predict children's externalizing behaviors (e.g., Johnston at al., 2009), Rubin and Mills (1990) found that, compared to mothers of average or aggressive children, mothers of withdrawn children are more likely to ascribe negative attributions to their preschool-aged children, suggesting that negative attributions may play an important role in the emergence of internalizing behavior problems as well. However, the effects of negative attributions on children's internalizing problems in early childhood remain unknown. Exploring these links in infancy and toddlerhood is important because, in addition to their direct effect on later internalizing problems (Peters et al., 2005), parental attributions may contribute to harsh and intrusive parenting behaviors, a known risk factor for eventual internalizing behavior problems (Wagner et al., 2016). Parents who attribute child misbehavior to children's intentions tend to show more hostility and less warmth in their parenting behavior, and are at greater risk for maltreatment (Berlin et al., 2013). Identifying the extent to which negative parental attribution styles in infancy influence harsh and intrusive parenting behaviors, as well as subsequent internalizing problems, may be helpful in preventing the vicious cascade effect that these attributions often initiate. Using data from a diverse longitudinal study (n = 206), the current study used a structural equation modeling approach to test if mothers' negative attributions measured at 6 months using the Infant Intentionality Questionnaire predicted teacher-ratings of children's internalizing problems in first grade as assessed using the Child Behavior Checklist (CBCL; Achenbach, 2000), as well as the extent to which a latent factor of observed harsh-intrusive parenting behaviors measured at ages 1, 2, and 3 years mediated this link. Results presented in Table 1 show that maternal negative attributions in infancy predict more internalizing problems in first grade, $\beta = 0.21$, $p = 0.04$, but this link becomes non-significant when observed harsh-intrusive parenting is included as a mediator, $\beta = 0.021$, ns. A significant indirect effect suggests that harsh-intrusive parenting mediates the association between early negative attributions and eventual internalizing problems, $\beta = 0.19$, $p = 0.009$ (see Figure 1). This is the first study to elucidate the longitudinal consequences of negative parenting attributions in infancy, and suggests that harsh-intrusive parenting behaviors are one mechanism through which the effects of early attributions are carried forward. This link has clinical implications for parenting interventions and the prevention of childhood internalizing problems. The developmental and clinical implications of these findings are discussed.

P1-H-214 Oxytocin Receptor Genotype Is Associated with Variations in Mother-Infant Engagement During the Double Still-Face Paradigm

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Oxytocin, a neuropeptide hormone, is robustly associated with maternal care, sociality, and susceptibility to stress in non-human mammals (Donaldson & Young, 2008). A smaller literature links oxytocin to human parenting (Feldman & Bakermans-Kranenburg, 2017). Variations in oxytocin rs2254298 receptor (OXTR) genotype may underlie these associations. A-allele (risk) carriers have diminished oxytocin availability and greater stress susceptibility, whereas G-allele (non-risk) allele carriers have greater oxytocin availability, less stress susceptibility, and higher social cognition (Crespi, 2016). In the current study, we examined whether maternal or infant OXTR allele risk status, or dyads' shared OXTR risk status (both partners carry the risk allele) is associated with variations in mother-infant interactive behavior assessed before and after exposure to social stress (maternal still-face) during the double Still-Face Paradigm (SFP) at 7-months postpartum. Analyses were based on data collected for 75 mother-infant dyads from low-income backgrounds in an ongoing longitudinal study. Maternal, infant, and dyadic (shared) OXTR allele risk status was determined from maternal and infant salivary DNA samples. Mother-infant dyads were videotaped during a double SFP paradigm at 7-months postpartum, which comprised five successive 2-minute episodes: baseline play, still-face1, reunion, still-face2, and reunion2. Blinded reliable coders scored the videotapes for multiple dimensions of maternal, infant, and dyadic interactive behavior using 5-point Likert scales. Composite measures of infant positive engagement (responsivity, social engagement, positive affect, and soothability; M alpha=.86) and maternal positive engagement (sensitivity, flexibility, warmth, regulation of infant distress, and positive affect, M alpha=.81) were created in each dyadic episode. Infants' attempts to re-engage the mother, and level of infant withdrawal, and negative and positive affect during the two SF episodes were also evaluated. Maternal, infant, or dyadic OXTR allele risk status was not associated with infant sex or demographics. In mixed ANOVAs, a main effect of dyadic OXTR allele risk on infant positive engagement was observed, $F(1,70)=4.319$, $p=.04$, along with a within-subjects effect for episode, $F=3.548$, $p=.002$, and a risk X episode interaction, $F= 5.54$, $p=.021$. Dyadic OXTR risk predicted lower infant positive engagement during baseline play but not during subsequent episodes (scores decreased across episodes for both groups). Figure 1. Dyadic OXTR allele risk also predicted lower maternal positive engagement, $F(1, 70)=4.75$, $p=.03$, with no significant risk X episode interaction. Mothers in both groups

decreased in positive engagement across the three play episodes, F=3.811, p=.048. Figure 2. In contrast, infant OXTR risk status predicted fewer infant attempts to re-engage the still-faced mother, F(1, 70)=6.01, p=.017, but not infant affect or withdrawal. In sum, dyads' shared OXTR allele risk status is linked to less positive infant and maternal engagement during dyadic play in a double SF paradigm at 7 months postpartum. In contrast, infant OXTR allele risk predicted infants' reactions during the still-face episodes. Mother-infant interaction quality and infant reactions to social stress have biological correlates that may reflect varying oxytocin levels associated with the OXTR genotype of the individual or dyad.

P1-H-215 Does concordance between jealousy behaviors and physiology reveal continuity or discontinuity across the first two years of life?

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Early research suggested that infants were limited to experiencing emotions requiring little cognitive processing (Baumringer, 2013). Other researchers, however, have argued that young infants have complex cognitive capabilities, including those that involve discerning dyadic social exchanges (Hamlin, Wynn & Bloom, 2007). This disparity makes it important to examine the ontogeny and continuity of complex socio-emotions in the first years of life. Researchers have found associations between frontal EEG asymmetry and jealousy responses (Harmon-Jones, Peterson, & Harris, 2009) even in infants (Mize & Jones, 2012; Mize, Pineda, Marsh, Blau, & Jones, 2014). The aim of the current study was to examine behavioral and affective responses to the loss of maternal attention. Additionally, the relationship between behaviors and EEG were examined at 12- and 24-months of age to address whether infants demonstrate stability in jealousy responses across development. Behavioral and physiological data were collected from 25 mother-infant dyads at 12-months of age and from 20 participants at 24-months-old. Mothers ignored their infants and attended to one of two objects: a life-like doll or a cookbook. Infant responses were coded during the conditions using primarily second-by-second observations for: gaze toward mother/object, proximity, touch, vocalizations, level of arousal and affect. Baseline EEG recordings were obtained at the frontal, central, parietal, and occipital regions at each age. Power scores were analyzed within the 6-9Hz frequency band and subsequent EEG asymmetry scores were obtained by subtracting within region left and right power scores, Ln(right) minus Ln(left). Higher levels of approach-style behavior were found during the doll relative to the book condition at both 12- and 24-

months for Gaze and Proximity (paired ts = 5.30 to 2.37, ps < .05) and at 12-months for Touch, p > .05. Further, higher levels of arousal were found in the doll condition at both ages (ts = 2.07 to 2.80, ps < .05), but significantly decreased across age, t=4.19, p < .001. Correlational analyses were conducted to examine relationships between EEG and the different approach-style behaviors at 12- and 24-months, see Tables 1 and 2 for contrasts. For Gaze, six contrasts showed differences with only one correlational difference worth noting for Proximity (lateral frontal, Book condition), and four for Touch, (one in mid-frontal-Book condition and three in mid- and lateral-frontal and parietal-Doll condition). Consistent with past research (Hart & Carrington, 2002), 12- and 24-month-old infants demonstrated more approach-style behaviors in the social rival (doll) condition, suggesting that infants demonstrate developmental continuity in their behavioral responses to the loss of maternal attention in a social-rival condition. Interestingly, preliminary analyses failed to demonstrate concordance between EEG asymmetry and individual infant approach behaviors across age. The most reliable measure, gaze, had 6 contrasts that showed different correlational patterns across age. This suggests some discontinuity of function and that different neurological/psychological mechanisms may underlie jealousy-related behavior at these two times in development. It should be noted, however, that one behavior may not fully capture jealousy and to more fully address this issue, additional contrasts will be examined including consideration of a global jealousy index.

P1-H-216 What's Going on in My Baby's Mind? Mothers' Executive Functions Contribute to Individual Differences in Maternal Mentalization

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Maternal mentalization (MM) refers to mothers' capacity to understand mental-states of themselves and their children and to regard their children as psychological agents (e.g., Zeegers et al., in press). In mother-infant interactions, MM can be divided into two dimensions: appropriate(A-MM) and nonattuned (NA-MM) interpretations of infants' mental-states (Meins et al., 2012). A-MM refers to interpretations that seem to be compatible with the infant's mental-states, whereas NA-MM refers to noncompatible interpretations. The aim of this study was to investigate the role of executive functions (EFs) in A-MM and NA-MM. We hypothesized that maternal EFs would be associated with higher MM. First, mothers need to monitor changes in the dyad in order to track their infant's mental-states. Thus, we expected a positive correlation between updating and A-

MM. Second, mothers should inhibit distractors in the environment and inappropriate automatic responses or comments. Hence, we expected a negative correlation between inhibition and NA-MM. Third, parents need to shift between the child's and their own perspectives. Thus, we expected shifting to be correlated positively with A-MM and negatively with NA-MM. Furthermore, the moderating roles of two infant characteristics, prematurity (as a stressful context) and child temperament (as a context of unpredictability and negative emotionality) were examined. Mother-infant free-play interactions were videotaped and coded for MM in a sample of 102 mothers and their 6-month-old infants (61 preterm, 41 full-term) using the mind-mindedness coding system (Meins & Fernyhough, 2010). Mothers completed the Infant Characteristics Questionnaire (Bates et al., 1979) for the assessment of child temperament. For EFs assessment, mothers completed computerized tasks when children were 66-months old. Updating was measured using the 2-back task. Response inhibition was measured using the antisaccade task, and resistance to interference (i.e., inhibition of distractors or irrelevant information) by combining the flanker and 2-back intrusion-cost effects. Finally, the cued task-switching task was used to measure shifting. Although MM was measured before EFs, EFs measures were used as statistical predictors under the assumption that individual differences in EFs are consistent across lifespan (e.g., Miyake & Friedman, 2012). Regression analyses, with education and vocabulary as covariates, revealed a positive association between A-MM and updating (β =.26, p = .026), which was moderated by child temperament (β =-.21, p = .032): the link was stronger when mothers rated their infant as more difficult (β =.49, p = .005) compared to easier (β =.07, p = .594; Figure 1). Resistance to interference and prematurity interacted in predicting NA-MM (β =.26, p = .018): the link was negative in the full-term (β =-.43, p = .024) but nonsignificant in the preterm (β =.10, p = .401; Figure 2) group. Shifting and response inhibition were not associated with MM. These findings suggest that EFs support MM. Appropriate references to infants' minds seem to rely on mothers' ability to monitor relevant information, especially when infants are perceived as more unpredictable. Misinterpretations of infants' mental-states seem to reflect instances in which mothers have difficulties in suppression of irrelevant information, but not in the stressful context of having a preterm infant.

