Bi-Ennial Conference 2017

October 12 – 14
Portland, Oregon

DoubleTree by Hilton Hotel
Portland

Abstract Book

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Friday October 13, 2017

Plenary Address

Relations Between Conceptual Development and Executive Function: In Dialog with Jean Piaget

Susan Carey, Harvard University

The adult human conceptual repertoire is a unique phenomenon on earth; non-human animals lack most of the 500,000 concepts lexicalized as single words in the Oxford English dictionary. Babies and animals cannot think about democracy, atoms, cancer, global warming, rational number or any of an infinitude of thoughts composed from one or more concepts they lack. Accounting for the origin of the human conceptual repertoire, over both evolutionary and ontogenetic time is a formidable challenge within the disciplines of developmental psychology and developmental cognitive science—it is no less than the challenge of accounting for conceptual development, and is the locus of modern versions of Piaget's constructivism. Another project within the science of cognitive development is characterizing developmental changes within domain general, content neutral representational/computational resources, such as attention, working memory, and executive function, the locus of modern versions of Piaget's stage theories. In my talk I will illustrate how these two developmental projects illuminate each other.

Plenary Symposium 1 – The Development of the Imagination

The Batman Effect

Stephanie Carlson, University of Minnesota - Twin Cities

Psychological distancing, which involves creating mental space between a stimulus and response, is thought to allow individuals to take a step back from the problem at hand and gain self-control (Liberman & Trope, 2014; Sigel, 1970). In a series of studies, my students and colleagues and I have demonstrated that children perform significantly better on measures of executive function and self-regulation when instructed to pretend to be an exemplary character, such as Batman (White & Carlson, 2015; White et al., 2017; Grenell et al., under review). In new research, we are investigating the boundary conditions on this phenomenon, including the qualities of the exemplar (competence, familiarity) and child characteristics (age, starting level of executive function). Ultimately, we hope this research adds to a body of evidence on a "growth mindset" and how, under what conditions, and for whom it can be most beneficial, leading to improvements in academic and social-emotional skills.

Inconceivable! How Children Mistake Failures of Imagination for Insights into Necessity

Andrew Shtulman, Occidental College

Children's intuitions about physical possibility are initially quite parochial. Preschool-aged children tend to deny the possibility of anything that defies expectation, judging events that are merely improbable (e.g., finding an alligator under the bed, growing a beard to one's toes) as physically impossible. Not until age ten do children reliably differentiate events that violate physical laws from those that violate mere statistical regularities, both in their judgments of what is possible and their justifications for those judgments. In this talk, I will explore the development of children's possibility judgment across domains, tasks, and contexts. I will also explore relations between possibility judgment and other forms of cognition, including the ability to differentiate fantasy from reality and the ability to differentiate moral transgressions from conventional transgressions. Overall, I will argue that developmental differences in the acceptance of extraordinary events track developmental differences in the ability to imagine circumstances under which those events might occur.

Paracosms: The Imaginary Worlds of Middle Childhood

Marjorie Taylor, University of Oregon

The capacity to generate imagined alternatives to our actual experiences is crucial for causal reasoning about real world phenomena and is evident in many types of activities in which people create or enjoy entirely fictional characters, places, and things (Byrne, 2005; Gopnik, 2009; Harris, 2000, 2013; Taylor, 1999). One manifestation in middle childhood is the creation of elaborate imaginary worlds called "paracosms" (i.e., parallel worlds). Paracosms are often highly elaborated and can include governments, religions, royalty, languages, special animals, customs, and many other features (Cohen & MacKeith, 1991; Root-Bernstein, 2014). Adult retrospective reports suggest that inventing paracosms in childhood might be related to later creativity (Root-Bernstein, 2006). In our research, we developed an interview strategy for collecting information about paracosms from the viewpoint of the children themselves (Taylor, Mottweiler, Naylor & Levernier, 2015) and then investigated the link between inventing paracosms and other types of creative behavior in two studies with 169 children aged 8 to 10 years, the period when paracosms are believed to be most common. The children who reported having paracosms (17%) did not differ from other children in verbal ability or working memory. They scored lower on inhibitory control, but higher on many of our creativity tasks, especially those involving social content. This research contributes to our understanding of paracosms, creativity, and other aspects of imagination in children's lives and development.

The plodding imagination of young children

Paul Harris, Harvard University

Although young children are often credited with a rich imaginative life, I argue that their imagination is ordinarily quite limited, reality-bound and pedestrian. It is restricted by their grasp of everyday constraints on what actually happens or ordinarily happens. Children need to be inspired by external input – by other people, by fairy stories, or by a religious education – if they are to be more imaginative.

Poster Session 1
A - Cognition in Applied Contexts

1-A-1　　　　　**Children's Narrative Reflections Reveal Engineering Learning during Tinkering Activities in a Children's Museum**

Diana Acosta[1], Maria Marcus[2], Lauren Pagano[1], Meriem Sadoun[1], Autumn Crowe[1], Catherine Haden[1], David Uttal[2]

[1]Loyola University Chicago, [2]Northwestern University

This project examines whether and how young children learn STEM-relevant skills during tinkering and making activities through direct hands-on experiences interacting with objects and parent-child conversations. 77 children ages 4 to 11 (M age = 7.02; 37 girls) and their parents worked to meet a design challenge to "make something that flies" in a tinkering exhibit at a children's museum. Immediately after finishing their creations, we elicited the children's oral narrative reflections about what they did and learned from the tinkering experience. The majority of these narratives included talk about the function of tools (58%), the sequencing of an engineering design process (70%), getting help from others (65%), and testing (90%). Parents who verbally encouraged their children to test their creations while building had children who talked more about elements of the engineering process in their reflections afterward. The work is contributing to understanding learning and remembering in real-world contexts.

1-A-2　　　　　**Timed Tests and Math Anxiety as Factors Affecting Elementary School Math Performance**

Jonathan Emmons[1], Caitlin Brez[1]

[1]Indiana State University

The current study sought to evaluate the effects of timed tests and math anxiety as factors that influence the math performance of second- and fourth-grade students, including evaluating differences based on gender. Relevant literature was reviewed, examining the concept of math anxiety and the effects of timed testing. In the experimental phase, students participated in an age-appropriate math test in either a timed or untimed condition. Each participant also responded to the Children's Anxiety in Math Scale (Jameson, 2013). Initial results from a three-way analysis of variance (ANOVA) revealed a main effect for gender on math performance, with males performing better. A separate ANOVA indicated a two-way interaction between grade and testing condition, confirming the original hypothesis that fourth-graders would perform better than second-graders in the timed condition. No differences were found between the math anxiety scores of males and females. Limitations and directions for future research are also discussed.

1-A-3　　　　　**Thinking About Data: The Effect of Warm-up Tasks on Covariation Strategy Use**

Victoria Jay, Christopher Osterhaus[1], Martha Alibali[2]

[1]University of Munich (LMU), [2]University of Wisconsin-Madison

Judging covariation, the relatedness of events, from data is challenging for both children and adults. Past studies suggest that this difficulty might stem from a tendency to focus on numerical values rather than proportions when interpreting data. In this study, children (ages 9-11, N = 62) were primed with a warm-

up task to encourage them to think of covariation values either in terms of proportions or in terms of numerical values, or they were not primed in a control condition. Participants' strategy use was examined at a posttest. Ratio priming did not increase participants' use of proportional strategies ($z = .57$, ns); however, number priming decreased use of proportion-based strategies ($z = -2.32$, $p = .02$). Thus, the warm-up task did not successfully support use of more sophisticated strategies, but it led some participants to shift to non-optimal strategies. These findings have implications for instructional communication about covariation.

1-A-4   Assessing Conceptual Understanding of Algebra

Abbey Loehr[1], Bethany Rittle-Johnson[1], Jon Star[2], Jane Kang[2], Kelley Durkin[1]

[1]Vanderbilt University, [2]Harvard University

Proficiency in algebra is critical to academic, economic, and life success (Adelman, 2006; NMAP, 2008). Unfortunately, national and international assessments have drawn attention to pervasive student difficulties in algebra (Schmidt et al., 1999). Competency in algebra requires developing both conceptual (i.e., knowledge of abstract concepts and general principles) and procedural knowledge (i.e., knowledge of mathematical strategies). Developing conceptual knowledge is critical; understanding of key concepts such as equivalence and variable is essential to success in algebra (Knuth et al., 2006). However, existing Algebra I assessments rarely assess conceptual knowledge and instead focus on procedural knowledge. One researcher-based effort in developing a conceptual knowledge assessment did not achieve acceptable reliability (Genareo et al., 2016). Another did demonstrate some evidence of internal consistency (Star et al., 2015). The goal of the study was to construct and examine the psychometric properties of a new Algebra I conceptual knowledge assessment. Given the lack of existing assessments, this important work is among the first to provide evidence for a reliable and valid measure, a process heavily emphasized by the AERA/APA/NCME (1999) testing standards. Students from 5 Algebra I classrooms participated (N = 87 students; M age = 14 yrs; 54% female; 20% ethnic minorities). Students completed the assessment at the beginning of the school year. The assessment included 11 multiple-choice items that targeted core algebra concepts such as equivalence, variable, and slope. Items were modified from existing assessments and developed in collaboration with a mathematics education researcher. Two criterion measures were gathered from school records: math course grade for the first semester of Algebra I and students' performance category on the state test (i.e., needs improvement, proficient, or advanced on the MCAS) in the previous year. Students will re-take the assessment at the end of the school year, and this data will be added to the presentation. On average, students solved 64% (SD = 24%) problems correctly. The easiest items focused on slope and linearity and the hardest items required knowledge of properties of solutions to systems of equations. Reliability was acceptable (Cronbach's Alpha = .68) and similar to what was found in Star et al. (2015). Criterion validity was examined by correlating accuracy on the assessment with students' course grades and state test scores. Accuracy was significantly correlated with course grades, $r = .40$, as well as state test scores, Spearman's rho = .60. Students who scored in the 'needs improvement' range (n = 4) on the state test solved on average 43% correct on the assessment, those in the 'proficient' range (n = 29) scored 52% correct, and those in the 'advanced' range (n = 45) scored 77% correct. Students began Algebra I with some knowledge of core concepts, but had much to learn. Findings suggest our assessment demonstrated acceptable reliability and validity. The validity of inferences that can be drawn from studies without information about the reliability and validity of key outcomes is limited because it is unknown whether these outcomes measure what they claim to (Hill & Shih, 2009). Thus, the development of valid and

reliable measures of conceptual knowledge of algebra is critical for evaluating the impact of interventions and developing theories of algebra learning.

1-A-5   Fostering Grit: Perceived School Goal-Structure Predicts Growth in Grit and Grades

Daeun Park[1], Alisa Yu[2], Rebecca Nyquist[3], Eli Tsukayama[4], Angela Duckworth[3]

[1]Chungbuk National University, [2]Stanford University, [3]University of Pennsylvania, [4]University of Hawaii-West Oahu

Grit, the inclination to pursue long-term goals with passion and perseverance, predicts academic achievement and professional success, but how to encourage grit in students remains an open question. The goal of the current study was to understand how perceptions of school culture influence the development of grit in middle school students. We conducted a year-long, prospective, longitudinal study (N = 1,277) examining grit, perceived goal-structures at school (mastery vs. performance), and academic achievement. In cross-sectional analyses, we found that students who perceived their schools as more mastery goal-oriented were grittier and earned higher report card grades. In contrast, students who perceived their schools as more performance goal-oriented were less gritty and earned lower report card grades. In longitudinal analyses, rank-order increases in perceived mastery school goal-structure predicted rank-order increases in grit over the school year, which in turn predicted rank-order increases in grades. Although in the hypothesized direction, changes in how students perceived performance school goal-structure did not predict changes in grit. These findings suggest that school environments that emphasize the value of learning for learning's sake may encourage children to sustain interest in and effort toward long-term goals.

1-A-6   Parent Mediation of Children's Strategy Learning from Daniel Tiger's Neighborhood App and Videos

Gabrielle Strouse[1], Eric Rassmussen[2], Malinda Colwell[2], Kristen Brady[3], Steven Holiday[2], Rebecca Densley[2], Holly Wright[2], Mary Norman[2], Georgene Troseth[3]

[1]University of South Dakota, [2]Texas Tech University, [3]Vanderbilt University

Adults can scaffold children's transfer of problem solving strategies from one story scenario to another by asking children to explain relevant story features (Brown, Kane, & Echols, 1986). Less is known about whether children acquire other transferable strategies from stories, such as those for emotion regulation, and whether parental mediation supports this process. In this study, 123 children were randomly assigned to 1) play the Daniel Tiger (DT) app and watch the DT television program, both of which presented emotion regulation strategies, 2) play the DT app and watch a control program, or 3) play and watch control media over a 2-week period. ANCOVAs indicated there were no group differences in children's use of the emotion regulation strategies at pre-test or immediate post-test; however, children in both groups exposed to the DT app displayed more strategy use at 4-week follow-up than those in the non-exposed group. Regression analyses indicated that the raw amount of time children spent with the app and show, as well as children's visible engagement and interactivity with the media, were not significant predictors of strategy use at follow-up; however, the amount of parental scaffolding provided during DT media use did predict strategy use. This study indicates that children can learn to use strategies for emotion regulation presented in children's media, and that parental scaffolding of the content may enhance children's acquisition and use of these strategies.

1-A-7   **Preschool Engineers: Choosing Materials That Can Support Walking on a Bridge.**

Shuqi Yang¹, Rochel Gelman¹

¹Rutgers University

In Yang and Gelman's (2017) study, three- to five-year-old children and adults were asked to predict whether bridges composed of rigid and non-rigid materials would support an elephant's walking across. They needed to decide whether the chosen material would make it safe for the elephant to walk on the bridge. If not, they should say that the elephant should walk around and take an alternative longer route. Regardless of the rigidity of the materials, three-year-olds were at chance while four-year-olds were just above chance in predicting the elephant's action. Five-year-olds and adults performed at ceiling. Younger children's failures in Yang and Gelman's (2017) study could be due to task demand. In particular, Yang and Gelman's (2017) task required children to first judge the material's absolute rigidity, and then predict the elephant's action. In addition, younger children frequently predict that the elephant will walk around the river, suggesting that they may be risk adverse. The present study lowers the demand of the previous task in two ways: 1) by implementing a forced choice paradigm where they only need to decide which material can construct a "good" bridge between two materials and 2) by not requiring the children to predict the elephant's action. Twenty-seven three- and 29 four-year-olds were first shown an animation in which a builder builds a bridge, using either "good stuff" (i.e., aluminum) or "not good stuff" (i.e., paper). Preschoolers were then shown that the elephant either successfully crosses the bridge (when it is constructed with "good stuff") or unsuccessfully crosses by falling into the river (when the bridge is constructed with "not good stuff"). Children were first asked to identify the materials from the initial animation and recall the events that occurred after the elephant walked on each bridge. In the test phase, participants were shown four pairs of materials (one rigid and one non-rigid material, see Figure 1). Children who did not pass the memory test were excluded from the analysis (9 three-year-olds and 2 four-year-olds). Fifteen out of 18 three-year-olds and 26 out of 27 four-year-olds were able to discriminate which materials would be used to create a "good" bridge for the elephant to cross (binomial test 1/2: threes: $p < 0.001$; fours: $p < 0.001$), suggesting that both three- and four-year-olds can take into account the relative rigidity of the material used for a bridge to support a given weight. The information processing requirements in the present study were reduced, but the memory demands were still too high for a third of the 3-year-olds. Their failures in the memory task could be due to general limitations on working memory capacity, a lack of conceptual understanding on the relationship between a material's rigidity and physical support or other factors. This will be investigated in the future research.

B - Cognitive Foundations: Memory, EF, Attention, Action

1-B-8   **Understanding the structure of executive function in young children using lab and classroom-based assessments.**

Sammy Ahmed¹, Alexa Ellis¹, Nicholas Waters¹, Ying Wang¹, Frederick Morrison¹

¹University of Michigan

Researchers from different disciplines have relied on multiple techniques when studying executive function (EF). However, it remains unclear whether these distinct assessments tap into the same underlying construct in children, whether EF skills constitute a unitary skill or if they exist separately in young children. We assessed 120 kindergarteners (mage=5.9 years) using 3 classroom-based and 3 lab-based measures of EF, intended to capture working memory, attentional control and response inhibition. The results from exploratory factor analysis support a three-factor structure. All three lab-based measurements (HTKS, backward digit span, & pair cancellation) loaded together. The classroom-based measures differentiated into two factors; one of which consisted of the three stop-time measures (inhibitory control), and another that consisted of all three distractibility scores (attention regulation). These results suggest that EF components are distinguishable in young children. These results also underscore the importance of measurement context when studying EF development in children this age..

1-B-9   The development of processes associated with belief change over the preschool years

Caitlin Atkinson, J. Randall Flanagan[1], Mark Sabbagh[1]

[1]Queen's University

Over the preschool years, core beliefs about the world go through significant changes in a number of content domains. Although the characteristics of these changes are well mapped out, little is known about why the later preschool years are a fertile period for belief change. Here, we examined developmental changes in 3-and 5-year-olds' capacity for belief change in a highly circumscribed context: changing beliefs about object weights. Because lifting objects is associated with stereotyped kinematics, analyses of those properties can provide insight into children's beliefs about the objects. In our study, 3- and 5-year-old children first lifted a light object, then the object was replaced with a second object that either looked same or different, but was 3 times heavier. We reasoned that when the heavier object looked the same as the first, children had to revise their initial beliefs about the weight of the object to achieve a smooth lift. The same extent of belief revision was not required in the different condition. Results showed that although all children adapted their lifting to the weight, only 5-year-olds showed a condition difference in their lifting of the heavy object. When lifting the heavy object, 5-year-olds showed evidence of holding competing beliefs about the weight of the object, but not in the different condition. We speculate that the capacity for belief change may develop during the preschool period and be a rate-limiting factor on conceptual development.

1-B-10   Regress for Success: Returning to Crawling Places Attentional Demands on New Walkers

Melissa Horger[1], Pascale Saad[2], Autumn Zillig[3], Sarah Berger[4]

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The acquisition of new motor skills creates opportunities for problem solving. We used adaptive locomotion as a window into infant cognition to examine the effect of motor experience and attentional load on infants' ability to devise alternative solutions. 85 walking infants (mean experience=1.65 mos; range=.10-10.32 mos) started upright at the opening to a tunnel leading to a caregiver at the far end. A

strict 15-step training protocol controlled when and how to highlight relevant details of the task. The session ended once infants crawled through or completed training without success. Walking and tunnel experience accounted for a significant proportion of the variance of spontaneous exploratory behaviors (R^2=.13, p<.01). Infants without tunnel experience (n=47) were more likely to explore and fail to fit their body to the tunnel. Exploration increased then decreased as a function of walk experience. Tunnel experience alone accounted for a significant proportion of the variance of number of training steps (R^2=.12, p<.01) and time to complete the task (R^2=.12, p<.04) and was associated with fewer training steps and faster task completion. For walkers to navigate a tunnel, they must devise an alternative locomotor strategy, fit their body to the tunnel, and maintain the strategy. New walkers are less able to come up with alternative strategies until walking becomes more automatized. Prior tunnel experience reduced attentional demands, but did not fully transfer a solution

1-B-11   Openness to Experience Mediates the Relation between Childhood Fantasy Proneness and Creative Performance

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Childhood fantasy proneness is related to creative performance but no research has examined how the personality factor 'openness', which also predicts creativity, may impact on this relationship. 465 participants (56% female; M age = 24 years, SD = 13.26; range 8 - 80 years) completed online measures of fantasy proneness (the Creative Experiences Questionnaire, CEQ), Big 5 personality traits(the Ten Item Personality Inventory, TIPI), and an objective divergent thinking test of creativity (how many uses can you think of for a cup?). After controlling for age and gender, there were significant correlations (ps < .01) between childhood fantasy proneness (items 1-6 from the CEQ) and openness (r = .13), and between openness and creativity (number of responses-fluency, r = .18; number of categories of responses-flexibility, r =.17; uniqueness of each idea-originality, r =.23). Mediation analysis revealed that openness was a significant mediator of the links between childhood fantasy proneness and creativity scores for fluency, flexibility and originality. Additional analyses confirmed that the relation between openness and creativity was not mediated by childhood fantasy proneness. The direction of these results suggests that childhood fantasy proneness is a precursor to developing the personality trait, openness to experience, which partly explains how childhood experiences may foster creativity.

1-B-12   Parental Linguistic Input and Its Relation to Hearing-impaired and Normal-hearing Toddlers' Visual Attention in Joint Object Play

Chi-hsin Chen[1], Irina Castellanos[1], Chen Yu[2], Derek Houston[1]

[1]The Ohio State University, [2]Indiana University

Infants learn about the world through interacting with their parents, who influence what they attend to and, thus, what they process and acquire. The interactions are multimodal, often involving coordinated exchanges of auditory and visual information between the two parties. These coordinated, multimodal interactions are crucial for early development. But what happens if one modality is impaired? In this study, we investigate the role of sensory systems in coordinated interactions and attention by studying children with impaired auditory input and compare them to normal hearing children. We examined how speech input provided by parents affected their toddlers' attention during joint object play. Three

groups of toddlers (aged 13-37 months) and their parents participated in the study. These children were hearing-impaired toddlers (HI group), normal-hearing controls matched on chronological age (CA group), and normal-hearing controls matched on hearing age (HA group). During the play session, we recorded parents' speech as well as children's moment-to-moment gazes using head-mounted eye-trackers. Parents' speech was analyzed using both quantitative and qualitative measures. The quantitative measures included: 1) quantity of input, 2) lexical diversity, and 3) syntactic complexity. The qualitative measures focused on utterances about the toys in play. These object-related utterances were divided into labeling, utterances about object features, utterances about object actions, open-ended questions, close-ended questions, and directives. Parents in all three groups had comparable input in most quantitative measures. With regard to qualitative measures, parents of CA children tended to use different types of utterances more or less equally frequently. On the other hand, over 50% of the utterances produced by the HI and HA parents were close-ended questions and directives. These results suggest that the input HI children received was more in line with their hearing age rather than their chronological age. We then asked whether different types of utterances affected children's visual attention during object play. We measured the length of children's gaze toward an object following different types of utterances and compared the gaze lengths against baseline. For the CA group, almost all utterance types were effective in extending children's attention to the objects parents talked about. For the HI children, most utterances, except for open-ended and close-ended questions, were effective in extending children's attention to objects. However, for the HA children, only utterances about object actions, close-ended questions, and directives were effective in extending their visual attention. These results suggest that the HI children's visual attention was affected by their parents' utterances in ways that were more similar to their CA peers. The current study showed that the amount of linguistic input HI children received was not different from their CA and HA peers. However, parents' use of utterances seem to be tailored to their children's hearing experience. On the other hand, the effects of parental speech input are modulated by children's cognitive ability. Our study is the first to examine the dynamical effects of different utterance types on children's visual attention in joint object play. The results also shed light on children's learning of object concepts and object names.

1-B-13   Using Language to Get Ready: Familiar Labels Help Children Engage Proactive Control

Sabine Doebel[1], Yuko Munakata[1]

[1]University of Colorado Boulder

A key developmental transition is the ability to engage executive functions proactively, in advance of needing them. We tested the potential role of linguistic processes in proactive control. Children completed a task in which they could proactively track a novel (target) shape on a screen as it moved unpredictably amidst novel distractors and had to identify where it disappeared. Children almost always remembered which shape to track, but children who learned familiar labels for the target shapes before the task had nearly twice the odds of tracking the target compared to children who received comparable experience with the targets but no labels, OR = 1.89, $\chi2 = 4.70$, $p = .03$. Many children who learned labels also spontaneously vocalized them when the target appeared (n = 11), and were marginally more likely to do so than children who did not learn labels (n = 3), $\chi2 = 3.41$, $p = .065$. Spontaneous vocalization of labels did not predict performance, consistent with the possibility that children who did not vocalize may have used inner speech to support proactive control. These findings provide the first evidence of a causal role for linguistic processes in proactive control, and suggest new ideas about how proactive control develops, why language supports a variety of executive functions, and how interventions might best be targeted.

1-B-14   Targeting the dynamics of cognitive control in children, adolescents, and adults: Evidence from reaching behavior in the Simon task

Christopher Erb¹, Jeff Moher², Stuart Marcovitch¹

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Human beings exhibit a remarkable capacity for cognitive control (CC) - the ability to align one's ongoing thoughts and actions with one's current goal and context. Current models of CC propose that the capacity is supported by a number of dissociable processes, including a response threshold adjustment (RTA) process that puts a "brake" on behavior by temporarily inhibiting motor output when conflict is detected (e.g., when two competing responses are activated), and a controlled response selection (CRS) process that "steers" activation in favor of the appropriate response in light of one's current goal (Frank, 2006; Shenhav, Botvinick, & Cohen, 2013). Given CC's role in supporting a range of social and cognitive capacities across the lifespan (see Diamond, 2013, for a review), a key challenge facing developmental researchers is to identify how the RTA and CRS processes contribute to age-related changes in CC. However, little is currently known about how these processes function during childhood and adolescence. This is due in part to an overreliance on traditional behavioral measures such as accuracy and response time, which provide limited insight into how cognitive processes unfold over the course of a response. To address this gap in our current understanding, Erb and colleagues (Erb, Moher, Sobel, & Song, 2016; Erb, Moher, Song, & Sobel, 2017) have used a technique known as reach tracking to record the path that a participant's hand travels to reach a response target. Their findings indicate that initiation time (the time elapsed between stimulus onset and movement onset) reflects the RTA process by indexing when the "brake" is taken off of behavior, while reach curvature (the degree to which a movement deviates from a direct path to the selected response location) reflects the CRS process by indexing when behavior is "steered" toward the appropriate response. Here, we used a reach-tracking version of the Simon task (Simon, 1969) to investigate the development of cognitive control in children, adolescents, and adults (N = 108). Across each of the age groups, initiation times were significantly elevated on incongruent relative to congruent trials and on trials preceded by an incongruent relative to a congruent trial. This finding indicates that conflict from both the current and previous trial served to increase response thresholds, resulting in the "brake" being applied for longer. In contrast to initiation time, reach curvature revealed an interaction between the congruency of the current and previous trial, such that reach curvatures were smaller when the congruency of the current trial matched that of the previous trial (e.g., reach movements were more direct on incongruent trials preceded by an incongruent trial than on incongruent trials preceded by a congruent trial). This finding indicates that participants were able to "steer" their behavior in the appropriate direction more readily when the demands of the current trial matched those of the previous trial. Importantly, initiation time revealed limited age-related gains in CC, while reach curvature revealed robust gains between childhood and adulthood, indicating that the RTA and CRS processes follow different developmental trajectories. In addition to shedding new light on the development of CC, these findings present a framework for future research to explore how these processes differ between individuals and are impacted by disorder or disease.

1-B-15   Infant fine motor skill predicts goal imitation of fine motor actions

Courtney Filippi¹, Amanda Woodward²

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Action experience is thought to shape action understanding (e.g., Woodward et al, 2009). However, little research has examined this link in the context of complex multi-step actions. Across 3 studies, we investigate 13-month-old infants' understanding of multi-step actions using a goal imitation paradigm. Study 1 demonstrates that infants selectively imitate the goal of obtaining a toy from a box but only when the goal is causally linked to the action sequence (p<.001). Results also show that for pincer grip actions, females (M=.85) imitated the goal more than males (M=.49, p<.004). Study 2 demonstrates that there are gender differences in pincer grip production--females produce more pincer grips than males (p<.014). In study 3, we test goal imitation and action production in the same individuals. During the goal imitation paradigm, 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). There was no such relation in the WH condition. This work demonstrates that infants can deploy their action knowledge of complex action sequences rapidly and provides strong novel evidence that motor skill predicts action understanding.

1-B-16   Individual and context effects on learning from fantasy

Courtney Grant¹, Rebekah Richert¹, Molly Schlesinger¹, Koeun Choi¹

¹UC riverside

The current study builds on prior research demonstrating the influence of children's trust in fantasy and media characters on their learning from those characters (Schlesinger et al., 2016). Forty-eight 3- to 5.5-year-old children (M=4.49, SD=0.63; 58% female) read stories featuring a clever or clumsy character. Following, participants watched videos of the same character solving a problem. After watching the video, participants attempted to solve an analogous problem and make explicit connections between the video and new problem (i.e., analogical connections). Children's social cognitive beliefs about the character's problem-solving expertise (i.e., expertise judgments) and if they could interact with him in real life (i.e., reality judgments) were evaluated. Participants' expertise judgments were negatively correlated with reality judgments, r=-.42, p=.003; and reality judgments were positively correlated with analogical connections, r=.29, p=.004. An ANCOVA testing condition differences in analogical connections revealed a main effect of condition, F(1,41)=8.78, p=.005, η2=.18; participants in the clever condition made more analogical connections. There was an interaction between condition and expertise judgments, F(1,41)=5.85, p=.020, η2=.13, and between reality and expertise judgments, F(1,41)=4.05, p=.050, η2=.09. This poster will explore these interactions and discuss the effects of reality and expertise judgments on children's learning.

1-B-17   When to gesture? How the timing of gesture and speech changes learning outcomes

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When learning a new concept, children gain a more robust understanding if encouraged to produce problem-solving strategies in both gesture and speech, as opposed to speech alone (Goldin-Meadow et

al., 2009). Here we ask whether the timing of these strategies affects children's ability to learn the concept and to flexibly transfer that knowledge. Children learning to solve math equivalence problems (e.g., 3+4+5= _ +5) were taught to produce correct problem-solving strategies in gesture and speech, either produced simultaneously (Gesture+Speech) or sequentially (with Gesture before Speech, or with Speech before Gesture). Preliminary data (N=55) suggest that timing matters: children learn better when they produce gesture before speech than when they produce gesture after speech. However, for flexible learning to occur, gesture and speech must be produced together. Results have implications for how gesture should be introduced as a learning tool in classrooms.

1-B-18   Does Cognitive Flexibility Training Improve Reading Comprehension for Elementary Students?

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The goal of this study was to measure the efficacy of four cognitive flexibility training procedures for improving reading comprehension during the elementary years. The training procedures involved sorting object or word cards simultaneously or sequentially. Our study was the first to utilize sequential sorting of words. To date, 35 second through fifth grade children (ages 8 through 12 years) have participated. Children completed two MAZE reading passages before and after training to measure gains in reading comprehension. Oral reading fluency, vocabulary, and executive functioning were measured as control variables. As expected, age, oral reading fluency, and executive functioning were related to reading comprehension. Sorting words sequentially led to large gains in reading comprehension, whereas the other three training procedures led to virtually no change in reading comprehension over time. These findings suggest training of reading-specific flexibility can improve reading comprehension during the elementary years.

1-B-19   Developmental differences in playing Concentration

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"Concentration" is a game that involves turning over pairs of cards to find matches. The game requires keeping both visual and spatial information available in the working memory. As these components of memory are thought to improve with age, adults are expected to have higher performance in the game "Concentration". But anecdotal reports from parents and other adults indicate that 4- to 6- year old children may perform very well on this type of game (Schumann-Hengsteler, 1996). Surprisingly, very few systematic studies have examined why "Concentration" seems to yield uncharacteristically high performance in these young children. This research attempts to bridge this gap in the literature while focusing on memory development through performance on the game. In the current study we sought to investigate the different memory strategies in 6- (N = 34) and 8-year-olds (N = 48) as well as in adults (N = 38) when playing concentration. Each participant played three computer-controlled games on a touch-screen each with 24 cards (12 pairs). One game depicted CONCRETE pictures of everyday objects or persons (e.g. a ball, a car, or a girl), one was with NUMBERS (from 1-12), and one was with ABSTRACT patterns. All participants were eye-tracked, allowing us to investigate anticipatory looking. Furthermore, all children were tested with the Flanker task (executive function) and the Finger Windows task

(visuospatial working memory) as potential predictors. HYPOTHESIS: Our "common sense"/null hypothesis was that adults would do better on the task than children in general (complete the game faster and in fewer steps). Our working hypothesis, however, was that we would find developmental reversals in one or more important aspects of game performance and that such age-differences would vary across game types (CONCRETE, NUMBERS, ABSTRACT). Specifically, we speculated that adults may be more "disturbed" by conceptual processing in their spatial memory process due to their more advanced conceptual system. If this was the case, we might see more "near-successes" (looking at the right card, but turning a wrong one) for adults than for children. RESULTS: We found that for all measures 8-year-olds performed as good as or better than adults. The 8-year-olds also outperformed the 6-year-olds on many measures. For instance, the 8-year-olds used fewer turns to complete the game than the 6-year-olds (p = .004), while adults' performance was intermediating that of the two groups of children on this measure. The type of card-stimuli affected the pattern of results and the balance of performance across age-groups ("What" affected the memory for "Where"). The 8-year-olds, for instance, had a significantly higher success ratio than the two other age groups, but only for the CONCRETE set of cards (p = .002). As speculated, the adults did have more "near-successes" than the children (p = .003). But surprisingly, this difference was driven primarily by the ABSTRACT set of cards. CONCLUSIONS: This study showed systematic developmental differences in the ability the successfully play concentrations. These differences were largely consistent with the notion of developmental reversals. The study also showed that that the type of stimuli affected performance differently depending on the age group of the participants. To our knowledge this is the first study of the Concentration game with this level of control.

1-B-20   Scene Repetition in Visual Search - U.S. and Japanese Preschoolers

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Recent research suggests that there are cross-cultural differences in visual processing; more focused and decontextualized visual processing for Western individuals and more distributed and contextualized visual processing for Eastern individuals. These findings strongly suggest cultural differences in the use of scene information to locate the target. Accordingly, we asked whether Japanese children may attend more to relations between the target and distractors in the scene; therefore, show the contextual cueing effect (repeated exposure of same contexts facilitate the search time for targets) earlier than the U.S. children. To test this, we used a variant of the contextual cuing paradigm, but with scenes from picture books. Preschool children from U.S. and Japan (n=40) were asked to find a target in the scene with some scenes repeating across blocks. We found that Japanese children searched targets faster with the repetition of the scenes, showing the contextual cueing effect earlier in the blocks, than the U.S. children, supporting the cross-cultural differences in how visual attentions may be allocated in young children. The study contributes the growing evidences of early attentional differences by cultures. The study raises important questions about developmental trajectory of fundamental cognitive processes and origin of these differences - how the visual experiences of young children may differ across cultures.

1-B-21   Exploring the Influence of Parents' Beliefs and Behaviors on Children's Developing Executive Function

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Recent research indicates that specific parent behaviors (e.g., stimulation, sensitivity, and control) measured during semi-structured, dyadic tasks affect the development of children's executive function (EF). The contributions of parents' knowledge about effective parenting and their self-reported behaviors, however, have not been thoroughly explored and may more holistically represent parents' influence on their children's development. By collecting survey data from parents and conducting direct assessments of children's inhibitory control, set shifting, and working memory, the current study investigated the influence of parents' knowledge and behaviors on pre-K children's developing EF with a predominantly African American sample (n = 52 parent-child dyads). Hierarchical regression analyses revealed that parents' use of non-reasoning, punitive strategies negatively contributed to children's inhibitory control and parents' good-natured/easygoingness positively contributed to children's set-shifting ability. Parenting knowledge did not significantly contribute to children's EF. Findings regarding both parents' behaviors and knowledge are discussed in the context of the ongoing development of parenting and EF interventions.