P1-H-217 Temperament in Toddlers Born Preterm: Early Childhood Behavior Questionnaire-very short form

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Preterm birth can impact some aspects of temperament such as high intensity pleasure, motor activation, perceptual sensitivity and cuddliness (Klein et al., 2013). The Early Childhood Behavior Questionnaire (ECBQ; Putnam, Gartstein & Rothbart, 2006) is a widely used measure of early childhood temperament. The ECBQ has a short and very short form created to facilitate the application, since the standard form contains 201 items and takes an hour to complete, which can be exhaustive depending on the study. However, in Brazil only the full version has been used till the moment. Therefore, study with the very short are needed to verify the applicability and validity of the instrument. The present cross-sectional study aims to examine the temperament of toddlers born preterm in comparison to toddlers born full-term. To reach this main purpose we also examined the psychometric properties of the ECBQ very short form, to establish the appropriateness of its use for assessing the temperament of Brazilian toddlers. The sample included 135 toddlers born preterm (gestational age mean = 29.82 weeks [±0.21]) and 86 born full-term (gestational age mean = 39.94 weeks [±0.08]). Mothers completed the ECBQ full version, but only the items of the very short-form of the instruments were used for this study. We conducted a confirmatory factor analysis (CFA) to verify whether the fit of the measurement model proposed by the scale's developer was also acceptable for a Brazilian sample. The ECBQ very short included 36 items with a three-factor structure (Negative Affect, Surgency and Effortful Control). Firstly, the CFA showed that the loadings of 12 items were not statistically significant. Therefore, we excluded these items and conducted the CFA again, which revealed an adequate overall model fit (RMSEA = 0.06; SRMR = 0.069; and x2 (249, n=221) = 451.324; x2 /df = 1.81). The final items of each construct were summed generating a score and a Student t test was performed to comparison between groups. The results showed that, regarding temperament, there were statistical significant between the two groups for the three factors, Negative Affect ($p<0.01$), Surgency ($p<0.01$) and Effortful Control ($p=0.01$). Compared with the toddlers born full-term, the toddlers born preterm exhibited higher scores on the Negative Affect (preterm M = 40.00; full-term M = 36.02) and Surgency (preterm M =38.24; full-term M = 33.95), and lower scores on the factor Effortful Control (preterm M =32.33; full-term M = 35.17). These findings indicated that children born preterm presented development vulnerabilities in temperament, showing poor emotional self-regulation at toddlerhodd. The results provide preliminary evidence for the applicability of the ECBQ-very short for measure the temperament of Brazilian toddlers. With this reduced version, it was possible to verify differences between the groups in the expected direction. These results encourage the use of the ECBQ very-short form which is a quick and easy method for assessing temperament and facilitates the application on large-scale surveys and hospital protocols.

Incorporation of temperament assessment in the treatment of children born premature holds promise for promoting healthy development in these vulnerable populations.

P1-H-218 Differentiating parenting and extrafamilial stress as predictors of dyadic dysregulation in Mexican-American mother-infant dyads

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Introduction: Everyone is exposed to some form of stress throughout their life. Parents experience everyday external stressors in addition to specific stress related to the parenting role. Indeed, the cumulative effect of stress has been extensively studied, with research highlighting the negative impact of both parenting stress and external stressors on parent and child competencies. Stress in one domain of life is thought to have an impact on others (Bolger et al., 1989; Crnic & Low, 2002); however, few studies have empirically tested differences between the effects of parenting and extrafamilial stress. The goal of the current study is to differentiate trajectories of parenting stress from extrafamilial stress and connect profiles of stress to the quality of parent-child interactions during infancy. Methods: This study draws from a sample of low-income, Mexican-American mothers using data from the Las Madres Nuevas project (N=322). A multimodal method of data collection was used, including observationaland parent-report measures. Latent Class Growth Analysis was employed using data from seven time points between infants' age 3 months to 24 months. After determining the number of latent trajectory classes for each stress variable, the BCH method (Bolck, Croon, and Hagenaars, 2004) was employed to compare classes on a continuous distal outcome (24-month dyadic dysregulation). Results: For parenting stress, five latent classes were identified: Low-Stable, Moderate-Stable, Moderate-Increasing, High-decreasing, and High-Stable. Examination of dyadic dysregulation across classes indicated that the High-Stable group had significantly higher dyadic dysregulation compared to the Low-Stable, Moderate-Stable, and High-Decreasing groups. The High-Stable group did not significantly differ from the Moderate-Increasing group. For extrafamilial stress, four latent classes were identified: Low-Stable, Low-Increasing, Moderate-Decreasing, and High-Stable. Examination of dyadic dysregulation across classes suggested that the Low-Stable extrafamilial stress group had significantly lower levels than the Moderate-Decreasing group. Although no other statistically significant differences emerged, the Moderate-Decreasing group was found to have the highest mean levels of dyadic dysregulation compared to the High-Stable, Low-Stable, and Low-Increasing extrafamilial stress groups.

See Figure 1 and Table 1 for a summary of all results. Discussion: These results indicated distinct trajectories for parenting versus extrafamilial stress and also suggest differential effects of parenting versus extrafamilial stress on dyadic dysregulation. Experiencing parenting stress at high levels, either consistently or over time, may have implications for future dyadic interactive behavior. Mothers with moderate but increasing parenting stress were comparable to mothers with consistently high levels of parenting stress, whereas mother's with initial high levels but decreasing parenting stress over time had significantly lower levels of dyadic dysregulation. In comparison, chronicity of extrafamilial stress does not appear to have the same negative effect on dyadic interactions. Examining longitudinal and developmental profiles of stress provided information above and beyond that of a single time point and allowed for a better understanding of the chronicity and complexity of stress processes.

P1-H-219 My Emotions: A New Self-Report of Mothers' Emotional Reactions to Infant Crying

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Prior research demonstrates that empathic/infant-oriented emotions are associated with sensitive parenting, whereas negative/parent-oriented emotions are associated with insensitive/negative parenting (Dix et al., 2003; Leerkes, 2010). Such emotions have primarily been assessed using a time-intensive interview approach. The My Emotions scale is a brief parental self-report designed to distinguish between specific infant-oriented and parent-oriented emotional reactions to infant crying. In this poster, we present evidence of the internal consistency, convergent validity with emotions measured via the interview approach and with self-reported cognitions about infant crying, and predictive validity to maternal sensitivity/behavior. Mothers (N = 240; 50% African American, 50% European American) completed the 20 item My Emotions scale when their infants were 6 months and/or 1 year old by rating the extent to which they tend to feel specific emotions when their baby cries on a 5 point scale from never to always. At both times, mothers were interviewed about their emotional reactions to infant distress using a video recall method. Maternal sensitivity was rated during free play and distress eliciting tasks when infants were 6 months, 1 year, and 2 years old using Ainsworth's sensitivity scale; scores were averaged over time. The proportion of time mothers engaged in egregiously negative maternal behaviors (e.g., mismatched affect, intrusiveness) during the distress eliciting tasks was also averaged over these time points. Mothers self-reported on their non-

responsiveness to infant crying at 6 months and 1 year on the Maternal Responsiveness Scale, which were averaged, and their use of over-reactive discipline on the Parenting Scale at 2 years. An exploratory factor analysis yielded 5 scales with good internal consistency reliability and significant stability from 6 months to 1 year (see Table 1). Mother reported anxiety, frustration, sympathy and empathy tended to demonstrate significant convergent validity with parallel interview measures, although the magnitude of associations was generally small (see Table 2). Amusement was not assessed via the interview technique; hence convergent validity is not reported. Mothers' amusement, anxiety, and frustration tended to correlate positively with negative beliefs and attributions about crying (mean r = .25) and with negative, non-responsive, and harsh behavior (mean r = .21) and negatively with infant-oriented beliefs about crying (mean r = -.19), but not with sensitivity (mean r = -.10). Generally, amusement and frustration were stronger correlates of maternal cognition and behavior than anxiety (mean r = .21 vs. .14). Mothers' empathy and sympathy correlated positively with infant-oriented beliefs about crying (mean r = .29) and with maternal sensitivity (mean r = .16) and negatively with negative, harsh, and non-responsive behavior (r = .13), but not with negative cognitions (mean r = -.08). Generally, empathy was a stronger correlate of maternal cognitions and behavior than was sympathy (mean r = .21 vs. .11). In sum, this brief parental self-report of emotional reactions to crying appears to be a reliable and valid measure and may be of use in applied and basic research when the time intensive interview approach is not feasible. In the future, the scale should be evaluated with fathers.

P1-H-220 Associations between Maternal Emotion Dysregulation during Pregnancy and Newborn Neurobehavior

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Background: Emotion dysregulation (ED) is a reliable correlate of psychopathology across the lifespan (e.g., Beauchaine, 2015). For a dysregulated pregnant woman, this may have implications for her unborn child. ED is partially heritable but during pregnancy ED might also influence newborn regulatory outcomes via in utero exposures to maternal stress. For instance, self-reported anxiety and depression during pregnancy predict negative newborn behavior reactions to stimuli (e.g., back arching, crying; Davis et al., 2004). Because ED and stress are complex, multifaceted constructs, it is important to use a multiple-levels-of-analysis approach, including respiratory sinus arrhythmia (RSA), behavioral observations, and self-report measures. The current study will utilize this

approach to advance understanding of intergenerational transmission of ED from mother to newborn. We hypothesized that maternal self-reported ED would predict poor infant self-regulation. Moreover, we predicted that maternal resting state RSA would mediate this relationship, such that greater self-reported ED would be associated with reduced RSA, which would in turn predict poorer infant self-regulation. Method: We recruited 74 pregnant women with a range of scores on a self-report measure of ED, the Difficulty in Emotion Regulation Scale (DERS). These women were in their third trimester and they completed physiological assessments at baseline and in response to the Trier Social Stress Task (TSST). Finally, participants completed a comprehensive self-report battery of ED, psychopathology, and stress. Shortly after birth, we administered the NICU Newborn Neurobehavioral Scale (NNNS) to assess early behavioral indices of infant self-regulation and stress. The NNNS self-regulation summary score is derived from the examiner's ability to soothe the infant while also incorporating a rating of the infant's ability to soothe him/herself. The stress signs summary score is a count of the number of stress signs (e.g., startles, hypertonia, back arching). Data collection is ongoing with an anticipated N = 162 (pregnant women and newborns). To examine these preliminary data, we ran a series of Pearson correlations. Preliminary Results: Psychophysiological data are forthcoming and are thus not included in these preliminary analyses. We found a trending negative correlation between maternal total DERS score and NNNS self-regulation ($r = -0.21$, $p = 0.070$), suggesting that as maternal ED increases, newborn self-regulatory capacity decreases. We also found a significant negative correlation between the DERS goals subscale and newborn self-regulation ($r = -0.23$, $p = 0.049$), meaning that maternal difficulty with goal-directed behavior predicted poorer infant behavioral regulation. Discussion: Preliminary results support our overarching hypothesis that maternal emotionality during pregnancy can predict newborn outcomes. Upon completing data collection, we will use Bayesian Structural Equation Modeling (SEM) to examine how resting RSA mediates the relationship between self-reported ED and newborn neurobehavior. We will also test a similar second model for stress. With Bayesian SEM, we will examine how RSA reactivity to the TSST mediates the relationship between self-reported stress and newborn (NNNS) stress. This project will advance developmental science by examining ED and stress across generations, which has implications for healthy child development and the emergence of psychopathology.

P1-H-221 Leveraging Python to process cross-cultural temperament interviews: Methodological demonstration in developmental science

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The importance of language use in the study of individual differences in temperament and personality has a long-standing history. For example, the lexical approach stipulates that significance assigned to individual attributes and their conceptual scope can be gleaned from the words available to describe the traits in a particular language (Saucier & Goldberg, 2001). Although self-report is the method of choice for studying individual differences in adulthood, in childhood parents represent the typical sources of information concerning youth temperament (Gartstein, Bridgett & Low, 2012). Interviews bring a wealth of information concerning the child and her "developmental niche", and are widely utilized in cross-cultural research (Harkness & Super, 2016). Despite their wide-ranging applications, interviews present with notorious data reduction challenges, as quantification of narratives has proven to be a labor-intensive process. The present study represents a demonstration project aimed at leveraging emerging technologies for this purpose. Specifically, we used Python natural language processing capabilities to analyze semi-structured temperament interviews conducted with US and German parents. US (N = 46) and German (N = 49) caregivers were interviewed in their homes regarding their toddler's temperament, with additional measures collected in the context of a larger project. The Temperament Interview (Kirchhoff et al., 2013) was designed to elicit information concerning mothers' views of their children's reactive and regulatory tendencies, addressing temperament as defined by the psychobiological approach (Rothbart & Derryberry 1981). This interview was developed specifically to capture cross-cultural differences in parental ethnotheories/socialization goals relevant to child temperament. Interviews were transcribed, with German narratives translated into English. A list of 99 temperament words was used as the basis for considering differences between US and German temperament descriptions (Anderson, 1968). Python natural language processing was utilized to identify these key temperament words in the caregiver interview protocols, compiling frequencies for each sample. The code opens each interview and the temperament word list, then examines each interview for the frequency at which each of these words appear. This output is then listed in descending order, with the most frequently appearing word first. Independent-groups t-tests conducted to compare German and US samples yielded a number of significant differences. Specifically, German parents described their toddlers as significantly more cheerful, friendly, careful, and angry compared to US caregivers. According to US mothers', their children were more independent and emotional, as well as timid. The former descriptions are in part consistent with previously reported differences, wherein German toddlers received higher sociability ratings, relative to their US counterparts (Kirchhoff et al., 2013). More frequent mentions of independence in the US temperament narratives can be thought of as

consistent with US being higher on the individualism cultural orientation dimension compared to Germany (Hofstede, 2001). These results contribute to the existing literature addressing cross-cultural differences in temperament and also provides an important demonstration of an advanced computational technique, leveraged here to quantify interview data concerning child individual differences.