1-B-22   Delaying gratification for self and other: The role of theory of mind

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Using a delay of gratification (DoG) task, Prencipe and Zelazo (2005) showed that 3-year-olds delay more for "other" (the experimenter) than they do for "self," whereas 4-year-olds made similar choices for self and other. This "integration" of first- and third-person perspectives with development may be due to age-related increases in theory of mind (Barresi & Moore, 1996; Prencipe & Zelazo, 2005). That is, older children understand the importance of delaying for both "self" and "other" but also understand that sometimes both "self" and "other" wish to gratify their immediate desires. This is in contrast to younger children who seem to gratify their own immediate desires, but indicate that others should delay gratification. Theory of mind allows children to take different perspectives- that of another person but also an outside perspective on the self. We sought to replicate the age-related changes obtained by Prencipe and Zelazo in 3- and 4-year-olds, and to examine self-other differences in DoG performance in older children (5-, 6-, and 7-year-olds). We also tested whether, as predicted by the "integration account," increases in theory of mind are associated with smaller self-other differences in DoG. Finally, we tested whether inhibition was positively related to DoG for self (but not other), because inhibitory demands might be stronger when one's own current and future desires conflict. Ninety-six 3- to 7-year-olds received a Choice Delay task with three reward types and were asked to choose for themselves and the experimenter (in a counterbalanced order) one reward now, or two, four, or six rewards later. Additionally, children were given two measures of theory of mind (Appearance-Reality and Contents False Belief) and inhibition (Head-Shoulders-Knees-Toes and Grass/Snow). Results revealed age-related improvements in DoG and interactive effects between age and perspective (i.e., self vs. other) on DoG performance. We replicated the findings of Prencipe and Zelazo for 3- and 4-year-olds, whereas 6- and 7-year-olds tended to delay more for self compared to other. Theory of mind significantly predicted DoG for self above and beyond age, but not DoG for other or DoG self-other differences in contrast with the integration account. Finally, as predicted, inhibition was positively related to DoG performance for self but not for other. These results suggest that theory of mind plays an important role in children's ability to take a third person perspective on their own DoG decisions but is not necessarily driving self-other differences in performance. Importantly, the results suggest that thinking about what someone else

should do might be an effective strategy to improve DoG performance in very young children (whose DoG is better when they take the perspective of "other"). Older children seem to understand that delaying is the best choice (and do so for themselves) but also understand others' desires for immediate gratification and often forego larger rewards on the experimenter's behalf.

1-B-23   Examining the Influence of Labels and Task Order on Preschoolers' Executive Function and Theory of Mind

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The present study examined the influence of labeling and task order on executive function (EF) and Theory of Mind (ToM) embedded in a search task. Approximately half of the 3-(n=43), 4-(n=32) and 5-year-old (n=16) participants completed EF questions first, in which participants were asked where they would search when an object was hidden in a new location after a habit was built to search elsewhere. The other half of participants completed ToM questions first and were asked to predict where a puppet that previously search for an object in one location would search when that object was moved to a new location out of the puppet's sight. For all participants, boxes were labeled for both the child and puppet by the (1) experimenter with a generic label "this box" (2) experimenter with a specific label "apple box", or (3) child/puppet with a specific label in response to the question "what box is the object hiding in". Results revealed that children performed worse on ToM compared to EF trials. Age predicted EF performance and level of labeling did not influence EF or ToM performance. There was an order effect in which answering ToM questions first actually related to worse performance on subsequent EF questions, suggesting the difficult task of considering other's behaviors may interfere with preschoolers' later ability to control behavior--possibly due to characteristic issues in cognitive flexibility or interference that arise when switching from a more difficult task.

1-B-24   The infant motor system predicts actions based on visual statistical learning

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Motor theories of action prediction propose that our motor system combines prior knowledge with incoming sensory input to predict other people's actions. This prior knowledge can be acquired through observational experience, with statistical learning being one candidate mechanism. But can knowledge learned through observation alone transfer into predictions generated in the motor system? To examine this question, we first trained infants at home with videos of an unfamiliar action sequence featuring statistical regularities. At test, motor activity was measured using EEG and compared during perceptually identical time windows within the sequence that preceded actions which were either predictable (deterministic) or not predictable (random). Findings revealed increased motor activity preceding the deterministic but not the random actions, providing the first evidence that the infant motor system can use knowledge from statistical learning to predict upcoming actions. As such, these results support theories in which the motor system underlies action prediction.

1-B-25   Relationships between Executive Functions and Academic Self-Regulation in Children and Adolescents

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The relationship between executive functions (EF) and self-reported regulation of academic behaviors was investigated in children and adolescents. Prior studies have indicated that these constructs are closely associated. Analyses were conducted using data from two studies, one targeting 6th and 7th grade students in a public middle school (MS; N=59, mean age=12.4), and one targeting 9th grade students in a private high school (HS; N=147, mean age=16.3). Measures of EF for both samples included the Dimensional Change Card Sort (DCCS) and Flanker. The n-back task was also administered for the HS students. Self-regulation of academic behaviors was measured with a modified version of the Self-Regulated Learning Questionnaire (SRL-Q) in both samples. In the MS sample, an ANOVA with SRL-Q composite score predicted by mother's education, father's education, DCCS, and Flanker indicated a significant effect of mother's education, $F(1,20)=6.95$, $p<.001$, $\eta p2=0.12$, and Flanker score, $F(1,20)=10.00$, $p<.01$, $\eta p2=0.22$. In the HS sample, an ANOVA with SRL-Q composite score predicted by the same set of variables in addition to the n-back, was conducted and revealed marginally significant effects for the DCCS score, $F(1,94)=2.87$, $p=.09$, $\eta p2=0.06$, and 4-back score, $F(1,94)=2.87$, $p=.06$, $\eta p2=0.04$. Together, these results suggest that the basic cognitive skills of EF play a significant role in MS and HS students' academic behaviors, specifically self-regulated learning.

1-B-26   Working Memory and Performance on 3- & 4-Option False Belief Tasks

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Recent work suggests a lack of construct validity in classic 2-option false belief (FB) theory of mind (ToM) tasks. Fabricius and Imbens-Bailey (2000) argued that preschoolers reason about an agent's current perceptual access to reality (PAR), and attribute ignorance to agents who lack access. Fabricius and Khalil (2003) found support for the PAR hypothesis using modified 3-option versions of classic FB tasks, in which 4-year-olds' attributions of belief decreased. One alternative explanation is that the addition of a 3rd option increased the working memory (WM) demands of the task. Indeed, WM is correlated with performance on standard FB tasks (e.g., Carlson, Claxton, & Moses, 2014). Thus, in this study, we investigated whether WM would predict preschoolers' performance on a battery of ToM tasks increasing incrementally in number of options. Four-year-olds (N = 43) and 5-year-olds (N = 42) were given three WM tasks (Corsi Block, Count and Label, and Word Span) and eight ToM tasks (Location and Contents versions of the 2-option true belief (TB), 2-option FB, 3-option FB, and 4-option FB). WM did not predict performance on 3- and 4-option FB tasks, nor did WM predict performance on the ToM battery after controlling for age. We replicated a pattern of responses on the 2-option TB and 2-option FB found by Fabricius et al. (2010) in support of the PAR hypothesis. These findings call for closer examination of the PAR hypothesis.

1-B-27   Infants' understanding of drinking: A new approach to the study of object-directed reaching

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Infants recognise that a reach towards an object is about that object, but we understand little about how they understand actions on non-discrete materials, like liquids. From means-end experiments we know that infants can recognise that the end-point of a reach is not necessarily the goal of that reach (Sommerville &Woodward, 2005). This suggests that infants might be sensitive to the contents of a container as the goal of a reach. We presented 12- to 14- month-old infants with reaches toward one of two cups on a stage. The cups were transparent and filled with different coloured liquids, each cup varying in shape and texture. Infants were familiarised to four reaches towards one of the cups. Between trials the volume of liquid was reduced by approximately 20%, as if the actor drank some of the liquid. Infants then observed the two cups having switched locations, one now empty and the other still full, followed by two test trials in which each cup was reached for (order counterbalanced). If infants view the cup itself as the goal of the actor's reach, they should expect actor to reach towards the now-empty cup, whereas if they view liquid as the goal, they should expect the actor to reach towards the full, previously un-reached for object. Infants looked equally towards each outcome (t(19)= .857, p=.402). We discuss several methodological and theoretical reasons why this outcome might have occurred, including the targets used and the change in the target over time.

1-B-28   Indexing working memory capacity in infancy

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Working memory (WM) is one of the first basic forms of executive function available to infants presumably from birth. WM capacity is quantified as the amount of information successfully retained over a variable delay used to help develop a plan, perform a task or solve a problem. Early WM capacity has been shown to be a better predictor of later academic success than early IQ (Alloway & Alloway, 2010). WM capacity has also been shown to be relatively stable throughout development, such that individuals exhibiting WM concerns at an early age continue to have issues with WM later on (Rose et al., 2012). There is ongoing debate in the literature in regard to how to properly measure WM in infancy and whether certain tasks are even tapping relevant WM constructs. This exploratory study examined individual- and age-related differences in WM capacity utilizing a range of methodologies that aimed to quantify WM in a sample of 6-12-month-old infants. Specifically, we compared performance across a battery of WM tasks differing in levels of cognitive load administered via experimenter and eye-tracker (ET). The WM task measured by experimenter included Piaget's A-not-B task. The ET WM tasks included adapted versions of: oculomotor delayed response (ODR) (Gilmore & Johnson, 1995), squares (Ross-Sheehy et al., 2003), delayed match retrieval (DMR) (Kaldy, 2015) and A-not-B (Piaget, 1955). In addition, a range of delay durations were varied for each task in order to examine what delays infants successfully tolerate at different time points in early development (ODR, Squares, DMR: 500ms, 750ms, 1000ms, 1250ms. A-not-B: 3000ms). Results indicate significant variability across tasks and delays. For ODR, infants performed significantly above chance levels (50%) for shorter delays (500ms, 750ms) while performance dropped down to chance for longer delays (1000ms, 1250ms). For squares, infants performed significantly above chance levels (33.3%) across all delay durations. For DMR, infants performed significantly below chance levels (50%) across all delay durations. For both ET and experimenter versions of A-not-B, infants performed significantly below chance levels (50%) at delays of

3000ms. Generally, older infants performed significantly better across all tasks and delays. In addition, investigation of individual differences across tasks, delays and domains are further 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.

1-B-29   Differentiating between Verbal and Nonverbal Predictors of Executive Function in Early Childhood

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Executive function (EF) has received a great deal of attention recently from both researchers and the general public, as the importance of EF has been shown to be vital to children's achievement inside and outside the classroom. Although substantial research has examined differences in EF across age, we still lack a solid grasp on the cognitive developmental foundations of EF in early childhood. Studies have linked infant attention to early childhood EF (Colombo & Cheatham, 2006; Cuevas & Bell, 2014), and both longitudinal and cross-sectional research has tied early communication and language development to EF performance (Kuhn et al., 2014; Muller et al., 2009). Though these findings and others agree that both verbal and nonverbal early cognitive abilities predict later EF, little research has differentiated between the two. The goal of the current study is to explore the relative associations of verbal and nonverbal cognitive abilities at 2 years with a range of EF abilities at 6 years. Data are from a large longitudinal study of behavior and brain development that includes single-born children and twin pairs. These data are from the subset of children with valid scores on the Mullen Scales of Early Learning (MSEL; Mullen 1995) at 2 years and on at least one of the EF measures at 6 years (N = 391; 50.9% male, N = 199; 49.1% singletons, N = 192). Scores from the MSEL subcales were used to generate verbal and nonverbal developmental quotients (VDQ & NVDQ, respectively; Short et al., 2013; Wetherby et al., 2004). Measures of EF at 6 years included working memory (WM) and fluid reasoning (FR) Factor Index (FI) Scores from the Stanford-Binet Intelligence Scales - 5th edition (S-B; Roid, 2003); FI scores were generated from verbal and nonverbal task performance. Additional tasks were spatial span (SSP) and Stockings of Cambridge (SOC) tasks from the CANTAB and the Global Executive Composite (GEC) from the parent-report Behavior Rating Inventory of Executive Function (BRIEF; Gioia et al., 2000). The association between VDQ and NVDQ scores and EF measures at age 6 was estimated using five different Generalized Estimating Equations, with the best subset of potential covariates from gender, father's education, mother's education, gestational age at birth, and twin status. Models revealed that Mullen NVDQ alone significantly predicted performance on both of the Stanford-Binet FI scores (WM: β = 0.42, SE = .06, p < .001; FR: β = 0.31, SE = .07, p < .001) as well as on the CANTAB SSP (β = 0.02, SE = .004, p < .001), while the impact of Mullen VDQ alone was nonsignificant on all tests. These results suggest that the nonverbal aspects of early learning at age 2 (here, visual reception and fine motor abilities) may be much better predictors of EF measures at age 6. However, they may also point to questions of the validity of such measures of verbal ability in very early childhood. These findings have implications for early intervention programs aimed at improving children's EF before they enter school.

1-B-30   Improving Executive Functions and School Readiness in a Head Start Population: Fantasy-Oriented Pretend-Play as a Protective Factor

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Research suggests that emotion regulation (ER), appropriate physiological reactivity, and executive functions (EFs) support the development of school readiness skills, especially among children raised in low-income environments (Bierman et al., 2008; Blair & Razza, 2007; Domitrovich et al., 1999; Passolunghi et al., 2006; Welsh et al., 2011). Although many preschool curricula have been developed to help scaffold school readiness skills in at-risk preschoolers, these curricula are often very costly and require extensive training to implement (Weiland & Yoshikawa, 2013). In order to improve upon the feasibility and sustainability of these programs, it is important to identify natural environmental experiences that are implicated in normative development. Studies suggest that children incur both socio-emotional and cognitive benefits through pretend-play (e.g., Black, 1992; Carlson et al., 2014; Thibodeau et al., 2016). Engaging in pretend-play, which typically involves cooperation, shared affect, and support among peers and adults, may provide a positive context to scaffold development. Analogous to the buffering effects of parental warmth and sensitivity (e.g., Ursache et al., 2013), engaging in enriching pretend behaviors and cognitions may serve to minimize the negative effects of poor ER on EFs and school readiness typically seen among low-income populations. The current study investigated how a propensity towards pretend-play and imagination can serve as a protective factor to minimize deficits in EFs and school readiness in a Head Start population. Results revealed that fantastical imagination moderated the relationship between ER and EF such that better cognitive performance was observed among children with poor ER skills and a high propensity towards fantastical imagination (e.g., believing in fairies) compared to peers who had poor ER and a low propensity towards fantastical imagination, $F(6, 183) = 34.82$, $p < .00$, $R^2 = .53$. See Figure 1. Similarly, pretend-play moderated the relationship between physiological reactivity and EF skills. Among children who displayed low physiological reactivity, those with a higher propensity towards pretend-play (e.g., pretending to be an animal) demonstrated better EF outcomes than their peers who had a low propensity towards pretend-play, $F(7, 44) = 2.04$, $p = .07$, $R^2 = .25$. Longitudinal data addressing the impact of fantastical pretend-play and imagination on school readiness in kindergarten is forthcoming. The present research suggests that fantastical pretend-play, a ubiquitous experience in childhood, serves as a protective factor to enhance EF outcomes among Head Start children with poor ER skills and low physiological reactivity. These data suggest that in addition to encouraging pretending behaviors in their classroom, preschool teachers should specifically focus on scaffolding fantastical pretense in order to facilitate both the behavioral and cognitive aspects of pretend-play that seem to be driving positive developmental outcomes. Because fantastical pretend-play can be easily implemented into existing classroom curricula at little to no cost, the findings from the present study have the potential to inform Head Start researchers, practitioners, and policy makers on how pretend-play can be used as an additional, cost-effective method to facilitate school readiness among Head Start preschool children.

1-B-31 Brain Imaging, Science Cognition, and Conceptual Change: A Literature Review

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While much research has been done investigating the neural processes in language and mathematics cognition, there is a gap in the literature regarding neural imaging studies in science cognition. Cognitive

scientists and science educators need a better understanding of how scientific concepts are represented in the mind and how changes in concepts are reflected within the brain. In this literature review, we review five fMRI studies on science cognition and conceptual change. In addition, we review two reaction time studies and two eye tracking studies. Findings from all studies support the role of error detection and inhibition in overcoming naive concepts. We discovered consist finding among the reviewed literature, highlighting the roles of assimilation and accommodation in science cognition and conceptual change. This supports current conceptual change theories, as well as theories regarding memory, inhibition, and error detection. Furthermore, we propose cognitive scientists, neuroscientists, and science educators must work together to develop rigorous brain imaging studies in science cognition.

1-B-32   One-shot learning of abstract object concepts in visually naïve animals

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To perceive the world successfully, newborns must learn to recognize objects across novel viewing situations (e.g., changes in viewpoint, lighting, and background conditions). Yet the development of this ability is poorly understood. While previous studies have shown that newborns can recognize objects presented on homogeneous backgrounds, it is unknown whether newborns can segment objects from complex backgrounds and recognize those objects across novel viewing situations. To address this issue, we used an automated controlled-rearing method with a newborn animal model--the domestic chick. We raised newborn chicks in strictly controlled environments that contained a single virtual object moving on a single background (Fig. 1A). We then used an automated two-alternative testing procedure to examine whether the chicks could recognize that object across novel backgrounds and novel viewpoints (Fig. 1B). Despite receiving experience with just a single object moving on a single background, the majority of chicks developed robust view-invariant and background-invariant object recognition abilities (Figs. 1C & 1D; overall recognition performance: M=71.3% (chance=50%), SE=1.7%; two-tailed, one-sample t-test: t(30)=12.5, p<.0001; Cohen's d=2.2). Thus, newborn brains contain mechanisms for decoupling objects from background scenes. More broadly, these results demonstrate impressive one-shot learning of abstract object concepts in visually naïve newborn animals.

1-B-33   Confidence scale use in preschool-aged children: Effects of disconfirming evidence

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Confidence scales have been infrequently used with preschoolers, and when they have, the type of scale used is typically chosen without support for its efficacy. The present research introduces a novel paradigm to facilitate children's ability to report their own confidence, based on a brief training relying upon the presentation of disconfirming evidence. This paradigm presents 3-, 4- and 5-year-olds with "windows" that range in occlusion (none, partial, and full occlusion). Children are prompted to use a three-point scale to assess their level of confidence that a target shape is located behind each window over three trials. All children receive disconfirming evidence for their belief on either the first or second trial. Initial results suggest that when evidence is revealed that violates children's expectations about the

presence of the target shape, this disconfirming evidence results in improvements in children's ability to calibrate their confidence on future trials.

C - Concepts, Categorization, Casual Learning

1-C-34   Infants' Expectations for How Sand Merges and Divides

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Infants' expectations about nonsolids like liquid and sand have been described as less principled than expectations about solid objects like chairs and cats. However, in two habituation-dishabituation, looking-time experiments with 5- to 6-month-old infants, we find infants have principled expectations about sand. In Experiment 1, after seeing one cup of sand poured behind a screen, infants look longer when the screen is removed to reveal two piles. Similarly, infants look longer at one sand pile after seeing two cups poured, $F(1, 32) = 12.26$, $p = .001$, $\eta^2 = .24$. In the current experiment, infants expect that one stream will produce one pile, even when the sand merges into the stream from two cups. They also expect two streams will produce two piles, even when the streams originate from the same cup. We discuss how these expectations cannot be based on object principles, suggesting early principles for nonsolids.

1-C-35   Causal Reasoning in the Adults: revisiting backwards-blocking

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The ability to engage in cause-and-effect (i.e., causal) reasoning is integral for understanding how the world works. Two special cases of causal reasoning that have received considerable attention in the literature are indirect screening-off (IS) and backwards-blocking (IS) reasoning. In studies that test these abilities, children first observe that two events (A and B) cause an effect and then that one of the events alone (A) causes (or does not cause) the effect. Compared to the IS condition in which children state that B is the sole cause when A fails to produce the effect, children in the BB condition generally rate B as significantly less causal than A (i.e, they show backwards-blocking). This finding is important because it presents as-yet unaddressed challenges to certain classes of associative models such as the Rescorla-Wagner model, which predicts that participants should treat B equivalently across the IS and BB conditions. This finding has led some to argue that human causal reasoning can best be explained within a Bayesian-inference framework, which can account for the BB and IS findings. Despite these findings, considerably less is known about whether adults' causal reasoning abilities are underpinned by a Bayesian mechanism or an associative mechanism and the evidence is mixed (e.g., Larkin et al., 1998; Lovibond et al., 2003) about whether, and to what extent, adults can engage in BB reasoning. The present series of studies were thus designed (1) to replicate with adults the conditions that children have been presented with and (2) to examine to what extent adults engage in BB reasoning. Specifically, we examined whether adults use BB reasoning to reason about two (Exp. 1), three (Exp. 2), and four (Exp. 3) objects using the well-established blicket-detector procedure. In a fourth experiment, we examined whether, and to what extent, BB reasoning generalizes to a novel series of 2D animated

blicket-detector like events. In Experiments 1, 2, and 3, 180 adult participants (Exp. 1 N = 60; Exp. 2 N = 60; Exp. 2 N = 60) were introduced to a machine called a blicket detector and told that it activated when blicket objects were placed on its surface. Participants were then shown four (counterbalanced) conditions that included the BB, IS, one-cause, and two-cause conditions. The latter two conditions served as control conditions and will be discussed more during the oral presentation. The design of Experiment 4 (N = 60) was similar to Experiments 1, 2, and 3 except that adults had to determine which of two objects caused a sun to pop out of a box when one of the objects made contact with it. In all four experiments, participants were instructed to rate objects A and B (Experiment 1 and 4), objects A, B, and C (Experiment 2), and objects A, B, C, and D on a scale from 0 (definitely not) to 100 (definitely is) both before (Exps. 1-4), at the midpoint of (Exp. 4), and after (Exps. 1-4) each condition. These rating measures--which is a novel feature of our studies--enabled us to assess whether--as BB implies--B's causal rating drops when A produces the effect. Results indicated that adults neither engaged in BB reasoning when asked to make inferences about 2, 3, or 4 objects nor when asked to reason about two objects after observing animated blicket-detector-like events (all p's > .05). These results challenge the notion that humans use Bayesian inference and have implications for future research and theorizing.

1-C-36   Impacting children's social inferences through a continuum framework

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Children make category-based decisions on social information from an early age (Gelman, 2003). Such categorical judgments have adverse consequences for intergroup relations (Allport, 1954). Here, we explore how thinking about members of a group as a continuum versus a set of categories might impact flexible thinking. One hundred fifty-six 5- to 8-year-old children from low-income, racial/ethnic minority families received training on either a continuum or a category framework and were asked about whether faces from the same or different groups engaged in various behaviors. A mixed model binary logistic regression controlling for multiple observations per child reveals a significant interaction between condition (categorical, continuum) and whether faces belonged to the same group (same, different) on children's likelihood of reporting faces as matching on social behaviors (OR = 4.11, p < .001). As depicted in Figure 1, children in the continuum condition were more likely to identify similarities between members of visually different groups (OR = 2.38, p = .006) and children in the categorical condition were more likely to identify similarities between members of the same group (OR = 0.53, p = .010). Implications for interventions to enhance intergroup relations will be discussed.

1-C-37   Do preschoolers differentiate between pets and food-source animals when attributing biological and psychological properties?

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Preschoolers use a number of strategies to guide future learning. Previous research reveals that children rely on human similarity and taxonomic group to assign biological and psychological properties to animals. In the present research, we ask if children consider category membership of pets and food-source animals. Preschoolers (N = 73) were asked to attribute biological properties (e.g., eats, breathes) and psychological properties (e.g., feel happy, feel scared) to animals using stimuli cards. The results

revealed that preschoolers assign more biological properties and primary emotions to pets than other animals suggesting that familiarity may increase children's knowledge. In addition, preschoolers assigned social, moral, and pain capacities to animals irrespective of category. However, they differentiated between humans, non-human animals, and an inanimate object for these characteristics, revealing early signs of beliefs of human uniqueness. Taken together, unlike adults, preschoolers do not dehumanize food-source animals, suggesting this developmental shift occurs after the preschool years.

1-C-38   Gender essentialism in transgender and gender typical children

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The developmental literature has extensive evidence for children's early gender essentialism (viewing gender as inborn, biologically based, and immutable). We investigated whether transgender children essentialize gender to the same extent. Because certain features of transgender children's gender identities do not align with an essentialist view, we suspected that their beliefs might differ from gender-typical children. In Study 1, we asked 239 4- to 12-year-olds (87 transgender, 65 gender typical siblings, 87 gender typical controls) to complete a standard gender essentialism task. A one-way ANOVA showed the three groups did not differ, $F(2,236)=1.08$, $p=.34$. Study 2 examined 203 6- to 11-year-olds' (81 transgender, 42 siblings, 81 controls) essentialism of sex (focused on biological differences between boys and girls) and essentialism of gender identity (focused on identity differences, e.g., a boy who feels like a girl). A one-way ANOVA yielded a main effect of group, $F(2,201)=26.78$, $p<.001$, showing that transgender participants and their siblings did not differ in their essentialism of sex ($p=.34$), and essentialized sex less than controls ($ps < .001$). For gender identity essentialism, a one-way ANOVA showed no differences between the three groups, $F(2,201)=2.12$, $p=.12$. Transgender children and siblings responded similarly across the tasks, suggesting that having a transgender identity and exposure to transgender identities might reduce essentialism.

1-C-39   Children's Evaluation of Learning; Which Activity Is Better for My learning?

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This study investigated how young children evaluate learning activities based on what and how much knowledge is used to perform tasks in counting domain. Sixty-four preschoolers aged 3 to 5 played two pairs of games: 1) a counting game in which children need to count vs. a non-counting game in which counting was not needed, 2) an easy counting game vs. a difficult counting game. After playing each pair of games, we asked children which game will allow themselves and others to do other counting tasks better. Older children were more likely to answer that the counting rather than non-counting game and the hard game rather than the easier one would be beneficial to improve counting ability. They were also better able to identify the underlying knowledge involved in each game beyond its superficial characteristics. Children's evaluation of counting activities was positively related with their own counting with age controlled.

1-C-40   Do Children and Adults use a Dichotomizing Heuristic When Reasoning about Social Groups? Developmental Changes and Effects of Generic Language

Hannah Kramer[1], Kristin Lagattuta[1], Deborah Goldfarb[1], Sarah Tashjian[2], Katie Kennedy[1]

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We examined whether 5-year-olds, 8-year-olds, and adults (N=181) use a dichotomizing heuristic (characteristics that belong to one group cannot apply to another) when forming impressions of social categories. For example, when a child hears that "boys are strong" have they also learned that the group distinct from boys--girls--are weak? To test this, we introduced children and adults to two fictional groups that were physically indistinguishable (Zuttles and Twiggums). Participants learned exclusively about Zuttle preferences and abilities in either generic (e.g., "Zuttles like apples") or specific language (e.g., "This Zuttle, Dax, likes apples"). Individuals then judged whether Twiggums would match or mismatch eight Zuttle characteristics (e.g., "Do you think Twiggums like apples or hate apples?"). Eight-year-olds and adults most often inferred that Twiggums would differ (Ms > 70% of traits); 5-year-olds responded at chance (see Figure 1A). Although participants in both language conditions distinguished the groups, generic language boosted the application of the dichotomizing heuristic (see Figure 1B).

1-C-41   Frequently Asked Questions: Patterns of Inquiry in Children and Adults When Viewing Novel Objects

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While previous research has touched on the types of questions we ask (e.g., Greif, Kemler Nelson, Keil, & Gutierrez, 2006; Legare, Mills, Souza, Plummer, & Yasskin, 2013), there has yet to be an investigation of developmental differences in how questions change as learners ask more questions and whether there are cognitive consequences of asking these questions. In this study, we looked at the questions children and adults ask when presented with new information. Participants viewed 12 illustrations of novel artifacts and animals and were prompted to ask three questions about each object. We found that both adults and children were adaptive in their questioning; they repeated prior questions in order to more easily remember them later, choosing to ask some prior questions over others. The content of their questions also resembled the content of their later memory and explanations of the items. Adults asked questions on many topics such as features, behavior, category membership, and social relevance. Preschool children, however, struggled to generate questions, instead generating observations resembling the content of adults' questions. When children did ask questions, they mimicked what we saw in adults; their questions were adaptive, becoming more similar over time. Given that there was no age difference between "observing" and "questioning" children, a mechanism other than general maturation may be influencing children's ability to ask questions.

1-C-42   Age-Related Differences in the Criteria for Judging the Persistence of Individual Animals and Artifacts

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What guides people's attributions of individual persistence to objects? We examined the disputed issue of whether these attributions depend on kind persistence (see Macnamara, 1986; Rips et al., 2006). In two studies, we presented adults, 5-year-olds, and 7-year-olds (n = 16 per age group per study) with stories in which animals and artifacts underwent continuous transformations that either preserved or altered the objects' kind. In Study 1, when the transformation was kind preserving, adults and children judged both animals and artifacts to be the same individuals. In contrast, when the transformation was kind altering, adults and 7-year-olds, but not 5-year-olds, judged animals to be the same individuals, whereas neither adults nor children judged artifacts to be the same individuals. In Study 2, the use of consistent kind labels to describe animals undergoing transformations led even 5-year-olds to judge them to persist through a kind-altering change. For animals, the results suggest that there is a change between five and seven years in the criteria guiding judgments of individual persistence - from a dependence on the persistence of kind to an independence from this constraint. For artifacts, the findings indicate that neither adults nor children judge a change in kind to support individual persistence, consistent with the view that they attribute a shallower essence (with a weaker principle of persistence) to artifacts than to animals (see Gelman, 2003).

1-C-43   Effects of priming variability on biological reasoning

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Several studies have shown that young children do not endorse dramatic life cycle changes such as metamorphosis (Rosengren, Gelman, Kalish, & McCormick, 1991) or changes within a species (Emmons & Keleman, 2015). These patterns have typically been attributed to essentialism (Shtulman & Schulz, 2008). We asked 71 children in kindergarten to third grade to endorse four types of change: size, color, species, and metamorphosis. Then, we primed them either to think about variability within a species, or to think about variability between species, or we did not prime them as a control. We hypothesized the within-species prime would decrease essentialist reasoning, increasing endorsement of metamorphosis, whereas the between-species prime would increase essentialist reasoning, reducing endorsement of metamorphosis. Then we gave children a lesson about metamorphosis. Finally, we asked participants to make more endorsements. We found that there was an interaction between prime type and grade. Relative to control, the within-species variability prime led to greater endorsement of metamorphosis among second and third graders (but not first graders and kindergartners), $F(1, 64) = 5.27$, $p = .025$, $\eta2= .08$. There was no difference between control and the between-species variability prime, $F(1, 64) = 1.99$, $p = .16$. Thus, priming students to think about within species variability leads them to get more out of a metamorphosis lesson, and this may be due to a reduction of essentialist thinking.

1-C-44   Sophisticated counterfactual reasoning in 4- and 5-year-olds

Angela Nyhout[1], Patricia Ganea[1]

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Counterfactual reasoning is a hallmark of the human imagination. Recently, researchers have argued that children do not display genuine counterfactual reasoning until they can reason about overdetermined outcomes. That is, they must be able to consider the removal of one of multiple causes that lead to the same outcome. In previous studies, children did not pass until at least age 6

(McCormack et al., in press; Nyhout et al., in press) to as late as age 12 (Rafetseder et al., 2013). We suggest that children's difficulty in previous studies stemmed in part from errors they made in representing the causal structure of events (e.g., by drawing unwarranted causal inferences). Across two studies, we presented 4- and 5-year-olds (N = 80) with a clear causal structure in a physical causation task based on the blicket detector paradigm. Children saw both overdetermined (2 causal blocks on a box) and single-cause trials (1 causal and 1 non-causal block on the box) and were asked what would have happened if one of the two blocks was not placed on the box. Five-year-olds' performance was at ceiling (ps < .001) and 4-year-olds' performance was above chance (p = .003 and .016). Data collection is currently underway with 3.5-year-olds. Given a clear and novel causal structure, preschoolers display adult-like counterfactual reasoning. We discuss the role of domain differences, deterministic vs. probabilistic causes, and stories vs. live events in children's counterfactual reasoning.

1-C-45   Deferred Imitation and Generalization of Familiar and Novel Events by 14-Month-Old Infants Born of Teenage Mothers

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Ongoing research in our labs shows that maternal stress during pregnancy can compromise learning and retention on the conjugate kicking task in 4-month-olds. We modeled 4 events with objects and tested imitation 3 times with the same infants at 14-months of age. More actions were imitated on day 1 (M = 4.96) and recalled on day 2 (M = 4.98) than at baseline (M = 3.13, p < .001); however, generalized imitation to dissimilar objects was not found (M = 3.31, p = .16). When events were subsequently modeled with said dissimilar objects, participants did engage in imitation (M = 5.02; p < .001); the limitation appeared to be in spontaneous generalization alone. The flexible learning abilities often found in this age group appears to be developing slowly in these children of teen mothers. Follow up measures with the same participants at 24-months of age are in progress.

1-C-46   Children's reasoning about causality and past-future relationships

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Our actions in the present have the power to change our future outcomes, but they cannot change the past. This causal distinction between past and future is a key component of a Western, linear concept of time. Despite decades of research both on children's understanding of time and their understanding of causality, it remains unclear when children understand that while the future can be altered, the past cannot. The present study explored this question by presenting 3- to 5-year-old children and adults with 3-step causal chains, and asking them to predict how counterfactual interventions to the present would impact past and future events. When they were told that an external agent intervened in the present, adults judged that the intervention would change the future but not the past, consistent with a unidirectional concept of time. In contrast, 3-year-olds were equally likely to say that future and past events would change. Differentiation of past and future emerged in 4-year-olds and increased

substantially with age. The present study provides the first evidence that preschoolers differentiate past and future events on the basis of their alterability.

1-C-47   Does socio-economic status affect children's abilities to distinguish reality from fantasy?

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Children begin to distinguish between reality and fantasy in the early preschool years, and this ability becomes more robust as they get older. However, few studies have examined the role of individual difference variables in making this distinction. The current study focuses on the role of socio-economic status, comparing the performance of low-SES children (N=76, mean age = 53.6 months, age range 38.6 to 71.0) and mid- to high-SES children (N=80, mean age = 57.1, age range 39.0 to 77.9) on a task that asked them to sort picture cards into "real" and "fantasy" boxes. Children in the low-SES group were less likely to sort correctly (mean = 13.1) than children in the high-SES group (mean = 16.6), a difference that remained significant even after controlling for age, which correlated with sorting ability ($F(1, 153) = 50.4$, $p < .01$). This difference could potentially be due to marginally greater attention to reading in high-SES homes (as determined by parental questionnaire, mean score = 8.6) than in low-SES homes (mean score = 7.4, $t(83) = 1.8$, $p = .08$), or to the significantly higher level of education for primary caregivers in high-SES homes ($t(86) = 9.1$, $p < .01$). Interestingly, children in the low-SES group scored significantly higher on a measure of fantasy orientation (mean = 3.9) than children in the high-SES group (mean = 3.3; $t(154) = 2.08$, $p = .039$), suggesting that greater engagement with fantasy may not assist children in making the fantasy/reality distinction.

1-C-48   Differentiating immoral actions from impossible actions: Preschoolers' beliefs about the choice to perform deviant actions

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Young children believe that some intentional actions are free choices (e.g., choosing to drink milk or juice for breakfast), while others are not (e.g., floating in the air). Prior research on children's understanding of possibility has shown that young children tend to judge any events that violate their expectations to be impossible, regardless of whether the event is genuinely impossible (e.g., floating in the air), merely improbable (e.g., owning a lion for a pet), or against moral values (e.g., lying to one's mom) (Shtulman, 2009; Shtulman & Phillips, 2017). In this study, we extended this research and investigated young children's beliefs about their own choice and other people's choice to perform immoral, impossible, improbable, imprudent, or ordinary actions. Thus far, we have found that, children between the ages of 4 and 5 (n = 87) believe they can choose to perform ordinary actions but cannot choose to perform immoral, impossible, improbable or imprudent actions. Interestingly, they are even less likely to report that they (or others) can choose to perform immoral actions compared to other types of deviant actions. Also, we found self-other differences in 5-year-olds; they tend to claim that they themselves have more choice to perform impossible, improbable and imprudent actions than others do. These findings suggest that children's conception of choice may vary across different types of constraints and psychological distance.