P1-H-222 Maternal History of Early Adversity Affects Sensitivity to Traumatic Stress During Pregnancy

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The Developmental Origins of Health and Disease theory posits that fetal exposure to maternal stress (e.g., prenatal depression) can have enduring effects on infant neurodevelopment through prenatal programming effects (Glover et al., 2010; Moog et al., 2017). Exposure to prenatal traumatic stress, such as intimate partner violence (IPV), is a particularly potent risk factor for prenatal depression and anxiety (Beydoun et al., 2012). Importantly, not all pregnant women exposed to IPV develop depression and anxiety, highlighting the need to identify moderators that explain this variability in stress sensitivity. An emerging literature guided by a lifespan model of perinatal health suggests that women with early life adversity (ELA) may be more vulnerable to prenatal mood problems (Alvarez-Segura et al., 2014; Wosu et al., 2015; Yildiz Inanici et al., 2017). Building on these findings, the present study aims to explore whether the association between IPV and prenatal mood/anxiety problems is moderated by maternal history of ELA. We hypothesize that ELA will increase later risk for prenatal depression and anxiety by heightening sensitivity to IPV during pregnancy. Participants include 255 pregnant women (aged 18-24) who are part of an ongoing longitudinal study of urban-living women assessed annually since age 5. The sample is racially and socioeconomically diverse (52% African-American; 33% receiving public assistance). ELA data were prospectively gathered annually from ages 5-16, including self- and parent-reported measures (Difficult Life Circumstances, Child PTSD Symptom Scale, Abuse Questionnaire) of multiple adversity domains integrated into a cumulative ELA index (e.g., poverty, single parenthood, trauma, physical/sexual abuse, community violence). During the year of pregnancy, women were evaluated for exposure to IPV (Conflict Tactics Scale) and prenatal depression and anxiety (Adult Self-Report Inventory-4). Based on a preliminary sample of 173 women (data cleaning for full sample in progress), prenatal IPV was significantly associated with prenatal depression, and this was moderated by maternal

ELA (Table 1). Intriguingly, findings suggest that the impact of ELA on prenatal sensitivity to IPV may be curvilinear (Figure 1): Compared to women with low ELA, women with moderate ELA exhibited higher depression when exposed to prenatal IPV, consistent with hypotheses. However, women with the highest ELA appeared to demonstrate a "blunted" effect to traumatic stress in pregnancy, such that IPV was associated with lower depression symptoms than any other group. These preliminary results are consistent with the Adaptive Calibration Model (Del Giudice et al., 2011), an evolutionary-developmental theory positing that although moderate stress will heighten sensitivity to stress, an extreme amount of adversity (e.g., multiple or chronic traumas) may ultimately blunt the biological stress response system. Our final presentation will expand on these findings by including other prenatal stress outcomes (anxiety and affective instability/anger) and exploring how developmental timing and type of adversity impacts maternal sensitivity to traumatic stress during pregnancy. Given strong evidence of the role of prenatal stress on fetal development, understanding how ELA impacts maternal vulnerability to prenatal stress is critical to preventing adverse perinatal and postnatal outcomes for mothers and their infants.

P1-H-223 Women's Sleep Deprivation Predicts Poor Inhibitory Control When Exposed to Infant Crying

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Executive function (i.e., inhibitory control, attention, and regulation of thought) is an important component of successful parenting (Barrett & Fleming, 2011; Deater-Deckard et al., 2012). Mothers' sleep, however, is often disrupted during the first year following birth largely due to infants' feeding schedules (Brown & Harries, 2015). Furthermore, inhibitory control is significantly impaired when adults are sleep deprived (Drummond, Paulus, & Tapert, 2006). However, limited research has examined how sleep deprivation may affect inhibitory control during parenting-related challenges. In this poster, we examine the association between sleep deprivation and performance on an inhibitory control task in three conditions: silence, when exposed to infant crying, and when exposed to loud traffic sounds. We anticipated that sleep disruptions would be associated with poorer inhibitory control during the cry condition. Nulliparous college-aged females (n=56, 53.6% White) participated in a laboratory visit. Participants reported the number of hours they typically sleep a night (M = 7.52, SD = 1.44) and the number of hours they

slept the night before the visit (M = 7.23, SD = 1.56); difference scores were calculated by subtracting hours of sleep the night before the visit from hours slept on a typical night (M = .29, SD = 1.56); 17 women reported sleeping less than normal (15 minutes to 4 hours). High scores indicate sleep deprivation prior to the visit relative to a typical night. Inhibitory control was measured with a computerized Go/No-Go Task. Participants were exposed to three sound conditions for a total of 6 minutes (i.e., 2 minutes per sound condition) during this task. Participants then rated their arousal during each sound condition on the 9-point Manikan scale from (1 = I felt calm to 9 = I felt agitated). Mean differences in participant arousal to the sounds were examined as a manipulation check using repeated measures ANOVA. Participants reported they felt significantly more agitated when they heard the cry recordings (M = 6.96) as opposed to silence (M = 2.31) and the traffic (M = 5.38) recordings. Simple correlations demonstrated that sleep deprivation was negatively correlated with No-Go accuracy (inhibitory control) during the cry and traffic conditions (r = -.344 and -.297 $p < .05$, respectively), but not the silent condition (r = -.095; ns). Fisher's r to z' transformation for dependent correlations was used to determine if the difference in the magnitude of the association between sleep and inhibitory control was greater for cry versus silent conditions than for traffic versus silent conditions. As expected, the association between sleep deprivation and inhibitory control was significantly larger for the cry condition than silent condition (z = 2.066; $p < .05$); the associations did not vary significantly for the silent versus traffic condition (z = 1.611; p = .108). That even modest sleep deprivation predicts poorer inhibitory control under potentially stressful parenting conditions (i.e., infant crying) may have implications for parenting given links between inhibitory control and parenting and frequent sleep deprivation when parenting an infant. Replication among samples of parents is warranted.

P1-H-224 Depressed Dads and Child Outcomes: The Protective Role of Marital Quality and Child Inhibitory Control

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Although much attention has been devoted to understanding the impact of maternal depressive symptoms on child outcomes, less is known about depression in fathers (Shaw et al., 2009). However, as the traditional view of family roles has shifted, with many fathers taking a more active caregiving role, researchers have become increasingly interested in understanding paternal depression and its associations with family processes and child outcomes (Lewis & Lamb, 2003). An estimated 4.8% of fathers are affected by depression

in the postnatal period, with rates increasing by 68% by age 5 (Garfield et al., 2014). Importantly, paternal depression has direct associations with higher child emotional problems, especially in early childhood (Fletcher et al., 2011). In considering the course of paternal depression and its potential influence on child outcomes, it is important to account for the broader context in which the parent-child relationship is embedded (Bronfenbrenner & Morris, 2007). Aspects of fathers' broader family context--such as the quality of their marriage and their child's level of inhibitory control (IC)--may influence both the chronicity of depression and the strength of its association with child outcomes. In fact, there is evidence that the family environment plays a more salient role in predicting associations between depression and child outcomes for fathers compared to mothers (Gutierrez-Galve et al., 2014). Using data from a diverse, longitudinal sample of low-income children (N = 136) and their families (Early Steps Multisite Study; Dishion et al., 2008), the present study explored the potential moderating role of marital relationship quality and child IC on associations between paternal depression and child internalizing problems when children were between the ages of two and four. Importantly, this study captured the diversity of fathering in the modern world, including biological, step- and adoptive fathers. We hypothesized that high levels of marital quality and child IC would act as protective factors, attenuating associations between paternal depression over time and between paternal depression and subsequent child internalizing problems. Measures for this study were taken from home assessments at child ages 2, 3, and 4, and included both mother and father reports when available (Table 1). Multiple regression analyses revealed several significant moderating effects. Consistent with hypotheses, the association between paternal depression at age 2 and paternal depression at age 3 was attenuated by high levels of marital quality (Fig 1a). High marital quality also attenuated the strength of the association between paternal depression at age 3 and child emotional problems at age 4 (Fig 1b). Thus, high marital quality may be protective in terms of lessening the severity and chronicity of paternal depression, and reducing the impact of paternal depression on child emotional problems. Child IC also attenuated associations between depression and later child emotional problems, consistent with hypotheses (Fig 1c). Overall, results highlight the importance of accounting for broader context when considering relations among paternal depression and child emotional and behavioral problems in early childhood.

P1-H-225 Individual differences in reflective functioning prenatally: Associations with maternal sensory perception and emotion processing

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Theory and research suggest that parenting capacities that play a role in child development may emerge while a woman is pregnant (e.g., Markin, 2013). One of these is a woman's use of reflective functioning (RF), which is the capacity to "mentalize" or determine the mental states of others and of self (e.g., Fonagy, Gergely, & Target, 2007; Slade, 2005). The significance of a woman's ability to mentalize her child after birth is well-established, yet few studies have examined a woman's ability to begin to conceptualize her child as a separate and intentional being during pregnancy. To address this gap, we examined whether various maternal factors were associated with individual differences in RF during pregnancy, including sensory-processing sensitivity, emotional clarity and emotional awareness, knowing the sex of the fetus, having prior children or not, whether or not the pregnancy was planned, maternal age, education, and income level. Pregnant women were recruited prior to 13 weeks gestation as part of a larger study examining the effects of stress on fetal and infant development. At 35-39 gestational weeks participants answered an open-ended prompt, "Describe your child," for a 5-minute period. To capture RF abilities, two coding scales were developed and applied to transcribed speech samples. A child-focused RF scale quantified a woman's mentalization of her fetus, and a self-focused RF scale quantified a woman's mentalization of herself. The Highly-Sensitive Person Scale (Aron & Aron, 1997) and the Difficulties with Emotion Regulation Scale (Gratz & Roemer, 2004) measured sensory-processing sensitivity and emotional clarity and emotional awareness. All other maternal factors were self-reported. Data collection is ongoing; a sample size of 70 is anticipated for the 2018 ICIS Conference. These preliminary analyses focus on the child-based RF scale (n=33). Correlations were examined to assess for potential multicollinearity and identity significant covariates to include in analyses. A multiple regression model was used to examine the relative contribution of significantly correlated maternal factors in explaining the total variance for RF abilities. Sensory-processing sensitivity and having prior children were significantly correlated with child-focused RF, such that women with greater sensory-processing sensitivity exhibited greater child-focused RF abilities, and women with prior children exhibited lower child-focused RF abilities. Preliminary findings from a multiple regression model (Table 1) show the model was statistically significant, $F(3,29) = 4.87$, $p = 0.02$, and accounted for a moderate amount of total variance in child-focused RF ($R2 = 0.26$). Only the characteristic of having prior children added statistically significantly to the model, $p = 0.02$. These results suggest women with prior children do not conceptualize their fetus as a separate and intentional being in the same way that women who are about to deliver their first child do. The novelty of internal fetal stimuli may be more salient for women who are pregnant for the first time compared to those with prior pregnancies and postnatal parenting experience. These

findings need to be tested in a larger sample size. Notably, these preliminary results are the first to examine maternal factors that may influence maternal RF abilities during pregnancy.