1-C-49   Do children think that nutrition and physical activities impact height and weight?

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Young children understand the influence of food on weight and height, but relatively little is known regarding children's understanding of physical activity on body size. To examine this issue, we examined how 3-year-olds, 4-year-olds, and adults (N=96) reason about the effects of activities and foods on height and weight. On the prediction task, participants heard vignettes in which two characters engaged in different activities (e.g., riding a bicycle vs. watching TV) or different foods (e.g., desserts vs. vegetables), and were asked to predict which would be "taller" or "fatter". On the explanation task, participants heard vignettes in which two characters engaged in different activities or different foods, and were asked to explain why one character was "taller" or "fatter". Overall, participants' judgments were significantly more consistent regarding food than activities. Additionally, there was marked improvement between 3 and 4 years of age, particularly on reasoning about effects of activity.

D - Cultural Learning

1-D-50   Yucatec Mayan Infants' Spontaneous Exploration of Objects: Alone and with Others

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While literature in developmental psychology has emphasized the importance of infant-directed interactions in infants' social learning, anthropological accounts indicate that such interactions are less frequent in many non-WEIRD (Western, Educated, Industrialised, Rich and Democratic) cultures. Additionally, studies show that older children contribute to their learning and development through self-directed activity, but little is known about similar implications of infants' self-directed activity. The current study investigates infants' self-directed activity by examining how Yucatec Mayan infants' exploration of objects differs in two contexts: during independent action and interaction with others. Hour-long videos of thirty 18-month old infants recorded in their natural surroundings were coded for time they spent acting independently and interacting with others; and further for time spent interacting with different objects, types of actions performed on objects, and nature of object interactions. Infants acted on objects for longer durations and performed more varied and complex actions on objects when acting independently than while interacting with others (see figure). Average time spent per activity was found to be significantly positively correlated with complexity in action when infants were acting independently, but not when they were interacting with others. Potential theoretical implications of this finding for infants' cognitive development are discussed.

1-D-51   Longitudinal study on children's developing conception of God's reality status: Cognitive and contextual factors

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Children construct boundaries between fantastical and real entities; by preschool, they distinguish God from other entities (Sharon & Woolley, 2004; Richert et al., 2017). In adults, belief in God is related to theory-of-mind and counterfactual reasoning (Buffone et al., 2016; Norenzayan et al., 2012). Current study examined factors related to belief that God is real in children from religious and non-religious homes across a two-wave study. 80 parent-child dyads participated (Wave 1: Mage=4.701, SD=.645; Wave 2: Mage=6.186, SD=.717). Backgrounds were ethnically and religiously diverse. Children understood their mother was "real." At both waves, children and parents indicated God's reality status and children's theory-of-mind was tested. At wave 2 children's counterfactual reasoning was tested. Regression analyses at wave 1 revealed no effect of theory-of-mind or parent's belief in God; a significant effect of age (β=.306, p=.010) and being a child of a religiously non-affiliated parent (β=-.316, p=.030). Same analyses for wave 2 revealed no effect of theory-of-mind, age, parent's belief, or religious group; counterfactual reasoning was trending (β=-.236, p=.051). See Table 1 for more details. By age 6, children from non-affiliated homes did not significantly differ from religious children. This poster will discuss implications for the role of: theory-of-mind, counterfactual reasoning, parents and other exogenous influences (i.e., school) on children's belief.

1-D-52   "The apple doesn't fall far from the tree": Latinx and European American college students' proverb comprehension

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Proverb comprehension is related to important narrative skills (e.g., word knowledge and analogical reasoning) in children and adolescents (Nippold, Allen, & Kirsch, 2001). Ethnographic work has shown that Mexican Heritage families use proverbs in everyday conversations with their children (e.g., Barajas, 2010). In a previous study, we found that Latinx college students reported hearing proverbs from their parents more often than European-American students (Solis & Callanan, 2017). The current study examined cultural variation in college students' proverb comprehension. We administered a proverb comprehension task to 62 college-aged participants and coded their comprehension of 10 proverbs. Latinx students were coded as understanding significantly more proverbs (M=5.2, SD=1.4) than European-American students (M=4.2, SD=1.8, F (1, 60)=4.94, p.04). These findings suggest that Latinx students' experiences listening to proverbs at home may contribute to better proverb comprehension. Exploring these links may be critical in developing literacy interventions for this growing population.

E - Language Development

1-E-53   Cross-Context Statistical Word Segmentation in Infancy

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Representations produced via statistical word segmentation appear to be word-like (e.g., Graf Estes et al., 2007). However, it is unclear whether these proto-words can facilitate future segmentation, similar

to known words (e.g., Cunillera et al. 2010; Mersad & Nazzi, 2012). To address this question, the present experiment exposed 9-month-olds to two artificial languages presented sequentially. The second speech stream included words of variable length, which can hinder statistical segmentation (Johnson & Tyler, 2010). A shared "anchor" word overlapped between the two speech contexts. Once segmented from the first speech stream, this anchor word could seed segmentation in the challenging second stream. After the speech exposure, we assessed listening time to syllable sequences that formed words and sequences that did not form words in the speech. When the variable word length speech was presented on its own, infants did not discriminate between stimulus types, $t(16)=-.82$, $p=.43$, suggesting they had not segmented the speech. However, when infants heard both streams sequentially, their listening pattern demonstrated a trend toward discrimination, $t(9)=1.99$, $p=.07$. Data collection is ongoing, but these preliminary results suggest that infants could seed segmentation in a difficult, variable word length context using word forms acquired during prior statistical learning. Infants may use the output of statistical learning to support the subsequent acquisition of complex patterns.

1-E-54   A latent profile analysis of 6-8 year-olds reasoning abilities during a narrative task

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This study explored children's ability to reason about a story character's mind during a narrative task. Participants between the ages of 6 and 8 were asked to tell a story from a wordless picture book. Following the narrative task, participants engaged in a think-a-loud task, in which they were asked to reason about the character's emotions, thoughts, and actions based on prompts from the picture book. Think-a-louds were transcribed and coded for emotion understanding, reasoning using pictures, and inferencing using mental state terms. A latent profile analysis was conducted, and three distinct profiles emerged, which differentiated participants based on whether they reasoned using pictures, made inferences using mental state terms, or both. Profile membership significantly predicted overall quality of narratives. This indicates that the specific mechanisms used to reason about story character's actions, differentially predict children's ability to understand a story and construct a narrative.

1-E-55   The statistics in everyday visual experience - but not everyday linguistic experience - support early word learning

Elizabeth Clerkin[1], Chen Yu[1], Linda Smith[1]

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We present evidence that challenges the conceptualization of word-learning as a mapping problem and suggests that the structure of visual objects may matter as much or more than the structure in parent talk. A recent study showed that the frequency distribution of objects predicts the order in which the objects' names are learned (Clerkin, et al., 2017). We extend this finding in a larger corpus of head camera scenes from 15 infants (8 to 12 m). We again find that the frequency distribution of objects in the 14,000 scenes is extremely right skewed with the most pervasive objects being those early learned names. We also transcribed parent talk during these scenes. We add four new findings: First, using latent semantic analysis, we show that the statistical structure of visual experience alone provides a rich base for object name learning. Second, in everyday contexts, parents rarely name the objects dominant in these scenes but instead talk about things not in view. Third, and fourth, the statistical structure of

the words does not match that of the objects: The frequency distribution for object names is much flatter than the distribution of objects; common object names do not differ dramatically in their frequency. Likewise, the semantic structure of parent talk does not highlight the semantic structure of early-learned words. In sum, early object name learning may depend heavily on the structure of objects in visual experience rather than the ease of word-object mappings.

1-E-56 **How do children think that blind people "see"? Developmental changes in the use of visual verbs.**

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Verbs of perception are associated with specific modalities. The verb "see" means to perceive with the eyes, whereas "touch" means to perceive through touch. Here, we examined how children and adults apply verbs of visual perception to agents with atypical sensory capacities - i.e. a blind agent. In Experiment 1, 12 4-years-olds (m age=4;6), 12 6-years-olds (m age=6;7), 12 9-years-olds (m age=9;6), and 12 adults were asked "what part of the body" a sighted and a blind agent would use to carry out 5 visual verbs (look, peek, see, stare, watch). As a comparison, they were also asked what part of the body a wheelchair-bound agent would use to carry out 5 motion verbs (hop, jump, run, skip, walk). For the blind agent, adults either said she can't (47%) or extended the visual verbs to other modalities, e.g. watch with ears (53%). Similarly, when applying motion verbs to a wheelchair-bound agent, adults either denied she could walk, etc. (40%) or extended the verbs, e.g. walk with hands (60%). Children behaved similarly to adults for the canonical agent (sighted and non-wheelchair bound; mixed-effect logistic regression model: $p > 0.05$). However, we observed a dramatic developmental shift in their responses with respect to the blind agent for visual verbs, and the wheelchair agent for motion verbs. Even while stating that the blind agent's eyes don't work, 4-years-olds overwhelmingly said that the agent would use her eyes to "see" (93%; â=8.88, $p < 0.05$). They also said the wheelchair-bound agent would use her legs to "walk" (85%; â=9.38, $p < 0.05$). By contrast, 9-year-olds never said the blind agent would use her eyes to "see" (â=-6.9, $p < 0.05$) or that the wheelchair-bound agent would use her legs to "walk" (â=-7.02, $p < 0.05$). 6-years-olds showed an intermediate pattern, being less likely than 4- and more likely than 9-years-olds to say that a blind agent would "see" with her eyes ($p > 0.05$) and that a wheelchair-bound agent would use her legs to "walk" ($p > 0.05$). In Experiment 2, we probed whether children's failures would carry over to endorsing labels of "look" and "see" as applied to a blind agent. Children saw photographs of the sighted, blind and wheelchair-bound agents pointing their eyes toward a pair of objects, and were asked for each agent "Is she looking at (the object)?" and "Does she see (the object)?" In some pictures, the sighted agents were blindfolded. For the sighted agents, all children said they were looking and could see, unless they were blindfolded ($p > 0.05$). However, the pattern for the blind agent was in line with Experiment 1: 4-years old judged that the blind agent was looking at the object and did see it (â=8.12, $p < 0.05$), 6-years-olds showed an intermediate profile (â=-1.15, $p < 0.05$), and 9-years-olds mostly judged that the blind agent neither was looking at the object nor saw it (â=-6.7, $p < 0.05$). Interestingly, children judged more often that the blind agent was looking at the object than that she saw it (â=-2.52, $p < 0.05$). In sum, 4-years-olds make striking errors in applying visual verbs to others with different capabilities, despite the fact that their behavior with respect to blindfolded agents is adult-like. The ability to extend verbs to agents who have different capacities from the canonical person undergoes a developmental shift between the ages of 4 and 9. This change could reflect the development of either the lexicon, the ability to reason about agents, or the interaction between lexical and agent knowledge.

1-E-57   The role of statistics and context in learning words from an unfamiliar language

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Across development, infants become more specialized in the types of sound sequences that they will accept as labels for novel objects. Early in development, infants tend to favor sound sequences that have high internal coherence (i.e., transitional probability - TP). Here we test whether infants come to rely less on statistical cues as they become more proficient in their native language. English-learning 21- to 24-month-old infants were familiarized with an Italian corpus, and were then presented with pairings between high TP (HTP) and low TP (LTP) words and referents. Across 3 experiments (n=102) we found that while infants continue to track TP information, high TP is no longer sufficient to give sound sequences word-like status, especially for infants with larger English vocabularies. Infants with smaller English vocabularies successfully mapped HTP word to referents (p<.05). However, when Italian HTP and LTP words were embedded in carrier phrases infants showed evidence of both tracking and using TP information in the service of word learning (p<.05). Our results suggest that tracking TPs gets learning off the ground, and that more mature word-learning processes reflect the integration of statistical and language-specific cues.

1-E-58   Long-term benefits of boosting vocabulary through reading and play

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Early vocabulary is key for later literacy development, so it is critical to develop effective methods for teaching words in early childhood. The current study was part of a large-scale vocabulary intervention in low-income preschools. Teachers taught 20 target words to their students (N = 140, Mean age = 52.4 months) through weekly book reading and playful activities for four weeks. Children were tested on target words before, immediately after, and 4.5 months after the intervention. Half of the words were briefly reviewed between the immediate and delayed post-test. The intervention was effective at teaching words: Children's scores increased significantly from pre- to post-test on an expressive vocabulary measure (d = 1.07, p < .001). The interim review helped children retain their knowledge over time: Scores for non-reviewed words were significantly lower at delayed post-test than at immediate post-test (d = 0.56, p < .001), but scores for reviewed words did not change (d = 0.10, p = .78). Scores on non-reviewed words were still significantly higher at delayed post-test than at pre-test (d = 0.53, p < .001). This suggests that even though these words may have been forgotten somewhat between immediate and delayed testing, children still retained much of what they had learned over four months later. Thus, this play and reading intervention shows potential for long-term learning of new vocabulary in young children.

1-E-59   Preschoolers' evaluations of definitions

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Preschoolers can use an informants' past accuracy of providing names for objects to decide from whom to learn. We used a selective trust paradigm to investigate whether 5-year-olds (N=23) also evaluate the quality of informants' definitions of familiar (e.g. silly) and unfamiliar (e.g. doltish) words. Children identified the informant who offered informative (e.g. doltish means goofy) over circular (e.g. doltish means doltish) definitions for four familiar (M = .71, t(10) = 2.04, p = .04, one-tailed) and four unfamiliar (M = .77, t(11) = 2.40, p = .02) words. However, children only reliably chose to learn new information from the informative definer in the unfamiliar word condition. This new information included asking about novel words (M = .92, t (11) = 8.86, p < .001) and novel object functions (M = .83, t (11) = 3.56, p = .002). Circular definitions of unfamiliar words may clarify that an informant is not apt to provide useful new information.

1-E-60   Word Learning with and without Visual Cues in Children

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Background. Vocabulary growth is essential to academic success throughout school. Because nouns tend to refer to concrete perceptually salient objects, they tend to be learned more quickly than verbs or adjectives. In this study, we investigated how providing visual cues may increase the ability of children to learn verbs and adjectives. Methods. One hundred fifteen 4-6 and fifty-five 7-9 year olds, completed a vocabulary assessment. They were read one of 3 stories, containing 5 novel words (including nouns, verbs, and adjectives) in one of two conditions: with or without visual referents. They then completed a picture pointing task testing the novel words. Results. A three-way ANOVA 3 (word class: noun, verb, adjective) X 2 (visual cues: with or without) x 2 (age: 4-6 and 7-9) on percentage of words learned revealed a main effect of age, with older children performing better than younger ones, $F(1, 168)=12.31$, $p<.001$, word class, with children learning more nouns, $F(1.946, 328.839)=3.40$, $p=.036$ but no effect of visual cues. Further, we found that word learning was correlated to vocabulary for nouns, $r=-.27$, $p=.015$, but not for other word classes. Conclusions. These results indicate that nouns are learned more easily than other word classes. Further, when learning nouns, the child's vocabulary knowledge was more important to predicting word learning than access to visual cues. Future research should focus on studying what type of context supports word learning the best.

1-E-61   Animacy and children's online interpretation of object and subject relative clauses

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Subject relative clauses (SRCs, "the deer that is chasing the cow") are typically processed more easily than object relative clauses (ORCs, "the deer that the cow is chasing"), but this difference is diminished by the presence of an inanimate head-noun in ORCs ("the tractor that the cow is chasing") (Mak, Vonk, & Schriefers, 2002). We investigated the influence of animacy on children's online processing of SRC and ORC sentences. Forty-eight English-speaking children (aged 4;5-6;5) and 32 adults listened to sentences that varied in the animacy of the head-noun (Animate/Inanimate) and the type of relative clause (RC) used (SRC/ORC). Concurrently, participants saw two images depicting the same two agents, carrying out reversed actions (e.g. a deer chasing a cow/a cow chasing a deer) and were asked to choose the picture

matching the sentence using a game-pad. We hypothesised that children would find ORC sentences more difficult in the animate condition than the inanimate condition. Participants' eye-movements were monitored to investigate online processing as a RC unfolds. Specifically, we focussed on anticipatory fixations after the onset of the RC ("that..."). We predicted more anticipatory looks to the picture matching a SRC-sentence in the animate condition compared to the inanimate condition. Both child and adult participants were quicker to respond to SRC sentences and children were more accurate with SRCs (adult performance reached ceiling). As expected, children were significantly more accurate with ORCs with an inanimate head-noun rather than an animate head-noun, but animacy had no effect on the response time for ORCs. Surprisingly, for SRCs, after the onset of the RC ("that...") children made more looks more quickly to the target in the inanimate rather than animate condition, suggesting greater anticipation for SRCs with inanimate head-nouns. Adults showed no preference for SRCs in the animate condition but they did in the inanimate condition, although this preference emerged earlier than it did with the children. These results appear counter-intuitive given children's performance in the forced-choice selection task. Children were more accurate with ORC sentences in the inanimate condition, yet during the RC they looked at the target less in this condition. The seemingly increased anticipation for SRCs in the inanimate condition may be due to surprisal at inanimate objects acting on animates, resulting in the inanimate SRC-image (e.g., the tractor chasing the cow) capturing more attention during the RC (or earlier in the case of adult participants). Alternatively, it may be due to the inanimate objects being more distinct from their animate competitors, making the SRC-image easier to identify more quickly, leading to earlier looks to this image. We are currently investigating these possibilities by repeating our experiment with animate-inanimate and inanimate-inanimate pairs. If surprisal at inanimate agents led to our eye movement results, we would again expect more looks to the inanimate SRC-image, however if the effects were driven by the animate-inanimate contrast we would expect more looks to the animate SRC-image. Regardless of the cause, our results show children's anticipatory fixations at RC-onset do not consistently predict performance.

1-E-62   A Pragmatic Limit on Children's Novel Name Mapping

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Children typically show a strong tendency to map a novel label onto a novel rather than a familiar object. This so-called disambiguation effect is weaker, however, when the familiar object has pragmatic significance. For example, preschoolers show a weaker effect when the familiar object is an unexpected match to something that the adult had just taught them to label. The current experiment (N=78) examined whether the disambiguation effect would be restored if (a) the adult who tested them was different from the adult who had taught the label or (b) if the same adult tested them, but asked them to identify the matching object before asking them to map the novel label. Both 3- and 4-year-olds showed a restored effect in response to (b), but only 3-year-olds did so in response to (a).

1-E-63   Can you see the difference? The bilingual advantage in visual language discrimination is not speech-specific

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Abstract: Previous studies have shown that 8-month-old bilingual infants outperform age-matched monolinguals in visual language discrimination, even when the languages contrasted are non-native (Sebastián-Gallés, Albareda-Castellot, Weikum, & Werker, 2012; Weikum et al., 2007). Here we test if this enhanced ability of bilinguals is based on a capacity to perceive more general regularities of language, and therefore not restricted to articulatory movements. Methods: We tested hearing bilingual and monolingual 8-month-old infants' capacities to discriminate two sign languages (British sign language -BSL- and Japanese sign language -JSL) by using a habituation paradigm. In the first experiment, full information from the video was provided to the infant; in the second experiment information from the face of the signer was not available by blurring the videos. Finally, in the third experiment, we presented the same videos used in the first experiment to three groups of adults (adult deaf ASL signers, monolingual and bilingual hearing non-signers). Results & Discussion: When full information was provided (experiment 1), bilingual and monolingual infants, were able to discriminate the two languages. However, when information from the face of the signer was not available to the infants (experiment 2), they could no longer differentiate between the two sign languages. In experiment 3, adult deaf ASL signers (with no previous knowledge of JSL or BSL) discriminated between the two sign languages, but neither monolingual nor bilingual hearing non-signers could. The results provide further evidence of differences in attention to the face during infant development. They show that previous experience with sign languages is needed to keep discrimination in adulthood. We are currently testing 12-14-month-old bilingual and monolingual infants to see the developmental trajectory of this ability in infancy for each group.

1-E-64   Effects of Emotional Valence in Children's Lexical Processing

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We tested the proposal that emotion information may provide a bootstrapping mechanism for children's vocabulary acquisition, helping to ground word meanings in felt experience. To do so, we investigated whether children's lexical processing is influenced by word valence. We presented 40 positive words, 40 neutral words, and 40 negative words in an auditory lexical decision task (ALDT), with 120 nonwords, and asked participants to decide whether each word was real or fake. Participants were 30 6-year-old children and 30 adults. Both children and adults showed faster responses to positive and negative words than to neutral words. In addition, children had higher levels of response accuracy for negative words than for neutral words. As such, children showed sensitivity to word valence in lexical processing, and at a younger age than had been established in previous research. These results are consistent with embodied, multimodal accounts of word meaning and lexical development.

1-E-65   The effects of comparison and contrast on children's learning of novel words

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Contrast promotes retention over and above comparison in some circumstances, but not others. This study examines word learning in 2 - 3-year-old children through comparison, contrast, and one-example conditions. In each condition children heard novel objects labeled with novel words, e.g., "wug." In the comparison condition, children were first presented with 3 same-category novel objects labeled with the same novel word (e.g. "This is a wug toy, this is a wug toy, and this is a wug toy"). In the contrast condition, one novel object was a member of the target category and two other novel objects were members of different categories. The objects were labeled as "This is a wug toy.", "This is not a wug toy.", and "This is not a wug toy." respectively. In a third condition, the one-example condition, children saw a single object that was labeled with the novel word. For all three conditions the test phase immediately followed the learning phase, and children were asked to select another of the target category from an array of four choices (e.g., "Show me the wug toy."). The results will inform the role of negative examples in contrast learning and will establish a baseline for future studies examining mechanisms of learning through contrast and comparison.

1-E-66   'Read conmigo': Do code-switching storybooks facilitate dual-language learners' comprehension of new words?

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Shared reading is a vehicle for language learning. Children's books and the adult-child conversations that they initiate expose learners, whether they are mono- or multilingual to new words in context and help build vocabulary. Previous research with Spanish speaking English learners (ELLs) has focused on how interventions that increase young children's exposure to shared reading can boost their English vocabulary, yet less is known about how shared reading can affect vocabulary learning for a wider variety of Spanish-English dual-language learners, such as balanced bilingual children, or English speakers learning Spanish (SLLs). In addition, little to no research has investigated the types of books that could best help dual-language learners grasp new vocabulary. Storybooks for bilingual children typically come in one of two types - books exclusively in one language (monolingual) and hybrid books that are grounded in one language, but highlight target vocabulary in a second (code-switching). In two first-of-their-kind experiments, we investigated how these different book styles can support Spanish and English speaking 2- to 5-year-olds learning new vocabulary. In Expt.1, SLLs heard two researcher-designed stories read by a bilingual experimenter with story type as a within-subjects manipulation. SLLs heard two stories - one entirely in Spanish and one in English with Spanish code words. Each story included six rhymed stanzas, each introducing a novel animal name. After hearing each story, children were tested with a simple three-choice picture pointing procedure, and an open-ended production task to assess their retention of the new animal names. A second parallel experiment evaluated ELLs with equivalent stories read either all in English or in Spanish with English code words.   In Expt.1 SLL participants (n=22) showed that their success in vocabulary learning from monolingual Spanish storybooks (M=4.4 correct identifications) was greater than with code-switching books (M=2.8, p<.01). Even though code-switching books were dominated by the more familiar language, the code-switching may have impeded vocabulary learning. However, in Expt.2 ELL participants (n=25) showed no difference in correct identification of the novel animals after hearing a monolingual English storybook (M=4.0) or a Spanish storybook with English code words (M=4.0). A closer look at the two studies revealed that within each experiment neither children's exposure to nor proficiency with the target language were mediating factors in the effects of storybook types. However, across the experimental groups there was a wide variety of experiences with both languages - while some SLLs were only using

Spanish 1-2 hours weekly, some ELLs were using English >30 hours weekly. This varied exposure not only potentially affects children's proficiency with their second language, but also the amount of code-switching they may experience, which could in turn affect how they respond to code-switching storybooks. Continuing analysis and expanded data collection currently underway will help further evaluate the importance of exposure to varied types of language use on how dual-language book types might best support vocabulary building. Nonetheless, our findings thus far support the hypothesis that when learning novel words from shared reading, dual-language learners may be sensitive to code-switching and for some immersive monolingual books are more beneficial.

1-E-67 First steps in creating a free, immersive, and adaptive computer-assisted-language-learning (CALL) program for helping refugees develop language skills

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Educators have sought to design cost-effective computer programs that enable users to learn languages without instructors for 60 years (Schmid, 2009). CALL (computer assisted language learning) programs have the broadest reach to serve people in developing countries, however, there are few programs which 1) serve non-English speakers learning non-English languages and 2) do not depend on task instructions in the learner's native language. This study set out to fill this gap using the Cerego adaptive multimedia learning platform (see Figure 1). The vocabulary learning module was part of a larger project, a digital care-package created by researchers in New York and Turkey for Syrian refugee children in Turkey (N=147, ages 9--14, M=11.75; SD=1.23). Participants in the treatment group used the module for 4 weeks, while control group participants did not. Each group took one of two alternate forms of a multiple-choice test in which they selected 1 of 4 images that matched a written prompt. A 1-tailed independent samples t-test demonstrated that participants in the treatment condition knew significantly more Turkish words (M=.687, SD=.267, N=96) than those in the control condition (M=.622, SD=.240, N=103); t(197)=1.813, p<.05; d=.24, making free, immersive CALL programs a promising venue for supporting language learners across the globe. Further investigations may expand the project's vocabulary-focused paradigm to a more comprehensive vocabulary-syntax scaffolding paradigm.

1-E-68 Self-Regulation and General Vocabulary Knowledge in a Guided Play Intervention

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Early vocabulary strongly predicts later literacy skills (National Early Literacy Panel, 2008). However, children may benefit differentially from vocabulary interventions based on their self-regulation and general vocabulary knowledge. Self-regulation may support children's attention to instruction and vocabulary knowledge may help children learn from language-rich activities. Here, teachers taught low-income preschoolers (N = 89) 20 target words using interactive book reading and guided play activities. Guided play provides adult-supported, goal-oriented learning in the context of playful, child-led exchanges. The intervention was successful: Children's scores increased significantly from pre- to post-test on an expressive vocabulary measure, d = 1.33. A mixed effects regression analysis indicated that both vocabulary (Peabody Picture Vocabulary Test) and self-regulation (Peg-Tapping Task) significantly

predicted difference scores, such that children with higher vocabulary and self-regulation made larger gains from pre- to post-test than children with lower levels, ßs > .14, ps < .001 (Figure 1). These results show that (1) larger early vocabulary supports continual word learning, suggesting that early intervention is critical, and (2) self-regulation skills enhance children's ability to learn new words, indicating a need to foster these skills to promote later academic learning.

1-E-70 Associations between Parent-Reported Sleep Problems and English Language Acquisition in 24- to 30- Month-Old Children

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Infant sleep has been associated with language learning in laboratory settings (Gómez et al., 2006; Gómez et al., 2011), but few studies have examined whether variability in child sleep problems is related to language acquisition in real-world contexts. The present study was conducted to determine whether parent-reported sleep problems were associated with English language acquisition in 60 typically developing children aged 24-30 months (mean age = 26 months). Parents completed questionnaires that inquired about demographic information, child sleep habits, and language acquisition (Fenson et al., 2007). Analyses of variance were conducted to determine whether parent-reported child sleep problems were associated with (a) child sleep habits and (b) language acquisition after statistically controlling for child age and whether the child was a single (English) or multiple language learner. Children with sleep problems protested more at bedtime and spent fewer minutes asleep in a 24-hour period relative to children without sleep problems. In addition, children with sleep problems produced fewer individual words, as indicated by a vocabulary checklist, and produced shorter utterances, as indicated by parent report of spoken phrases, relative to children without sleep problems. These findings indicate that sleep problems in early childhood are associated with reduced language production in real-world contexts. Potential mechanisms and implications will be discussed.

F - Moral Development

1-F-72 The development of beliefs about censorship

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What are children's intuitions about the nature of censorship? Should people be allowed to watch morally sensitive content? Who should make decisions about censorship? We presented 5-10-year-old children with an initial study to examine the development of attitudes about censorship. Children were shown vignettes about 8 movies that a child (themselves or another person) wanted to watch, and then asked to decide if the content was permissible to view. We hypothesized that children would more often censor depictions of intentional wrongs than accidental wrongs, even when holding constant the results of the acts. The 8 vignettes featured acts across 4 different domains (harming human, harming animal, harming property, and purity violations); each domain was presented once as intentional and once as accidental. Overall, children censored intentional acts more than accidental acts. We found no differences based on domain presented. After children completed this first task they were presented

with two authority figures (parents vs. teacher or teacher vs. government) who disagreed about whether a movie should be censored. Children reliably trusted parents over teachers, but they trusted government and parents equally. This work suggests that children have an early notion of censorship that is sensitive to intentional harm across domains. Ongoing studies are investigating how this changes with age and cultural context, and how censorship of media, ideas, and speech compare.

1-F-73   Children's collaboration induces fairness rather than generosity

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Children across diverse societies reject resource allocations that place them at a disadvantage (disadvantageous inequity aversion; DI). In certain societies, older children also reject advantageous allocations (advantageous inequity aversion; AI). Other work demonstrates that after collaboration, children reduce inequity by sharing. However, it is unknown whether collaboration leads to greater sharing because it encourages prosociality (Generosity Hypothesis) or because collaboration elicits stronger egalitarian tendencies (Equality Hypothesis). Here we use measures of inequity aversion that can disambiguate between these hypotheses. We tested 7- to 13-year-old children from rural India, a population that has shown DI but not AI, and 4- to 10-year-old children from rural Canada, a population that shows both AI and DI. Pairs of children worked either collaboratively or in parallel obtaining candy that was then used in a test of DI and AI. Results showed that in both societies collaboration did not encourage children to accept DI offers, providing evidence against the generosity hypothesis. However, in both societies older children demonstrated AI after collaboration but not after parallel work and children in Canada showed AI at an earlier age than was previously observed. This suggests that collaboration can induce a willingness to sacrifice an advantage to achieve equality, consistent with the Equality Hypothesis.

1-F-74   Children's Moral Judgments about Access to Opportunities

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From early in development children are aware of inequalities between themselves and others and between third parties. As they gain experience as members of social groups, children gain awareness of broader inequalities in society, including economic inequalities. One important question concerns how children use this knowledge. Some studies indicate that children correct inequalities between individuals and groups. However, negative attitudes towards disadvantaged groups also emerge in childhood. One consequence of economic inequality is differential access to opportunities, including educational opportunities, for individuals of high- and low-wealth backgrounds. This study examined children's moral judgments and decisions about whether to correct or perpetuate a pattern of unequal access to opportunities between high- and low-wealth peers. Understanding whether children judge it fair to rectify economic inequalities in access to opportunities is a crucial step towards reducing biases in development, with implications for reducing social stratification across the lifespan. In order to place these issues in a familiar context, participants (N = 267, ages 8-14 years) decided whom to admit to an educational summer camp opportunity. In a between-subjects manipulation, we specified that only

children from high-wealth backgrounds or only children from low-wealth backgrounds had access to this opportunity in the past. Children were more supportive of admitting peers of low-wealth backgrounds to the educational opportunity when they had evidence that low-wealth peers had been excluded in the past. Further, children who chose to admit low-wealth peers reasoned about broader economic inequalities, indicating that awareness of societal disparities enabled children to reject a pattern of economic exclusion. These results contrast with previous work indicating that children hold assumptions about wealth and deservedness. Instead, this study provided new evidence for how awareness of intergroup relations can contribute positively to moral judgments in childhood. Over and above egalitarian principles, awareness of economic inequality enabled children to make complex moral judgments that took others' welfare into consideration. However, when peers of high-wealth backgrounds had been excluded in the past, children's decisions differed as a function of their own economic status. The higher children's family income, the more they supported admitting high-wealth peers in this context. This suggests that higher-income children may face a challenge in integrating their moral concerns about broader inequality and their social concerns for benefiting members of economic groups that are similar to themselves. These emerging socioeconomic differences in children's judgments may also have implications for other inclusion and exclusion decisions in childhood (e.g., friend groups, clubs). Economic inequalities are a part of children's everyday peer interactions, yet this study was the first to examine the links between children's perceptions of economic inequalities, their own economic status, and their moral judgments about access to opportunities for peers of high- and low-wealth backgrounds. In addition to the contribution to basic science in social-cognitive and moral development, these results have broader implications for educators and policy-makers interested in designing programs that encourage consideration of economic inequality and fairness in childhood.

1-F-75   Children's Third-party Punishment of Unequal Resource Allocations in a Computer Game

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Humans are willing to punish individuals who violate fairness norms, even if they have to pay a cost and are not directly affected. This so-called costly third-party punishment is important to stabilize norms and well-established phenomenon in adults (Fehr & Fischbacher, 2004). Recent developmental studies show that this behavior first emerges around 5 to 6 years of age (McAuliffe et al., 2015). However, this previous research on children used imagined players or puppets as recipients. Thus, it is unknown whether children will punish selfish individuals in a live interaction with peers. Therefore, we developed a novel computer game to examine whether children punish unfair resource divider in a live interaction where we could control each individual's behavior. We tested N=36 5- to 9-year-olds. They were led to believe that they are having a live interaction with two other players: a divider and a recipient. The divider can divide the 6 coins either equally (3:3) or selfishly (6:0) between him/herself and the recipient. After the divider's offer, children could either accept (no punishment) or reject (punishment) the offer by pressing one of the two buttons (Fig. 1). Results revealed that children punished the divider more often for unequal than equal offers (β = 2.00, p < .001) (Fig. 2). This tendency to punish unfair divider was observed across all age groups. This is the first demonstration of children's third-party punishment in a live setting.

1-G-76   **Parent Mental Rotation Skills Predict the Mental Rotation Skills of their Children**

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Spatial skills are important for completing everyday tasks, have been linked to early mathematics achievement (Mix & Cheng, 2012), and predict future success in STEM fields (Humphreys et al., 1993; Shea et al., 2001; Wai et al., 2009). Given the importance of spatial skills for both children and adults, much research has explored the development of spatial skills, with some studies focusing on the role parents play on the development of early spatial thinking. For example, mothers' use of spatial language (e.g., "little", "left", "under") has been found to predict pre-kindergartners' spatial language use and performance on several spatial tasks (Pruden, Levine & Huttenlocher, 2011). Additionally, highly spatial activities (e.g., block building) elicit greater spatial language than activities with less spatial content (e.g., puppet play, drawing) (Ferrara, Hirsh-Pasek, Newcombe, Golinkoff, & Lam, 2011). While there is compelling evidence linking parent spatial language use and child spatial performance, no studies to date have examined the relation between the spatial skills or parents and their children. The present study seeks to further explore the development of spatial skills by examining parents' performance on a mental rotation task and its relationship to their children's performance on a mental rotation and transformation task. Participants included 37 children (17 females; 20 males) between four-and-a-half and five-and-a-half years of age and their parents (35 females; 2 male). Parent and child dyads completed an age-appropriate mental rotation task separately during a lab visit. Children were tested on the Children's Mental Transformation Task (CMTT, Levine, Huttenlocher, Taylor, & Langrock, 1999) in which they were asked to mentally rotate and translate shapes and objects. Meanwhile, parents were tested on the Revised Vandenberg & Kuse Mental Rotations Test (MRT; Peters, 1995) where they were asked to match a target figure to rotated versions of the figure. Results from a linear regression analysis suggest parent scores on the MRT are significantly predictive of child scores on the CMTT (b = 0.24, p = 0.03, R2 = 0.13); specifically, child's CMTT scores increase 0.24 for every one-point increase on the MRT. These findings hold even when controlling for child sex, age, receptive vocabulary scores, and family socioeconomic status (b = 0.24, p = 0.03, R2 = 0.26). These results suggest that children's mental rotation skills were explained by their parents' mental rotation skills. Given previous findings linking parent spatial language use and child spatial ability, we argue that the relation between parent and child mental rotation ability may be explained by the amount of spatial language being used in the home setting. Our future work will explore the mechanisms driving the relation between parent and child mental rotation abilities, examining whether parents with strong mental rotation abilities use more spatial language resulting in their children also having strong mental rotation skills.