P1-H-226 Maternal Depressive Symptoms Moderate the Relationship between Dyadic Flexibility and Child Emotion Regulation

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Parents play an important role in children's developing emotion regulation, particularly during the period of infancy into early childhood. One important dimension of the parent-child relationship is dyadic flexibility, which theorists typically conceptualize as a positive process whereby parents and children have a greater affective or behavioral repertoire to select from, and parents possess the ability to adapt their behaviors to best support children's emotion regulation. Parents with higher depressive symptoms show qualitatively different parenting behaviors characterized by less flexibility. It is not yet clear whether parental depressive symptoms also change the nature of the effects of flexibility on child regulatory outcomes. The current study examines this question by assessing whether maternal depressive symptoms moderate the effect of parent-child flexibility on child emotion regulation in a short-term longitudinal study. Mothers and their 3-year-old children (N=100) participated in a free play task during a laboratory session, and mother and child behavior was coded continuously into mutually exclusive states. Behavioral flexibility was assessed by plotting behavioral trajectories using State Space Grids, which were composed of parent behavior on the x-axis and child behavior on the y-axis, creating a 2-dimensional state-space consisting of all possible dyadic behavioral states. Flexibility was measured as the total number of transitions between distinct behavioral states, providing a real-time measure of how often behavior changed throughout the course of the task. Maternal depressive symptoms were measured via self-report on the Center for Epidemiological Studies Depression Scale. Child emotion regulation and negativity/lability were measured 4 months later via mother-report on the Emotion Regulation Checklist. Control variables included life stress, measured with the Life Events questionnaire, child effortful control, measured using Kochanska's task battery, and dyadic overall positive behavior. A path analysis was performed to test associations between mother-child behavioral flexibility, maternal depression, and measures of child emotion regulation; significant paths are displayed in Figure 1. There was a significant positive effect of flexibility on child negativity/lability, however, this effect was significantly moderated by

maternal depressive symptoms. An analysis of simple slopes revealed that mother-child behavioral flexibility predicted higher child negativity, but only when maternal depressive symptoms were high (β=.13, p<.001; see Figure 2). Similar effects were observed in the prediction of child emotion regulation, but were of marginal significance. The post-hoc analysis of simple slopes revealed that when depressive symptoms were high, flexibility predicted lower emotion regulation (β=-.04, p<.05), and when depressive symptoms were low, flexibility predicted higher emotion regulation (β=.05, p<.05). Results of this study suggest that while parent-child behavioral flexibility may support children's emotion regulation in typical populations, it may be less adaptive in the context of maternal depressive symptoms. This could reflect the fact that mothers with higher levels of depressive symptoms show an inconsistent pattern of responses rather than a deliberate adjustment of behavior to suit children's needs. Future work should further clarify flexibility's function in the context of mental health symptoms.

P1-H-227 Fear is in the eyes: the influence of maternal affect on infants' preference for emotional faces

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Introduction Previous research suggests an attentional bias towards fearful faces and other threat-related stimuli emerges during the first year of life. Seven-month-old infants exhibit a robust looking preference for fearful faces compared to happy or neutral faces (Peltola, Leppänen, Palokangas, & Hietanen, 2008), yet our knowledge about the real-time processing of these emotions is still limited. Additionally, the developmental antecedents of this attentional bias are unclear, with previous studies suggesting a role for maternal anxiety (Morales et al., 2017), maternal disposition, and infant temperament (de Haan et al., 2004). In the current study, 7-month-old infants completed a visual paired-comparison task with happy and fearful faces using eye tracking. This method can reveal the specific affective features infants use to inform their looking preferences. We also examined associations between infants' looking preferences and maternal negative affect. Method Preliminary analyses include data from 10 infants, with collection from an additional 20 infants in progress. At 3.5 months, the infant's primary caregiver completed the Positive and Negative Affect Schedule (Watson & Clark, 1994), a self-report measure of emotional experience. At 7 months, infants saw two female models from the validated NimStim Face Stimulus set (Tottenham et al., 2009) expressing happy and fearful facial expressions side-

by-side, while visual fixations were recorded using an eye tracker. For each face, we calculated two measures of fixation (number of fixations, dwell time) for two interest areas (eyes, mouth). Hypotheses We hypothesized that infants would exhibit increased fixation and dwell time towards fearful faces overall, as well as increased fixation towards the eyes of fearful faces compared to happy faces. Based on previous research demonstrating that maternal anxiety was positively correlated with an attentional bias for angry faces (Morales et al., 2017), we hypothesized that increased attention to fearful faces would be positively correlated with maternal negative affect. Results To examine infants' overall preference for fearful faces, we ran two paired samples t-tests on fixation and dwell time to happy and fearful faces. For fixation, we found the predicted preference for fearful faces ($M = 49.64$) compared to happy faces ($M = 38.17$; $p = 0.05$). To examine infants' allocation of attention within faces, we ran 2 (emotion) x 2 (feature) repeated-measures ANOVAs. For fixation, the predicted interaction was marginally significant ($p = 0.08$). Follow up analyses revealed that infants showed a trend to exhibit more fixations to the eyes of fearful faces compared to happy faces ($p = 0.08$; Figure 1). Contrary to our prediction, we found a significant negative correlation between maternal negative affect and dwell time to fearful faces ($r = -0.88$, $p = 0.05$). Correspondingly, we found a marginally significant positive correlation between maternal negative affect and dwell time to happy faces ($r = 0.86$, $p = 0.06$). Thus, higher maternal negative affect was associated with decreased looking time to fearful faces and increased looking time to happy faces. These preliminary findings offer insight into the real-time processing that underlies the fear bias, as well as developmental antecedents that may predict its emergence.

P1-H-228 Parental Burn-out : Influence of demographic factors and Infant temperament

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Parenthood can prove to be a difficult and stressful experience, as mothers and fathers are exposed to any number of chronic stressors inherent to their role as parents (Latson, 1995). These feelings of stress, combined with the accumulation of seemingly challenging situations, can lead to a state of so-called parental burnout. Many factors explain the interindividual differences in parental burnout as defined by Roskam, Raes and Mikolajczak (2017). This study, which included 272 parents, examines the relationship between parental burnout assess by PBI (Roskam et al., 2017), demographic factors (gender of parents and children, age of parents and children and number of children

present in the family home) and infant temperament (IBQ & ECBQ), assessed by the parent. With regard to demographic factors, our results show that the younger the parents surveyed, the more they report a high sense of personal accomplishment, but they tend to feel more exhausted. Similar results are observed when we look at the age of children. In addition, the number of children at home slightly increases the emotional distance between the parent and their children. This first result of our study is consistent with previous studies (e.g., Mikolajczak, Raes, Avalosse, & Roskam, 2017) who show that parent of children below 5 years old are more at risk to develop parental burn out than the other. This result shows how import is it to focus study on parent of young children. Another result found by Le Vigouroux, Scola, Raes, Mikolajczak, & Roskam (2017) showed the impact of individual differences in parental burnout. Three personality traits are linked with parental burn out: a high level of neuroticism, a low level of conscientiousness, and a low level of agreeableness were all found to be risk factors for parental burnout. Theses two results conduct us to question in a second step of our study the effect of the perception of the infant temperament assess by IBQ (3 to 18-month-old) and ECBQ (18 to 36 months old) on parental burn out. If individual differences in parental personality traits could be protective factors or risk factors to develop parental burnout we could hypothesis that the perception of the infant temperament too. Analyses test the individual variability effect on the infant temperament on parental burn out in our population of 272 parents. We hypothesis that perceiving infants with high level of arousal and more negative affect are at risk to develop parental burn out. This study is the first one to our knowledge to link this two field of research.

P1-H-229 Fourteen-month-olds' Associative Learning of Food-Related Emotions

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Similar to how they learn about objects, infants may also learn about food through social referencing. Social referencing of other's expressions of food-related emotions (disgust and happy) may play a vital role in teaching infants about food. While infants' understanding of some emotions (e.g., happy) is well-studied (Grossmann, 2010), less is known about their understanding of disgust, a primarily food-related emotion. Food-related emotions, disgust and happy, denote liking and disliking foods, and young children use them when choosing foods to eat (Hendy & Raudenbush, 2000). Therefore, understanding how and when infants begin understanding food-related emotions is important because it may affect later food preferences. The current study investigates 14-

month-olds' understanding of disgust by assessing their ability to form associative links between facial and non-linguistic vocal expressions of disgust and happy. Experiment 1: 14-month-olds (n=33, M=13.97mos, SD=0.28mos) were tested using a Switch-design habituation procedure. Infants were habituated to congruent pairings of emotional expressions (Figure 1), then tested with a Same Trial (congruent pairings) and a Switch Trial (incongruent pairings). Results: Infants looked significantly longer at the Switch Trial compared to the Same Trial (Figure 2a), indicating that they noticed when disgust and happy facial expressions were paired with vocalizations that did not match in affect. By 14-months, infants have already had some exposure to emotional expressions and can use them to evaluate ambiguous objects and situations (Mumme et al., 1996). Therefore, our participants likely possessed some a priori knowledge of both disgust and happy expressions. This type of a priori knowledge has been shown to influence whether infants show a novelty or familiarity preference in habituation procedures (Oakes, 2010). Thus, infants' increased looking time to the Switch Trial (incongruent pairing) might be explained by (1) infants having just been habituated to the congruent pairings or (2) the incongruent pairing violated their a priori knowledge. To test these alternative explanations, we conducted Experiment 2. Experiment 2: 14-month-olds (n=32, M=14.08mos, SD=0.25mos) were tested using the same procedure as Experiment 1, except they were habituated to incongruent pairings of the emotional expressions. They were again tested with a Same Trial (incongruent pairing) and a Switch Trial (congruent pairing). Results: Infants looked equally at the Same and Switch Trials (Figure 2b), suggesting that they were not able to learn the incongruent pairings during habituation. Together, these experiments indicate that, by 14-months, infants already seem to have enough previous experience with happy and disgust expressions that they have already formed an association between vocal and facial expressions of these emotions. In fact, it seems that this experience influences their ability to learn emotional expression pairings that contradict this a priori knowledge. Overall, the results of these experiments enhance our understanding of how these early associative learning skills develop, in terms of food-related emotions. It is important for us to understand how infants come to refine these associative learning skills in order to form a more symbolic/conceptual understanding of emotions, particularly food-related emotions which guide them when evaluating potential foods to eat.

P1-H-230 Cortisol Concentrations in Human Breast Milk: Associations with Infant Crying

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Background: Breastfeeding is beneficial for infant health and development. A longer duration of breastfeeding has been related, for example, to fewer illnesses and better cognitive development, even beyond infancy and childhood. Less research has been devoted to the possible effects of biological constituents of breast milk on offspring phenotype. In animals, concentrations of cortisol - a glucocorticoid stress hormone - in maternal milk have been found to be related to offspring behavior. The aim of the present study was to longitudinally investigate whether breast milk cortisol is related to infant crying and fussing. Method: At 2, 6, and 12 weeks of infant age, mothers (N=70) collected a morning sample of their breast milk and kept a 3-day infant behavior diary to measure crying and fussing. Cortisol was extracted and quantified from breast milk samples. Results: Breast milk cortisol was not related to total duration or frequency of infant crying and fussing. A significant interaction between milk cortisol and infant sex on crying and fussing bout length indicated that more milk cortisol seemed to be related to longer bouts in female infants, but shorter bouts in male infants. Conclusion: These findings might point at differential lactational programming effects of breast milk cortisol depending on infant sex. Future studies with larger populations are needed to replicate these findings and to discard alternative interpretations of the results.

P1-H-231 Enhanced Sensitivity to Fearful Faces at 3 Months of Age

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Increased sensitivity to threat-related emotional stimuli, such as fearful facial expressions, emerges in the first year of life (Peltola et al., 2009; Safar & Moulson, 2017). There is some debate about when this increased sensitivity develops, with more recent studies reporting earlier emergence (Heck et al., 2016; 2017; Yrttiaho, Forssman, Kaatiala & Leppänen, 2014). Five-month-old infants show difficulty disengaging attention from fearful faces (Heck et al., 2016; 2017; Yrttiaho et al., 2014), as well as differences in their neural responses over occipital-temporal brain areas to fearful compared to non-fearful facial expressions (Yrttiaho et al., 2014). It is presently unknown whether infants younger than 5 months show enhanced sensitivity to fearful faces. The goal of the current study was to explore whether 3-month-olds demonstrate increased sensitivity to fearful compared to happy faces at the behavioural and neural level. At 3 months of age, 60 infants (M age= 89.56 days, SD= 12.17, 43 boys) participated in a spontaneous preference task, where they saw

pairs of female faces expressing happy and fearful facial expressions. Following the spontaneous preference task, event-related potentials (ERPs), a non-invasive measure of the brain's electrical activity, were recorded from 36 of these infants (21 boys, M age = 89.22, SD = 12.71) in response to happy and fearful female faces. Neural components Nc, a negative-going component that reflects attention allocation (Courchesne, Ganz, & Norcia, 1981), and N290/P400, developmental precursors to the adult N170 face sensitive component that reflect early perceptual processes (de Haan, Johnson & Halit, 2003), were analyzed. Three-month-olds showed a significant looking preference for fearful over happy faces (M = .56, SD = .14, t(59) = 3.234, p = .002, two-tailed, d = .42). Thirty-nine of 60 infants showed a preference for the fearful faces, which was significantly greater than expected by chance (binomial probability, p = .027, two-tailed). Neural responses over occipital-temporal electrode sites also differed for fearful compared to happy faces (F(1,35) = 5.879, p = .021, ηp^2 = .144). Three-month-olds showed a smaller (less negative) N290 for fearful (M = 4.33 μV, SD = 5.43) compared to happy (M = 2.22 μV, SD = 6.04) facial expressions. No significant difference in neural responses to happy and fearful faces were found for the Nc and P400 components. The current findings suggest that sensitivity to fearful faces may develop earlier than previously reported. Differences in neural responses to fearful compared to happy faces over occipital-temporal brain areas may reflect early perceptual sensitivity to fearful faces already present by 3 months of age.

P1-H-232 Reduced Empathic Responding of 6-month-olds as an Early Marker for Subsequent ASD Diagnosis

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Empathy is an inborn socio-emotional capacity, essential for the development of adaptive social skills. It has already been established that children diagnosed with ASD (Autism Spectrum Disorder) have impaired empathic abilities which can be observed during the second year of life (McDonald & Messinger, 2012) and that they show reduced concern for distressed others as compared to typically-developing children. Yet, no study to date has examined empathic responses during the first year of life as a potential predictor of subsequent ASD diagnosis. This is likely due to the widespread theoretical assumption that empathic concern emerges only during the second year of life (Hoffman, 2001). However, more recent findings show that typically-developing infants can and do express

empathy towards another in distress, as early as the first year of life (Roth-Hanania, Davidov, & Zahn-Waxler, 2011; Davidov et al., 2013). Based on these findings, we posited that among infants at familial-risk for autism, atypical empathic responding observed during the first year may serve as an early marker for a later diagnosis of ASD. The present study sought to examine early empathy, as a prodromal sign of ASD. This is a prospective longitudinal study of infants at high-risk (due to an older sibling with an established ASD diagnosis). We predicted that diminished empathy at 6 months will positively correlate with subsequent ASD diagnosis. Infants were assessed at ages: 6, 12 and 18-months. At 6-months, infants' responses to distress enacted by their mother and by an experimenter were assessed and blindly coded for empathic concern (on a 0-3 validated scale). In addition, infants' social interest was measured using an eye-tracking task where their preference for images of people vs. objects was examined. At 12 months, a neurological and developmental exam was conducted, and when infants were 18-months, they went through a comprehensive diagnostic evaluation which included the use of screeners (SACS, M-CHAT, Q-CHAT), a developmental assessment and a standard ASD observation scale (ADOS-2). We present results from the first 15 infants who have completed the study so far (data collection continues, but 15 is already a sizable amount for a prospective ASD-sibling study). Four infants were diagnosed with ASD when they were 18 months, one with delayed communication abilities, and ten as typically-developing. In accordance with our hypothesis, empathic concern at 6-months was significantly and negatively correlated with ASD diagnosis, r=-.72, p=.003. Moreover, infants later diagnosed with ASD showed significantly lower empathic responding mean scores as compared to a large normative sample of typically-developing 6-month-olds that we have collected (N=155; respective means: 0.45 vs. 1.03, t=-11.6, p<.001). In Contrast, at-risk infants found to be typically-developing, did not differ from the normative sample in their empathic responding (1.10 vs. 1.03, t=.54, ns). In addition, there was a significant negative correlation between infants' preference for people vs. object (proportion of trials in which the infant first fixated on the person image), and subsequent ASD diagnosis, r=-.67, p=.012. These highly promising findings suggest that ASD may be detected early in very young infants based on their empathic and social responding profile.

P1-H-233 Maternal Emotion Regulation Strategies Moderate the Relation Between Infant Attachment and Later Child Anxiety Risk

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Early attachment relationships play a crucial role in a child's emotional development (Cohen et al., 2005). Attachment to a caregiver is defined as an emotional bond, with infants in insecurely attached relationships displaying distrust in their caregivers' ability to provide consistency and security (Ainsworth, 1989; Bowlby, 1982). Insecure attachment in infancy has been linked to future psychopathology, such as anxiety (Belsky & Cassidy, 1994); however, the associations are of moderate strength. Less is known about the role environmental factors, such as parenting characteristics, play in strengthening this relationship. Research suggests infant attachment style depends on maternal sensitivity and behavior towards their child (Ainsworth, 1978). Although maternal emotion regulation putatively underlies these behaviors, emotion regulation difficulties themselves have not yet been investigated in the relationship between attachment security and anxiety outcomes. Thus, the current study investigates how maternal access to emotion regulatory strategies influences the relation between infant attachment and future risk for anxiety. Appropriate emotion regulation strategies may buffer the influence insecure attachment has on anxiety risk. Mother-child dyads (n = 126) participated in the Strange Situation (Ainsworth, 1978) as part of a larger laboratory visit when their toddlers were 12-16 months old. Attachment was observationally coded consistent with Ainsworth (1978), and relationships were categorized as secure or insecure (i.e., avoidant and resistant combined). One year later, mothers reported on their own emotion regulation strategies via the Difficulties in Emotion Regulation Scale (Gratz & Roemer, 2004) and their toddlers' risk for anxiety via the Inhibition to Novelty and Separation Distress subscales of the Infant-Toddler Social and Emotional Assessment (Carter et al., 2001). Infant attachment and maternal emotion regulation variables were centered at their means. Moderation analyses revealed a significant interaction between infant attachment and maternal emotion regulation strategies in relation to child separation distress ($t = -3.032$, $p = .003$; see Figure 1), suggesting infants in insecure, relative to secure, relationships had more separation distress at low levels of maternal regulatory strategies. Additionally, results also revealed a significant interaction between attachment and maternal emotion regulation strategies in relation to child inhibition to novelty ($t = -2.129$, $p = .036$; see Figure 2), such that infants in insecurely attached vs. securely attached relationships had more inhibition to novelty at low levels of maternal regulatory strategies. Results suggest attachment in the context of maternal emotion regulation is a strong predictor of anxiety risk. Furthermore, when in insecure attachment relationships, infants' risk for anxiety may be exacerbated when mothers are unable to access adaptive strategies to regulate their own emotions. Mothers' difficulty in regulating their own emotions may create an inconsistent, unpredictable environment for these infants, which may in turn increase their inhibition to novelty and separation distress over time. Results

will be discussed in the context of the larger literature on attachment, parenting behaviors, and anxiety development.

P1-H-234 Infant Attention to Facial Expressions Varies with Maternal Perceived Stress

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Prior research has demonstrated infants' development of an attentional bias towards fearful facial expressions that emerges between 5 and 7 months of age. The fear bias is thought to develop, at least partially, in an experience-dependent way, meaning that environmental cues might alter the nature and timing of infants' attention to fear and other emotional expressions. In particular, infant exposure to high levels of stress, via factors such as poverty or maternal mental health, might shape infants' early social environment in a manner that alters their development of emotional attention. To test this, we examined a predominantly low-income sample (N=44) of mother-infant dyads to determine whether infant attention to facial expressions at 6 months differs with exposure to maternal stress reported at 2 months. Infant attention to facial expressions was assessed using an eye tracking paradigm in which infants were shown a central face stimulus with an emotional expression (i.e., fearful, happy, angry, or non-face) followed by a distractor stimulus that appeared after 1000 milliseconds to one side of the face. Attention was operationalized as the time it took an infant to disengage from the face stimulus and shift their gaze to the distractor stimulus. Maternal stress was assessed by self-report on the Perceived Stress Scale (PSS) and by the number of stressful life events reported on a Recent Life Events Questionnaire (RLEQ). Infants disengaged significantly faster from non-face stimuli compared to angry ($t=4.51$, $p<.001$), happy ($t=6.40$, $p<001$), and fearful faces ($t=-6.69$, $p<.001$). At 6 months, infants in this sample did not exhibit a bias to fearful expressions, although average saccadic reaction times were somewhat longer to fearful faces compared to the other faces types (Table 1). However, infants did disengage significantly faster from angry compared to fearful expressions ($t=-2.66$, $p=.011$), and showed a trend towards disengaging faster from angry than happy faces as well ($t=-1.69$, $p=.099$). Infant time to disengage from angry faces at 6 months was also negatively correlated with maternal PSS at 2 months ($r=-0.437$, $p=.033$), so that infants of mothers who reported higher levels of subjective stress were quicker to disengage from

angry faces than infants of mothers who reported lower levels of subjective stress (Figure 1). In a linear regression model, maternal perceived stress at 2 months significantly predicted infant disengagement from angry faces at 6 months above and beyond family income and the number of stressful life events reported on the RLEQ at 2 months (ΔR^2=.433, F=8.622, p=.014). Together, these results suggest that mothers' subjective level of stress impacts infants' development of emotional attention, above and beyond the experience of poverty or exposure to other stressful life events. We are continuing to follow these infants at 9 and 12 months to establish the stability of this pattern over time, and to examine whether there is a shift in the development of the fear bias compared to infants growing up under less stressful circumstances.

P1-H-236 Parenting behaviors moderate the link between maternal emotion dysregulation and toddler anxiety symptomatology

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Parents' own emotion regulation skills may contribute to their children's anxiety (Han & Shaffer, 2013), although few studies have examined this linkage (a) in mothers with younger children and/or (b) over time. Moreover, less is known about the contexts in which parent emotion dysregulation (ED) may be most salient to toddler anxiety symptoms. Given the moderate, but inconsistent, links between parental ED and parenting behaviors (e.g., Rutherford et al., 2015), and the contribution of parenting behaviors to child anxiety (McLeod et al., 2007; Chorpita & Barlow, 1998), parental ED and parenting behaviors may interact to predict toddler anxiety. As such, the current study examines how the relationship between maternal ED and later toddler anxiety symptomology may depend on mothers' parenting behaviors. Participants were 77 mothers who participated with their toddlers (58.7% boys; Time 1 and 2 Mage = 26.77 and 38.80 months, respectively) at two time points. At Time 1, mothers completed The Difficulties in Emotion Regulation Scale (Gratz & Roemer, 2004) to report on their emotion dysregulation. During their Time 1 visit, mother-child dyads also participated in a low-threat (puppet show) novelty episode, and observed intrusive, comforting, and protective parenting behaviors were coded similarly to previous studies (Buss, 2011; Kiel & Buss, 2012). At Time 2, mothers reported on their toddlers' anxiety symptomatology via the Anxiety/Worry subscale of the Infant-Toddler Social and Emotional Assessment (Carter et al., 2001). Time 1 variables were mean-centered and three moderation models were computed via the PROCESS macro for SPSS (Hayes, 2013). Maternal comfort during the puppet episode

significantly moderated the relation between maternal ED and toddler anxiety symptomatology (b=-.64, p=.01). The Johnson-Neyman technique revealed that the relation between maternal ED and toddler anxiety symptomatology became significant when maternal comfort was ¡Ü.060 SD above the mean, such that among mothers who exhibited average and lower levels of comforting behaviors, greater ED was strongly related to greater toddler anxiety (see Figure 1). Additionally, maternal intrusive behavior emerged as a marginally significant moderator in this longitudinal link (b=-.90, p=.08), with greater maternal ED relating to greater toddler anxiety for mothers who showed less intrusive behavior (region of significance ¡Ü.03 SD above mean maternal intrusiveness; see Figure 2). The model with protective behavior was not significant. These results suggest that the deleterious linkage between maternal ED and toddler anxiety is more pronounced among mothers who engage in fewer comforting or intrusive behaviors toward their children. It appears that for toddlers whose mothers are more involved (either through comforting or even intrusive behaviors), their mothers' ED does not contribute to their later anxiety symptoms. Mothers with greater ED may be more internally-focused during novel and/or stressful situations with their child and may be less involved in the parenting of their child, resulting in fewer intrusive and comforting behaviors. Furthermore, we are continuing data collection to incorporate larger sample sizes into our longitudinal models and extend our understanding of the role of parenting behaviors in the relation between maternal ED and toddler anxiety over time.