1-G-77   **Examining the Development and Functional Role of Spatial-Numerical Associations**

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Spatial-numerical associations (SNAs) have been documented across development and species. Yet the functional significance of such ubiquitous associations remains unclear. Although it has been

hypothesized that SNAs are related to better mathematical abilities (Opfer, Thompson, & Furlong, 2010), some evidence suggests a negative relation between SNAs and math ability, at least in adulthood (Cipora et al., 2016). To address the unexpected pattern in adults, we examined the relation between SNAs and math proficiency early in development (i.e., 66 5- to 8-year-old children). To shed light on extant inconsistent findings in the literature, we include multiple measures of SNAs to ensure convergent validity, and multiple tests of math ability to determine whether the relations vary by type of math ability. The two SNA paradigms included a magnitude comparison task and a novel paradigm, the place-the-number task (Aulet, Yousif, & Lourenco, 2017). In the magnitude comparison task, children were presented with two dot arrays and selected the array which contained more dots. SNAs on this task were measured by a congruency score: the difference in accuracy on congruent and incongruent trials (congruent trials consisted of arrays with more dots presented on the right). Children's congruency scores were significantly greater than zero, $p < .05$, $d=.27$, suggesting a significant SNA. In the place-the-number task, an Arabic numeral was presented at a random location on screen and children then recreated this location after a brief delay. SNAs were calculated by regressing average horizontal bias for each numeral (final - initial location) onto the corresponding numerical value. This analysis revealed slopes were significantly greater than zero, $p < .05$, $d=.26$, consistent with a significant SNA. Moreover, and crucially, SNAs on both paradigms were significantly correlated after controlling for age and accuracy, $r(52)=.30$, $p < .05$, suggesting a stable SNA. Children's math ability was assessed with three measures: cross-modal arithmetic (Barth, Beckmann, & Spelke, 2008), approximate symbolic arithmetic (Gilmore, McCarthy, & Spelke, 2007), and exact symbolic arithmetic (Woodcock Johnson Calculation subtest; Woodcock, McGrew, & Mather, 2001). Performance was significantly correlated across several of these tasks (cross-modal arithmetic and approximate symbolic addition, $p < .05$; approximate symbolic addition and subtraction, $p < .001$; approximate symbolic arithmetic and exact symbolic arithmetic, $p < .001$). However, the relations between SNA and math measures were less consistent. SNAs on the place-the-number task were not correlated with any measure of math ability, and although SNAs on the magnitude comparison task were correlated with cross-modal arithmetic, $r(48)=-.30$, $p < .05$, even after controlling for age, verbal proficiency, working memory and short-term memory, this correlation was negative, suggesting stronger SNAs were associated with worse performance on cross-modal arithmetic. Despite evidence for a negative relation between SNAs and math in adults, we argue that the relation observed in the present study may reflect task demands specific to the magnitude comparison task. We suggest the differences in task demands across SNA paradigms could account for contradictory findings in the literature. We conclude with a discussion of the multi-faceted nature of SNAs and how these different features may relate to math ability.

1-G-78   Proportion Estimation Strategy in Number Line Estimation and Non-Verbal Numerical Acuity Correlate with Math Ability in 6- to 8-Year-Olds

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Children's performance on certain lab-based number tasks has been found to predict formal math scores, but the reasons for these links are debated. In a group of 6- to 8-year-old children (n=98), we assessed performance on two lab-based number tasks (a 0-100 number line estimation task, and a dot discrimination task), as well as standardized math ability (TEMA-3). We found that older children used more sophisticated proportion estimation strategies in the number line task, which led to reduced bias and higher accuracy. Children who spontaneously inferred and used the midpoint of the number line as an additional reference point to guide estimates showed higher math ability than children whose data

indicated the use of less sophisticated strategies. Accuracy for dot discrimination was another unique predictor of math ability, and we found no evidence that non-numerical factors were responsible for this link. Little correlation was found between number line estimation and dot discrimination accuracy, suggesting that bounded number-line estimation ability is not dependent on the approximate number system. The current work shows that one link between number line estimation and math ability is a function of proportion-based strategy use, which is a cognitive process separate from and independent of internal number representations.

1-G-79   Improving Children's Conceptual Understanding of Fraction Addition

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Fraction arithmetic is among the most challenging topics children encounter on the path from whole numbers to algebra. Children display poor conceptual understanding of even the most basic fraction arithmetic operation, addition, for example by estimating the sum of two positive fractions to be smaller than one of them alone (Braithwaite, Tian, & Siegler, in press). To remedy this difficulty, we enhanced a computer game shown to improve knowledge of fraction magnitudes, Catch the Monster with Fractions (Fazio, Kennedy, & Siegler, 2016), by adding virtual manipulatives - unit fraction strips - which players could concatenate to represent the sizes of both individual fractions and fraction sums. Fourth and fifth graders who played the game using individual fractions for one day and fraction sums for one day (experimental group) showed large improvements in number line estimation of individual fractions, equal-denominator sums, and unequal-denominator sums. Children who played the game using only individual fractions on both days (control group) also improved on these three measures, but by substantially less than the experimental group on estimation of unequal-denominator sums. The findings indicate that concatenation of unit fractions is a sound conceptual framework for understanding both fractions and fraction addition, and that the benefits of this framework depend in part on direct practice applying it to the case of unequal-denominator addition.

1-G-80   How an understanding of layers unfolds: A new mental folding task for young children

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Although mental folding is an important spatial skill with direct applications to STEM, it has been largely ignored in early childhood research. In the present study, children (N=28; ages 5.5-9.0) watched an experimenter fold a piece of paper and punch a hole through the folded layers on eight trials. On each trial, children were asked to imagine the locations of the holes if the paper were unfolded, and draw their response on a separate sheet of unfolded paper. Analyses reveal that fold characteristics--including number of folds, fold axis, and hole placement--significantly impact children's accuracy and error patterns. Additionally, age-related variations in performance indicate that children have difficulty identifying the number of layers until ages six to seven years, suggesting that younger children may not fully understand the three dimensional nature of mental folding.

1-G-81   Math and Memory in Bilingual Preschoolers: The Relations between Bilingualism, Working Memory, and Numerical Knowledge

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Bilingual children demonstrate a 'bilingual advantage' for working memory. Relatedly, children's competency in mathematics is supported by their working memory capacity. Therefore, the link between working memory and mathematics may lead to greater numerical knowledge in bilingual children. We investigated whether there was a bilingual advantage for working memory and whether bilingual children demonstrated greater mathematical understanding than monolingual children. Participants (N=74; Mage= 4 years;11 months) completed measures of numeral identification, addition, symbolic, and nonsymbolic magnitude comparison skills. Children also completed a measure of nonverbal working memory and a measure of intelligence (Block Design, WPPSI-IV; Wechsler, 2012). There were no significant differences between monolinguals and bilinguals in age, gender, or intelligence. All analyses controlled for age, gender, SES, and intelligence. A regression analysis revealed that bilingualism was a significant predictor of working memory β^*=.25, t(68)=2.35, p=.022, R2=.26. Bilingualism was also significant predictor of numeral identification, β^*=.32, t(67)= 7.30, p=.009, R2=.08, and addition, β^*=.36, t(67)=3.60, p<.001, R2=.34. Further, the relation between bilingualism and addition was explained by working memory, β^*=.40, t(68)=3.79, p<.001, R2=.44. Results will be discussed in terms of understanding the unique cognitive and academic advantages bilingual children may have.

1-G-82 Number Stroop-like Interference Effects Can Be Eliminated by Language

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How does language interact with our core cognitive capacities, such as our intuitive perception of number, length, and size? We propose that language narrows attention to a subset of possible cognitive representations at the expense of others. Five- and six-year-old children were given a Stroop-like interference task in which non-numeric cues (e.g., size, length) were in conflict with the number of dots on a screen. When children were given a broad linguistic cue (i.e., being asked whether there are "more" blue or yellow dots), we found that their attention was drawn towards the conflicting, non-numeric dimensions. Alternatively, when given a more specific linguistic cue that exclusively refers to number (i.e., being asked how "many" blue/yellow dots there are), children no longer showed any bias towards non-numeric cues, instead attending solely to number. We suggest that certain linguistic cues (i.e., "many") have a privileged status with specific core representations (i.e., number).

1-G-83 Relations between patterning, calculation skill, and key concepts in early math

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Patterns are often considered central to early mathematics learning, and recent empirical research has linked patterning skills to global mathematics achievement (e.g., Rittle-Johnson, Fyfe, Hofer, & Farran, 2016). However, little is known about how patterning skill relates to specific types of mathematics

knowledge. In the current study, 36 children from 5 to 13 years old (M = 9.1 years) completed a pattern extension task and three well-studied math tasks that tapped calculation skill and knowledge of key math concepts (inversion and equivalence). Overall, children were quite successful on the pattern extension task. Across 24 items, the average score was 83% (SD = 19%), and all but three children solved more than half of all pattern items correctly. Importantly, success on the pattern task was related to mathematics performance. Regression analyses revealed that patterning skill significantly predicted calculation scores over and above age and working memory, β = .51, p = .001. However, patterning skill did not predict concepts scores, β = .07, p = .71. Results suggest that patterning may play a key role in the development of some aspects of early mathematics knowledge.

1-G-84   The Influence of Narrative Context on Children's Proportional Reasoning Performance

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Non-symbolic proportional reasoning is an important skill that correlates with fraction knowledge and math achievement (Siegler, Thompson, & Schneider, 2011). Despite having an intuitive sense of proportion, children struggle to match discrete proportions due to a whole number bias (Boyer, Levine, & Huttenlocher, 2008). Previous research has used a computerized proportion matching task in a context of mixing juice and water. We hypothesized that a more familiar context using skyscrapers and blocks would improve performance. Second and 3rd graders (N=94; M age=8.46, SD age= 0.58; 46 girls) completed a proportional equivalence choice task using discrete proportions in one of four conditions in a 2 (narrative context: juice, skyscraper) x 2 (presentation format: computer, blocks) between-subjects design. An ANOVA showed a significant main effect of narrative (F(1, 90)=8.93, p=.004), a marginal main effect of format (F(1, 90)=3.38, p=.069), and no interaction (p=.996). Participants in the juice narrative outperformed participants in the skyscraper narrative. Though the findings contradicted our predictions, they suggest that performance is strongly influenced by narrative context. The juice narrative may evoke holistic processing, whereas the skyscraper narrative may emphasize discreteness and evoke incorrect counting strategies. Future research should investigate how a narrative may support proportional reasoning to help students overcome learning challenges with fractions.

1-G-85   An Integrative Data Analysis of Gender Differences in Children's Understanding of Mathematical Equivalence

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Children's formal understanding of mathematical equivalence predicts mathematics achievement in elementary school and algebraic equation-solving in middle school. Thus, it is important to understand factors that contribute to variations in children's understanding of mathematical equivalence. The present study examined gender as a potential source of variation. Girls' greater difficulties with novel problems and reliance on taught algorithms point to a pattern of procedural learning, which may serve them well when problems are written in the traditional format (e.g., a + b = __), but not when operations are on both sides of the equal sign (mathematical equivalence problems, e.g., a + b = __ + c). An integrative data analysis was conducted with 960 second- and third-graders across 14 previously conducted studies. Measures included problem solving, problem encoding, and equal sign definition.

Children performed poorly on all measures. As predicted, girls were less likely to solve mathematical equivalence problems correctly than boys, p = .007, even though there were no gender differences in calculation accuracy. Additionally, girls were more likely than boys to use the "add-all" strategy, p = .02, an incorrect strategy that has been shown to be more resistant to change than other incorrect strategies. There were not statistically significant differences for encoding or defining the equal sign, suggesting that deficits may reflect girls' tendency to follow taught algorithms.

1-G-86   Functional overlap between numerosity and count word representations in the developing brain

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Learning to map numerical symbols (e.g., number words) onto their quantitative meanings is a key step in the acquisition of formal mathematics. However, the contribution of pre-existing numerosity representations to the acquisition of counting is highly debated. The current study turns to neural data to test for functional overlap in the representations underlying numerosity processing and counting sequences in children who are learning to count. If regions that support numerosity processing are important for the acquisition of counting, then there should be functional overlap of these representations before children have mastered the count list. Using functional magnetic resonance imaging (fMRI), we first identified numerosity processing regions in 3- to 5-year-old children during a numerosity comparison task. To identify neural representations of counting, we measured changes in BOLD signal while those same children listened to counting and alphabet sequences. We found that the bilateral intraparietal sulcus (IPS) supported representations of numerosities and counting sequences, but not alphabet sequences. These same regions were also recruited more for number words outside of children's counting range suggesting that IPS is important for the acquisition of count words. Taken together, this is the first neural evidence that evolutionarily-primitive numerosity processing regions of the brain are functionally related to the acquisition of counting over child development.

1-G-87   I'm Sure I'm Going to Win This One, and I Feel Great! Children's Ability to Form Expectations Based on Mathematical Probability

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We investigated 4- to 10-year-olds' and adults' (N=205) ability to consider mathematical probability when forming expectations about the future. Participants played six chance games, each with a different probability of winning (depicted pictorially): high (.9, .8), moderate (.5, mystery), and low (.2, .1). Using pictorial scales, individuals predicted whether they would win or lose each game (including certainty; not so sure, kind of sure, really sure) and how they felt before playing each game (from very bad to very good). All age groups hierarchically differentiated their thought and emotion ratings in line with probability (high>moderate>low; see Figure 1A and Figure 1B). Still, there was strong evidence for an age-related positivity bias: Adults were the most pessimistic and the 4- to 5-year-olds were the most optimistic before playing low-probability games; the youngest children also forecasted more positively than older children and adults prior to the moderate-probability games. Similarly, 4- to 5-year-olds felt

better than other age groups before playing games that they had only a moderate to low chance of winning.

1-G-88   A latent profile analysis of Grade 1 processing speed, executive function, counting skill, and math achievement

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Moderate and positive relations between processing speed, executive functions, and mathematics may obscure specific profiles of children for which these skills are discordant. The present study addressed this issue examining N = 194 children in Grade 1. Latent profile analyses were conducted to examine clusters of children that vary in counting skill, math achievement, executive function, and rapid naming skill. Exploratory models testing 2 to 8 classes were examined. A 4 class model provided best fit. The largest group, containing 68% of the sample was defined by average skill across all abilities assessed. Another 15% of the sample scored higher than average on all skills and 5% were in a group that scored lower than average. The group of primary interest was the final 12% of the sample which was marked by some divergence in processing speed compared to executive function and mathematics skills. Despite average rapid naming skill, this group was below average on math outcomes. Thus, the results suggest processing speed may be necessary but not sufficient for developing math achievement. In contrast, below average executive functions may hold children back - both profiles with below average cognitive flexibility showed below average math performance. Importantly, the results suggest that aggregating across full samples may lead to obscuring small but separable groups of children for which development of general cognitive skills and mathematics is not synchronic.

1-G-89   Children's Use of Decision Rules in Two Probabilistic Reasoning Tasks

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Forty-one 7-11-year-olds played a computerized version of a task devised to assess children's understanding of proportions and probability (modeled after Falk, Yudilevich-Assouline, & Elstein, 2012) as well as a probability discrimination task (O'Grady, Griffiths & Xu, 2016). We report two main findings. (1) Participants progressed from 1-dimensional strategies to 2-dimensional strategies with age. However, compared to Falk et al. (2012), we report higher proportions of older children continuing to rely on incorrect decision rules, perhaps due to the slower math curriculum in the U.S. (2) Children's strategy was correlated with better performance on approximation trials requiring a proportional understanding of probability ($r = 0.67$, $t = 5.2$, $df = 34$, $p < 0.001$) but not on trials which can be solved using simpler strategies ($r = 0.1$, $t = 0.59$, $df = 34$, n.s). Thus, in both precise calculations and approximations, children's proportional reasoning improves with age.

1-G-90   Exploring the ratio processing system among primary school children: Behavioral and neural evidence

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A growing body of research has demonstrated a phylogenetically and ontogenetically conserved ability to process nonsymbolic ratio magnitudes. We have suggested that this ability depends on a "ratio processing system" (RPS), and that the RPS helps support the acquisition of symbolic fraction knowledge (Lewis, Matthews & Hubbard, 2015). Here, we tested whether the RPS is involved in processing symbolic vs. nonsymbolic ratio magnitudes among 2nd and 5th graders at behavioral and neural levels. Children were asked to decide which of two ratios was numerically larger in three conditions: symbolic (Fraction-Fraction), non-symbolic (Line Ratio-Line Ratio), or mixed (Line Ratio-Fraction). Both groups made fast, accurate comparisons in all three formats, with classic distance effects: they were faster and more accurate for "far" ratios (1/7 vs. 8/9) than for "close" ratios (2/3 vs. 3/5). Both groups were fastest/most accurate in the nonsymbolic condition and slowest/least accurate in the symbolic condition. Neural distance effects revealed greater activation for close vs. far comparisons in a partially overlapping parietal-frontal network across conditions, with children showing greater activity than adults in bilateral frontal regions and right parietal cortex. Our results are consistent with the foundational role of the RPS in symbolic fractions processing, but also demonstrate a critical role for educational experiences in building these behavioral and neural representations.

1-G-91   Childrens numerical comparison is independent of number representation

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Children's numeracy is a key construct in numerical and mathematical cognition. Numeracy is typically assessed by performance on the numerical comparison task which then predicts performance on symbolic arithmetic tasks and standardized math assessments (Chen & Li, 2014; Gilmore, McCarthy, & Spelke, 2010). Training with non-symbolic comparison can also lead to improvement on symbolic tasks (Park & Brannon, 2013, 2014). Though the relationships between performance on non-symbolic numerical comparison and other tasks are well catalogued, there is less evidence of what the underlying mechanisms that contribute to individual variation are. Examination of the mechanisms involved in completing numerical tasks is both essential for theory and has practical benefit. Evaluation of the relationship between numerical tasks is constrained by our characterization of the cognitive and neural mechanisms of behavior relevant to completing the tasks. We evaluate potential mechanisms individual differences in numerical comparison by evaluating two hypotheses: Precision hypothesis and Decision hypothesis. Variations in performance due to developmental or individual differences are caused by differences in the precision of number representation. Learners have some internal representation of number values, be it via neural tuning curves (e.g., Nieder, Freedman, & Miller, 2002; Prather, 2012) or mental number lines (Siegler & Opfer, 2003). Number representation may be through neural tuning curves associated with numbers reported in both non-human primates and humans (e.g., Moskaleva & Nieder, 2014; Andreas Nieder & Dehaene, 2009). The precision hypothesis is consistent with prior computational modeling work that demonstrates how increases in precision of neural coding is associated with improved performance on a number tasks (Dewind & Brannon, 2012; Prather, 2012). Secondly, we consider the Decision hypothesis. In this case individual differences in numerical comparison performance are due to variation in decision-making that is independent of numerical representation. Completion of the numerical comparison task requires a comparison between two items, specifically the internal representation of those items. Prior work on perceptual decision-making shows that variations in thresholds for evidence accumulation can account for some variation in task

performance. Across two experiments we combine empirical data and computational modeling. Participants in both experiments (n = 30; n = 53) completed a non-symbolic numerical comparison task and a free response estimation task. In the free response estimation task participants estimated the number of dots briefly presented (without counting). We presented participants with the same number of dots, in random configurations, multiple instances across the entire stimulus set. Thus we are able to calculate a measure of the variation (or precision) of participants' estimates of a particular value that is separate from accuracy. No comparison to another amount is needed thus consistency of performance on the estimation task should primarily rely on the precision of numerical representation. Participants with more precise internal representations of number should perform better on the numerical comparison task. In both experiments we failed to find evidence of a significant relationship between representation precision and performance on numerical comparison while accounting for children's mathematics achievement.

1-G-92   Identifying Fraction Concepts Measures as Effective Screeners of Mathematics Risk Status

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Fraction knowledge predicts algebra achievement and mathematics achievement more broadly (Siegler et al., 2012). Yet many students struggle to learn fractions starting in fourth grade and are at risk for mathematics difficulties (Resnick et al., 2016). The integrated theory of numerical development posits that understanding fraction magnitudes on the number line is especially important for success in more advanced mathematics (Siegler & Lortie-Forgues, 2014). The present study explored three fraction measures (i.e., fraction magnitude estimation on the number line, general fraction concepts, and fraction arithmetic) as potential screeners for identifying students at risk for later difficulties. Receiver operating characteristic (ROC) curve analyses assessed the diagnostic accuracy of the fraction measures for identifying fourth-graders who did not meet state standards on the end-of-the-year mathematics test in fourth grade (n = 411), fifth grade (n = 362), and sixth grade (n = 304). A combined measure of fraction number line items and general fraction concepts items consistently yielded high area under the curve (AUC) values and emerged as an accurate screener of risk status (Table 1). The fraction arithmetic measure fell below accuracy standards. Based on cognitive research, the study identifies a practical screening tool that is useful both for research and practice.

1-G-93   The Roles of Visuospatial Memory and Arithmetic Strategy Choice on Arithmetic Accuracy

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Children's visuospatial memory predicts children's overall mathematics achievement through early adolescence (Li & Geary, 2017). The purpose of this study was to better understand this relation in early childhood for a foundational aspect of mathematics - arithmetic problem solving. It tested the hypothesis visuospatial memory helps children execute mental calculation strategies (count-on and decomposition) that, unlike a count-all strategy, may involve visualizing and manipulating numbers

along a mental number line. We expected that first graders with better visuospatial memory are more likely to use count-on and decomposition to solve arithmetic problems, which, in turn, leads to greater accuracy on arithmetic. First graders (n = 266) completed simple and complex addition problems as well as a number line estimation task with a 0 to 100 number line. As expected, visuospatial memory was positively related to the use of count-on and decomposition, and these relations were mediated by number line estimation percent absolute error. Further, the influence of visuospatial memory on arithmetic accuracy was mediated by use of these strategies. The present results suggest one pathway through which visuospatial memory influences later mathematics achievement is through early arithmetic strategy choice.

1-G-94   Effects of Cognitive Supports for Learning Fractional Magnitudes by Analogy

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Fraction knowledge is important for student success (Siegler et al., 2012). To test the effect of analogical supports (Richland et al., 2007) on improving fraction knowledge, 109 fourth and fifth graders were assigned to one of three training conditions with different analogical bases: whole numbers, percentages, or fractions as well as a control condition with no analogical base. We measured students' accuracy when placing (number-to-position, NP) and identifying (position-to-number, PN) fractions on 0-1 number lines across four timepoints: pretest, training, immediate posttest, and delayed posttest. We modeled children's accuracy on each training and posttest task with separate ANCOVAs to test for condition effects, controlling for pretest, grade, executive function (flanker task), and math achievement. There were significant effects of training condition on both NP, F(3,101)=23.90, p<.01, and PN training tasks, F(3,101)=47.47, p<.01. Children in each analogical training condition outperformed children in the control condition during training for both NP and PN, ps<.01 (see Figure). Condition did not affect accuracy on 0-1 NP posttest problems. Condition only mattered for accuracy on 0-4 NP posttest problems, p=.04, revealing an advantage for whole number analogies over control, p<.01. Analogies may contemporaneously improve children's fraction estimation, however, only analogies to whole numbers may support transfer to untrained tasks.

1-G-95   Breaking down gesture: Understanding which components of gesture promote learning

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Experience physically rotating objects facilitates mental rotation skill development in children (Frick et al., 2013), but so does producing a rotation gesture (Goldin-Meadow et al., 2012). To explore the impact of these different experiences, we examined the mental rotation skills of 4- to 6-year-olds before and after they were asked to rotate actual objects, rotate objects on an iPad incorporating some components of physically rotating an object, or produce rotation gestures over objects. Study 1 (N=107) revealed that not seeing the outcome of the rotation (which occurs only in gesture) predicted the greatest gains in mental rotation ability. But gesture also involves the grasping and turning components found in action (although, in gesture, these components do not cause physical change in the environment). Study 2 (N=72) asked whether gesture's action components (grasping/turning) played a

role in supporting learning gains, or whether the same gains could be realized by imagining object rotation during training - a condition that also did not reveal outcome. Results showed that the benefits of gesture in supporting mental rotation gains stem from both its action components and the lack of visible outcome.

H - Social Cognition

1-H-96   Success does not imply knowledge: Preschoolers believe that accurate predictions reveal prior knowledge, but accurate observations do not

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To avoid learning inaccurate information from ignorant agents, we often need to assess how knowledgeable our informants are. Prior work has focused on investigating whether children understand that informant errors imply ignorance. In our work, we ask the converse question: Under what circumstances do correct responses signal knowledge? 4- and 5-year-olds (n = 128 across ages and conditions) watched two puppets interacting with two opaque containers. One puppet accurately predicted the contents of each container (first describing the contents and only afterwards revealing them). The other puppet made an accurate observation of the contents (first revealing the contents, and then describing them). Although both puppets always made correct statements, children judged that the predictor was more likely to have had prior knowledge about the containers (69%; 95% CI: 58.33-83.33%), and that he was also more likely to know the contents of a third container (77%; 95% CI: 66.67-89.58%) - except when the contents of this container had been changed out of both puppets' view (48%; 95% CI: 33.33-62.5%). When agents provided conflicting testimony about the contents of a new container, children endorsed the predictor's testimony (75%; 95% CI: 59.38-90.62%). In sum, we find that preschoolers are sensitive to subtle actions that signal an agent's prior knowledge, using these actions not only to decide who knows what, but also to decide which agents to trust.

1-H-97   "I can do it now!" Young children strategically select information to inform others about the self

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Reasoning about others' beliefs about the self is critical for daily social interactions and building relationships with others. Here, we ask whether children can infer what others think of their own competence and selectively communicate information to revise these beliefs. In Study 1, children (Age:3-5, N=91) learned to operate one of two toys (Observed Toy) while a naïve confederate observed; the confederate watched the child fail twice and left the room either after the child's eventual success (thinking that the child can operate the toy; Present Condition), or before the success (thinking that the child cannot operate the toy; Absent Condition). In the absence of the confederate, children in both conditions learned how to operate another toy (Unobserved Toy). Children were asked which toy they want to show the confederate. Children in the Present condition showed the Unobserved Toy to the confederate, reflecting a desire to teach (72%, p = .004), whereas children in the Absent condition

overrode this desire to show the Observed Toy to demonstrate their competence to the confederate (38%, p = .144; Present vs. Absent: p = .001). Study 2 replicates this finding exactly (Age:4, N=38; Present vs. Absent: p = .042). Together, these results suggest that children can not only spontaneously infer others' beliefs about their own competence, but can also actively communicate to change others' beliefs.

1-H-98   "PAL can just be themself": Children Respond to Annedroids' Genderless TV Character

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The innovative Canadian children's program Annedroids introduces viewers to "PAL," a human-like android, whom a child scientist named Anne programmed to choose its own gender. Viewers witness PAL's explorations of what girlhood or boyhood would mean, culminating in PAL's series-finale decision to eschew a binary gender identity and "just be me." While some research has examined counter-stereotypical characters' influence on children's thinking, the impact of characters actively constructing gender identities is unknown. We showed twenty-one children (ages 8 to 10) in the US selected Annedroids segments highlighting PAL's gender exploration. We identified themes in their reactions to PAL's characterization and tracked their reactions to PAL's decision, measuring the flexibility of their attitudes about gender before and after viewing. We found that children who believed PAL should choose a gender (as opposed to those comfortable with PAL remaining ungendered) showed increased flexibility in thinking about gender after viewing the selected clips.

1-H-99   Individual Differences in Children's Ability to Detect Subtle Emotions in Others

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Prototypical or obvious displays of emotion are usually easier to identify than subtle or less obvious displays of emotion. Individual differences were investigated among 5- to 9-year-old children during an emotion detection game with 3-second videos displaying manipulated intensities of 100%, 75%, or 50% of adult actors' full expressions of basic emotions. Children's mean detection accuracy showed a significant linear trend of intensity (p < .05), where accuracy was greatest for trials showing 100% of the expressions and lowest for trials showing 50% of the expressions. When focusing on individual performance, a subset of children who readily detected the least obvious emotions (i.e., more than half of the trials showing 50% of the expressions) were significantly better at detecting both happiness and fear. However, their greater detection of subtle emotions did not distinguish them from the other children's detection of sadness, surprise, anger, or disgust. Furthermore, all children's overall emotion detection rates were positively correlated to parental reports of how frequently children "respond to questions when asked" and how frequently children "understand the impact of their behavior on others" (r's > .60, p's <.05). The current study supports the idea that individual differences in social awareness are tied to individual differences in perceptual abilities where socially receptive children seem to be more sensitive at detecting subtle displays of emotions in others.

1-H-100   Theory of Mind and Teacher-Rated Social and Academic Competencies in Emerging Adolescents

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This study investigated emerging adolescents' ToM (Theory of Mind) or mental state understanding, and their teachers' ratings of their social and academic competencies. Our primary goal was to explore individual differences and associations among ToM, and teachers' peceptions of emerging adolescents' academic and social competenciesThis study describes Year 1 (2015-6) data (13 schools, Ontario, Canada) (N = 146; 97 females; Mage = 13.5 years, SD = 5.436), . Twelve12 participating teachers. participated in the study,such Results showed no gender differences in the ToM total score (ToM stories + RMET) (M = 29.48, SD = 5.06). ANOVA results showed significant (p < .05) gender differences in teachers' ratings of physical aggression (boys > girls, F = 6.62, p = .012), prosocial behaviours (girls > boys, F = 13.30, p = .00), behavioural conduct (girls > boys, F = 21.20, p = .00), academic ratings (girls > boys, F = 12.60, p = .00). Our findings suggest that gender may influence the relations among adolescents' ToM and teacher ratings of students' academic and social competencies.

1-H-101   The Role of Coordinated Joint Engagement with Social Partners in Infants' Emerging Understanding of Intentional Actions

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Infants' understanding of the intentional nature of human action develops gradually across the first year. A key question is how this foundational social-cognitive ability develops. In the current study, we explored the hypothesis that experience coordinating engagement with social partners shapes infants' developing understanding of others as intentional agents. Infants (N = 100) completed a series of tasks at two time points: M = 7 and 10 months of age. At both Time 1 and Time 2, infants' joint engagement ability was assessed in a semi-structured play session with a researcher. Intention understanding was also assessed at both time points using an experimental measure of infants' ability to visually predict the goal of an intentional reaching action. Analyses revealed three key findings: (1) Between Time 1 and Time 2, infants showed substantial improvements in both their social engagement in the play task and their intentional action processing; (2) Infants who demonstrated more coordinated engagement with the researcher at Time 2 also displayed better concurrent intentional action processing; (3) Infants who coordinated engagement with the researcher more frequently at Time 1 showed better intention understanding 3 months later. Together, these results highlight the importance of social interaction as a developmental mechanism and suggest that infants enrich their understanding of the intentionality of human action through triadic interactions with social partners.

1-H-102   Preschoolers' consideration of competing confidence and accuracy cues in informants

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Children and adults trust confident people more than those who lack confidence. However, a person may be overconfident or display unwarranted hesitancy. Two studies investigated whether children discount the confidence of consistently inaccurate people and the uncertainty of consistently accurate ones. In Study 1, 4- and 5-year-olds (N=96) saw two people provide novel facts, one confidently, the other hesitantly. Children preferentially trusted the confident person (59%, p=.033). For half the children, the confident person had a history of inaccuracy and the hesitant one a history of accuracy: for these, age was correlated with a preference to trust the accurate but hesitant person (r=.382, p=.007). Study 2 increases the salience of confidence, and also tests whether children modify their learning strategy in high-stakes situations: Half of the children are told that they must answer all questions correctly to win stickers whereas the other half are told they will win stickers regardless of their answers. Preliminary findings (N=39) find strong trust of the confident person (79%, p<.001) and replicate the positive correlation between age and reliance on a hesitantly inaccurate person (r=.526, p=.021). When controlling for age, higher stakes appear associated with a greater trust in an overconfident person (44% vs. 30%, ns, preliminary data). Together, these findings suggest an increasing understanding of the value of accuracy over confidence during the late preschool years.

1-H-103   Separate age-related changes in the use of face and race cues for social judgments

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The ability to make judgments about the basic moral character of others is a significant developmental achievement. The present research examined whether, when, and how children and adults attended to facial features and social category (race) to inform judgments of face pairs differing in race (Black, White) and facial trait (trustworthiness, dominance, and competence). Study 1 found that adults used both face and race cues: as expected, they consistently selected the trustworthy, submissive, and competent face as "nice." Yet on trials that varied race, adults were more likely to pick the Black face as "nice," indicating an intention to correct for bias. Study 2 found that older children (age 7-13) in Canada, like adults, used both face and race cues, and similarly corrected for bias, although to a lesser extent than adults. In contrast, younger children (age 5-7) used only face cues and ignored race cues. Study 3 replicated the overall pattern of results in the U.S. with a more racially-diverse sample, suggesting that these results are robust across varying experiences with race. Together, three studies in two contexts reveal that, while the use of face cues in social judgments is present from the earliest ages, the use of race cues emerges later in childhood. The findings have implications for understanding developmental change in both children's explicit prejudice and their understanding of the moral imperative to be fair.

1-H-104   The development of positive and negative targeted social reciprocity

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Social reciprocity, or the propensity to pay back our benefactors and antagonists, has been proposed to be critical to social group functioning. We explored the development of positive and negative social reciprocity. In Exp 1, 4-5-year-olds (N = 40) were assigned to a minimal group and then completed 4 trials in which they received a benefit (1 sticker) from one of four possible benefactors (depending on trial type: an in-group member, out-group member, or neutral individual). Children were then provided

a new sticker and tasked with giving it to one of the 4 individuals previously seen. We coded whether children engaged in targeted individual-level reciprocity (gave back to their benefactor), targeted group-level reciprocity (gave back to the benefactor's in-group), or neither. We documented a surprising lack of either individual or group-level reciprocity in children's giving behavior. We replicated this effect when groups were further emphasized (Exp 2; N = 41), with children up through age 8 (Exp 4a; N = 42), and when groups were based on gender or nationality (Exp 5; N = 40). Thus, young children did not engage in positive social reciprocity: children did, however, engage in negative social reciprocity; they stole from individuals and groups that had stolen from them (Exp 3; N = 40 & Exp 4b; N = 39). We propose that negative and positive reciprocity follow distinct developmental trajectories and may be underpinned by separate cognitive processes.

1-H-105   Follow the near-peer leader: Examining the impact of birth order and task familiarity on children's imitation of a child model.

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Imitation is a robust social learning mechanism used by children (Barr & Hayne, 2003; Legare & Nielsen, 2015). Previous studies examining children's imitation have tended to use adult models and little attention has been paid to children's imitation of older peers. Here, we explore the impact of 4-5-year-old children's (N = 42) birth order (oldest sibling, younger sibling, only child) and task familiarity (a task with novel objects versus a task with familiar objects) on their imitation of an older peer. Past observational research has indicated that infants with older siblings are more likely to imitate other children, but this has not been explored experimentally with young children. Children's tendency to learn from other children might also be task-specific (Jaswal & Neely, 2006; VanderBorght & Jaswal, 2009) so we examined if children's familiarity with the objects might impact their imitation. As depicted in Figure 1 and supported by a GLMM analysis, there was a marginally significant interaction between task type and birth order $F_{(2, 78)} = 2.42$, $p = .096$. Planned comparisons indicate that birth order impacted children's imitation of the familiar task ($F_{(2, 41)} = 4.33$, $p = .020$), but not the novel task ($F_{(2, 41)} = 0.76$, $p = .476$). Younger siblings imitated more of the target actions in the familiar task than oldest siblings. We discuss implications for why birth order impacts children's likelihood of imitating an older peer, but only for tasks with familiar objects.