P1-H-237 Neurodevelopmental origins of infant regulation during a mother-infant face-to-face paradigm

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Early life experiences can have long lasting consequences to fetal and postnatal brain maturation and play a critical role in shaping children's socioemotional development. We focused on emotion regulation (ER), or the ability to modify, inhibit, or maintain the occurrence or intensity of emotion. ER is an important marker for early socioemotional development (Calkins, 1999). Given that the neural circuitry implicated in social and emotional behavior appears to be especially impressionable by early life experience (Davidson & McEwen, 2012), it is surprising that little is known about how the infant brain's early microstructure impacts behavioral phenotypes of ER in childhood. It is unknown whether microstructural differences in neural white matter are present early in

life or if alterations associated with emotional dysregulation develop over time. Here, we examine how neonatal microstructural white matter alterations relate to infant regulatory behaviors during a mother-infant face-to-face interaction at 6 months of age. Infants underwent non-sedated, multi-shell diffusion MRI at 1-month of age. After standard image processing, data were fit to the neurite orientation dispersion and density imaging model. From this, we calculated parameters for the intra-cellular volume fraction (VIC) and orientation dispersion index (ODI) and aligned these to a study-specific template. At 6 months of age, mothers and infants participated in the Still Face Paradigm (SFP; Tronick et al., 1978), from which we scored infants' use of effective ER strategy (visual distraction and self-soothing) during the "still-face" episode of the SFP. Voxel-wise associations between 1-month infant white matter microstructure (VIC and ODI) and infant ER behaviors at 6-months used nonparametric permutation testing and threshold-free cluster enhancement. Infant gender, age (corrected to a 40-week gestation), and infant motion during scanning were included as covariates. Self-distraction during the SFP was positively associated with VIC in the inferior superior longitudinal fasciculus (Figure 1). Self-comforting during the SFP was negatively associated with temporal VIC and ODI in the inferior fronto-occipital fasciculus and uncinate fasciculus (Figure 2). The inferior superior longitudinal fasciculus and inferior fronto-occipital fasciculus are both white matter tracts connecting temporal white matter to the prefrontal cortex. The uncinate fasciculus connects areas including the amygdala and hippocampus (both implicated in emotional reactivity and regulation) to the fronto-orbital cortex. In sum, differences in white matter development as early as 1-month of age may be a substrate for differences in the development of effective behavioral ER strategies in later infancy. Furthermore, early ER behaviors are shaped through repeated interactions with caregivers (Kopp, 1989). An integral component of this reciprocal exchange is parents' sensitivity to infant cues, or parents' ability to accurately read and interpret an infant's needs and respond appropriately (Ainsworth et al., 1978). Parents who are more sensitive and involved have infants who learn to use ER more effectively (Planalp & Braungart-Rieker, 2015). Further analyses will examine how maternal sensitivity during the SFP might moderate relations between early brain microstructure and behavioral development of ER.

P1-H-238 Environmental and Temperamental Predictors of Infant Adjustment at 12 months

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Although linkages between children's parenting environments, early temperament, and children's adjustment post-infancy have been well-studied, little is known of parental and constitutional predictors of behavioral problems and competencies in infancy. The present study examined infant temperament, bedtime parenting quality, and household chaos as predictors of infant behavior adjustment at 12 months. This study is unique in including of two environmental predictors of infant adjustment, bedtime parenting and household chaos, each parent-based but functioning at different levels of analysis and each predictive of children's outcomes (Wachs & Evans, 2010). This study also examined parenting quality and household chaos as moderators of linkages between infant temperament and infant adjustment. Consistent with diathesis-stress and differential susceptibility hypotheses, we expected that any temperament X environment interactions obtained would show that variations in environmental quality would bear stronger relations to 12-month adjustment among temperamentally reactive infants than among unreactive infants. Data were drawn from an NICHD-funded study of parenting, infant sleep and child outcomes. Infant temperament was measured at 6 and 9 months of age utilizing the Infant Behavior Questionnaire-Revised (IBQ-R; Gartstein & Rothbart, 2003) which yields superfactors of Surgency, Negative Affectivity, and Regulation. These factors were each meaned across the two age points to create more reliable indices of temperamental reactivity. Household chaos was measured at 1, 3, 6, 9 and 12 months of age using the Descriptive In-home Survey of Chaos--Observer ReporteD (Whitesell et al., 2015). Mothers bedtime emotional availability was observed at 1, 3, 6, 9 and 12 months from the digital videos of mother-infant bedtime interaction and assessed using Biringen's (2000) Emotional Availability Scales (EAS). Chaos and EA scores were stable across age and were combined for each participant across age. Finally, 12-month infant behavioral problems and competencies were assessed from mothers using the Infant-Toddler Social and Emotional Assessment (ITSEA; Carter & Briggs-Gowan, 2006). Multiple regression analyses (Table 1) revealed that higher household chaos predicted lower infant social relatedness and internalizing problems at 12 months, and higher maternal bedtime EA predicted less atypical behavior. Infant regulation, from the IBQ-R, was positively associated with 12-month social relatedness and infant competencies and negatively associated with 12-month infant dysregulation. Temperamental negative affectivity was positive linked to 12-month externalizing and internalizing behavior and dysregulation. Interestingly, temperamental surgency was positively linked with both 12-month externalizing problems and infant competencies. Finally, a significant interaction was obtained between infant negative affectivity and mother's emotional availability at bedtime in predicting 12-month infant externalizing behavior. Analyses of simple slopes revealed that the positive association between negative affectivity and externalizing

behavior was significant when EA was low, but non-significant when EA was high (Figure 1). Additional analyses will examine maternal EA as a moderator of links between household chaos and 12 month infant adjustment, followed by a discussion of the protective role that high quality parenting plays among infants at risk.

P1-H-239 Child Externalizing Problems: What Type of Parenting Leads to Negative Outcomes

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Infancy is a critical time for the development of self-regulation abilities (Kopp, 1982; Kochanska, Coy, & Murray, 2001). Development of maladaptive regulation abilities, during infancy, such as those seen in externalizing behaviors, could lead to poor school readiness. Additionally, infant externalizing patterns have demonstrated stability across infancy and into toddlerhood (Lorber, Del-Vecchio, & Smith-Slep, 2015). Kindergarten readiness is essential for academic success, and a child's preparedness relies heavily on the skills she/he learns before entering school. Effortful control also emerges during early childhood and underlies the development of self-regulation (Eisenberg, 2005 & Blair, 2002). Environmental factors such as parenting can shape externalizing behaviors; specifically, warm, supportive parenting is associated with lower rates of child externalizing behaviors and improvement in child self-regulation (Eisenberg et al., 2005, etc). In addition to parenting style, parent personality can affect parenting abilities (Belsky, 1984). The purpose of the present study is to examine how aspects of parenting characteristics and parent personality come together and whether different types of parents shape the relationship between infant externalizing problems and negative outcomes in kindergarten. 114 children (59 boys; Mage =67.92 months, SD = 4.15) and their parents visited the lab and completed questionnaires. Parents completed questionnaires about their parenting (e.g. CCNES, PPQ), their own personality characteristics (e.g. PANAS, SEFQ), and their child's behaviors (e.g. ITSEA, HBQ, CBQ). Questionnaires were completed twice, once when the child was 18 months, and again when the child entered kindergarten. A Latent Profile Analysis (LPA) was conducted to identify parent profiles (BIC = 2531.744; BLRT = 91.41, $p < 0.00$; Entropy = 0.758). Analyses revealed 3 profiles; Average, Positive, and Inconsistent. The "average" and "positive" parenting profiles were at or above means in measures such as authoritarian parenting and positive emotional support, and lower in attributes such as rejecting behaviors and punitive punishments. The "inconsistent" profile had both positive and negative

characteristics that at times contradicted each other, such as rejecting and emotionally supportive. Focusing on the inconsistent profile, we found a predictive relationship between externalizing at 18 months and effortful control at age 5 that was fully mediated by having an inconsistent mother (b= -.2894, R-sq= 0.0642, p= 0.0318). Specifically, children's externalizing at 18 months coupled with higher probability of inconsistent parents was predictive of the lower effortful control at age 5. The present findings show infants with early externalizing behaviors have poorer outcomes by kindergarten if their caregivers are inconsistent. Early externalizing behaviors may result in increased opportunities for parents to respond with harsh punishment and decreased opportunities for warm responses. Failure to appropriately parent early externalizing behaviors can further exacerbate the child's behavior, ultimately leading to lower effortful control. Future research should continue to examine mechanisms that will help elucidate the process through which infant externalizing patterns and parenting shape and contribute to academic outcomes.

P1-H-240 The Relation between Maternal Emotion Regulation and Maternal Protective Parenting Behaviors is Moderated by Toddler Temperament

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Research suggests that women with a low threshold for physiological arousal and difficulty regulating their emotions are prone to displaying ineffective parenting behavior that may increase risk of psychopathology in infants and young children (Bugental et al., 1999; Lorber, 2012). Poorly regulated mothers might perceive developmentally normative challenges for their children as distressing. This may lead them to engage in overprotection, which has been linked to children's later anxiety development (Root et al., 2015). Dysregulated fear, a temperamental predictor of anxiety (Buss, 2011), is found to elicit maternal protective behaviors (Kiel & Buss, 2014). However, not all mothers with emotion regulation (ER) difficulties exhibit overprotection, so it is important to examine the context in which this relation occurs. Research suggests that mothers tend to have heightened stress reactivity in response to infants with reactive temperament, which in turn predicts negative parenting behaviors (Martorell & Bugental, 2006). Cortisol, a stress hormone, contributes to emotional arousal in stressful challenges (i.e., cortisol reactivity), and may be an important context to consider (Rodrigues et al., 2009). The aim of the current study is to determine the contextual roles of toddler dysregulated fear (DF) and maternal cortisol reactivity in the relation between maternal emotion regulation

difficulties and protective parenting. Fifty-four mother-toddler dyads (expected n = 70) participated in laboratory visits at toddler ages 12-15 and 24-30 months. At infant age 12-15 months, mothers reported on their ER via the Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004). One year later, toddlers and their mothers engaged in two low-threat episodes (i.e., puppet show and clown; Buss, 2011) in order to measure toddler DF and maternal protective parenting. Mothers provided three saliva samples (pre-visit, mid-visit, and post-visit). Cortisol reactivity was calculated as Area Under the Curve with respect to increase (Pruessner et al., 1997). Maternal ER, toddler DF, and maternal cortisol reactivity interacted to predict maternal protective parenting. Probing revealed that higher maternal ER difficulties predicted more maternal protective parenting behaviors at 1 SD DF and 1.85 SD of maternal cortisol reactivity ($t=2.01$, $p=.05$). Additionally, lower maternal ER difficulties predicted more maternal protective parenting behaviors at 1 SD DF and -1 SD of maternal cortisol reactivity ($t=-2.01$, $p=.05$). Post-hoc analyses indicated that this effect may be driven by maternal impulsivity and lack of access to ER strategies as measured by the DERS. Results suggest that maternal ER difficulties predicted protective parenting when maternal biological reactivity and toddler DF were high. Additionally, lower ER difficulties predicted overprotection when maternal reactivity was low and toddler DF was high. Overall, toddler dysregulated fear appears to be an important context under which maternal emotion regulation relates to protective behaviors. Results importantly suggest that toddler temperament is an important context to consider when determining whether or not maternal ER difficulties, both behaviorally and biologically, could influence engagement in parenting behaviors that confer risk for anxiety. Results with the full sample will be discussed in the context of the larger literature on parent-child interactions.

P1-H-241 Child Maltreatment and Cortisol Secretion: A Meta-analysis

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Maltreatment is associated with various physical and mental health problems. One of the main hypotheses used to explain this association is a mediation by the dysregulation of the hypothalamic-pituitary-adrenal axis (HPA axis), often measured by cortisol secretion. However, studies examining the association between maltreatment and cortisol secretion have provided mixed results. The aim of this study is to conduct a meta-analysis to clarify the association between maltreatment and baseline cortisol secretion in children aged 0

to 5 years. To account for variability in the methods of primary studies, moderating variables were considered: cortisol dysregulation direction (hyper vs hypocortisolism), living environment (biological family vs foster care), type of cortisol outcome, risk level of the control group (low vs high), children age and publication year. Method: Relevant studies were systematically collected in September 2017 using databases (MEDLINE, PsycINFO, Embase and FRANCIS) for the period between 1980 and 2016. Reference lists from articles related to the topic were also examined and experts in this field of study were contacted. Studies were selected if they included two groups of participants: one exposed to maltreatment and the other, a control group not exposed to maltreatment. Studies had to contain at least one baseline cortisol measurement (one assessment of cortisol secretion during the day, cortisol awakening response, diurnal cortisol slope or area under the curve) in participants aged 0-5 years. Only peer-reviewed and published studies were retained, while those conducted in a clinical setting were excluded. Final study selection was made by consensus between authors. Results: Eight studies including 20 effect sizes were selected as they corresponded to the inclusion criteria. Cohen's d was used to test for main and moderating effects. Results reveal a significant association between child maltreatment and cortisol secretion ($d = .34$, $p < .001$; CI: .20 - .49). No moderating effect was found for cortisol dysregulation direction, living environment, type of cortisol outcome, risk level of the control group, children age and publication year (Table 1). Discussion: Results confirm a significant association between child maltreatment and cortisol secretion in children aged 0 to 5 years. Further work is needed to investigate the mediating role of cortisol secretion and to gain clearer understanding of how maltreatment and health issues are related. This association also underlines the importance of preventive intervention to enhance physiological regulation in maltreated children.

P1-H-242 Maternal Anxiety is Associated with Decreased Attention to Emotional Stimuli in Infants

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There is a consistent relationship between social anxiety and attentional biases for threatening faces that has been first documented as young as preschool age. Although attention biases to threat have been implicated in the development and maintenance of anxiety, there is a dearth of longitudinal studies beginning early in infancy tracking this

potentially important developmental relationship. We used data from a large cross-sectional sample of infants between the ages of 4 to 24 months to examine the relationship between attention and anxiety risk over the first two years of life. We used several passive viewing eye-tracking tasks designed to tap into associated attentional mechanisms across a wide age range. In an affective overlap task designed to examine attention disengagement, infants were presented with a centrally located face (either neutral, angry or happy) on a screen, followed quickly by a geometric shape that appeared simultaneously to the left or right of the center image. We measured dwell time to the faces and latency to disengage from the face to look to the geometric shape. In a second task--an affective dot probe paradigm--infants were presented with pairs of one neutral and one emotional (either happy or angry) face followed by a dot probe that replaced the location of one of the two faces on the screen. We measured infants' overall dwell time to the face and latency to shift their visual attention to the probe. These two tasks tap into slightly different attentional patterns, and can act together to build a picture of how an individual's attentional system is processing emotional expressions. Indeed, using these two tasks individually, we have already reported that maternal anxiety predicts attention bias to threatening or angry faces in the overlap task (Morales et al., 2017) and that temperamental negative affect predicts latency to disengage from threatening faces to detect a probe in the dot-probe paradigm (Perez-Edgar et al., 2017). Here we sought to examine more global processing of emotional faces across the two tasks, and its relationship with an important predictor of childhood anxiety--maternal anxiety. We present data from 74 infants aged 4--24 months on the overlap task, and an additional 88 infants of the same age on the dot-probe task. Results demonstrated that maternal anxiety (as measured by total score on the Beck Anxiety Inventory, BAI) was negatively correlated with fixation duration on the overlap task to neutral ($r=-.30$, $p=.009$) and happy ($r=-.28$, $p=.016$) faces; the same trend was approaching significance for angry faces ($r=-.210$, $p=.07$). Similarly, BAI was negatively correlated with fixation duration to the happy faces on the dot probe task ($r=-.22$, $p=.04$). Together, these results across tasks suggest a general relationship between maternal anxiety and decreased infant attention to emotional faces across the first two years of life.

I: Translational Science

P1-I-243 The Baby Actions and Behavioral Index (BABI): A new scale to measure infant behavior

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Assessments of newborns and young infants are important because they help clinicians identify infants in need of care, help researchers identify infants at greater risk, and may help to identify new parents who require additional support with their infant. While a number of infant behavioral assessments are currently used, there are several significant shortcomings to these measures (e.g., restricted age of infant, requirement for extensive training of administrator, cost of the assessment, absence of established behavioral norms for comparison, etc.). Therefore, the present study sought to develop a new measure of infant behavior that combats these issues. A PhD level Certified Family Life Educator with expertise in infant behavior and a counseling psychologist developed the 14 item scale across critical domains of infant eating, infant stomach issues, infant crying, and infant sleep issues. The scale was administered to 74 parents (73 mothers and 1 father) of 3.5 week old-6 month old (M= 3.67 months, SD = 1.55 months) infants along with the Mother-Infant Bonding Scale, the Edinburgh Postnatal Depression Scale and the Generalized Anxiety Disorder 7-Item Scale. During initial analyses, one of the eating issue items was not normally distributed, and the correlation between the other two eating items was unexpectedly small; therefore, the three items pertaining to eating issues were removed. We conducted EFA with the varimax rotation. The scree plot suggests that a three factor model (crying, sleeping and stomach issues subscales) best captures the items in our scale. Additionally, the eigenvalue of three-factor model was higher than 1, whereas the eigenvalue of four-factor model was less than 1, further indicating the validity of the three-factor model. The Confirmatory Factor Analysis is presented in Figure 1. Final Scale items are presented in Table 1. Correlations between the BABI stomach issues, crying issues, and sleep issues subscales and the Mother-to-Infant Bonding scale, anxiety scale, and postpartum depression scale were conducted. Significant Pearson partial correlations (controlling for whether or not the parents participated in floating class) were found for the relationships between infant stomach issues and bonding issues $r_{partial}(70) = .312$, $p = .008$ as well as depression $r_{partial}(70) = .221$, $p = .049$, and between infant cryin issues and bonding issues $r_{partial}(70) = .338$, $p = .004$, maternal anxiety $r_{partial}(70) = .252$, $p = .033$ and maternal depression $r_{partial}(70) = .244$, $p = .039$ Potential clinical and research applications of the instrument include identification of caregivers in need of support, screening for further clinical assessment, and the furthering of research into infant outcomes related to early regulatory difficulties and parent-child bonding.

P1-I-244 Maternal influence on early infant emotional regulation: A study of 3-month infant behavior, cortisol and frontal EEG

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Prenatal maternal stress and depression program fetal regulatory tendencies (Sandman, Davis, Buss & Glynn, 2012), and early postnatal interaction between mother and infant sets the stage for future parent-child interactions and for the child's psychobiological and neurological development. Relative right EEG asymmetry (greater activation in the right hemisphere compared with the left) is associated with depression in adults and with withdrawal behavior in both infants and adults (Bruder, Stewart & McGrath, 2017). While there is a large body of research connecting maternal depression to infant EEG asymmetry, the current study sought to add to the sparse literature on the links between maternal anxiety and infant baseline EEG asymmetry. Furthermore, associations between maternal mood, maternal sensitivity and infant stress regulation were assessed. The current study is the first to assess the relationship between infant-mother dynamics and infant EEG at 3 months of age. Forty-eight mother-infant dyads were followed longitudinally starting from the third trimester, and continuing after birth with measurements taken in the neonatal period, at 6 weeks and 3 months postnatal. Frontal activity was assessed across three frequency bands: alpha 1 (3-6Hz), alpha 2 (6-9 Hz) and broadband (3-12 Hz). Frontal asymmetries were calculated by subtracting the natural log of the alpha power of the electrode in the left hemisphere from that of the right frontal electrode. Infant stress regulation was measured by cortisol reactivity in response to a combination still-face/arm restraint task. Significant associations between higher maternal depression at newborn and patterns of greater relative right frontal alpha activity in 3-month infants were confirmed across all three frequency bands at mid-frontal scalp sites (F3/F4). However, maternal depression was unrelated to lateral frontal asymmetry (F7/F8). See Table 1 for correlation sizes and significance levels. Non-significant trends indicate that higher maternal anxiety may be associated with greater right lateral-frontal asymmetry for alpha 1 ($r = -.38$, $p = .076$). Results suggest that maternal anxiety and maternal depression may differentially influence infant brain activity in opposing frontal sites. See Figure 1. Swingler and her colleagues (2014) hypothesized that maternal sensitivity would be more critical for positive infant affect and appropriate regulatory behavior for infants with right frontal asymmetry, previously shown to have more withdrawal tendencies. Here, for infants with relative right frontal EEG asymmetry, greater time spent in mutual gaze was associated with more positive infant affect ($r = .57$, $p =$

.001). Furthermore, for infants with relative right midfrontal asymmetry (alpha 2), those with highly sensitive mothers had lower cortisol levels poststressor (M = .40, SD = .20) than infants with mothers low in sensitivity (M = .72, SD = .29), t(11) = 2.32, p = .04. Finally, for infants with mid-frontal relative right asymmetry, higher maternal anxiety at newborn was strongly correlated with significantly lower cortisol poststressor (r = -.579, p = .038). While negative maternal mood does predict brain patterns associated with negative infant affect, quality mother-infant relationship dynamics may nonetheless encourage positive infant affect and healthy physiological stress regulation even when brain patterns associated with dysregulation have been established.

P1-I-245 Maternal Postnatal Psychosocial Distress: Associations with the Breast Milk Microbiome

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Breast milk (BM) is the most important source of nutrition for millions of infants. It transfers many bioactive components to the developing infant, including immune components, hormones, peptides, oligosaccharides and a wide array of microbes. The bacterial strains in maternal milk vary between women and are subject to changes over time. It remains largely unknown which maternal factors may explain the variation of microbial development in BM during the first months postpartum. One maternal factor that may impact BM microbial composition is maternal postnatal psychosocial distress. This study investigates the association between maternal postnatal psychosocial distress (i.e. maternal postnatal anxiety, stress and depression) and BM microbiota composition across the first three months postpartum in healthy breastfeeding women. This study included a sample of 59 mothers after full term pregnancies. Maternal postnatal psychosocial distress was measured using self-reported questionnaires during the first 3 months post-delivery. Milk samples were collected simultaneously. For BM microbial identification, Illumina technology based on sequencing of the 16S ribosomal RNA gene was used. Overall, at the phylum level, Firmicutes were the most frequent and abundant bacterial phyla (albeit decreasing over time), followed by Proteobacteria and Actinobacteria (both increasing over time). Within the phylum Firmicutes, Staphylococcaceae and Staphylococcus, respectively Family and Genus, were the most abundantly and frequently present, and both decreased over the 3 month period postpartum. Family Streptococcaceae and Genus Streptococcus were the second most

abundant and frequent phyla present and their levels remained stable over time. Levels of maternal postnatal anxiety, stress and depression were independently associated with changes in the composition of milk microbiota at different time points. Low levels of maternal postnatal anxiety were associated with lower reads two weeks post partum of Family Enterococcaceae and Genus Enterococcus compared to higher levels of maternal postnatal anxiety. Moreover, low levels of maternal postnatal anxiety were associated with a higher number of reads two weeks post partum of the Family Actinobacteria and the species Bifidobacterium infantis. The amount of reads belonging to the Order Lactobacillales were higher in milk from mothers with low levels of anxiety postpartum compared to milk samples from mothers with high levels of anxiety. Regarding maternal postnatal stress, the number of reads two weeks post partum corresponding to Class Clostridia, Familiy Veillonellaceae, Family Streptococcaceae and Genus Veillonella were highest in milk samples of mothers with low/medium reported levels of stress. For maternal postnatal depression, sequences related to Genus Fusobacterium were only detected in milk samples from mothers with high levels of depression. Finally, compositional differences were found in breast milk from mothers with no maternal postnatal psychosocial distress compared to milk from mothers with high levels of psychosocial distress. Class Bacilli, Order Bacillales, Genus Staphylococcus and Class Actinobacteria mainly drove the differences between both groups. This study shows an association between maternal postnatal psychosocial distress and microbial composition in healthy breastfeeding women up to three months postpartum. Existing evidence warrants further exploration of the BM microbial ecology.

P1-I-246 Water, Sanitation, and Hygiene (WASH) & Infant Health: Efficacy of a Child-Focused WASH Intervention for Caregivers in Rural Laos

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Stunting, a condition defined by low height-for-age, affects over 40% of children under 5 years in Laos. Stunting is associated with impaired cognitive ability, fewer years of schooling, physical and mental health problems, and death from common, preventable infections before age 5. For many children in Laos, stunted growth starts prenatally as a result of poor maternal nutritional status and worsens gradually during the first 2 years of life. Thus, the first 1000 days (from conception to a child's second birthday) is a critical window of opportunity during which timely interventions can have a considerable and

lasting impact on the prevention of stunting and its consequences. It is becoming increasingly clear that stunting cannot be completely reversed by improving children's diets if they live in highly unhygienic environments. Growing evidence suggests that there is a link between stunting and water, sanitation, and hygiene (WASH). Most notably, contaminated water (affecting 37.3% of rural Lao populations), lack of access to or improper use of sanitation facilities (affecting 52% of rural Lao populations), and poor hygiene practices increase the risk of children being exposed to harmful pathogens and thereby developing enteric infections and diarrheal disease. Chronic exposure to such pathogens and frequent infections and/or diarrheal episodes in early life can cause inflammation and irreversible damage to the gut, which impairs a child's ability to properly absorb nutrients and leads to stunted growth. Furthermore, as children are introduced to complementary foods, begin crawling and walking on the floor, and continue putting objects in their mouth between 6 months and 2 years of age, infants and toddlers are perhaps the most vulnerable to the negative developmental consequences of unhygienic conditions and pathogen exposure. The present study examines the efficacy of a child-focused WASH education program for caregivers, which promotes WASH-related practices aimed to prevent young children from harmful pathogen exposure (via child hand-washing, safe disposal of child feces, hygienic child feeding practices, etc.). The intervention aims to increase parental knowledge around why healthy WASH practices are important for children's health and development, as well as how and when to use such practices. In a pilot study, data was collected from 75 caregiver-child dyads across two small remote villages in Laos. Caregivers with at least one child under 5 years (preference given to children less than 3 years) were invited to participate. One village (n=33) received the WASH intervention, whereas another comparison village (n=42) received no intervention. Data were collected across two time points. At Time 1, caregivers completed a baseline set of survey questions (assessing demographics, child height/weight, WASH knowledge, WASH-related practices, cognitive development, etc.) prior to receiving the intervention. Immediately following the intervention, caregiver intervention-related knowledge was assessed. At Time 2 (which occurred one month after Time 1), caregivers completed a set of survey questions nearly identical to those at Time 1. Preliminary findings suggest that the WASH intervention significantly improves WASH-related knowledge (see Figures 1 & 2). Additional analyses are underway to explore the impact of the intervention on WASH-related behavioral practices one month after the intervention, relative to the comparison group.