1-H-106   The Effect of Praise Type and Linguistic Cues on Parents' Beliefs About Their Children

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Previous research has demonstrated that parents' beliefs and expectations about their children's academic achievement are important predictors of children's actual academic performance and motivation; however, few studies have explored how such beliefs and expectations originate. The present study examined how parents' beliefs are affected by two specific aspects of teacher-provided feedback: praise and linguistic framing. Parents (N = 230) were asked to imagine that their child received one of three types of positive feedback (i.e., person praise: "smart"; process praise: "works hard"; or combination praise: "hard worker") from their child's teacher. Following both the presentation of positive feedback and a subsequent hypothetical scenario in which the child fails, parents (a) indicated

what they would think and what they would say to their child, and (b) completed scales assessing causal attributions and expectations for their child's future performance and effort. Overall, few differences were found across conditions in the numerical rating scales. For the open-ended responses, however, parents in the combination praise condition made significantly more references consistent with an adaptive motivation orientation (e.g., strategy use) relative to parents in the person praise condition. These findings suggest that praise containing aspects of both person and process praise might have a particularly adaptive influence on parents' beliefs regarding their child's performance.

1-H-107 Children eat more food when they prepare it themselves

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Encouraging children to participate in food preparation is recommended by pediatric guidelines and has been included in public health interventions. However, little is known about whether the act of preparing a food specifically increases children's intake of that food or whether this effect might differ for healthy and unhealthy foods. The present study examines whether 5- to 7-year-old children (N=64) eat more of a food they prepared themselves compared to the same food prepared by someone else. Children participated in a laboratory study in which they prepared either a salad or a dessert and then had the opportunity to eat the food they prepared and/or a nearly identical food prepared by someone else. We found that children ate more of a food they prepared themselves ($F(1,51)=13.5$, $p=.001$), but we observed no effect on children's evaluations of each food. A similar pattern of results was observed in an analogous toy assembly task ($F(1,56)=17.3$, $p<.001$). In addition to increasing children's intake of healthy foods, this study suggests that food preparation also increases children's intake of unhealthy foods, including desserts that children already enjoy eating. More specific recommendations are needed if the goal of involving children in food preparation is to promote health.

1-H-108 Concern for group reputation increases prosociality in young children

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Concern for reputation constitutes one of the main motivations for prosociality. Children from about age 5 onwards care about their personal reputation and for example steal less and help more when they are observed by a peer (Engelmann et al., 2012; Leimgruber et al., 2012). In the current study, we explored the existence of a concern for group reputation and its positive effects on levels of prosociality in 5-year-old children (N=144). Groups of three children were assigned to the same minimal group. Each child received ten toys and was told that she/he could share any number of toys with children from a different kindergarten. We varied (1) group reputation, i.e. whether the group's combined donation was public or private and (2) individual reputation, i.e. whether children's individual donations were public or private. We found an interaction between group reputation and individual reputation (GLMM: estimate±SE = $-0.401±0.200$, $z = -2.008$, $p = .045$). Post-hoc tests revealed a significant difference between the group public / individual private and the group private / individual private conditions ($p < .001$) showing that children were more generous when donations of the group were public even though individual contributions were unknown. We also found a significant difference between the group

private / individual public and the group private / individual private conditions (p = .009) indicating that children donated more toys when individual contributions were public.

1-H-109   Evaluating Consistency of 5-year-old's Prosocial Behaviors and Fairness Evaluations

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There is disagreement concerning whether young children's tendency to engage in different prosocial behaviors (e.g., helping, sharing) reflect one underlying construct, or whether they are distinct abilities. We examined 5-year-old children's prosocial behaviors and whether they relate to a relevant ability - evaluating fair versus unfair distributors. We found that, although children's (n=101) helping behavior was not related to their non-costly sharing, p=.430, it was significantly related to costly sharing, such that helpers were more generous than non-helpers, p=.004. Children's behavior in the two sharing tasks was significantly correlated, p=.006, such that those who were more generous in the non-costly sharing task were more generous in the costly sharing task. Further, children's degree of preference for fair distributors was not related to their helping, p=.540, nor their non-costly sharing, p=.409, but was significantly negatively correlated with their costly sharing, p=.020. That is, children who were less likely to show a preference for the fair distributor were more likely to engage in costly sharing. In sum, there is consistency across prosocial behaviors, such that those who are more likely to help are also more likely to share. However, young children's tendency to engage in prosocial behavior is not related to their fairness evaluations. Thus, this work indicates that children's socio-moral evaluations and prosocial behavior may be distinct capabilities.

1-H-110   The curse of knowledge in children's estimates of how widely known information is among their peers

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The ability to estimate what others know is crucial for communicating with others effectively. Yet, this ability is sometimes compromised by the Curse of Knowledge (CK): a tendency to be biased by one's knowledge when reasoning about a naïve perspective. The CK leads to overestimations about what others know and hinders the ability to reason about other perspectives. Research examining the implications of the CK on children's reasoning is limited. No research has examined whether the CK affects children's estimates about the commonality of knowledge. If children know certain information, are they more likely to overestimate how many peers also know this information? The goals of this research were to: 1. Create a task that examines the CK on children's estimates of the commonality of knowledge. 2. Examine whether performance on the task correlates with performance on a published CK measure (the Visual Hindsight Bias Measure; Bernstein et al. 2007). We presented children with 8 factual questions and taught them the answers to half. For each question, children estimated how many of their peers will know the answer. We predicted that if children were affected by the CK, they would overestimate how many peers know the answers to the questions that were known versus the questions that were unknown. Findings revealed a correlation in children's performance with the Visual Hindsight Bias Measure (even after controlling for age) and shed light on the mechanisms underlying the CK.

1-H-111   Establishing the external validity of self-other differences in children's understanding of mental states: Parent reports of knowledge understanding are related to self-other differences in knowledge access tasks

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Recent studies have found that children are better at reporting their own knowledge states than reporting others' knowledge states (Gonzales, Fabricius, & Kupfer, 2017). Typically children do not show self-other differences with false belief tasks (Wellman, Cross, & Watson, 2001) so it is important to establish that self-other difference in knowledge access tasks have some external validity. The current study (N = 285) examined the relation between 3- to 6-year-old's ability to report their own and other's knowledge states and parents' reports on the knowledge subscale of the Children's Social Understand Scale (Tahiroglu et al., 2014). Children were better at reporting their own states than others' states which replicates previous findings. For children who passed only the self-version of the task, parents reported that children had a better understanding of knowledge than children who failed both the self- and other-versions but a worse understanding than children who passed both versions. Together, these findings support the external validity of self-other differences in children's mental state understanding.

1-H-112   False belief understanding and complementation: a developmental EEG study

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False belief understanding (FBU) enables people to consider conflicting beliefs about the same situation. Complementation is an embedded syntactic structure in a sentence (She said that the cats were fighting), which is hypothesized to be required for FBU. The present study aimed to identify the electrophysiological correlates of FBU and complementation in both children and adults. Children (N = 36; M= 10.51 years; 16 girls) and adults (N = 44; M= 19.41 years; 27 female) watched 48 cartoon stories in animated vignettes of FBU and complementation scenarios. Wavelet analyses on single trials were conducted. Child data showed modulation of parietal alpha power (8-12 Hz) by the experimental manipulation: decreased sustained alpha power was observed in FBU compared to complementation conditions. Such results were consistent with adult data where beta power (13-20 Hz) differentially reflects FBU and complementation. Together, our results suggest neural population activity shows complementary sensitivity to FBU and complementation. Such results provide important foundations to further examine the development of these fundamental cognitive processes.

1-H-113   The development of gender stereotypes about spatial skills, reading, and general academic ability

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Spatial skills, such as mental rotation, are crucial for success in science, technology, engineering, and math. The male mental rotation advantage is small in childhood, but increases with age (Lauer & Lourenco, 2017). Spatial-gender stereotypes may fuel this increase, but evidence is sparse. We asked when children begin to hold gender stereotypes about spatial abilities versus other academic domains, and whether those beliefs predict skill. Children (K-4th-grades; N=365; 200 girls) completed newly-developed measures of gender stereotypes in spatial, reading, and general academic domains. Children chose which novel character (male or female) was best at tasks in each domain ("same" responses were <10% of trials). Across domains, girls' own-gender-bias decreased with grade whereas boys' did not (grade x gender: $F(1, 356)=7.05$, $p=.008$); this effect did not differ by domain (grade x domain x gender: $F(1, 356)=0.14$, $p=.866$). For all domains, K-1st-graders chose their own gender above chance (ps<.01). In 3rd-4th grades, girls did not differ in their choice of boys and girls (ps>0.35); boys chose their own gender above chance in spatial and reading (ps<.05) and marginally in general academics (p=.059). For boys only, higher spatial own-gender-bias related to lower spatial skill. There were no relations between reading own-gender-bias and reading achievement. In sum, across domains, girls endorsed gender equity at older ages, whereas boys remained own-gender-biased.

1-H-114   Children's Transmission of Directed vs. Observed Actions from Video

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Research has shown that young children preferentially transmit actions (teach them to another) after viewing them in a live directed versus observed context (Vredenburgh et al. 2015). However, it is unknown whether this effect is apparent across early development and across media context (video). In the current study, 3 to 6 year old children (current N=31) were shown videos of models acting on novel objects. Half of these models directly addressed the child before acting, and half spoke to themselves before acting. Each model demonstrated a different way to act on the same novel object. At test, an experimenter who had not seen the videos entered the testing room and asked the child to teach them how to use the toy. Preliminary results suggest that older (> 4 years) children transmitted marginally more of all modeled actions than the younger children (<4 years, p=.07). However, only younger children appear to preferentially transmit the directed (62%) versus observed (38%) tool actions. These results suggest that pedagogical cues may be more influential for action transmission early in childhood, with the effect fading as children get older. Data collection is ongoing.

1-H-115   Like me, or liked by mom: Parental influences on infants' similarity preferences

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Young infants prefer similar others, and this preference strengthens across infancy (Hamlin, Mahajan, Liberman, & Wynn, 2013). Infants also act based on emotional information from their caregivers, a process known as social referencing (Klinnert, 1984). The present study examines whether infants' preferences for similar others change across development in response to conflicting parental messages. We present 7-, 14- and 20-month-olds with a choice between two different-colored pairs of mittens. Afterward, infants view two presentations: i) a puppet-mitten-choice, in which one puppet chooses the same mittens the infant chose and the other chooses the opposite; ii) a parent-puppet-choice, in which

their parent expresses positive feelings toward the dissimilar puppet and negative feelings toward the similar one. Finally, babies are offered a choice between the dissimilar puppet that was favored by their parent, and the similar puppet that was disfavored. Puppet choice differed by age (p = .034, Goodman-Kruskal's gamma = 0.411). Planned comparisons revealed older infants performed differently from the younger two ages, who did not differ from each other [20- and 7-month-old infants, t(29.4) = 2.023, p = .026; 20- and 14-month-old infants, t(27.4) = 2.397, p = .012 (see Figure 1)]. While the younger ages chose similarity-to-self over liked-by-mom (N = 23 of 33, p = .035, binomial test), older infants did not, suggesting an increased reliance on parental messages as infants mature.

1-H-116   The development of prosocial behavior in Mayan children in a rural Mexican context

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This study analyses the role of social cognitive development (i.e. understanding goals, desires, and emotions) in the emergence of domain-specific prosocial behaviors such as helping, sharing, and comforting in a rural Mayan context. The results are part of a large cross-cultural mixed methods examination of the frequency and developmental trajectories of prosocial behaviours in 3-6 years old preschool children (n = 132; Mage = 4.87; SD = 0.89; 71 females). The present study used structured behavioral tasks modeled after Dunfield et al. (2011) to examine children's responses to instrumental need, material desire, and emotional distress. Consistent with previous research, children were more likely to respond prosocially when needs were apparent (experimental condition) than in similar situations where needs were absent (control condition). Participants regardless of age helped in response to instrumental needs. Helping occurred more frequently than comforting, which in turn occurred more frequently than sharing, only partly supporting previous literature. Importantly, these results indicate that more cognitively complex prosocial behaviors like responding to emotional distress emerge later in development (Dunfield & Kuhlmeier, 2013). Moreover, when compared to North American participants, the results suggest a potential effect of culture in instances where socialization may affect the understanding of the mental states of others and motivation/expectation to act prosocially.

1-H-117   Curiosity, Knowledge, and Acceptance: Early Evidence of a Developmental Shift in Motivated Reasoning about Science

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Increasing science literacy will not lead to appreciably greater support for science (NASEM, 2016). This consensus statement from the National Academies of Science is based on a comprehensive review of the literature, most of which shows that as science knowledge increases, people become even more polarized, using their knowledge not to converge with scientific consensus, but to more strongly motivate their ideologically-based positions. Increasing science curiosity, on the other hand, may be a more fruitful endeavor. Not only do we find no polarization along science curiosity, but recent work shows that people higher on science curiosity are less likely to engage in motivated reasoning (e.g., selective exposure; Kahan, Landrum, Carpenter, Helft, & Jamieson, 2017). Yet, before science curiosity is mobilized to combat motivated reasoning, we first need to understand how and when such attitudes

towards science develop and whether they change over time. The current study is the first step in doing so. After screening a science documentary, students enrolled in a Florida high school (N = 167, ages 12-18) completed our questionnaire, which captured science curiosity (modified from Kahan et al, 2017), science knowledge (Kahan 2014; 2016), film engagement, and beliefs about evolution and climate change. We found that, like for adults, science curiosity is a more robust predictor of engagement with science media than is science knowledge. Moreover, there were no significant changes in science curiosity (or science knowledge) across age. Students and adults do differ, however, in the relationships between knowledge, curiosity, and acceptance of scientific issues. We will discuss these results in more detail.

1-H-118   Preschoolers rationally deploy effort in social learning and collaborative contexts

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Across two experiments we explored how children learn to allocate effort efficiently on their own and in social contexts. In Experiment 1, we tested the qualitative predictions of a Bayesian model of how children might learn how hard to try from adult models. Children saw an adult exert either high or low effort and succeed or fail at a task and then were given a similar, but impossible task to try. Consistent with the predictions of the model, children persisted longer in the high than low effort success conditions, but adult effort had no effect on children's persistence in the failure conditions. In Experiment 2 (pre-registered) preschoolers were asked to allocate roles between themselves and a partner across two component tasks (one easy, one hard) to successfully achieve a goal. Participants used relative ability, as indexed by the age of their intended partner, to determine who should do the harder and easier of two tasks in a cooperative interaction. But in a competitive context, children always gave their partner the harder task. Collectively, these results suggest that children can integrate information about the probability of their own and other's ability to rationally allocate effort.

1-H-119   Children retrospectively reevaluate word meanings generated by unreliable speakers

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Preschoolers track informants' reliability, preferring to learn new information from previously reliable informants (Koenig & Harris, 2005). In the majority of studies on children's selective learning, reliability demonstrations precede the presentation of novel information. However, in many learning contexts children do not know informants' reliability status beforehand. Some research indicates that preschoolers are able to reevaluate beliefs about causal properties retrospectively (e.g., Sobel, Tenenbaum, & Gopnik, 2004). Can children retrospectively reevaluate verbal information after discovering that the informant was unreliable? Using a between-subject design, we tested 34 4-6-year-olds (Mage=5.03) who watched an experimenter label two novel objects. The experimenter subsequently revealed that she was either accurate or inaccurate in naming familiar objects. Children's knowledge of novel labels was tested in a forced-choice procedure. We anticipate testing 48 children altogether, and data collection is ongoing. Children chose correct objects corresponding to the tested labels significantly more often when the informant was revealed to be reliable (81%) than when she was unreliable (52%), Wald=11.37, p=.001. By preschool, children can retrospectively reevaluate verbal

information based on the new knowledge about the reliability of the information source. Such an ability has important implications for the correct transmission of information in social learning situations.

1-H-120 Developmental Changes in Categorizing Others into Multiple Social Roles

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Categories allow children to make inferences about novel situations (Rhodes, 2013), which can then guide their interactions with others (Nguyen & Chevalier, 2015). However, this process can be complicated because individuals often belong to many different, sometimes interrelated, categories. The current study examines whether children and adults differ in their willingness to simultaneously categorize a person into two roles (e.g., a mother and a daughter). Participants included 36 children (Mage = 5.17) and 21 adults. Participants were asked whether individuals could simultaneously belong to two social categories. We probed five types of social categories, including: occupational, behavioral, familial, social, and biological. Data analyses reveal that adults classified individuals as simultaneously belonging to two categories significantly more often than children did, p < .05, for all category types except biological, where there was no difference in responses. Our data suggest that children are still developing the ability to reason about the social categories to which a given individual may belong.

1-H-121 Inhibitory Control Moderating the Impact of Emotion Knowledge on Prosocial Behavior in Preschoolers

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This study investigated inhibitory control's moderation of children's emotion knowledge on their prosocial behavior to identify cognitive mechanisms of socialization. Head Start preschoolers (N = 214) completed emotion knowledge vignettes (Assessment of Children's Emotional Skills, ACES, Schultz, Izard, & Bear, 2005) and an inhibitory control task (Gift Task; Kochanska et al., 1996). Teachers completed the Preschool Peer Victimization Measure (PPVM; Crick, Casas, & Ku, 1999). As hypothesized, inhibitory control moderated the relation between emotion knowledge and prosocial behavior, such that children who had good emotion knowledge and the inhibitory control skills to apply this knowledge in social interactions were the recipients of more prosocial behavior from peers (see Figure 1). The moderation was significant, b = .008, SEb = .004, β = .936, p < .05, and accounted for 9.6% of the variance in PPVM prosocial subscale scores. These findings suggest that cognitive skills interact to facilitate prosocial behavior with peers. Additional findings will address how cognitive skills interact to facilitate children's prosocial behavior.

1-H-122 Does First-hand Experience Improve Children's Ability to Discern Between Helpful and Tricky Informants?

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Prior research on children's trust has typically offered children either first-hand information about an informant's intentions (e.g., they directly observe someone helping another person) or second-hand information (e.g., they are simply told someone is helpful). We tested whether receiving both kinds of information facilitates selective trust in a helpful vs. tricky informant. 3- and 4-year-olds searched for a sticker 6 times after hearing conflicting advice from two informants about the sticker's location. Children did not receive feedback during the sticker-finding task. In the second-hand condition, the researcher simply described one informant as "helpful", and the other as "tricky" before the trials began. In the combined condition, children were first asked to guess what animal was in a box after each informant offered advice: each informant gave consistently helpful or consistently deceptive advice. Children received feedback by peeking inside the box. The informant's intentions were then described as in the second-hand condition and the test trials followed. This project is pre-registered at the Open Science Framework with a designated sample of 100. The findings so far (N = 22) are that children in the combined condition trust the helpful informant 75% of the time whereas those in the second-hand condition do so 61% of the time. If this pattern remains with the full sample, it would suggest that children benefit from experiencing informants' intentions first-hand.

1-H-123   The Influence of Attractiveness and Race on Learning and Socialization Preferences of Young Children

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From an early age, children judge attractive individuals more positively than unattractive individuals (Dion, Berscheid, & Walster, 1972; Langlois et al., 1987; 1990; 1991; 2000). Recent research indicates that young children also use attractiveness when making inferences about from whom to learn--even when the attractive informant is inaccurate (Bascandziev & Harris, 2014; 2016). Here, we asked how children weight two visual cues to social group membership: attractiveness, and race. Across two studies, we presented 62 4-5-year-old children with pairs of racial ingroup and outgroup faces, who differed in attractiveness (Study 1: matched for race; Study 2: racial contrast), and a novel object. Children were asked whom they would like to ask about the name of the new object (ask question), what label they endorsed as the object name (endorse question), and which informant they preferred to socialize with (socialization question). In Study 1, children selectively preferred the attractive informant for all question types greater than would be expected by chance, (ts > 4.50, ps < .000) and the race of the face pairs did not have any effect on this preference. In Study 2, children selectively preferred the attractive outgroup member over the unattractive ingroup member for the ask and socialization questions (ts > 3.67, ps <.01). We discuss the relative weighting of attractiveness and race on children's selective learning from others.

1-H-124   Does social context change performance of capuchin monkeys (Cebus [Sapajus] apella) and children (Homo sapiens) in a dichotomous choice task?

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Species' abilities to solve apparently similar problems are influenced by a variety of factors, including cues derived from their ecology and differences in their cognition. For example, previous studies show that cleaner fish outperform capuchin monkeys and two ape species in a choice task derived from fish ecology, presumably because they were better at recognizing the relevant cues to solve it. However, humans are rarely studied using this comparative lens. Therefore, we tested children (Homo sapiens) on a version of the task originally designed for fish. Here, choosing plate A gave participants access to a sticker on plate A as well as plate B, whereas choosing plate B gave them access only to the sticker on plate B. Although the children performed equally well as one population of cleaner fish, they performed worse than another fish population (Fisher's exact test, two-tailed, $N_{children}=14$, $N_{fish}=6$, P=0.01). In a second study, we tested whether adding a social component would make the task more salient for the primates. Monkeys did not improve their performance in the more social task (exact Wilcoxon signed-rank test, two-tailed, N=8, P=0.25), whereas preliminary data indicate that children did (Wilcoxon, two-tailed, N=6, P=0.06). These results emphasize the importance of considering how species' propensities influence experimental performance and, critically, highlight the importance of focusing the comparative lens on children in addition to nonhuman animals.

1-H-125   Do children selectively trust an informant on the basis of the quality of the causal information they provide?

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Much of what children learn comes from the explanations others provide them with, what they are told rather than what they have discovered for themselves. Researchers have suggested that children come to pedagogical situations with previous ideas about a) the state of the world and b) the knowledgeability and helpfulness of informants and rationally update these inferences in light of new evidence (Landrum, Eaves, & Shafto, 2015). The selective trust paradigm, where two informants provide a child with conflicting information about familiar objects, was developed to examine this process of children deciding who to trust. Using this paradigm, it has been repeatedly demonstrated that three-year-olds and older will selectively trust previously accurate object-labellers to provide them with new object labels over previously inaccurate object-labellers (Mills, 2013). Whilst interesting, these findings fail to examine whether and how preschoolers can simultaneously learn new information from others and assess these individuals' epistemic value. Moreover, most selective trust studies are word-learning tasks, much less attention has been paid to whether preschoolers are similarly selective when learning causal relationships. The present research sought to address these gaps in the literature by investigating whether pre-schoolers would selectively trust an informant on the basis of the quality of the causal information they provided. The research aimed to a) replicate Gillis & Nilsen's (2013) finding that from four-years-old children seem to selectively trust inductively-sufficient informants over ambiguous ones and investigate whether this consideration holds in the domain of causal relationships and b) to see if even younger children, three-year-olds, would be similarly discerning. The present study involved three-, four- and five-year-olds (N=66) learning about a novel toy, "the Elsa-Finder"; similar to a jack-in-the-box where one of two levers caused a picture of Elsa from "Frozen" to appear (Figure 1). The children learned about the causal function of the levers by witnessing two adults use the toy, one clearly demonstrating which lever played the critical causal role, and the other ambiguously (see Schultz and Bonawitz, 2007). After witnessing both demonstrations, children then had a chance to show they knew how to use the toy and indicate which demonstrator they trusted more as a teacher. It was found that the preschoolers readily learned how to use the novel toy, but, counter to predictions, did not

selectively trust the clear demonstrator who allowed them to make this correct causal inference (Figure 2 and 3). This suggests that even when preschool children are learning about a motivating causal relationship, they still cannot simultaneously learn the novel information and evaluate sources of information that vary in inductive-sufficiency. We are currently investigating whether school-aged children, six- to eight-year-olds, will show such a consideration for information sufficiency given a wealth of research that demonstrates that from seven-years-old children appear to appreciate the inherent shortcomings of ambiguous information (Beck & Robinson, 2001). Additionally, we are investigating whether children's Interpretative Theory of Mind (IToM); their appreciation that people construct an interpretation of reality that may differ from others (Myers & Liben, 2012), predicts their selective trust behaviour over and above their age.

1-H-126　　　　　"Is it worth it?": How costs affect how children seek information from others

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When gathering information, one must commit to expending time or energy to gauge its accuracy. This time and energy may be seen as a "cost" - or a situational or environmental factor that needs to be overcome in order to reach a goal. To look at how children seek information when faced with costs, four- and 5-year-old children (N = 51) were given questions that were doctor-related, mechanic-related, or neutral (i.e., unrelated to either domain) and were asked to assign each question to either a doctor puppet or a car mechanic puppet. Importantly, children were not able to access both puppets equally when assigning the question cards: children could assign cards to one puppet immediately but had to expend a cost (e.g., 30 second delay; complete another task) before assigning cards to the other puppet. Overall, regardless of costliness, children selected the appropriate expert for the domain-relevant items (M = 5.37 of 8, SD = 1.89), t(50) = 5.20, p < .01, and preferred the non-costly expert for neutral items (see Figure 1; M = 3.00 of 4, SD = 1.30), t(50) = 5.51, p < .01. Importantly, though, when access to the domain-relevant expert was costly, children's selections of him were only at chance levels (M = 1.96 of 4, SD = 1.59), t(50) = -.176, p = .86. Thus, evidence supports that children generally recognize which expert they should go to for certain questions, but they are more hesitant to do so when access to an expert is costly.

1-H-127　　　　　The Development of Emotion Perception Strategies

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The perception of emotional expressions is believed to involve template-matching. However, template matching is not universal: Adults with autism spectrum disorder may use a rule-based strategy. This study examined emotion perception strategies in children aged 6 to 15 years old. Participants chose the better representation of expressions from images that varied in terms of exaggeration. In a control task, participants chose the more realistic image from the same stimulus set. With age, children were less tolerant of exaggeration in the emotion perception task, suggesting an early reliance on a rule-based strategy and the later development of a template-matching strategy. There were no significant differences between the age groups for the control tasks. A template-matching strategy may develop during late childhood.

1-H-128 **Cognitive disfluency reduces biased mindreading on young children**

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The purpose of the present study is to examine the hypothesis that young children's egocentric errors in mindreading are caused by the intuitive use of heuristic with insufficient analytic thinking, which is the mechanism that explains adults' cognitive biases observed in many kinds of reasoning tasks. Two experiments are planned to investigate the effect of cognitive disfluency, which is known to promote more analytic thinking for adults on the young children's false belief reasoning. In Experiment 1, fifty six children (ranged 3;6-4;6) answered two false belief tasks, a Sally-Ann task and a Smarties task. In the disfluent condition, animated stimulus presented in computer display was blurred just before the critical questions were made (a Sally-Ann task) or children were asked to wear glasses that partly blocked the field of view (a Smarties task). In the fluent condition, the intact images were presented. In a Sally-Ann task, participants in the disfluent condition made significantly less error (48%) than participants in the fluent condition (70%). Experiment 2 replicated the facilitative effect of blurred display on mindreading both in a Sally-Ann task and a Smarties task. These results showed that cognitive disfluency reduced egocentric biases of mindreading in young children. This suggests that biased mindreading in children and cognitive biases in adults partly stem from same cognitive mechanisms.

1-H-129 **Do children use demand principles to choose resources for themselves?**

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We investigated 4-10-year-old children's ability to understand and use demand principles when making decisions about which of two resources to choose for themselves. We showed children (n=62) two boxes containing different numbers of face-down stickers (8 and 2) and told them that other children had already taken stickers. Children were asked to choose which box they wanted to take a sticker from by "buying" one with a token (low-stakes condition) or trading a sticker they just received (high-stakes condition). Children were then asked which stickers the other children liked better. When asked about other children's preferences, 83% chose the box containing fewer stickers, suggesting that they understood that those stickers were in higher demand. However, the ability to use demand information increased with development: overall, when selecting a sticker for themselves, older children (7-10 years) were significantly more likely than younger children (4-6 years) to choose the higher demand box (low-stakes: p=0.04; high-stakes: p<0.01). Furthermore, only older children's decisions were influenced by the stakes: older children were significantly more likely to choose the higher demand box in the high-stakes versus the low-stakes condition (p=0.03), with no difference in younger children's performance (p=0.38). These results suggest that children understand demand principles, but their ability to use these principles varies as a function of both development and decision cost.

1-H-130 **"Who has the best way of thinking?: Children's Judgments of Speaker Calibration are Related to Parents' Authoritarian and Epistemological Values**

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Preschoolers prefer learning from competent agents (K&H, 2005). Do they recognize that speakers who are poorly calibrated--i.e. whose certainty is not justified by evidence--are not the best informants? Further, how might individual differences in these skills relate to parent epistemological beliefs? Four- to 8-year-olds observed a Calibrator adjust the certainty of her predictions in accordance with statistical evidence; contrasted with an Overconfident speaker who was always "very sure" (Exp. 1). In Exp. 2, speakers additionally justified their certainty (or lack thereof) in either objective terms (Calibrator: "because of the blocks I saw") or subjective feelings (Overconfident: "because I have a good feeling about it"). We found that children whose parents have authoritarian/objectivist epistemological views privilege certainty as a cue for competence (Exp. 1), but this doesn't extend to situations in which certainty is justified by subjective feelings (Exp. 2). Further, children with evaluativist parents--integrating objective and subjective dimensions of knowledge--are more likely to indicate that the Calibrator had the "best way of thinking" (Exp. 1) when speakers offer no explicit insight into their reasoning, but accept confident conclusions about ambiguous data if they are justified by subjective feelings (Exp. 2). Results suggest that parents' understanding of the nature of knowledge is related to children's evaluations of speakers on the basis of calibration.

1-H-131 Egalitarian beliefs affect the expression of stereotypes about social status in older (but not younger) children

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Adults often express and endorse stereotypes linking race to social status, but the developmental trajectory of these stereotypes has been unclear. Although some studies show that children expect White people to be higher status by age four (Olson et al., 2012), others reveal that 6-year-olds do not show this behavior (Mandalaywala, Tai, & Rhodes, in prep). One possibility is that older children view race as linked to social status, but do not explicitly express these stereotypes because they also consider other concerns in their responses (e.g., fairness, social desirability). If so, older children who do not express race-status stereotypes should take longer to respond, indicating the increased deliberation involved in expressing egalitarian attitudes. To test this possibility, children's (N = 52) reaction times while making either stereotype-consistent or inconsistent judgments were coded using Datavyu. 3.5- and 4-year-olds did not differ in how long they took to assign social status to White or Black targets regardless of whether they made stereotype-consistent or inconsistent responses, ps > .10. Among 5- and 6-year-old children, giving a stereotype-consistent or inconsistent response did not predict how long they took to assign social status to White targets, p = .829, but did predict time to assign status to Black targets, p = .008, with those responding in stereotype inconsistent ways taking longer than those who responded in a stereotype consistent manner.

1-H-132 Preschoolers' evaluations of people who do not help

Brandon Terrizzi[1], Amanda Woodward[1], Jonas Ventimiglia[1], Jonathan Beier[1]

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Children's moral theories are closely linked to their social evaluations. Even infants view helping as good and hindering as bad (Hamlin et al., 2007). Yet morality also prescribes what one ought to do; in some contexts, inaction itself is impermissible. Because older children recognize an obligation to help (Miller et al., 1990), we investigated how preschoolers evaluate a person who refrains from helping. Three- to six-year-olds (N = 133) viewed two videos each. Children in the Helpful condition 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. Children 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 matched baseline actor; 2 (Condition) x 2 (Video) x 4 (Age) interaction, F(3, 125) = 5.44, p = .002. By 5, their play preferences between actors followed the direction of these ratings (p = .035 and .013, respectively). Young children thus negatively evaluate those who fail to help through inaction, and these judgments guide their social preferences. At this poster, we will discuss additional data on children's projections from unhelpfulness to other personal traits (e.g., "breaks promises") and an ongoing study of their consideration of external factors that limit a person's ability to help.

1-H-133   Moral and Epistemic Agents: Infant Evaluations of Ignorant and Withholding Agents

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Do children evaluate communication in moral terms (for signs of cooperation), epistemic terms (for signs of knowledge), or both? We presented 30 toddlers (17.5-32.4 months, m = 22.6 mo.) with communicative exchanges in which a confederate experimenter asked two agents for novel object names. In response, agent A was always informative ("That's a toma!"), and either agent B admitted ignorance, ("I don't know!"), or agent C withheld the label ("I'm not telling!"). Children's agent preferences were measured for label learning, imitation, object preference, and selective helping. Condition differences were found for label learning tests; X^2 (2) = 7.23; p = .027. When agent B was previously ignorant, children accepted more novel labels from the neutral agent, A. In contrast, when agent C was uncooperative, they did not accept either agent's label. No effects were found for imitation, preference, or helping tests. Forthcoming comparisons between tests will determine whether agent cooperation and competence differentially informs social preferences and learning decisions.

1-H-134   Children's Accent-Based Social Preferences are Indeed Social

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From a very early age, infants demonstrate social preferences for speakers of their native language (Kinzler et al., 2007). These preferences continue and strengthen throughout childhood (Kinzler et al., 2009; Okumura et al., 2014). Despite repeated demonstration of these types of preferences, what drives them is unknown. One hypothesis is that children use language and accent as ways to identify whether an individual is a part of their social group or not (e.g., Kinzler et al., 2007). However, there are alternative hypotheses that are consistent with previous findings. For example, a recent study suggests that infants' preference for native speakers is driven by a desire for information (Begus et al., 2016). In two experiments we explore the former hypothesis, and, in particular, the possibility that children's

accent-based preferences are driven by inferences about social group membership based on geographic background. In Experiment 1 (N=90 4-6-year-olds) we first investigate the influence of accent and geographic background on children's inferences about shared group-level preferences. In each condition, children were taught about a cultural custom of one speaker, and then asked which of two other speakers shares the same custom. Critically, one of the two speakers had the same accent and the other had a different accent. Across conditions, information about geographic background was manipulated. When no information about background was provided, children inferred that speakers with the same accent were more likely to have the same cultural customs (p<.001). However, when they were told that all three speakers were from the same place, or that all three speakers were from different places, children no longer made accent-based inferences (ps>.629). These findings suggest that children use accent as a cue for whether speakers are likely to come from similar or different geographic backgrounds, and it is this knowledge that drives their inferences. When this geographic information is provided to children, they stop using accent as a basis for these inferences. In Experiment 2 (N=90 4-6-year-olds) we ask whether information about geographic background has similar effects on children's inferences about social preference. In this experiment, we asked which of the two speakers (the one with the same accent or the one with a different accent) the first speaker would prefer to befriend. Again, when no information about background was provided, children inferred that speakers with the same accent were more likely to be friends than speakers with different accents (p<.001). When they were told that all the speakers live in the same place, children were still more likely to choose the speaker with the same accent (p=.002), though at significantly lower rates than if no geographic information was provided (p=.033). When all speakers were from different places, children were equally likely to select a speaker with the same accent or a speaker with a different accent (p=1.00). We demonstrate that pre-school aged children's accent-based social preferences are driven by social inference, and that geographic background in particular mediates these preferences. These findings reinforce that children's accent-based social preferences are socially driven.

1-H-135   Preschoolers' evaluations of social includers and excluders

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Social exclusion is harmful. To alleviate it, excluded children pay greater attention to group norms (Watson-Jones et al., 2016) and others' mental states (White et al., 2016). An even more direct strategy, however, would be to select future social partners according to whether they have previously acted inclusively or exclusively. We thus investigated preschoolers' abilities to track and socially evaluate those who have excluded them. Children played catch twice; one pair of puppets included them, and the other excluded them. A preliminary study with 4-year-olds found mixed results; however, among only children who accurately reported which puppet had shared best (n = 20 of 32), evaluations strongly favored includers. Here we replicate and extend this result, via planned analyses conditioned on an explicit memory check and expansion to older children. Both 4- and 5-year-olds who passed the memory check (4 years: n = 16 of 28; 5 years: 11 of 16) evaluated includers more positively (t(15) = 6.96, p < 0.01, t(10) = 3.14, p = .01) and recommended that a new puppet play with a prior includer (p's = .04 and .03). This supports two broad conclusions. First, young children are surprisingly poor at knowing who has excluded them. We are now coding additional game behaviors, to determine whether children experienced exclusion as negative. Second, those who do recall their treatment form coherent representations of prior partners, capable of supporting plans for future partner choice.