P1-I-247 Infant Predictors of Toddler Obesity

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Using CDC growth charts and a criterion of greater than or equal to the 95th percentile, it is estimated that 5% of US infant boys younger than 2-years-old are obese, and that 11.4% of infant girls are at that level, for a total of 8.1% (Ogden et al., 2014). While these amounts are fairly close to what an epidemiologist might consider ideal, such trends for infants suggest that increased attention be paid to the factors that may contribute to excess weight gain lest their prevalence rates for obesity in childhood be even higher. Previous studies have identified numerous risk factors to be associated with early obesity, among them high birth weight and energy intake, low activity or energy expenditure, high maternal body mass index (BMI), rapid early infant growth, short duration of sleep, and overly controlling feeding styles. The aim of the present study was to examine these various factors in a predictive model of high infant BMI-for-age. Low-income mothers were recruited at a WIC center, were either black or Latina, and all formula-fed their infants. Ninety-one mother-infant pairs were observed at home while feeding when their infants were 12-months-old using the Nursing Child Assessment Feeding Scale (NCAFS)--a rating scale of mother and infant behaviors coded during a feed (Sumner & Spietz, 1994). Infant Difficultness was assessed with the Infant Characteristics Questionnaire (Bates et al., 1979). Infant motor activity and sleep duration was also measured over a 24-hour period using MicroMiniMotionloggersTM (Ambulatory Monitoring, Ardsley, NY). Dyads were re-visited at 24- and 36-months, with the infants again weighed and measured. An analysis of BMI for age and sex showed that 24 of the infants (~26%) were at or above the 85th percentile at 24-months. A regression analysis was conducted to predict BMI-for-age at 24 months, using the following as independent variables: infant birth weight, infant weight gain from 3-6 months, maternal weight, infant difficultness score, maternal feeding sensitivity score, number of feeds, and infant total motor activity and total minutes of sleep at 12-months. The regression revealed infant birth weight ($t=2.909$, $p<.01$), infant weight gain from 3-6 months ($t=2.537$, $p<.02$), and difficultness score ($t=2.157$, $p<.05$) as positively predictive of BMI-for-age at 24-months, with sleep duration showing a negative association ($t= -2.192$, $p<.05$). Using the same variables to predict BMI-for-age at 36-months, infant birth weight ($t=2.542$, $p<.03$), difficultness score ($t=2.562$, $p<.03$), and sleep duration ($t= -3.025$, $p<.01$) were again significant and in the same direction. However, negative associations now emerged for maternal sensitivity during feeding ($t= -2.610$, $p<.03$) and infant activity counts ($t= -2.841$, $p<.02$). These results not only underscore the significance of obesity as a concern in infancy, but also indicate the multiple factors that may be at work in promoting early excess weight gain.

For some time, factors such as heavier birth weight and rapid weight gain over the first postpartum months have been recognized as promoting early overweight, with lower activity level theorized as influential but inconsistently related. More recently, insufficient sleep and infant difficulty have also been implicated. The present results suggest that all of these factors exert an impact, and that future work should continue to examine their separate and interactive contributions to early overweight and ch

P1-I-248 Maternal Distress and Early Caregiving

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Introduction: The type of caregiving that a child receives in early life, especially from the primary caregiver, can have long-term developmental consequences. A factor that may influence maternal caregiving, and hence child development, is maternal distress. The current study investigated associations between maternal distress in late pregnancy and the early postnatal period and caregiving in the first half year. Specifically, the quality of maternal caregiving and closeness between mother and child, operationalized as holding, breastfeeding, and co-sleeping, were examined. Since earlier literature provided mixed results associations were studied in an exploratory way. Methods: A total of 193 healthy mother-child dyads were included. Prenatally, self-reported maternal stress, anxiety and physiological stress (saliva cortisol) were assessed to operationalize maternal distress. Postnatally, self-reported maternal stress and anxiety were assessed at three and six months. To assess quality of maternal caregiving, mothers were videotaped while bathing their infant at five weeks postpartum. To operationalize closeness of caregiving, at six weeks and five months postpartum mothers completed a diary on infant holding for four days. Mothers also completed daily diaries on night-time co-sleeping and weekly diaries on breastfeeding during the first six postnatal months. Hierarchical and logistic regressions, repeated measures ANOVAs, and multilevel mixed models were conducted. Gender, birthweight, maternal educational level, and parity were taken into account as potential confounders. Results: Maternal prenatal and early postnatal distress were not significantly associated with quality of maternal caregiving. More holding at 6 weeks was predicted by higher levels of pregnancy-specific hassles and lower levels of fear of bearing a handicapped child. Higher levels of maternal prenatal anxiety were related to more holding at five months postpartum. As can be seen in Figures 1a and 1b, the effects of prenatal anxiety on holding were stronger at five months, while the effects of prenatal daily hassles were stronger at 6 weeks. Maternal prenatal and early postnatal distress were

not significantly associated with breastfeeding. Maternal prenatal evening cortisol was related to more co-sleeping. Maternal prenatal daily hassles were related to less co-sleeping. Discussion: The results provide evidence of links between maternal prenatal distress in late pregnancy and mother-infant closeness in the form of holding and co-sleeping. No links were found with quality of care and breastfeeding. Differential results were found for the specific maternal prenatal distress variables and holding and co-sleeping. Maternal postnatal distress was not related to the quality of maternal care and mother-infant closeness. In summary, in this study maternal prenatal distress was linked to caregiving whereas no associations were found between maternal distress during the postnatal period and caregiving. Future studies should replicate the current results and examine underlying mechanisms. This may offer starting points for prevention and intervention options.

P1-I-249 Exploring the role of eye contact in everyday interactions: Joint engagement in infants later diagnosed with ASD

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Infants develop in a complex social environment, full of opportunities for emerging social communication. Given that differences in social communication are a core feature of Autism Spectrum Disorder (ASD), joint engagement (JE; i.e., the ability to actively engage with the same object as a social partner) likely plays a key role in understanding the development of ASD. Research on JE in infants at heightened risk (HR) for ASD has primarily focused on infants' eye contact and gaze following in structured interactions (e.g., Sullivan et al., 2007; Ibañez et al., 2013), but recent work suggests that eye contact is relatively infrequent during naturalistic interactions in typical development (TD; Yu & Smith, 2013). Furthermore, while toddlers with ASD spend less time than their TD peers in JE with eye contact (coordinated JE), moments of JE without eye contact (supported JE) are prevalent across outcome groups (Adamson et al., 2009). However, these findings have not been extended to HR infants. The present study aims to examine supported and coordinated JE, as well as engagement with objects, in HR infants in the second year of life. </p> Participants included 43 HR infants, as well as a comparison group of 14 infants with no family history of ASD (Low Risk; LR). Infants and their caregivers were video-recorded at home while playing with a standard set of toys for 5 minutes at 12 and 18 months of age. Observations were coded into mutually exclusive engagement states described by Adamson and colleagues (2004, 2009), including supported and coordinated

JE and object engagement, such that the end of one code signifies the beginning of another code. For both forms of JE, the infant must be actively involved with the same object as the caregiver. In supported JE, the child does not glance towards the caregiver's face despite being jointly engaged. In coordinated JE, the infant must acknowledge the caregiver's role in the interaction (i.e., by glancing toward the caregiver). In object engagement, the child engages solely with objects. </p> Proportions of time spent in each engagement state were calculated for each visit. Preliminary analyses were conducted with a subset of LR (n=6) and HR (n=19) infants, with descriptive values shown in Table 1. As can be seen in Table 1, the proportion of time spent in coordinated JE increased across time for LR but not HR infants, with the difference between groups at 18 months approaching significance (p=.052). In contrast, supported JE accounted for a substantial proportion of the interaction at 12 and 18 months, and did not differ between groups. Interestingly, HR infants spent more time in object engagement than LR infants at 12 months (p<.05) and less time unengaged (p<.01). </p> These preliminary data highlight potential emerging differences in coordinated but not supported JE for LR and HR infants. If supported JE is indeed prevalent in early interactions for HR infants, these contexts might have utility in supporting communicative development. Better understanding these interactions may therefore enhance our knowledge base for translating interventions and preventative measures for HR infants.

P1-I-250 Severity of Autism Symptoms, Not Fearfulness, Predicts Attention and Approach Behaviors to Fear-Eliciting Stimuli in Toddlers

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Introduction: Anxiety disorders are common in children with ASD, affecting up to 40% of them (van Steensel et al., 2011). In nonclinical populations, attention and proximity to a threatening stimulus in early childhood have been linked to later anxiety (Crockenberg & Leerkes, 2004, 2006). In typically-developing (TD) infants, parent-reported fearfulness was positively correlated with observed fear reactivity during fear-inducing probes, and fear reactivity was negatively correlated with gaze toward the threat (Braungart-Rieker, Hill-Soderlund, & Karrass, 2010). However, parent-reported measurements of specific temperament traits were not predictive of those same traits observed during in-vivo paradigms (Gagne et al., 2011). Little is known about the relationships among approach

and attention to threat and parent-reported fearfulness in toddlers with ASD. Hypotheses: Parent-reported fearfulness will be positively correlated with duration of attention directed toward the parent and negatively correlated with duration of attention toward the frightening stimulus. Furthermore, parent-reported fearfulness will be negatively correlated with duration of approach to the stimulus and positively correlated with duration of escape from the threat. Study Population: 170 toddlers between 13 and 32 months of age (M = 21.49, SD = 3.61) including 56 typically-developing (TD) toddlers, 70 toddlers with ASD, and 44 toddlers with developmental delays (DD) and other behavioral problems. Clinicians established diagnostic status based on several assessment tools (MSEL, ADOS, and Vineland). Methods: The participants were administered three fear-eliciting tasks based on the Laboratory Temperament Assessment Battery, Locomotor Version (LabTAB; Goldsmith & Rothbart, 1999): (1) crawling spider, (2) scary masks, and (3) roaring dinosaur. Indices of attentional vigilance to threat (proportion of looking time to the threat, or parent) and approach-avoidance behaviors (proportion of body movements towards the threat, or escape towards the parent) were rated offline by blinded coders and averaged across the three episodes. Parents reported Fear on the Early Childhood Behavior Questionnaire (ECBQ; Putnam, Jacobs, Garstein, & Rothbart, 2006). Severity of autism symptoms was indexed using the calibrated severity score from the Autism Diagnostic Observation Schedule 2-Toddler Module (ADOS2-T: Lord et. al., 2012; M=4.22, SD=2.83). Results: Correlations between ECBQ Fear score and the attentional vigilance to threat and approach-avoidance behaviors were not significant (all ps > .68). However, we observed significant correlations between severity of autism symptoms and duration of approaching the threat, r=.30, p<.001, duration of attention toward the threat, r=-.19, p=.01 and duration of attention to the parent, r=-.22, p=.003. Results suggest that parent-reported fearfulness is not associated with duration of attention or approach behaviors towards fear-eliciting stimuli, but toddlers with higher autism severity spent more time approaching the threats. Children with more severe autism symptoms also looked less at the stimuli and at their parents, which is consistent with previous findings of associations between abnormal attention and symptom severity (Campbell et al., 2014). The mechanisms underlying the link between higher severity of ASD symptoms and atypical approach and attention are unknown and require further examination.