1-H-136   Questioning supports effective transmission of knowledge and increased exploratory learning in pre-kindergarten children

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Ideally, educational contexts optimize transmission of knowledge but also foster further learning. Past work suggests that direct instruction from knowledgeable teachers is effective in transmitting knowledge, but can limit children's further exploration. Here we ask how questions from knowledgeable teachers ("pedagogical questions") affect learning and exploration as compared to direct instructions. We tested preschoolers' (N = 120, age = 4.0 - 6.0 y) exploration of a novel toy with multiple hidden functions after they watched one target function being introduced in one of four ways: children were either directly instructed by a knowledgeable teacher, asked a pedagogical question by a knowledgeable teacher, overheard a pedagogical question from a knowledgeable teacher to a naïve informant, or overheard a naïve question from a naïve informant to a knowledgeable teacher. We found that children who received or overheard pedagogical questions explored the target function as much as those who received direct instructions (p = .86), and more than those who overheard naïve questions (p = .03). Moreover, compared to direct instruction, pedagogical questions also lead to longer exploration, more variations in actions tried on the toy, and discovery of more non-target functions, ts > 2.4, ps < .02. We conclude that a teacher's choice of pedagogical method may differentially influence children's learning and exploration.

1-H-137   Children's Perception of Interactive Biological Motion Predicts Their Social Competence

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Social perception is important in children's daily interaction. They need to recognize others' actions and reason the underlying communicative intentions, so that they can give an appropriate response. Previous studies have mainly explored children's intention understanding by setting an ostensive or implicit communicative cue (e.g., a point or a marker). Little is known about children's understanding of communicative intention in dyadic interactive behaviors and its potential contribution to social competence. Containing rich social information, biological motion (BM) is a concise way to present the social interaction. This study explored the development of children's ability to extract the communicative intention from social interaction in dyadic BM and its relation to social competence in 4- to 6-years-olds (current N = 81). Children's perception of social interaction was measured by discriminability (d') of perceiving interaction in dyadic BM. The task consisted of 9 interactive BM trials and 5 non-interactive BM trials. For each trial, children were shown a video of a dyadic BM and told an interactive description and an individual description, and then they were asked to choose the corresponding description for the video of a dyadic BM stimulus they watched. Children's social competence was assessed by a teachers' report of Children's Social Competence Scale (CSCS). Considering the influence on both perception of social interaction and social competence, children's language ability was also measured by Chinese version of Peabody Picture Vocabulary Test, revised edition (PPVT-R). Results suggested that perception of social interaction continues to develop in early childhood, and positively predicted social competence among children with higher discriminability of

interactive BM, regardless age or language ability. However, for children with lower discriminability of interactive BM, only the age and language ability correlated with children' social competence positively. These results revealed different contributions of age, language ability and social cognition in children' social development.

Symposium 1 – Social-Causal Reasoning: Insights from Comparative, Developmental, and Computational Perspectives

How can I help? 24- to 48-month-olds provide help specific to the cause of others' failed actions

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Humans are remarkably helpful creatures compared to other animals (Tomasello, 2009). Even toddlers spontaneously help when they see someone fail to achieve a goal (e.g., Warneken & Tomasello, 2006). But there are many reasons why someone might fail, and consequently, many ways to help. In order to help effectively, we need to understand why someone is struggling so that we can tailor our assistance to their needs. One fundamental distinction is whether the cause of failure is the agent's own actions or something external to her in the world. We routinely make these judgments about our own failed actions. For example, if you are struggling to buy a ticket from a machine but the person before you succeeded, you are likely using the machine incorrectly. However, if the person before you also failed, perhaps the machine is not reliable. Furthermore, these inferred reasons inform our decisions about what to do next: if you are the source of your failure, you might seek help; if the machine is broken, you might try a different one. Pre-verbal infants can make such inferences about their own failed actions (e.g., on a toy), and respond appropriately: asking for help if the cause is likely internal and reaching for a new toy if it is external (Gweon & Schulz, 2011). If we are able to make these inferences about our own failures as infants, at what point are we able to direct this reasoning toward others and use it to inform our decisions of how to help? Across two studies, we investigate 24- to 48-month-olds' abilities to reason about the causes of others' failed actions and offer help accordingly. In both experiments, children observed an adult fail to activate a toy because she either (a) used the toy incorrectly, or (b) chose a faulty toy. Children could help by handing the adult a new (working) toy or by demonstrating the correct way to use the toy on which the adult had acted. The critical question was whether children would provide help that best addressed the likely cause of this person's failure (i.e., the toy or her own actions). In Experiment 1 (N=52), when children were given evidence that someone was likely failing due to something about the world (e.g., a faulty object), they were more likely to provide help that changed this external variable (i.e., handing her a new toy). But when the evidence suggested that her own actions were at fault, children were more likely to help by keeping the world constant and showing her the correct action to take (i.e., acting on the original toy in a new way). Experiment 2 (N=64) confirmed these findings in a simpler paradigm where only one cause was possible at a time. Together these studies suggest toddlers are not only helpful but are selective and flexible in the help they provide. They are able to reason about the causes behind their own and others' failures and appropriately respond to support successful action. While young children are constantly helped and taught by others, the ability to harness this knowledge to figure out how to effectively help others themselves is present early in life.

I can do it myself: Domesticated dogs prioritize independent problem-solving over looking back

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Humans are highly flexible problem-solvers. From 16 months of age, human infants dynamically deploy social and independent problem-solving strategies based on the likelihood that they can solve a problem independently. When infants face manageable challenges (e.g., locating a toy they saw hidden 3 seconds earlier), they often rely on independent problem-solving strategies (e.g., seeking the hidden toy on their own; Goupil et al., 2016; Gweon & Schulz, 2011). However, when infants are given information that they are incapable of solving a problem, either due to lack of ability (Gweon & Schulz, 2011) or lack of knowledge (Goupil et al., 2016), they shift away from independent problem-solving strategies and recruit help from others. Thus, human infants flexibly deploy social and independent problem-solving strategies based on the likelihood they can solve a problem independently. Recent work suggests that our close primate relatives do not share our human-like degree of flexibility in their own problem-solving strategies. Overall, non-human primates tend to generally place more emphasis on independent problem-solving strategies than social problem-solving strategies (e.g., Herrmann et al., 2007; Horner & Whiten, 2005; Tomasello et al., 2005). However, it may be more fruitful to compare humans to a different non-human species, one that shares many human-like aspects of social problem-solving - domesticated dogs (Canis familiaris; e.g., Hare & Tomasello, 2005; Topál, Kis, & Oláh, 2014). In the current studies, we investigate whether domesticated dogs share the same degree of flexibility in their problem-solving as human infants. In two experiments (modeled after Gweon & Schulz, 2011), we presented dogs with an unsolvable task and examined the strategies they used in response to failure on this task. In each experiment, dogs could employ either of two alternative strategies after giving up on the unsolvable task - looking back to a human for help or attempting to solve an alternative independent problem-solving task. In Experiment 1 (N=40), we found that dogs prioritized independent problem-solving strategies (i.e., attempting an alternative task) over social problem-solving strategies (i.e., looking back for help) when both strategies were available. In fact, in Experiment 2 (N=40), dogs continued to prioritize independent problem-solving strategies in situations where human infants would look back and seek help (Gweon & Schulz, 2011). Specifically, dogs continued to prioritize independent problem-solving strategies, even when they received evidence that they might be incapable of solving the independent problem-solving task without some help from a human. These findings not only demonstrate that dogs place more weight on independent problem-solving than previously thought, but they also provide new evidence that humans may be unique in the degree to which they flexibly integrate social and independent problem-solving strategies. Ongoing work probes these questions further by investigating whether dogs will begin to place more weight on social problem-solving strategies when the cost of independent problem-solving strategies is increased.

How do causal knowledge and sensitivity to intentions influence copying behavior in children, capuchin monkeys and dogs?

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Observing the effects of other individuals' actions is a valuable way to learn how complex objects and artefacts work. But how does a learner infer which out of potentially many actions they see a social partner perform are causally necessary? Answering this question has implications for understanding the mechanisms underpinning uniquely-human cumulative culture. Across two experiments we used a comparative, developmental and computational approach to explore how sensitivity to social cues and causal knowledge influence which actions a learner copies. In Experiment 1, 3-to 5-year-old children (N=38) and capuchin monkeys (Sapajus sp.; N=21) saw a demonstrator perform a 2-action sequence on a puzzle-box, which then dispensed a reward. We manipulated (1) the causal plausibility of the first action in the sequence; and (2) the intentionality of the demonstrator. We found that children faithfully copied the 2-action sequence following a pedagogical demonstration (i.e. when the demonstrator used ostensive cues), even when the first action was causally implausible. With decreasing cues to the demonstrator's intent, children were increasingly likely to omit the causally implausible action. This performance was best captured by a computational model of a learner who was sensitive to both causal plausibility and pedagogy; i.e. a learner who inferred that a pedagogical demonstrator was a helpful teacher. In contrast to children, capuchins were not sensitive to the demonstrator's intentionality (though they were sensitive to causal plausibility), and their behavior was best predicted by a model of a learner with no conception of intentional action. This suggests that children, but not capuchins, are sensitive to a demonstrator's intentions--particularly the intent to teach--and they rationally integrate this information with evidence about causal plausibility when choosing which actions to copy. In Experiment 2 we presented the same observational causal learning task to 18-to 30-month-old toddlers (N=42) and domesticated dogs (Canis familiaris; N=36) to further explore the mechanisms underpinning children's performance in study 1. Given that both toddlers and dogs are sensitive to ostensive cues, we predicted that if receptivity to ostension is sufficient for pedagogical reasoning (as per the 'natural pedagogy' account, Csibra & Gergely, 2009), then both groups might perform similarly to 3-to 5-year-old childrens. If, on the other hand, true pedagogical reasoning requires the learner to represent the demonstrator's intent to teach (i.e. mental state representation), then toddlers' and dogs' performance might be more similar to capuchins'. Neither toddlers nor dogs were more likely to copy the 2-action sequence following a pedagogical demonstration, compared with when they saw an intentional but non-ostensive demonstration. This suggests that receptivity to ostensive cues is not sufficient to trigger a pedagogical interpretation of causal action. These findings suggest that differences in copying behavior between species can at least in part be explained by broad differences in understanding of intentions--especially the intention to teach (Experiment 1). Furthermore, sensitivity to ostension does not automatically lead to pedagogical inference (Experiment 2), and therefore while receptivity to ostensive cues may be a necessary prerequisite, it is not sufficient for the transmission and maintenance of cumulative culture.

Integrating Perspectives on Social-Causal Reasoning

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Children actively seek to understand the causal structure of the world around them. Causal learning involves children's observation of and interaction with the environment. As the talk by Bridgers et al. demonstrates, children's learning is not exclusively the product of children processing information individually, but instead is inextricably embedded in social activities and practices. Understanding how

children learn causal knowledge requires not only an understanding of how children update beliefs about the world given novel information, but also an understanding of the processes by which children learn in collaboration with caregivers, educators, and peers. Crucially, children's ability to learn in collaboration with others far surpasses that of any other species. However, relatively little is known about which aspects of cognition uniquely support children's learning in social contexts. Pinpointing these unique aspects of human cognition requires research that goes beyond traditional developmental approaches and integrates comparative perspectives as well. As the talks by Johnston et al. and Tecwyn et al. demonstrate, by comparing human learning to that of other species, we can begin to understand which aspects of learning in childhood are shared across other species and which have the potential to support children's uniquely complex system of social learning. Even more depth is added to the picture when we integrate computational approaches alongside developmental and comparative perspectives. By comparing models of different types of learners, we can begin to pinpoint the particular assumptions and sensitivities children have when learning from others that are not shared with other species. The talk by Tecwyn et al. provides a particularly nice example of this by using comparative computational modeling to reveal the importance of children's sensitivity to intentionality when learning from others. As discussant in this symposium, I will underscore the importance of studying basic cognition (e.g., causality, problem-solving) in social contexts for better understanding learning beyond the laboratory in real-world settings. I will also emphasize what we gain by taking a 'triadic' (comparative, developmental, computational) approach to understanding causality within social contexts, drawing parallels to my own research studying human cognition and behavior across cultures.

Symposium 2 – Variation in parent-child conversation and the development of core cognitive competencies

Talking about the mind across three different language contexts and two cultures

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The aim of this study was to broaden our knowledge of how parents talk about the mind by examining language socialisation practices from two quite different cultures: Iran and New Zealand. We analysed references to the mind across a range of language socialisation contexts, including picture description, 'Describe your child' and past-event reminiscing. Our goals were to (1) examine the relation between maternal use of mental state terms, mindmindedness, and elaborative reminiscing, (2) compare language styles between the two groups of mothers, and (3) identify which aspects of parental references to the mind were most consistently related to ToM ability. The sample comprised 120 children and their mothers, 60 Iranian (IR) and 60 New Zealand (NZ) children with a mean ageIR of 56.3 months (range: 39 -77 months) and mean ageNZ of 52.95 months (range: 36 -72 months). Both samples were given the Wellman theory-of-mind battery plus a second-order theory-of-mind task (Hughes, 2000), two executive function tasks and the PPVT task. Mothers' and children's mental state language use was coded from a wordless picture description task (Ruffman et al. 2002), mothers' mindmindedness was coded from the 'Describe your child task' (Meins et al. 2003),and mothers' level of elaboration on past-events was coded from a reminiscing task (Reese & Cleveland, 2006). In preliminary

analysis of the 'Describe your child' data, NZ mothers made more frequent mindminded comments about their child (although as a proportion of overall comments there was no difference to Iranian mothers). Interestingly, the percentage of mind-minded descriptions predicted ToM performance only in the NZ group. Further analysis will examine the extent to which mothers from these two cultural groups elaborate about past events, including the type of memory cues that mothers offer, the level of perspective-sharing discussion, as well as correlations between maternal talk in these three socialisation contexts. Discussion will focus on how knowledge about what cultures privilege with respect to what they choose to talk about with their children, and how they talk about their children, has the potential to broaden our insights into how children's socialisation influences their socio-cognitive development.

Telling Stories At Home: How Pretend and Narrative Support Children's Early Cognitive Development

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Much research has examined how language use in the home relates to differential outcomes for children (Hart & Risley, 1995), and increasing attention is being paid to differences between contextualized ("here-and-now") and decontextualized ("then-and-there") speech. While most parent-child talk is situated in the here-and-now (Cummins, 1984), previous research has particularly implicated parental use of decontextualized language in children's later academic outcomes (Beals, 2001; Demir et al, 2010). Families often use decontextualized speech while telling personal narratives (stories of personal experience about the past or future) and playing pretend (including making an object represent another, attributing actions or thoughts to inanimate objects, and assuming another role). This paper examines early use of narrative and pretend during spontaneous parent-child interactions, and links these language socialization practices to children's later cognitive outcomes. Our participants are 64 parent-child dyads drawn from a larger study on language development; we examined frequency of narrative and pretend speech during 90-minute spontaneous interactions when the child was 14-, 30-, and 58-months. These time points were selected to represent differences in dyadic interactions over time. Our outcomes are children's theory of mind (ToM) and spontaneous use of higher-order thinking (HOT) at 58 months. While the development of ToM has been linked to pretend and narrative because they encourage children to simulate or describe others' mental states (Lillard et al, 2013), these relationships have not been investigated using multiple observations of parents and children in naturalistic settings. Higher-order thinking (HOT) is broadly defined as talk that links two or more representations together, through the use of inferences, comparisons, abstractions, and hierarchies. Children's spontaneous use of HOT at 58 months has been linked to children's inferencing and analogical reasoning ability at ages 9 and 11 (Freeman, 2015), which highlights the importance of early HOT for children's later school success. HOT may be supported by narrative and pretend because the decontextualized nature of these speech types might encourage speakers to make the links between representations more explicit. For example, a parent might provide an inference for a character's actions during a pretend interaction ("He went to the cave in order to save the princess") or when telling a personal narrative ("I was late for work today because I almost hit a deer!"). We find that parents and children tend to use decontextualized speech rarely at 14 months, pretend more frequently at 30 months, and narrative more frequently at 58 months. Across development, parents and children incorporate HOT into their decontextualized speech at higher rates than with contextualized speech, suggesting that narrative and pretend may serve as "breeding grounds" for HOT. Results for our second

outcome (ToM) are forthcoming, but we expect narrative and pretend to have different impacts on ToM skills at 58 months, which may reflect differences in how tied to the present context these different types of decontextualized speech must be. Understanding differences in cognitive skill developed by early interaction types will strengthen our understanding of how parental language use in the home environment may contribute to differences in children's school-entry skills and later educational outcomes.

Pedagogical questions during parent-child interactions correlate with children's causal learning and exploration

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The ability to learn and discover causal relations is a core cognitive achievement that develops early in life (Gopnik & Schulz, 2007). Recent lab experiments have shown that questions from knowledgeable others who intend to teach ("pedagogical questions") prompt children to learn and explore causal properties of a novel toy (Yu, Landrum, Bonawitz, & Shafto, under review). Furthermore, parents' tendencies to ask children pedagogical questions has been shown to vary both between and within social groups (Yu, Bonawitz, & Shafto, in press). Here we ask whether individual variations in children's causal learning and exploration are associated with variations in parent-child interactions in general, and in parents' pedagogical questioning in particular. In this study we live-coded brief episodes of parent-child interactions in public spaces, before inviting children to participate in an experiment in which they were shown a novel toy with multiple hidden causal properties. Results showed that aspects of parent-child interactions, including frequencies of parents' pedagogical questions, correlated with children's causal learning and exploration during the experiment. Furthermore, frequencies of pedagogical questions also predicted parents' likelihood to consent their children to participate in the experiment. A total of 109 parent-child dyads (children aged between 3.0 and 6.3y) were observed from two sites: an indoor exhibit in a zoo and an indoor playground. Two coders live-coded 5-minute episodes of parent-child interactions with regard to the time lengths of different patterns of interactions (parents actively engaging with children, passively watching or following children, and separated from children), and the frequencies of parents' questions, statements, and commands towards children. For questions we differentiated between those used to teach (pedagogical questions) and those used to seek information or to make a point. After the observation, children were invited to participate in a test, during which they were introduced to a novel toy with 5 hidden causal functions. An experimenter asked children about one target function ("What does this button do?") before leaving them alone to play with the toy. Children's responses were coded for causal learning (activating the target function) and exploration (total time playing, number of unique actions performed, number of non-target functions activated), measured both for the first minute of play and for the total time. Results revealed that after controlling for testing site and age, children whose parents spent more time watching and following them were less likely to discover the target function during the first minute of play, $r(42) = .33$, $p = .02$. On the other hand, children whose parents asked more pedagogical questions discovered more non-target functions of the toy, $r(42) = .32$, $p = .03$, and also performed more unique actions during the first minute of play, $r(42) = .29$, $p = .05$. These results suggest that parent-child interactions, especially parents' use of questions to teach, is associated with children's causal learning and exploration. Moreover, a logistic regression model showed that parents who asked more pedagogical questions were also more likely to

have their children participate in the experiment, B = 1.49, p = .05, which indicated that causal learning and exploration in children who participated in the experiment could be different from those who did not participate.

Improving Young Children's Spontaneous Focus on Number Through Guided Parent-Child Interactions in a Children's Museum

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Early differences in children's foundational number skills are shaped by interactions with parents in the home (Levine et al., 2010; Susperreguy & Davis-Kean, 2016). However, it is largely unknown whether and how parents can foster preschoolers' spontaneous focus on number (SFON), a measure of attention to small numbers of objects that predicts later mathematical achievement (Hannula-Sormunen, 2015). Here we examine if a simple math-related prompt in the informal learning context of a children's museum can promote math-related conversations between parents and children, and ultimately lead to improvements in children's SFON. We asked fifty-four preschool-aged children and their parents to play together in a children's museum exhibit using either a numerical prompt or a non-numerical prompt (control condition). Before and after playing with their parent, children completed an imitation task to measure individual differences in their tendency to spontaneously focus on number without being explicitly instructed to pay attention to number. After playing with their parent, children whose parents received the numerical prompt showed greater spontaneous focus on number compared to children in the control condition. These findings suggest that giving parents different prompts in a museum can lead to different learning experiences for their children. When parents encouraged children to play in ways involving numerical content, children subsequently sharpened their spontaneous focus on numerical information in an unrelated task.

Symposium 3 – The development of spatial reorientation: An old puzzle, a new formulation

The neural representation of directions and borders in developing rats

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The hippocampal formation contains neurons whose firing represents a code for the position and orientation of an animal in space. Collectively, these cells are thought to constitute a neural map of space, or "cognitive map" (Tolman, 1948; O´Keefe & Nadel, 1978), by means of which an animal can remember locations and navigate to goals. O´Keefe & Nadel (1978) suggested that the hippocampal cognitive map may represent a Kantian synthetic a priori system, not requiring extensive experience of space for its construction, which may therefore emerge early during post-natal development. Research by ourselves and others (Wills, Cacucci et al, 2010; Langston et al, 2010) confirmed that some components of the neural map are indeed set up early during post-natal development (e.g. Head

Direction cells, which code for orientation), although others emerge only after extensive experience of exploration (e.g. grid cells, which may provide a distance metric for space). In work presented here, we investigate the sensory cues that support the most precocious features of the neural map of space: the neural representations of head direction, and of environmental boundaries. Head Direction (HD) cells are present as early as P12, as soon as detection of spatial signals is possible, and up to 3 days before eye opening (Tan et al, 2014; Bjerknes et al 2014). However, prior to eye opening, HD cells display severely impaired directional signalling, suggesting that although a rudimentary HD system can emerge independently of vision, visual information is needed to attain full network maturity. We tested whether the poor directional signalling of HD cells before eye-opening can be rescued by supplying alternative, non-visual, sensory cues. We recorded putative HD cells whilst rat pups explored an open arena much smaller than used previously, leading to increased contact with environmental boundaries. From P13 onwards, neurons displayed little or no directional tuning in the standard arena, but adult-like HD cell directional signalling in the smaller box. Furthermore, by examining the short-time scale firing of neurons in the standard arena, we showed a coherent internal representation of direction is present, and that impaired directional tuning results from the slow drift of the ensemble with respect to the external world. We conclude that the internal structure of the HD cell network is adult-like before eye-opening, but that it operates in an open-loop mode until vision, or alternative sensory feedback modalities, are available. We have previously shown that environmental boundaries play a fundamental role in the development of the cognitive map: in pre-weanling rats, place cells are more accurate and stable if their place fields are close to an arena wall (Muessig et al, 2015). To elucidate the neural representation of boundaries in the developing hippocampus, we investigated the development of boundary-responsive neurons, specifically Boundary Vector Cells (BVCs) in the subiculum. We found that BVCs were present in the subiculum from at least P17 onwards. As in the adult, BVC firing generalises to all boundaries to movement, for example walls with different sensory features or open drops. In adults, each BVC is tuned to represent a specific distance and direction from a boundary. Preliminary analyses indicate that short distance-tuned BVCs are over-represented in developing rats, suggesting that the neural representation of space may scale with development.

Children's use of asymmetry and illusory depth as cues for reorientation

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Much research has shown that children use the geometry of a space to reorient themselves (e.g., Hermer & Spelke, 1994, 1996). This robust finding has led to many questions about the nature of the geometric information that children use when orienting in accord with layout geometry. To address this question, we tested children on a reorientation task in which we removed geometric information by using a square room with three white walls and one featurally distinct wall. A sticker was hidden under a nondescript box in one of the four corners of the room while the child watched. Next, the child was blindfolded and spun until disoriented; then the blindfold was removed and the child searched for the sticker. Rooms with informative geometry, like the rectangles typically used in such tasks, constrain conclusions about the reorientation process. In such settings, children can solve the problem by identifying a corner with a unique set of features, and thus do not need to reorient themselves, i.e., they do not need mentally align a remembered representation of the room with the physical space. A square room with a single distinct wall acting as a reference point for alignment thus creates a more stringent

test of reorientation. Specifically, for hiding locations at one of the two intersections of blank walls, these intersections can only be distinguished from each other on the basis of their spatial relation to the feature wall. Thus, we focused on searches at these non-distinct corners as the critical measure of reorientation. Furthermore, by removing informative geometry from the surface layout, we created a blank canvas in which we could experiment with specific aspects of what might be meant by 'geometry' by manipulating the visual stimulus on the distinct wall. Researchers have speculated that the primacy of geometric information in reorientation behavior reflects an evolutionary bias to preferentially attend to aspects of natural landscapes that would support navigation (Hermer-Vazquez, Moffet, & Munkholm, 2001). Accordingly, we manipulated the scenes on the feature wall to test three the effects of three characteristics of natural environments: asymmetry, illusory depth, and environmental boundary. Six different feature walls were used: plain red, red-white gradient, symmetric object, asymmetric object, symmetric landscape, asymmetric landscape. A total of 208 children between 3 and 7 years old (M = 59.5 months) participated. Older children outperformed younger children, p<.05, and younger children performed no better than 50% chance on the critical reorientation measure. Given the floor effects in younger children, we focused our analysis of the visual features on the older children. An ANOVA on Sex, Condition (Red, Object, Landscape), and Symmetry (symmetric, asymmetric) revealed only a main effect of Symmetry (p<.05). Performance was above chance (one-tailed) in the red wall condition, t(23) = 1.82, p = 0.082, and all three asymmetric conditions: landscape, t(15) = 4.17, p = 0.001, object, t(15) = 2.53, p = 0.023, and gradient, t(15) = 2.01, p = 0.063. We conclude that asymmetry, but not illusory depth, is an important cue to children's emerging reorientation abilities.

Modularity of geometric processing? Children's reorientation behavior as a case study

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A foundational issue in cognitive science, philosophy, evolutionary biology, and computer science has been the extent to which mental representations are modular rather than distributed in nature. This debate has also fascinated developmental psychologists. In the domain of navigation, seminal work revealed the failure of children to integrate geometric and featural information when reorienting, and these findings have been interpreted as evidence for a 'geometry module' impenetrable to non-geometric information (Hermer & Spelke, 1994). Though an abundance of recent work has demonstrated that featural information can be integrated with geometric information, a recent proposal has emphasized modularity of a different kind. Spelke and colleagues (e.g., Spelke et al., 2010; Lee et al., 2012) have proposed that children's ability to reorient is supported by only a subset of geometric cues--namely, distance and direction. Other geometric cues such as length and angle are thought to be restricted to a system of object and form analysis and, thus, not available for reorientation. This perspective posits even greater specialization for reorientation than previously thought. Is geometric processing truly supported by such a highly-specialized 'module'? To address this question, we first replicated the work of Lee and colleagues (2012) who used fragmented spaces to show that children use distance, not length, to reorient (Experiment 1). Importantly, however, our subsequent work addressed a critical confound in the design of these experiments: global shape. Distance information in the prior work was always construed within a fragmented space that formed a rectangle, and length information was always construed within a fragmented square. Thus, if children were sensitive to global shape information, they would have difficulty when this shape provides no

navigationally-relevant information (as with the square). Indeed, like Lee and colleagues, we found that children (N=28, Mage = 42 months) were only successful in the distance condition, as indicated by their ability to successfully search for a target at its original location or its geometric equivalent (p<.005). In a first follow up experiment, we added perpendicular appendages to the walls to decrease the salience of global shape (Experiment 2). Crucially, children (N=28, Mage = 48 months) succeeded in using length in this case (p<.05), and at comparable levels to that of distance, suggesting an equivalence between the two cues. We then made global shape more salient in the distance condition (Experiment 3) and found that children (N=28, Mage = 48 months) failed to use distance information in this case, providing further support for an equivalence between geometric cues. Thus, contrary to recent work, our findings suggest flexibility within a system of reorientation. Children reorient by way of both distance and length cues, casting doubt on a modular perspective of geometric processing.

A New Paradigm Showing the First Direct Evidence of Cue Integration in Reorientation

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A central debate in cognitive development is how the developing mind is organized. One view is that the mind is composed of core modules, each with a unique function (e.g. Spelke & Kinzler, 2007), while an opposing position views the mind as an integrated system (e.g. Twyman & Newcombe, 2010). Much of the evidence for this debate in cognitive development has come from the domain of spatial cognition, with a focus on a navigation process termed 'reorientation', or the ability to regain one's spatial position following disorientation. In the current, two-step modularity account of reorientation, all species, regardless of age, use geometry, and only geometry, to guide reorientation, and non-geometric cues can be used in a second step to retrieve hidden objects (Lee & Spelke, 2010). This is a particularly powerful claim, since with the current reorientation paradigm, there is both a reorientation component and search component. Thus, any instances of feature use are attributed to the search process, and the use of geometric cues to the reorientation process. To evaluate this claim, we have devised a new reorientation paradigm. In this task, participants start facing an assigned direction in the center of the room, are disorientated, and then are asked to return to their original position. Thus, there is only a reorientation process and no search for a hidden object component. Secondly, the geometric cues (a trapezoid shaped room) and feature cues (a black and white 2D checkerboard strip) can be independently used to return to the original facing direction. After a training phase where participants face and return to an initial direction (4 trials), in the test phase, the feature moves a small distance toward the nearest corner, or a small, medium, or large (onto a different wall) distance away from the nearest corner. Since participants could respond in any direction (360 degrees), they could choose to shift with the feature panel, to ignore the feature panel and use the geometric cues, or to respond at an intermediate position between the two cues. As this was the first use of the new reorientation paradigm, we begin with human adults (n=83, mean age = 20.7 years). The data demonstrate that both geometric and feature cues are important in reorientation, and that these cues are integrated in spatial memory in some of the test conditions, depending on how far the feature moved and the salience of the nearest corner (acute corners are more salient than obtuse ones). Thus, the new paradigm has demonstrated that feature and geometric cues are integrated in spatial memory in a reorientation task, at least for human adults, and that cue salience influences relative cue use, supporting the adaptive combination theoretical framework (Newcombe & Huttenlocher, 2006). This new paradigm can be

extended in many directions, including to ask questions such as how early integration is observed in development, and if cue integration dissolves with aging.

Symposium 4 – The development of spatial reorientation: An old puzzle, a new formulation

Exposure to Nonverbal Bias Can Create Prejudice Among Preschool Children

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Intergroup prejudice exists early in human development and is well documented in the preschool years (e.g., Aboud, 2003), though little is known about the mechanisms by which new prejudices are created in early childhood. We examine whether exposing preschool children to biased nonverbal signals directed toward a novel individual can lead them to develop prejudice against that individual's larger social group. We argue that children's observation of biased nonverbal signals (anxiety and discomfort) directed toward others is a key mechanism by which prejudices are learned by children as early as preschool. In Study 1 we introduced 81 4-5-year-old children to two unfamiliar groups of people. Then children watched a video recorded interaction in which an adult actor displayed positive nonverbal signals toward an adult from one group and negative nonverbal signals toward an adult from the other group. Then we asked children a series of questions to assess their prejudice against people from each of their groups. We hypothesized that children would exhibit prejudice against people in the same social group as the person who received negative nonverbal signals. Consistent with our preregistered hypotheses, children showed significant prejudice against the group whose member received negative nonverbal signals, Wilcoxon signed-ranks test, p = .031. A chi-square goodness-of-fit analysis was also used to compare the distribution of responses on the generalized prejudice measure to the expected pattern of the data if participants were responding by chance. Participants selected the group whose member received positive nonverbal signals marginally more often than would be expected by chance, $\chi2(3, N = 81) = 7.72$, p = .052, $\phi = .31$. In Experiment 2 we tested whether exposure to biased nonverbal signals could lead young children to develop prejudice against whole nationalities of people. We presented 81 4-5-year-old children with maps of fictional places and introduced children to people from both places, before being exposed to nonverbal signals directed toward a single individual of each national origin. Finally, children were asked a series of questions to assess their bias against people from each of the places. We hypothesized that following exposure to the nonverbal bias manipulation children would exhibit prejudice against people of the same national origin as the individual who received negative nonverbal signals. Consistent with our preregistered hypotheses, children showed a significant prejudice against the nationality whose member received negative nonverbal signals, Wilcoxon Signed Rank Test, p = .046. A chi-square goodness-of-fit analysis confirmed that children disproportionately selected the nationality whose member received positive nonverbal signals, $\chi2(4, N = 81) = 40.33$, p < .001, $\phi = .71$. Identifying the origins of intergroup prejudice in childhood may be critical to the development of strategies to overcome prejudice and minimize the adverse consequences it has on our society. The current findings demonstrate that group prejudices can be created among preschool children through exposure to biased nonverbal signals - which has important implications for

understanding the establishment of group prejudices of all kinds, including those based on race, ethnicity, and religion. We argue that exposure to biased nonverbal signals may be one of the fundamental processes through which prejudices are transmitted from adults to children.

Building Bias: Children use statistical social information to reason about social preferences

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How do children learn about the societal attitudes and status associated with different groups? Recent research suggests that adults' explicit and implicit biases can be communicated to children through explicit statements and non-verbal bodily cues (Rhodes, Leslie, Bianchi, & Chalik, 2017; Skinner, Meltzoff, & Olson, 2017). Here we explore a new idea: whether children attend to patterns of people's social choices. In the real world, children consistently observe people making social choices (e.g., who to walk, sit, or eat with). Children may attend to such social choices to make inferences about the relative social status of different groups. Research demonstrates children use statistical evidence - specifically the probability that object choices are statistically non-random - to infer their object preferences (Kushnir, Xu, & Wellman, 2006). For instance, if a child sees someone pick a baseball out of a box of mostly soccer balls, she will infer a preference for baseballs. Providing children with language emphasizing the emotions of the chooser may be particularly helpful to children making these inferences (Garvin & Woodward, 2015). We presented 96 3-5-year-old children with a task in which they saw a puppet select either all red or all blue dolls, from a mixed set of both. Critically, across conditions the same choices were framed as either social choices ("friends") or object choices ("toys"). Items selected were drawn from a set in which the preferred group was statistically in the majority or the minority. We compared social and nonsocial choices to ask whether children infer preferences in the social domain, and whether such inferences might be more robust in the social than the nonsocial domain. After viewing the puppet's choices, children were asked which item the puppet will play with again. Options included an individual from the chosen group, an individual from the non-chosen group, and a third individual from an unknown group. Overall, there was a significant effect of social versus object framing (2 = 5.042, p < .05). Children predicted that the puppet would choose a member of the chosen group again in the social, but not in the object condition. Examining the data in more detail, only the social condition in which the preferred item was a member of a statistical minority reached significance independently (2 = 6.751, p <.05). We were also interested in how social choices impact children's assessment of leadership. After the choice task, we asked children which of the three friends they thought was the leader. When the preferred group was in the statistical minority, children inferred that an individual from this group is the leader (2 = 6.521, p < .05) . In contrast, when the preferred group was in the statistical majority, children selected a member of the third, novel group as a leader, who notably is the most numerically rare of the three (2 = 5.827, p < .05). To conclude, we provide a novel framework for exploring how children might use statistical social information in learning about group-based attitudes.

Parents' Discomfort Drives Children's Decreasing Endorsement of Racial (but not Gender) Stereotypes

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Norms discouraging expression of racial stereotypes are more prevalent than those about gender stereotypes and racist behavior is seen as more egregious than sexist behavior (Rodin, Price, Bryson, & Sanchez, 1990). Decreases in racial biases between ages 6 and 10 (Baron & Banaji, 2006) have been attributed to an increasing awareness of norms (Monteiro & de Franca, 2009). If awareness of norms increases with child age, we would anticipate the endorsement of racial stereotypes but not gender stereotypes to decrease as children grow older. Study 1 tests this hypothesis by asking children about their endorsement of racial and gender stereotypes. Study 2 considers who children learn norms from parents. Through these studies, we evaluate how stereotype endorsement changes as a function of children's age and parents' reactions to stereotyping. In Study 1, 6-10-year-old children (N=48) were asked about racial and gender stereotypes. Children indicated whether "all", "most", "some", or "none" of the people in a group fit a stereotype (e.g., lazy). "Some" responses indicate non-endorsement as children are not generalizing to an entire group, whereas "all" or "none" responses indicate stereotype endorsement as children believe the traits to be true of the whole group. Results indicate a significant interaction between age and social category on stereotype endorsement, $F(1,44)=5.77$, $p=.02$. Endorsement of racial stereotypes decreased with age ($r=-.63$, $p<.001$), but endorsement of gender stereotypes did not differ across child age ($r=-.27$, $p=.19$). These findings support the theory that increased knowledge of societal norms leads to children's decreasing endorsement of racial stereotypes over time. However, it is unclear how children learn these norms. Study 2 explores two possible types of parental cues that children receive about the appropriateness of stereotyping: indirect cues through parents' reported discomfort about children's stereotype use and direct cues through parents' verbal responses addressing the statement. Parents rate their discomfort with and likelihood to address statements that they imagine their child saying that endorse stereotypes (e.g., "all Black people are lazy") or not (e.g., "some Black people are lazy"). Preliminary results from Study 2 (N=103) suggest parents are more uncomfortable with children's endorsement of racial than gender stereotypes ($t(100)=-2.91$, $p<.01$), replicating work that shows gender stereotypes are considered more acceptable than racial stereotypes. Additionally, parents report more discomfort with racial stereotype endorsement for older children than younger children ($r=-.29$, $p=.03$), but there is no difference in parents' discomfort with gender stereotype endorsement across child age ($r=.05$, $p=.76$). Parents do not vary in the likelihood of directly addressing their children's stereotyping in either the race ($r=.06$, $p=.65$) or gender ($r=-.08$, $p=.62$) conditions as children age. The current findings suggest that although parents do not differ in their likelihood of directly addressing children's race or gender stereotyping as children age, they report more discomfort with older children's endorsement of racial (vs. gender) stereotypes. Discussion will draw connections between these findings and previous work on parents' 'colorblind' racial socialization, and will explore whether interventions targeted at parents may be effective for reducing children's biases.

Social exclusion in intergroup peer contexts: Disentangling wealth and race

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Social inclusion and exclusion decisions based solely on group membership (such as race or gender) reflect a form of prejudice, particularly when such decisions provide access to opportunities. While many studies have examined children's evaluations of exclusion based on racial, gender, and minimal groups, much less research has investigated how children perceive and evaluate exclusion based on

wealth status. Previous research has indicated that children are aware of wealth inequalities and assign traits (e.g., hardworking, lazy) to individuals based on high or low wealth status. However, it remains unclear how children apply this knowledge to their everyday peer interactions. Moreover, wealth and race are often confounded in many studies (e.g., comparisons between high wealth/White and low wealth/Black samples). Research methodologies rarely disentangle these variables. This paucity of research has led to a gap in our knowledge about how children make decisions about social inclusion and exclusion based on wealth and race. The present study investigated children's perceptions of exclusivity and evaluations of the wrongfulness of exclusion for four groups that varied by wealth and race. Using a sample of participants aged 8-14 years, and drawing on prior findings displaying wealth as highly valued but also associated with exclusivity, we predicted that children would perceive high wealth groups as more exclusive than low wealth groups, controlling for race, and would evaluate wealth-based exclusion as more acceptable than race-based exclusion. Evenly divided by racial groups (European-American and African-American), 8-14-year-old children (N = 163, M = 11.31 yrs, SD = 1.85 yrs) evaluated an intergroup exclusion vignette depicting peer clubs that varied in wealth (high, low) and race (African-American, European-American). To assess children's perceptions of exclusivity based on wealth, children answered "Which club would be more likely to say that someone cannot join their club?" To assess children's perceptions of wrongfulness of exclusion, children evaluated four vignettes. The specific vignettes depicted: 1) a high wealth group excluding a low wealth peer; 2) a low wealth group excluding a high wealth peer; 3) a European-American club excluding an African-American peer; 4) an African-American club excluding a European-American peer. Participants rated the wrongfulness of exclusion on a 6-point Likert-type scale ranging from 1 (really not okay) to 6 (really okay). Children's reasoning behind their perceptions and evaluations was captured for all measures with verbal prompts ("Why?"). A higher proportion of participants chose the high wealth group as more exclusive (.92) than chose the low wealth group (.08), regardless of race (p < .001). Further, children evaluated all forms of exclusion to be wrong (ps < .001). However, they evaluated exclusion based on race (M = 1.99) as more wrong than exclusion based on wealth (M = 2.38) (p < .01). This finding remained regardless of what specific wealth or racial group was being excluded. Reasoning data for children's perceptions and evaluations will also be discussed. These results inform children's perceptions of wealth and race in social exclusion and reveal the role that wealth status plays in intergroup contexts, an understudied variable for research on racial attitudes, and one that sheds new light on intergroup relationships and attitudes in childhood.

Oral Papers I – Social and Moral Cognition

O1.1   Collaboration benefits active learning in older children, but not younger children

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Does collaboration affect how children generate and learn from evidence? Despite the importance of collaborative learning in major theories of child development, there has been surprisingly little research on the early ontogeny of collaborative learning skills. Drawing upon recent demonstrations of successful coordination in children's peer collaborative problem-solving, here we explore early school-aged

children's individual and collaborative performance in an active category learning task. We specifically investigate whether differences in children's abilities to plan and coordinate information gathering actions contribute to the developing effectiveness of collaborative learning. Five to 8-year-olds (N = 168) participated as individuals or dyads. Children played a board game, based on Markant and Gureckis (2014), in which they selected exemplars from a continuous two-dimensional space in order to learn a unidimensional categorical preference of a puppet (e.g. liking big, not small toys; Figure 1A). In a collaborative condition, dyads jointly selected learning examples. In an individual condition, children completed the game alone. After the learning phase, children individually completed a categorization task. Using decision boundary models, we assessed whether children's responses followed the correct unidimensional rule (i.e. reflected the diagnostic dimension) or a different rule (e.g. a two-dimensional rule or random responding). Did older (7 & 8-year-old) and younger (5 & 6 year-old) children's learning vary by condition? There was an age by condition interaction (p = .007; Figure 1B), such that older dyads learned the correct rule more so than older individuals, OR = 1.74, p = .036, and younger dyads, OR = 3.56, p < .001. In contrast, younger individuals learned the correct rule marginally more so than younger dyads, OR = 2.04, p = .09. Older and younger individuals demonstrated similar learning. Did variation in dyad planning contribute to the age difference in collaborative learning? Older dyads produced more verbal plans for exemplar selections than younger dyads (d = .29, p = .044), particularly joint plans involving both partners (d = .41, p = .025). Importantly, planning talk was a positive predictor of learning in the task (logit β = .25, p = .005) and partially explained the age effect of collaboration. Did variation in children's information sampling contribute to collaboration benefiting older children, but not younger children? A measure that characterized samples in terms of structure (i.e. more/less randomness; Kempe et al., 2015) predicted learning in the task, such that more structured samples were associated with greater learning (logit β = .04, p = .022). There was an age by condition interaction for this measure (p = .016), such that older dyads generated the most structured samples and younger dyads generated the least structured samples (in comparison to each other and individuals of both ages). This variation partially explained the overall age by condition interaction on learning. Taken together, these findings suggest children's abilities to coordinate and benefit from collaboration during active learning rapidly develop in the first years of formal schooling. Moreover, these results provide new insight into the development of specific skills that facilitate effective collaborative learning (i.e. verbal planning and information sampling), thereby suggesting potential targets for intervention.

O1.2 Children's Views on the Acceptability of Revenge

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Although there is a great deal of research on how children make sense of interpersonal conflict and moral transgression, we know surprisingly little about how children view one dimension that is a factor in some conflict scenarios: revenge. The two studies presented here explored this question with children and comparison groups of adults. In Study 1, we tested 152 3-to-11-year-old children and a group of 50 21-to-69-year-old adults. A minority (range 23% - 34% across four age groups) predicted that a child would act vengefully, even when given a very good reason to expect that he/she would (information about intentions); there were no age differences. Within all four age groups we tested (3-to-5, 6-to-7, 8-to-11, and adults), a vengeful response to being victimized was viewed as less acceptable compared to walking away or telling a teacher. However, across age groups, the adult group was the most positive

about the vengeful response; they differed significantly from all three younger age groups. We also found that taking an unequal amount of revenge -- i.e., overkill -- was viewed as significantly less acceptable by participants of all ages, compared to a vengeful behavior that was equal in proportion to the original transgression. Finally, in Study 1 we tested whether individual differences among children with regard to their thinking about the acceptability of revenge would predict observed vengeful behavior. Children were led to believe that another child had slighted them by not sharing, and we tested whether the act of reciprocating the non-sharing behavior would be associated with children's responses to the earlier scenarios; it was not. In Study 2 we tested 126 3-to-11-year-old children and a group of 40 21-to-67-year-old adults. We asked about punishment deservingness, and found that 3-to-7-year-olds did not differentiate between proactive and vengeful forms of aggression when recommending punishment. The 8-to-11-year-olds and the adults, however, had a more nuanced view, judging that a proactive aggressor was more deserving of punishment that an aggressor who was exacting revenge. However, when asked to rank which was less acceptable -- proactive or vengeful aggression -- only the adults were above chance (ranking proactive as worse). In order to rule out the concern that the younger children simply viewed all acts of retaliation as bad, we also presented a playful revenge scenario in which one child returned another child's playful hit in a pillow fight. The mean responses of all age groups indicated that the playful revenge was seen as acceptable. The results indicate that people across a wide age range are disinclined to predict vengeful behavior (at least in the scenarios involving child victims that we used). Perhaps relatedly, revenge was also viewed as less acceptable by all age groups when compared to actions such as walking away from a conflict or seeking help. We found that young children did not differentiate between revenge and proactive aggression the way that people aged 8 and older do on measures of acceptability and punishment deservingness. Intriguingly, while revenge was not viewed kindly by any age group, the adults in the study consistently viewed revenge as more acceptable than did the children. Theoretical and practical implications are discussed.

O1.3 What was he thinking?!: Examining group differences in Theory of Mind and socio-moral reasoning between aggressive, prosocial, non-social, and prosocial-aggressive children

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Myriad research in child development identifies that aggressive youths vary substantially compared to peers with regard to how they conceptualize socio-moral behavior. The aim of the current study was to examine the development of social and moral cognitions in early childhood as they relate to aggressive and prosocial behaviors. We hypothesized that children who engage in immoral behaviors think differently about morality, others' intentions, and others' perspective of morality, compared to peers. 176 preschool-age children (33-78 months, Mage=53.24 months, SD=9.86) from a sub-rural Midwestern community completed 5 tasks of Theory of Mind (ToM; Wellman & Wooley, 1990; Wellman & Liu, 2004; Flavell, 1986; Baron-Cohen, et al., 1985; Harris, et al., 1986). In addition, children were read vignettes and answered questioned pertaining to characters' morally-relevant ToM and moral judgment (Killen et al., 2011), which assessed children's understanding of intent and judgment of wrongness. Children also completed the dual puppets interview (Sengsavang, Willemsen, & Krettenauer, 2015), wherein children indicate preferences for moral and immoral behaviors. Based on responses during the dual puppets

task, children were identified as belonging to one of four behavioral clusters: (1) not prosocial, not aggressive ("Non-socials"; n=27; Mage=52.56 months, SD=9.53); (2) not prosocial, aggressive ("Aggressives"; n=64; Mage=48.76 months, SD=8.64); (3) prosocial, not aggressive ("Prosocials"; n=51; Mage=57.84 months, SD=9.47); (4) prosocial and aggressive ("Balanced"; n=34; Mage=55.29 months, SD=9.36). A series of ANCOVAs (controlling for age and verbal skills) revealed several group mean differences. On ToM tasks, non-socials performed best, significantly outperforming aggressives [M=3.09, SD=0.20, vs M=2.40, SD=0.13; F(3,170)=3.49, p=.02, η².06]. We found several group mean differences for children's perceptions of others during the story of accidental harm as well. Prosocials, compared with the balanced group, were more likely to attribute blame to victims [F(3,170)=4.01, p=.01, η²=.07]; however, groups did not differ in their tendency to attribute blame the accidental transgressor. Prosocials also indicated greater hostile attribution, compared to non-socials [F(3,170)=2.26, p=.08, η²=.04]. Differences emerged for children's perceptions of others during the story of intentional transgressor as well; for instance, non-socials were more likely, compared to all others, to recommend no punishment for the transgressor [F(3,170)=3.90, p=.01, η²=.07]. Overall, these findings suggest that there are important underlying cognitive mechanisms which may differ according to behavioral patterns. For instance, findings for non-social children may suggest that greater mental state understanding allows for disengagement from social interactions (both positive and negative), which may provide objectivity. Prosocial children gave more blame to victims and indicated greater hostile attribution toward the accidental transgressor, which overall may imply greater adherence to societal mores (e.g., "bad things happen to bad people"). Lastly, aggressive children performed worse overall on ToM tasks, which may suggest that aggressive children behave so out of frustration for lack of social understanding. Limitations and future directions will be discussed.

O1.4   The relation between single-parent status, subjective socioeconomic status, and children's executive function and theory of mind: Possible advantage to disadvantage?

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Prior research indicates that early familial environments influence developmental outcomes of children, including the development of certain aspects of cognition. For example, stressful, unpredictable, and/or chaotic home environments are associated with problematic developmental trajectories (Belsky, Schlomer, & Ellis, 2011). Parents' spousal status and socioeconomic status are commonly used as indicators of stressful familial contexts. For instance, children raised in poverty consistently underperform their more affluent peers on measures of Theory of Mind (ToM) (Baker, Bordoff, Moeyaert, & Tisak, 2017), and children of single-parent families underperform on metrics of executive function (Sasser, Beekman, & Bierman, 2015). Our study investigates the interplay of these risk indicators on children's cognitive development. That is, we were interested in the influence of living in a one (versus two) parent household in concert with the impacts of poverty, and how this interplay relates to performance on ToM, inhibitory control(IC), and cognitive interference in early childhood. We hypothesize that children of disadvantage would perform more poorly on ToM, IC, and interference. 105 preschool-age children (Mage=51 months; Range=38-70) completed two standard ToM tasks (Baron, Cohen, Leslie, & Frith, 1985; Gopnik & Astington, 1988). Additionally, children completed the Day-Night Stroop task (Gerstadt, Hong, & Diamond, 1994). Responses were coded for inhibitory control (as

measured by accuracy), and interference (response time). Additionally, verbal skills were measured by the Peabody Picture Vocabulary Test - Version 4 (Dunn & Dunn, 2007). Parents completed demographic information for the child's primary residence, including the number of parents in the home, and the subjective socioeconomic status (SSS) as measured by parents selecting a rung on a ladder (with higher rungs indicating higher status: Goodman et al., 2001). Hierarchical regression revealed a moderation by parents' spousal status on SSS and cognitive interference [$F_{(4,94)}$: 4.08, p=.01, R^2=.17, ΔR^2=.10]. We conducted simple-slopes analyses (Aiken, West, & Reno, 1991) to better understand this relation. Children of single-parents responded more quickly when the family was of low-SSS, compared with high-SSS[B=0.36, t(94)=3.26, p=0.001]. We found the opposite pattern for children of two-parent families; children responded more quickly if the family reported high-SSS [B=-0.121,t(94)=-1.93, p=0.059]. Findings for inhibitory control were significant, [$F_{(4.94)}$=3.14, p=.007, R^2=.25], although there was not an SSS-by parentage interaction. Furthermore, results regarding Theory of Mind were additionally significant,[$F_{(4,94)}$=3.03, p=.008, R^2=.24]; again, however, there addition of the SSS-by-parentage interaction term did not reach significance. Findings suggest that disadvantaged children might be differently affected than previously believed. Although these children are often considered "at-risk" for a number of negative outcomes, we found that children of low-SSS, single-parent households respond more quickly than many of their peers (indicating less interference), equal to their two-parent, high-SSS peers. Many interpretations are plausible; for instance, disadvantaged children may experience adaptive exposure to multiple environmental stimuli, which may help them to develop greater resilience to such distractors. Implications and limitations, will be discussed

O1.5 More optimistic than adults? Children make optimistic future predictions for both themselves and others

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Optimism may play a critical function in the early years of life, serving as a catalyst for how children learn, confront challenges, and overcome setbacks. However, surprisingly little is known about the emergence and development of optimism in children. Optimism is briefly defined as a cognitive bias in which individuals overestimate the probability of positive future outcomes (Sharot, 2011). Roughly 80% of adults make optimistically biased predictions, and this bias extends to situations in which base-rates (known probabilities) - and not personal knowledge - should influence outcome predictions (Lench & Ditto, 2008). Further, the optimism bias only applies to predictions for self-relevant outcomes, not for others (e.g., Weinstein, 1980). Although a general bias toward positivity is seen in how children perceive themselves (Stipek & Iver, 1989), and is stronger in children under age 6 compared to older children (Schuster, Ruble, & Weinert, 1998), it is not yet known whether this bias extends to future event predictions with known base-rates for either oneself or others. We posit that optimism may present more broadly in children, and may also be affected by early experiences. Our study investigates the development of optimism across a racially and socioeconomically diverse sample of 3- to 6-year olds.. To date, 102 children (M=4;7, Range=3;0-6;9; 39 Black, 9 Hispanic, 40 White, 13 Multi-Racial) have participated in an experimental task that tests if children make optimistic (more positive than base-rate), realistic (same as base-rate), or pessimistic (more negative than base-rate) predictions for future event outcomes. Children are presented with 12 scenarios in which they are taught a base-rate (almost always/sometimes/almost never) for a semi-novel event (e.g., Balloon animals almost never fly away).

For 6 trials children make predictions about themselves (Imagine you got a balloon animal. Do you think your balloon animal will or will not fly away?); for 6 trials they make predictions for others (There is a child who got a balloon animal. Do you think their balloon animal will or will not fly away?). Base-rates and question type were counterbalanced between children. Our preliminary results reveal that children provided more optimistic responses than would be expected by chance or if they provided realistic responses, for both themselves (M=1.67), t(101) = 6.114, p<.001, and others (M=1.00), t(101)=3.910, p<.001, with more optimistic responses provided for themselves than others, t(101)=2.051, p=.043. This key finding indicates that at least a subset of children do make optimistic predictions about future events. Further, whereas these predictions are stronger for themselves than for others, unlike adults, children also make optimistic predictions for others. Surprisingly, whereas self-relevant predictions do not appear to change with age, older children provided more optimistic responses for others than younger children, r=.246, p=.016. Data collection is wrapping up, with a planned enrollment of 160 children; thus, we hesitate to make claims about this finding at this point. However, if this finding is reliable, it has important implications regarding how future expectations change over childhood. We also collect parent-reports on family background and children's experiences, and findings will be discussed in terms of how early experiences affect (or do not affect) early optimism, and implications for risk and resiliency.

Symposium 5 – Mind in motion: The development of cognitive processes in real Time

The neural dynamics of the "mysterious midline barrier" in infants' goal-directed reaching

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The mechanisms responsible for action understanding continue to be a source of considerable debate and controversy among social cognitive neuroscientists, motor neurophysiologists, cognitive scientists, and developmental scientists. One of the most prominent theories suggests that actions are understood by observers mapping perceived actions to their own motor representations (Rizzolatti & Sinigaglia, 2010). If correct, then the development of action understanding should be linked to motor development. Critically, the early development of goal-directed reaching in infants affords a unique opportunity for studying the contributions of motor experience. Although infants begin to demonstrate goal-directed reaching between 16 and 20 weeks of age (Bertenthal & Clifton, 1997), they reach initially for objects with only their ipsilateral hand (i.e., hand on the same side of the body as object). Bruner (1969), referred to this inability of young infants to reach across the body midline as the "mysterious midline barrier," arguing that contralateral reaches do not occur before 7 months of age. If action understanding is related to motor experience, then the development of infants' motor simulation of an ipsilateral reach should emerge earlier than their motor simulation of a contralateral reach (Boyer & Bertenthal, 2016). During the past decade, my colleagues and I have been studying this question with a modified version of the A-not-B search error (Piaget, 1937/54). Infants are tested in an observational version of this task in which they do not search themselves until the final B-trial. If infants map observed

actions to their own motor representation, then they should demonstrate the search error even if they do not overtly search on the A-trials. In a series of experiments (see Bertenthal & Boyer, 2015 for a review), this hypothesis was confirmed. Subsequent research has revealed more about the temporal dynamics of this process. For example, infants' motor representations can be primed by the repeated observation of a model reaching for objects just prior to testing. In this talk we will present new evidence from an EEG study with 9-month-old infants to directly test our hypothesis that the neural correlates for the observation of ipsilateral reaching develop more rapidly than those for contralateral reaching. Infants' neural activity was recorded with an EGI 64 Channel Geodesic EEG System. On each trial, they observed a live experimenter reaching ipsilaterally or contralaterally for an attractive object, while their visual attention and hand movements were also recorded for offline assessment. After artifact removal, the EEG time series for each trial was analyzed with a Morelet wavelet to calculate the time series of the amplitude of the signal at each frequency ranging from 3 to 50 Hz. The results were consistent with previous findings suggesting that alpha suppression measured in central and frontal electrodes is systematically related to action observation, but more importantly, alpha suppression was greater during ipsilateral than contralateral reaching. Ongoing analyses are designed to further explore the time course of alpha suppression and when exactly suppression begins to diverge between ipsilateral and contralateral reaches.

Neural patterns underlying the development of planning in tool use

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Flexible, purposeful tool use requires action planning. Adults' action plans keep both the initial contact with the tool and the end goal in mind, even when the end goal stretches far into the future. Children, however, show dramatic deficits in planning when the end goal is not immediately accessible to perception. For example, participants of all ages normally reach for the handle of a hammer using an overhand radial grip. But when the handle points away from the dominant hand, an initially uncomfortable underhand grip is required to ensure the desired final position of the tool. This phenomenon of sacrificing comfort in the initial grip to allow for a comfortable end position is called "end-state comfort." In contrast to adults, young children frequently select a comfortable initial grip, as if planning for start-state comfort. As a consequence, their hand is in an awkward end-state position when they use the tool. Indeed, children do not show consistent planning for end-state comfort until 10 or 12 years of age. Here, we examined the possible sources of differences in action planning between young children and adults. We innovated a novel method for obtaining electroencephalography (EEG), head-mounted eye tracking, motion tracking, and video simultaneously in an end-state comfort hammering task. First, we replicated previous work showing deficits in 4-year-old children's action planning. Then we compared EEG and visual attention for each age group for trials requiring planning for end-state comfort (handle pointing away from dominant hand) and trials that required planning only for start-state comfort (handle pointing toward dominant hand). At the neural level, we found differences in readiness potential over sensory-motor sites preceding initial end-state comfort grips in adults compared with the readiness potential preceding similar grips in young children. We used support vector machine (SVM) and random forest (RF) algorithms to describe preparatory neural patterns underlying differences in planning between the age groups. We also show that participants' fixation location and motion kinematics are correlated with their grip. These results indicate that young

children's deficits in planning for end-state comfort stem from differences in neural activity and visual attention prior to moving the hand.

Object fitting by preschool children: The dynamics of spatial coordination

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Relating objects to other objects efficiently is a hallmark of skilled action. To do so, individuals need to engage in planning that is tied to the spatial structure of the objects. Developmentally, advances in relating objects become evident in the preschool years as children begin to use tools, build structures and solve problems that require more complex forms of spatial planning. Across these types of relational activities, one important form of spatially coordinated behavior involves fitting objects into apertures. Prior work on object fitting suggests that before 20-24 months, young children do not align an object with an aperture until after it contacts the aperture area. In contrast, after this period, children already align the object with the aperture prior to object contact, indicating gains in the prospective control of action that are tied to the spatial relation between object and aperture. Nevertheless, the process by which children achieve this type of spatial coordination is not well understood. Most research on object fitting has focused on whether or not children pre-align an object by the time it contacts the aperture, but not the process by which they do so. To understand developmental changes in this underlying process, we report two studies. We used motion-tracking technology to chart the process by which children prospectively orient objects with respect to apertures. In Study 1, children between 16 and 33 months (N=30) wore reflective markers on their hands, enabling us to densely track their spatial adjustments in three dimensions. Manual displacements of the handheld rod were separated into translations (changes in the lateral position of the object) and rotations (changes in the orientation of the object). Results revealed that prior to 24 months, children mainly used a two-step approach in which they initially translated the rod to the aperture and subsequently rotated the rod to match the aperture's orientation. In contrast, older children evidenced a more integrative strategy: They simultaneously coordinated translational and rotational displacements as they transported the rod to the aperture. Further, the oldest children evidenced such coordination soon after they picked up the rod, suggesting they had formulated an action plan at the outset of the task. Additionally, their translations became more efficient, covering a shorter distance. In Study 2, we added a handle to the rod to understand how a more complex three-dimensional structure affected spatial coordination. A new sample of children (N= 30, 17-36 months) was tested. Children were asked to insert the distal segment (rod) of a handled object into an aperture as they held the object by its handle. Results indicated that the increased spatial demands associated with the handled rod interfered with children's ability to pre-align the rod. Children did not consistently pre-align the distal segment (rod) of the object relative to the aperture until approximately 30 months. Adding a handle to the rod thus delayed pre-alignment of the rod by about a half-year. Results will be considered in relation to how object structure influences the dynamics of spatial coordination by young children.

The development of the neural systems that support production and perception of handwritten forms

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The development of the neural systems that support production and perception of handwritten forms. Karin H James & Sophia Vinci-Booher Indiana University Department of Psychological and Brain Sciences The successful production of a form during handwriting is reliant on the ongoing perception of the motor output, forming an action-environment-perception-action loop. Here we studied the development of neural systems that support the perceptual guidance of handwriting, and the motor control that is required for production. Using a novel fMRI safe tablet that allowed visual guidance of the hand in real time, we measured the BOLD response during letter production and perception of handwritten letters in 5-6 year olds, 8-9 year olds and adults. In adults, motor production of letters recruited a widespread left parietal to frontal network as well as bilateral inferior frontal regions, whereas the perception of the produced letter recruited the bilateral fusiform gyri, and right parietal cortex. In older children, a similar system was used as adults for both production and perception of letters except that the activation was higher overall in the right hemisphere. However, in the youngest children, the dorsal systems were recruited in the same manner, but there was no activation in the ventral temporal regions in any contrast. These results suggest that a) the different components of handwriting recruit different regions of the overall handwriting system in all age groups, b) only the two older groups recruit the ventral temporal cortex during letter perception - specifically the putative 'visual word form area' is not recruited in the youngest children and c) that recruitment becomes more left lateralized with increased experience and/or age. Therefore the motor production involved in handwriting recruits a similar neural system regardless of age, but the perception of the handwritten form requires different neural systems that change through development.

Symposium 6 – Number, Proportion & Probability: Distinct Influences on Children's Probability Judgements

Proportional and Probabilistic Reasoning in Primates and Children

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Adults employ proportional reasoning in their everyday lives, but acquiring formal knowledge of proportions is notoriously difficult (Siegler et al., 2013). Despite these challenges, there is evidence that human infants, pigeons, and non-human primates have some understanding of proportions (Denison & Xu, 2014; McCrink & Wynn, 2007; Honig & Stewart, 1989; Rakoczy et al., 2013). Drucker, Rossa, & Brannon (2015) trained rhesus macaques (Macaca mulatta) to discriminate between two arrays of objects that each contained positively and negatively associated items. Monkeys successfully picked the array that held the more favorable ratio of positive to negative items. This was true even when the correct array had the smaller number of total items, or the smaller number of good items. Performance on this task was dependent on the ratio-of-ratios between the two arrays. Ratio dependent performance is a signature of the Approximate Number System (ANS; Feigenson, Dehaene, & Spelke, 2004). The ANS is an intuitive capacity to represent number without language or symbols. Understanding the development of an intuitive sense of proportion may ultimately provide insight into why formal proportional reasoning is so difficult. We assessed the relationship between ANS acuity and

children's proportional reasoning with symbolic and non-symbolic binary choice probability tasks. Children 6 - 8 years old were shown two gumball machines each containing differently colored gumballs or numerals. The child's task was to pick the machine with a greater likelihood of producing the preferred color gumball. Overall, children completed both the symbolic ($t(86) = 8.38$, $p < .001$) and non-symbolic ($t(86) = 14.04$, $p < .001$) gumball tasks at above chance level. Children were better at the non-symbolic version of the task ($t(86) = 7.19$, $p < .001$), and performance on the two versions were highly correlated ($r = .62$, $p < .001$). Children's ANS acuity was significantly correlated with performance on both the non-symbolic ($r = -.40$, $p = .003$) and symbolic ($r = -.37$, $p = .006$) gumball tasks. Children's ANS acuity ($F(1,50) = 4.67$, $p = .04$) and non-symbolic probability performance ($F(1,50) = 4.31$, $p = .04$), each contributed unique variance to their general symbolic math ability, as measured by KeyMath-3 Numeration (Connolly, 2007). A separate model determined that symbolic and non-symbolic gumball accuracy each contributed non-unique variance to predict KeyMath-3 Numeration score ($F(2,46) = 4.40$, $p = .02$). Taken together, these data suggest that ANS acuity and non-symbolic ratio computation are distinct but related abilities, and that both predict general symbolic math skills. We further hypothesized that practice with non-symbolic proportional reasoning would boost symbolic proportional reasoning skills. Consistent with this prediction we found that for the children who could identify all digits between 1-30 completing the non-symbolic gumball task first resulted in significantly better performance on the symbolic gumball task ($t(64) = 2.19$, $p = .03$). In contrast, task order did not affect performance on the non-symbolic probability task ($t(64) = 1.28$, $p = .20$). This finding suggests that experience with non-symbolic presentation of a probability task can facilitate a child's ability to make symbolic probabilistic judgments.

Proportional Matching and Probability Judgement: Related yet Different

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Cognitively processing relative quantities has been proposed central to the development of basic mental abilities (Bonawitz et al., 2014; Jara-Ettinger et al., 2016; Kidd et al., 2013; Tenenbaum et al., 2011) as well as formal academic success in the STEM disciplines (Jitendra et al., 2016; Resnick et al., 2016; Siegler et al., 2012). Relative quantity, however, is notably dispersed, in that there are many ways to conceptualize the very units of analysis, ranging from quantities that can be counted or symbolically annotated to implicitly experienced event outcomes. A side-effect of this dispersion has been the emergence of a variety of ways of studying the development of relative quantity processing, with some assumption of interchangeability of proportionality and probability concepts when studied with similar spatially depicted stimuli (Acredolo et al., 1989; Schlottmann & Wilkening, 2012). To our knowledge, however, no studies have scrutinized the relations and differences between relative quantity concepts measured with proportionality versus probability task formats, which is the aim of the present study. We adapted two spatially illustrated computerized relative quantity tasks: a proportional equivalence match-to-sample task (Boyer et al., 2008) that involves viewing a sample proportion that is conveyed as a cover-story character's "juice mix" recipe and selecting a proportionally equivalent match from two alternatives, and a probability judgment task (Jeong et al., 2007) that involves choosing the preferable of two spinner gambles (Figure 1). Crucially, the same quantitative item structures were used across the 40 trials of each task, and so both tasks involved discriminating between the same relative quantity choice alternatives. We administered these tasks to kindergarten through fifth-grade students (N = 96, 16 per

kindergarten, 1st-, 2nd-, 3rd-, 4th-, and 5th-grades). The results indicate that age was significantly correlated with performance on the proportionality match-to-sample task ($r = .246$, $p = .016$) and the probability judgment task ($r = .42$, $p = .003$). Also, performance on the two tasks was correlated ($r = .318$, $p = .002$; Figure 2), even after controlling for age with partial correlation ($r = .247$, $p = .016$). Mixed model ANOVA, revealed main effects for school grade, $F(5, 90) = 5.71$, $p < .001$, $\eta p2 = .241$, and, importantly, experimental task, $F(1, 90) = 164.84$, $p < .001$, $\eta p2 = .647$, with higher accuracy in the probability judgment task ($M = .797$, SEM = .021) than in the proportionality match-to-sample task ($M = .521$, SEM = .014), and no interaction between the school-grade and task, $F(5, 90) = 1.21$, $p = .309$, $\eta p2 = .063$. Thus, the findings indicate that though related from an individual differences perspective, the probability and proportionality task formats resulted in performance differences. This pattern suggests the two tasks are likely differentially effective in conveying relative quantity information to children and that each task potentially elicits different cognitive strategies. In combination, these findings suggest that caution must be used in interpreting when in development children understand relative quantity.

Both Numerical and Visuo-spatial Features Influence Binary Probability Judgments Across Development

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Accurately predicting the outcome of a probabilistic situation requires the comparison of probabilities, which can be computed using a variety of symbolic and non-symbolic representations. Research on non-symbolic number processing has shown that humans and animals share an ability to approximate integers (Dehaene, 2011) and rational numbers (Drucker, Rossa & Brannon, 2015; Jacob, Valentin & Nieder, 2012), both of which could influence judgments about probability. In two experiments children were presented with images containing two groups of red and white marbles and were asked to select one of the groups to take a marble from with the goal of collecting marbles of a target color (red or white). The images differed in how probable it is to draw a red or white marble (by varying ratio of ratios), as well as the number and size of target marbles and non-target marbles. In experiment 1, we presented two trial types for each ratio of ratios to 48 participants (N=24, 6-year-olds; N=24, 7-year-olds). Total equal trials contained groups with the same number of marbles while target equal trials displayed groups with an equal number of target color marbles. Performance on both trial types was significantly above chance for both six-year-olds (M total_equal = 0.76, SD = 0.20, t = 6.42, df = 23, p <.001; M target_equal = 0.64, SD = 0.19, t = 4.08, df = 23, p <.001) and seven-year-olds (M total_equal = 0.90, SD = 0.11, t = 17.86, df = 23, p <.001; M target_equal = 0.83, SD = 0.14, t = 11.31, df = 23, p < .001). Furthermore, analyses using Generalized Linear Models with Mixed Effects (GLMMs) revealed performance increased with increasing ratios of ratios and was higher on total equal compared to target equal trials and seven-year-olds made more correct responses compared to six-year-olds. In Experiment 2 we replicate our findings from Experiment 1 with a wider age range and more difficult ratio of ratio comparisons (N= 39, 7-8-year-olds; N= 51, 9-10-year-olds; N= 28, 11-12-year-olds). In order to further investigate the role of numerical information in children's probability judgments we substituted target equal trials for number vs proportion trials in which the number of target marbles in the losing distribution was larger than the number of target marbles in the winning distribution. We also presented area-anticorrelated trials in order to assess the influence of area on probability judgements. Performance on total equal trials was above chance for all three age groups (M7-8s = 0.78, SD = 0.17, t =

10.09, df = 38, p < .001; M9-10s = 0.85, SD = 0.13, t = 18.99, df = 50, p < .001; M11-12s = 0.88, SD = 0.08, t = 14.67, df = 27, p < .001). Although performance on area-anticorrelated trials was lower than performance on total equal trials, children in all three age groups still performed significantly above chance (M 7-8s = 0.58, SD = 0.25, t = 2.02, df = 38, p = .049; M 9-10s = 0.69, SD = 0.26, t = 5.27, df = 50, p < .001; M 11-12s = 0.77, SD = 0.17, t = 8.12, df = 27, p < .001). Importantly, performance on number vs proportion trials did not differ from chance for any of the three age groups. Analyses using GLMMs revealed that across age groups, both area-anticorrelated trials and number vs proportion trials had a similar influence on performance suggesting that at least some children were recruiting both ratio processing and integer approximation in their binary probability judgments.

Symposium 7 – How an Understanding of Kinship and Friendship Influences Children's Social Judgments

Four-year-old children favor kin when the stakes are higher

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Only in cases when the stakes are high--donating a kidney or risking injury to rescue someone in peril--do adults report more willingness to help siblings over close friends (Stewart-Williams, 2007). When people are dividing plentiful, low-value resources, children expect them to share equally with friend and siblings (Olson & Spelke, 2008). However, will children show a kinship preference when the stakes are higher? We first tested young children's relative favoring of kin versus friends and strangers in distributing limited resources--one item instead of many (Spokes & Spelke, 2016). We found that 3- to 5-year-old children (n=252) shared more with kin and friends than with strangers but did not favor kin over friend, either when reasoning about fictional characters (Experiments 1, 3) or about their own friends and family (Experiment 2). This pattern of results could have occurred for two reasons: first, young children do not yet have the kinship index mechanisms that guide adults' recent altruistic favors and reported likelihood of donating an organ to siblings (Lieberman, Tooby & Cosmides, 2007). Second, the hypothetical costs and rewards used may not be relevant or valuable to children. To distinguish between these hypotheses, we asked whether children would show a preference for kin if the cost was more relevant to them--their own time and effort. In the present experiment, we asked if children would work harder for kin over non-kin when playing a challenging geometry game (Dillon, Huang, & Spelke, 2013). Each round, they could earn stickers for a different recipient: themselves, a parent, sibling, friend, or an unfamiliar child. Children could end the round whenever they wanted. We measured the number of trials played, trials answered correctly, and duration of play. Data for the number of trials and duration played were log-normally distributed, so we log transformed these variables prior to analyses (Csibra, Hernik, Mascaro, Tatone, & Lengyel, 2016). Across these measures, one-way ANOVAs revealed that four-year-olds (n=24) played more trials for their kin relations--siblings and parents--than for non-kin--friends and strangers, $F(1, 46) = 4.27$, $p = .044$, answered more trials correctly, $F(1, 46) = 4.57$, $p = .038$, and played marginally longer, $F(1, 46) = 3.14$, $p = .083$. There was no main effect of recipient when comparing across all four recipients nor significant pairwise comparisons. Five-year-olds (n=24) did not differ when playing for kin versus non-kin (ps > .05). These findings provide

initial evidence that four-year-old children calibrate their time and effort in a task differently according to who will reap the rewards, but five-year-olds do not. Five-year-olds may find the task easier and less costly or may have different social experiences having attended school. Nonetheless, we found that children's social decisions depend upon the recipient of their generosity. We provide initial evidence that children may favor kin when the stakes are higher and resources--their time and effort--are more meaningful to them: four-year-olds played more trials and did so more accurately when winning for kin.

Toddlers' expectations for social partners to respond to each other's distress

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People with positive social relationships are inclined to act prosocially toward one another. This is supported by comparative data in non-human primates (Cheney & Seyfarth, 2007), cross-cultural data across diverse societies (Hruschka, 2010), and observational data in children as young as 18 months (Howes & Farver, 1987). Although even infants infer third-party relationships from others' interpersonal behaviors (e.g., Rhodes et al., 2014), it is unclear whether young children also expect that positively affiliated individuals will support each other if one becomes distressed. Because verbal methods used with older children (Furman & Bierman, 1983) may underestimate toddler's social knowledge, we used eye-tracking to examine toddlers' implicit expectations. We investigated 30- to 36-month-olds' expectations that people who have interacted in an affiliative manner are more likely to provide prosocial support for one another than people who have not. In Study 1, children viewed videos introducing three people (N = 24). One video depicted a friendly interaction between the Protagonist and another actor (the "Friend"), and the other showed a third actor playing alone (the "Non-Friend"). Next, children viewed the Protagonist fall behind a desk, while the Friend and Non-Friend remained on screen. Although children looked equally between the two visible actors following the Protagonist's fall, t(22) = .66, p = .51, they looked longer at the Friend after the Protagonist requested aid, t(23) = 2.79, p = 0.01. This indicates that children track relationship information relevant to prosocial predictions, but may only apply this knowledge when help is requested directly. Study 2 replicated and extended these findings (N = 32). To determine whether children in Study 1 had merely relied on the co-presence of the Protagonist and Friend to generate their expectations, the interaction videos now featured the Protagonist and Non-Friend engaged in side-by-side non-interactive play. Additionally, we were interested in whether children's preferential looking to the Friend was a specific response to the Protagonist's distress, or whether it might be driven by a more general interest in friendly people. Children thus viewed videos with two different trios of actors. In a counterbalanced, within-subject design, one video depicted the original falling event while the other showed the Protagonist answer a phone behind the desk. Unfortunately, order effects suggested that the two videos were not sufficiently distinct. Examining only the videos that each child viewed first, we observed the predicted pattern of looking. When the Protagonist had fallen, children looked preferentially at the Friend, t(13) = 2.36, p = 0.03, reaching significance after the second request for help. This response was specific to events where the Protagonist required aid. When she had answered her phone, children looked equally at both actors, t(13) = 1.47, p= 0.17. Because we could not perform the planned within-subject comparisons, we are rerunning this study with a fully-powered between-subjects design. These results indicate that toddlers draw upon knowledge of a person's social relationships to predict who will come to her aid. The eye-tracking technique developed here will be a valuable tool for further investigations of prosocial

predictions during the early preschool period, when children are too old for looking-time methods but too young to provide reliable explicit reports.

The Developing Appreciation of the Moral Significance of Close Relationships

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Adults take into account social relationships when making moral evaluations, judging that the act of helping a stranger is nicer than the act of helping a friend, and that the act of not helping a friend is worse than the act of not helping an unknown individual. Here, we explore the development of these moral intuitions. In two studies, we examine how children (ages 5-6-year-olds, 8-9-year-olds, N = 205) and adults (N = 71) assess acts of helping and not helping in relational contexts. We found that older children and adults value supererogatory acts that go above and beyond our social obligations--they judged that the act of helping a stranger is a nicer act than that of helping a friend. Older children and adults also express that not helping a friend is worse than not helping a stranger. Our youngest age, in contrast, showed no such appreciation: They instead valued the act of helping a friend over the act of helping a stranger. They also did not think it was any worse to not help a friend over a stranger. This was not due to differences in the understanding of how friendship influences other's actions: Participants of all ages shared the expectation that a person is more likely to help a friend than to help a stranger. Young children appear to value actions that fulfill and reify social obligations and to lack a mature appreciation of supererogatory actions.

The social value of secrets: children use disclosure of personal information to make inferences about patterns of friendship

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Tracking and predicting relationships is important, but there is little research on children's reasoning about friendships and alliances. In a recent study, children expected a distributor who gave out resources partially to be friends the person he favored (Liberman & Shaw, 2017). Here, we ask whether 3- to 11-year-olds make similar friendship inferences when the item being shared is not physical, but is instead personal information, like a secret. We ran 5 studies (total N= 751) asking whether children expect people to share secrets selectively with friends whether they use secret sharing (or non-sharing) as a cue to infer friendship. In Study 1 we presented participants with a protagonist and two other characters and told them that the protagonist was friends with one of the other characters, but not the third. We then told participants two things about the protagonist: he had a personal secret and he had won an award. Participants were asked whom he would share this information with: the friend, the non-friend, or both. Although 3- to 5-year-olds did not differentiate the types of information, 6- to 11-year-old children expected the protagonist to share the secret only with the friend, but to be more likely to tell both other characters about the award. Thus, children understand that people want some information to be shared more widely, and that they think secrets will be shared selectively with friends. We next examined whether children used secret sharing as an indication of friendship. To do this, we presented participants with a similar set-up as Study 1, but told them that the protagonist shared a personal secret with one of the characters and shared something else with the other character: either

(a) a fact learned in school (Study 2), (b) a cookie (Study 3), or (c) a sports team affiliation (Study 4). In all cases, 6- to 11-year-olds predicted that the protagonist would be better friends with person she told a personal secret (Figure 1). Thus, children understand that disclosing a secret can indicate friendship, and that it can do so more strongly than (a) disclosing other types of information, (b) sharing physical items, and (c) being on the same team. In a final study, we told participants about 3 characters: A and B are friends, and A tells B a personal secret. Then, B interacts with C, and either keeps or tells A's secret. Children's judgments of A and B's closeness changed based on B's behavior: when B kept the secret children increased their friendship judgments, but when B shared the secret, children lowered their friendship judgments. These patterns were not found when A told B a fact instead of a personal secret, suggesting children understand that disclosing someone's personal information is particularly relevant to predictions about friendship. Taken together, these results demonstrate that children expect people to share secrets selectively with friends, and use secret sharing to make inferences about third-party patterns of friendship.

Symposium 8 – Exploring cross-cultural variation in the development of children's attitudes toward risk

Cross-cultural variation in children's risk and time preferences

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In recent years, researchers have documented large cross-cultural differences in economic decision-making among adults, revealing variability in underlying risk and time preferences across cultures. However, we know surprisingly little on the development of these preferences in childhood. This study investigates cross-cultural variability in risk and time preferences among children. Using two novel tasks -- a risky gamble task to elicit risk preferences (N = 299) and a delay discounting task for time preferences (N = 281) -- we collected data from children ages 4-18 from four diverse populations in Ecuador, Argentina, India, and the U.S., ranging from hunter-horticulturalists in rainforest communities to city-dwelling urbanites. We find that children in all populations show sensitivity to stakes in both risk and time tasks. However, we also find striking cross-cultural differences in behavior between subjects. In the time task, children in India, the U.S., and Argentina tend to prefer more rewards for tomorrow, while Ecuadorean children exhibit a different pattern in time preferences, equally preferring to consolidate resources for today or for tomorrow. In the risk task, children in India, the U.S., and Argentina are more risk-seeking, while Ecuadorean children are much more risk-averse. These findings are the first to highlight that cross-cultural differences in risk aversion and temporal discounting can be traced into childhood, and highlight the utility of cross-cultural methodology in expanding our understanding of how preferences develop.

Risk of personal loss drives children's effort to protect common goods: a cross-cultural behavioral study

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Human cooperation is exceptional, especially our ability to extend cooperation to strangers and across generations. However, the motivation to cooperate can be fragile if the outcome of cooperative efforts are uncertain and out of sight. Instead of cooperating to preserve global common goods such as biodiversity and ecosystems, people are prone to satisfying more certain personal and immediate needs. Previous research with adults in Western societies suggests that the perception of risk to personal resources influences contribution to environmental common goods. However, many environmental common goods need global contributions, and risk perception varies considerably across cultures. In addition to little being known about cultural differences in risk perception, little is also known about the development of these perceptions. We conducted a modified public goods game among a population of adolescents (age 7-12) in the Democratic Republic of Congo (N=236), the United States (N=216), and China (N=216). In a group setting, participants could contribute to a fund that supports the preservation of tropical forests. Each group is told that either all, half, or none of their personal endowment will be lost if they do not collectively reach a predetermined threshold for the fund. We found that in all three cultures and across all age groups, the greater the risk of losing personal resources, the greater the mean individual contribution to the fund. However the sensitivity to risk and the mean percentage of the personal endowment donated differed among the three cultures. Mean contributions differed across the risk conditions for children in all cultures, with the trend of younger children contributing less to the common good compared to older children. This study has implications for how researchers, educators, and conservationists communicate to diverse populations about environmental threats.

Risk taking among Hadza hunter-gatherer children

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A growing body of research on the evolution of risk preferences suggests that pronounced sex differences are a consistent trait cross-culturally, suggesting deep evolutionary roots. Here, we report data from the first study on sex differences in risk preferences in a population of hunter-gatherers, the Hadza of Tanzania. We report on sex differences using both incentivized economic games and naturalistic foraging data on food returns. In the economic games, pronounced sex differences emerged that increased throughout childhood and were greatest among adolescents. In the naturalistic foraging data, the mean number of calories boys brought to camp remained stable with age, while the variance in their caloric returns increased with age. Among girls, the variance remained stable with increased age. The results from both studies are consistent with the adult sexual division of labor wherein boys, beginning in middle to late childhood, begin to target riskier foods (e.g. large game animals). The Hadza continue to occupy a subsistence environment more similar to that in which our species evolved, they tend no crops, and a subset of the population still primarily subsists on wild foods. To the extent that analysis of behavioral patterns among the Hadza allows us to make inferences about our past, we suggest that based on our data, it is likely that sex differences in risk preferences may have been present long before the advent of agriculture.

Oral Papers II – Language Development

O2.1   **A Playful Context Enhances Bilingual and Monolingual Preschoolers' Motivation and Private Speech**

Jeremy Sawyer[1]

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Children's private speech (audible self-talk during activity) has been studied primarily as a cognitive tool for thinking, planning and self-regulation. This study investigated whether private speech may also function as a tool for motivation. Vygotskian and self-determination theory suggest that children can develop to become agentic and motivated, or disengaged and alienated, due largely to their social conditions of development. Thus, it is essential to study children's private speech and motivation in social and pedagogical contexts that are central to child development. U.S. preschool enrollment is expanding, accompanied by a decline in play-based pedagogy and concomitant growth of didactic, teacher-centered approaches. To illuminate the effects of such trends, this study examined the relative impact of playful and non-playful contexts on preschoolers' private speech and mastery motivation. Mastery motivation involves children's ongoing attempts to master challenging activities, and its components include performance, persistence, challenge seeking, and independence in problem solving. In addition, approximately half of the study's participants were bilingual. A recent review suggested that bilinguals may use more developmentally advanced private speech, or a wider variety of private speech functions than monolinguals. To explore potential bilingual advantages in private speech, a subgroups analysis compared the private speech of bilingual and monolingual participants. 47 preschoolers were randomly assigned to engage in challenging fishing and puzzle activities in one of two conditions (playful or non-playful) that simulated contrasting preschool contexts. The playful condition featured sociodramatic role-play, and emphasized intrinsic motivation and prosocial connection. In contrast, the non-playful condition was framed as work production, emphasizing extrinsic rewards and individual performance assessment. Children's private speech, mastery motivation, and the relations between them were compared between and across conditions. Children's private speech was classified as cognitive, metacognitive, motivational, or partially internalized, based on a synthesis of prior work, and a new category of playful private speech was explored in relation to playful and non-playful conditions. Across both activities, children in the playful condition displayed significantly higher mastery motivation. Children in the playful context demonstrated better performance and persistence on fishing, and greater challenge seeking and independence on puzzles. Across activities, children in the playful context used more frequent total private speech, especially during the most challenging parts of each activity. Children in the playful context used more frequent cognitive and playful private speech while fishing, and more cognitive and metacognitive private speech on puzzles. In general, children who used more playful private speech were more persistent, while children who used more cognitive private speech were more independent. Within the playful condition, bilinguals used more developmentally advanced (partially internalized) private speech, but less diversity of (externalized) private speech functions than monolinguals. Implications for possible bilingual advantages in private speech are considered. In sum, findings support the use of playful pedagogy for promoting preschoolers' motivational development, and motivationally beneficial private speech.

O2.2   Moving from unknown to known: Developmental differences and changes in neural oscillatory processing as a word is learned

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Introduction. Word learning from context is a complex skill that is integral to academic and social success. There are estimates that only 5% of words encountered in text by 4th graders are learned in one exposure (Nagy & Herman, 1987), but identifying when and how a word is learned, or has a corresponding semantic representation, is difficult with behavioral measures alone. The goal of the current study is to determine how the neural signal underlying a word changes as it moves from being unknown to known, how it differs from ages 8-10 to 13-15 years, and what that reveals about the recruitment of working memory, semantic retrieval, and unification during learning of new words from context. Method. Thirty-six children ages 8-10 years old (M= 9.3, SD= 0.85) and twenty-six children ages 13-15 years (M=14.2, SD= 0.78) participated in a word learning from context task using EEG. All children were right-handed, monolinguals with no history of developmental delay or deficit. The task included 50 visually presented sentence triplets, each of which ended with a nonsense word to be learned. Cloze probability increased across sentence presentations within the triplet. ERP Analysis. Single trials were averaged together to obtain a stable waveform ERP for each condition and each electrode for every subject. The N400 was computed between 300-400 msec at midline electrodes (Fcz, Cz, Cpz). Time Frequency Analysis. Using time frequency analysis of the EEG, we investigated changes in the neural signal during processing of the final word (-100 to 1500 msec) across the following three frequency bands associated with the skills necessary for word learning. 1)Theta (4-8 Hz), related to semantic retrieval, 2) lower gamma (30-50 Hz), associated with the unification skills necessary to integrate and create a cohesive message, and 3) alpha (9-12 Hz), linked to working memory skills. A monte-carlo cluster correction permutation analysis was used to determine statistically significant differences. Results. During learning of the target word, both age groups demonstrated an attenuation of the N400 across presentations. Older children showed a significant attenuation of the N400 at presentation 2, while this attenuation did not occur until presentation 3 in younger children. Both age groups displayed increases in gamma, alpha and theta across presentations, however the weighting of these varied by age. Older children revealed significant differences in gamma and theta, but not alpha. Younger children showed increased engagement of alpha across presentations but gamma and theta changes did not reach significance. Discussion. Taken together our findings revealed developmental differences existed in the neural signal as a word shifts from being unknown to known. Based on our ERP findings, a word shifted from being unknown to known for both groups of children, but this occurred more quickly in older children. Based on the time frequency analysis, younger children required recruitment of additional working memory (increases in alpha) as a word was being learned. Alternatively, older children relied less upon working memory, and rather recruited semantic retrieval (increases in theta) and unification (increases in gamma) as a word shifted from being unknown to known. We speculate that the maturation of working memory allows for the engagement of additional cognitive resources, such as semantic retrieval and unification, to aid more complex forms of word learning.

O2.3   Are Infants' Information Seeking Gestures Specialized for Early Word Learning?

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For decades, researchers have argued that infants' pointing gestures provide the "royal road to language" (Butterworth, 2003). Pointing gestures are one of the first ways infants communicate, and are also one of the strongest predictors of early vocabulary (Colonnesi et al, 2010). Thus, it is critical to understand why infants point, and how pointing relates to learning. In addition to pointing for imperative reasons ("get me that!"; Bates et al., 1975) and declarative reasons ("look at that!"; Liszkowski et al., 2004), research has recently established that infants also point for interrogative reasons ("what is that?"; Begus & Southgate, 2012). This information-seeking motive of pointing has been argued to be an important mechanism that drives early information acquisition. While research has established that infants can and will point for information-seeking reasons, it remains unclear whether infants seek out a particular type of information when they point, and how this relates to learning various types of information. The goal of the current study was to answer these questions. In a within-subjects experiment, we elicited 18-month-olds' interest in out-of-reach novel objects (N = 36). After infants indicated which object they were interested in, an experimenter provided information for that object: either a label, function, or no information (i.e., experimenter acknowledged infants' interest in object). Infants were later tested on their memory of labels or functions in a preferential-looking-paradigm. We repeated this procedure 9 times with each infant, so that each infant was given each information-type 3 times. Of primary interest was whether infants showed more or less communicative persistence when presented with the various types of information (labels vs. functions vs. no-information), and whether infants learned labels compared to functions more readily. As in prior research, communicative persistence (e.g., additional gestures) was used as an index of infants' satisfaction with the response given to their initial communicative attempt. When infants pointed towards a novel object and received a label in response, they persisted fewer times (Mean persists = 1.50, SE = .49) than when they were given no information about an object (M = 2.89, SE = .30, Z = 3.34, p = .0008), or an object's function (M = 2.77, SE = .63, Z = 3.03, p = .002), but infants successfully mapped both labels and functions onto objects (Mean % increase in target looking = .17, SE = .08, t(29) = 2.05, p = .02). When infants expressed their interest in the novel object in ways other than pointing, such as reaching or looking, they were equally satisfied with receiving object labels, functions, or no information, and did not successfully learn either labels or functions (all p's > .05). These findings demonstrate that pointing gestures are uniquely produced to obtain labels for objects. Moreover, these findings demonstrate that infants' pointing gestures, but not other preverbal behaviors, are a general learning mechanism that reflect a heightened readiness to learn both labels and functions for objects. By disentangling the ways in which infants' use their pointing gestures to seek out information, and how this translates into learning, these findings bring us closer to understanding the unique role that infants' pointing gestures play in early development.

O2.4 The role of information structure in children's comprehension of complex sentences - testing two hypotheses

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English allows two different clause-orders for complex sentences with adverbial clauses, e.g. (1) She checked her emails before she went home. vs. (2) Before she went home she checked her emails. Children have difficulty correctly interpreting isolated sentences like these up to the age of 6 or 7 (e.g.,

Blything, Davies, & Cain, 2015). However, in spoken discourse, sentences occur in context, and contain both new information and given information, which allows the listener to link it to the previous discourse (e.g., Sue went home. Before she went home, she checked her emails). We identified two hypotheses in the literature about how information structure affects the processing of complex sentences: (1) Sentences are easier to process, if given information precedes new information (Haviland & Clark, 1974). (2) Sentences are easier to process, if the information presupposed in the subordinate clause is given (Gorrell, Crain, & Fodor, 1989). We tested which of the two hypotheses better predicted English-speaking 4- and 5-year-olds' (N=80) understanding of four different types of adverbial sentences (after, before, because, if), using a forced-choice task on a touch-screen laptop: Children had to choose between two picture stories (instruction: "Touch the matching story!"), which differed in the order of in which the two events occurred. We systematically manipulated clause-order (main-subordinate, subordinate-main), and whether a context sentence provided information about the main or the subordinate clause (given main, given sub). We recorded accuracy as well as response times (RT). We also took standardised measures of working memory, inhibition, receptive vocabulary, and general language ability. We analysed the data using generalised mixed-effects models in R, including random effects for items and subjects. Our results support hypothesis 1. While five-year-olds performed better than four-year-olds ($z = 4.805$, $p <.0001$), children of both age groups showed the same pattern: They performed better when the initial clause -whether main or subordinate - was given, for example, when the subordinate clause was given, and the complex sentence was in sub-main order) ($z = 4.846$, $p < .0001$; see Fig.1). We also found that information structure had a differential impact on the "iconicity effect", which is the observation that children find sentences easier to understand if the order of events in the sentence reflects the order of events in the real world (sentence 1 above is iconic, sentence 2 is not) (Blything et al., 2015; Clark, 1971). The iconicity effect was more pronounced when the subordinate clause was given, and less pronounced when the main clause was given. Our findings show that children are sensitive to information structure from an early age, and that even minimal contextual information modulates children's processing preferences. We will present the complete data set, including the RT data, as well as the effects of different sentence types, age, and individual differences in children's processing, and discuss the theoretical implications of the results.

O2.5   More than maternal sensitivity: A longitudinal investigation of parent-child interaction, early language, and executive function

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By school-entry, children from low socio-economic status (SES) families trail behind their higher-SES peers academically (Reardon, 2011). Research suggests that executive function (EF), the control of attention and behavior, contributes to SES-related discrepancies in school achievement (Raver, et al., 2013). Zelazo (2015) proposes that children's EF is driven by language, through cognitive reflection and representational thinking (Cole, et al., 2010; Marcovitz & Zelazo, 2009), apparently encouraged by supportive parental interactions (Blair, et al., 2013; Matte-Gagné & Bernier, 2011). While associations between early language and EF in preschool are found (Kuhn, et al., 2014; Kuhn, et al., 2016), few longitudinal studies examine whether predictors of language development relate to children's development of EF. One such predictor is symbol-infused joint engagement (SIJE): episodes of shared attention with a parent infused with words and gestures (Adamson, et al., 2004). We propose that

children who engage in more, higher-quality episodes of SIJE will have stronger language, and as a result, stronger EF. This study examines the associations between SIJE at 24-months, when EF begins rapid development, language at 36-months, and EF at 54-months, right before school-entry. We hypothesize that SIJE predicts EF and that child language mediates this relationship. Drawn from the NICHD Study of Early Child Care and Youth Development, 155 participants had Symbol-Infused Joint Engagement (SIJE) assessed during the three-box task, a semi-naturalistic interaction in which parent and toddler play with a book and two toys (Vandell, 1979). SIJE was coded 1-7 based on amount and quality (Adamson & Bakeman, 2015). Parenting, a control variable, was a composite of maternal sensitivity (NICHD ECCRN, 1999) and cognitive stimulation (HOME; Caldwell & Bradley, 1984). Language was assessed using the Reynell Developmental Language Scales (Reynell, 1990). The Continuous Performance Task (Rosvold, et al., 1956) measured sustained attention. The Woodcock-Johnson-Memory for Sentences subtest (McGrew, et al., 1991) measured verbal working memory. The Delay of Gratification Task, (Mischel, 1974; 1981) assessed behavioral inhibition. Structural equation modeling (SEM) predicted the longitudinal paths from SIJE to language to a latent composite of EF measures, statistically controlling for maternal education, child age at 24-month visit, and parenting. Fit indices suggested acceptable fit ($\chi 2(8)=11.94$, p=0.06, CFI=0.89, TLI=0.80, RMSEA=0.076). Measures of attention, behavioral inhibition and working memory load together into the EF construct. There was a direct effect of SIJE coded at 24-months on the children's language at 36-months (B=3.37, SE=0.091, Z=3.68, p=0.001, ß=.394). SIJE accounted for differences in EF above and beyond the effect of parenting, (B =.490, SE =0.102, Z=4.68, p=0.001, ß=.332). There was a direct effect of language at 36-months on EF at 54-months, (B=0.109, SE=0.039, Z=2.77, p=0.006, ß=.262). Indirect effect analyses indicate the relations between JE and EF are mediated by language abilities (B=0.36, SE=0.03, Z=1.18, p=0.24, ß=.36), suggesting that differences in child language skills account for the contribution of SIJE in toddlerhood to EF at school-entry. These findings support Zelazo's theory (2015) and elucidate potential areas for interventions that promote both language and executive function to bridge the achievement gap.

Poster Session 2

A - Cognition in Applied Contexts

2-A-1   Creative Minds: Creativity and it's Relation to Cognitive Flexibility and Persistence

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Creativity is the production of original and unique ideas linked to their appropriateness and utility (Runco & Jaeger, 2012). Creative adults display higher cognitive flexibility, than those who are less creative (Zabelina & Robinson, 2010). Persistence is also important to the creative process and adults undervalue their creative ability (i.e., estimate they will generate few creative responses when asked to persist on a creative task, Lucas & Nordgren, 2010). To extend these finding across age groups, 100 adults, 40 first graders and 36 fourth graders completed a task where they were asked to generate creative responses to a prompt, and estimated their ability to generate additional creative responses before they persisted on the task. Confirming past research, adults with higher cognitive flexibility

exhibited more responses on a creative task than those with lower cognitive flexibility, $\beta = 1.90$, $t(99) = 2.04$, p=.004. However, cognitive flexibility was not related to creativity for first or fourth graders, ps >.42. Adults, $t(99)=9.30$, p<.01, and first, $t(39)=5.63$, p<.001, fourth graders, $t(35)=2.90$, p=.008, all undervalued their persistence on the creative task. The current study replicated adult creativity findings and suggests that undervaluing persistence in creativity starts at a young age but cognitive flexibility does not play a role in children's creativity, perhaps because of the dramatic development in this period (Jacques & Zelazo, 2005).

2-A-2   **Letter writing instruction for children: A content analysis of children's handwriting workbooks and storybooks**

Nick Fears[1], Leah Walsh[1], Jeffrey Lockman[1]

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Automaticity when writing letters is a critical achievement in the early school years, but it is not known whether handwriting workbooks are optimally organized to promote automaticity when writing the letters of the alphabet. In order for automaticity to develop in English, children must master writing each of the 52 letter forms (uppercase and lowercase forms of all 26 letter categories). Optimal organization of handwriting workbooks, which are used to teach handwriting, should provide uniformly distributed practice for all letters. To investigate the organization of children's handwriting workbooks for optimal handwriting development, we analyzed for case-sensitive letter frequency distributions in children's handwriting workbooks (N=10) and children's storybooks (N=100). Results indicate that letter frequency in children's handwriting workbooks is highly correlated (i.e. uppercase=0.710, lowercase=0.942, ps<.01) with that of children's storybooks and are not optimally distributed for children's handwriting development. This is most evident when comparing the frequency of "e" (M=201.45) to "q" (M=23.64) in handwriting workbooks. Further, children are presented the five most prevalent letters (M=149.40) more than five times as often as the five least prevalent letters (M=27.65). To develop automaticity in letter writing, children need practice with all letters of the alphabet despite their distribution in the English language.

2-A-3   **Children's action errors: A diary study in their natural environment**

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Researchers have documented children's action errors both in the lab and in naturalistic settings such as trying to sit into a toy car far too small for their bodies (i.e., scale error), or grasping at two-dimensional pictures (i.e., grasping error). In this study, we examined an additional error-type related to media, characterized by children performing motor actions that are inconsistent with the affordances of electronic media (e.g., attempting to physically interact with an object or person on an electronic medium). These behaviors, in general, exist in part due to children's inherent desire to explore the world. Yet their persistence in repeating these errors warrants a richer examination, as it suggests that children may have inaccurate mental representations of their surroundings leading to action errors. We recruited parents of young children between 10 and 36 months (N = 46) to complete a six-month diary study in their homes. The study was broken into three two-month periods, during which they recorded

all behaviors that could be classified into these three types of errors in their homes. Our preliminary results suggest that these errors occurred in the majority of children and across the age range studied, and that large individual differences exist. Forthcoming analyses will examine these individual differences and relate them to aspects of children's experience and development.

2-A-4   Testing the Faded Worked Example Effect with Cognitive Load Theory: It Works, but For Whom?

Dana Miller-Cotto[1]

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Cognitive Load Theory (CLT) suggests that novice learners may have limited working memory capacity, and thus difficult materials may impose cognitive load and thus prevent learning. To remedy this, CLT proponents have suggested using various form of worked examples, or a problem with each worked out solution step and the answer. One variation of faded worked examples, where in a series of successive problems the last steps are removed, encouraging students to supply the final step(s) until all he steps are removed and they are solving the entire problem on their own. However, little work has tested Cognitive Load Theory, specifically to faded worked examples, while accounting for cognition. I examined the effectiveness of faded worked examples and how the effectiveness differed based on students' prior knowledge, executive functioning, and cognitive load. Participants (N = 114) were randomly assigned to: (1) worked examples with self-explanation prompts, (2) fading with self-explanation prompts, (3) fading, and finally (4) problem solving only and assigned five links of homework (pre-test, three nights of the intervention, post-test). Assignments were on ASSISTments, an online computer tutor. On day one of the experiment, students were administered the online assessments of working memory, inhibitory control, and attention shifting pretest via ASSISTments, followed by the pre-test. Students' prior knowledge was assessed with a pre-test designed to capture knowledge of calculating the area of 2 dimensional and 3 dimensional figures. To measure students' working memory capacity, the WOMBAT (Englund, Decker, Woodlief, & Distefano, 2014) prompts students to complete this battery during the pre-test phase of the experiment. Similarly, inhibitory control and attention shifting were tested using the Flanker Task. Days two, three, four of the experiment are identical; students were exposed to one of the four conditions at random. After each problem, students completed 9-point Likert scale to assess students' mental effort during learning and testing phases (Paas, 1992), the cognitive load measure. Repeated measures analysis of variance was conducted to determine group differences between the two fading and two non-fading conditions. There was a main effect of condition, $F (1, 72) = 1.73$, $p = .029$, $2 = .065$ with the fading condition (M = 66.15) exhibiting a higher posttest score than the non-fading condition (M = 63.07). To determine individual differences, an exploratory factor analysis was first conducted to create a factor score based on performance on the pre-test, WOMBAT, Flanker Task, and cognitive load measures. A regression analysis with the factor score and the dummy codes for each experimental condition was conducted. The overall model was statistically significant ($F [7, 67] = 4.078$, $p < .001$) with the first propensity score being the only significant predictor of posttest scores (B = 21.723; $t [70] = 2.628$, $= .873$, $p = .011$). Though not significant, all B's for the three interaction terms were negative showing that student propensities interacted with the three instructional conditions in a manner that predicted lower posttest scores for students with higher initial propensities for students in the three experimental conditions, particularly pronounced for the fading and self-explanation combined condition. Findings are discussed in terms of educational implications.

2-A-5   **Exploration, explanation, and scientific reasoning in a children's museum**

David Sobel[1], Susan Letourneau[1], Aiyana Willard[2], Graciela Solis[3], Cristine Legare[2], Maureen Callanan[3]

[1]Brown University, [2]University of Texas, [3]UC Santa Cruz

This project examines how exploring and explaining support children's learning during a visit to a children's museum. Museums provide an ideal setting because they are designed both to encourage spontaneous exploration (e.g., Gaskins, 2008; Van Schijndel, Franse, & Raijmakers, 2010) and to foster parent-child explanatory conversations (e.g., Callanan & Jipson, 2001). Children (n=101, 49 girls, age range 36.20-86.60 months, Mean age=60.09 months) and a caregiver played at a gear exhibit. After dyads finished, children participated in a set of follow-up tasks designed to investigate their causal reasoning and understanding of the nature of science. Parents were given questionnaires about their attitudes towards science, their beliefs about children's play and learning, and their goals for their museum visit. We found that older children engaged in more systematic exploration of the exhibit, in which they tested systems of gears immediately after constructing them. Parental causal language related to the extent to which children tested the gear machines they created. Descriptive and non-causal language showed little relation to children's exploration. Parental attitudes about science also related to children's systematic exploration. Overall, this project qualifies and quantifies the interaction between exploration and explanation for children's learning.

2-A-6   **Prediction of parent facilitative behaviors when co-using digital media with preschoolers**

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Parents report they do not support digital reading with preschoolers in the same way they support print: they discuss the story less, provide fewer labels, and less often have their child tell parts of the story (Strouse & Ganea, 2017a; 2017b). Lab-based studies confirm that parents reading digital books spend less time talking about the story and more time talking about the device, leading to lower child story comprehension (Chiong et al., 2012; Krcmar & Cingel, 2014). In this study, 43 parents of preschoolers reported their attitudes, motivations, and usage of media; children were interviewed about their usage and preferences. In line with prior research, parents reported using more facilitative behaviors when reading with print than digital media, $t(42) = 3.50$, $p = .001$ and believed that print was more educational and more fun, $ps \leq .001$. Regression analyses indicated that parents who viewed digital media as more fun were more likely to have children who expressed a preference for digital over print media ($b = 1.47$, $p = .035$), and that parents who viewed digital media as educational and who used digital media to bond with their children were more likely to engage in facilitative behaviors during usage ($b = 1.98$, $p = .024$; $b = 2.44$, $p = .004$). These results indicate parent attitudes are linked to both parent behaviors and child preferences, and offer parent attitudes as a potential target for interventions aimed at changing how parents and children co-use digital media.

2-A-7   **Pedagogical questions in parent-child conversations**

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Questioning is a core component of formal pedagogy. Parents commonly question children, but do they use questions to teach? Theories on informal pedagogy (Csibra & Gergely, 2009; Shafto, Goodman, & Griffiths, 2014) suggested that when children watch demonstrations from knowledgeable and helpful others ("pedagogical demonstrations"), they assume that others are intentionally teaching them, and draw strong inferences from the demonstrations. Inspired by these theories, we examine the role of "pedagogical questions" in teaching and learning--these are questions from a questioner who already knew the answer and intended to help the questionee learn. Transcripts of parent-child conversations were collected from the CHILDES database to examine the frequency and distribution of pedagogical questions. Analysis of 2166 questions from 166 mother-child dyads and 64 father-child dyads (child's age between 2 and 6 years) showed that pedagogical questions are commonplace during day-to-day parent-child conversations, and vary based on child's age, family environment, and historical era. The results serve as a first step towards understanding the role of parent-child questions in facilitating children's learning.

B - Cognitive Foundations: Memory, EF, Attention, Action

2-B-8   Do teacher's ratings of self-regulation predict children's executive function and academic achievement?

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Teachers' ability to accurately rate students' cognitive growth has implications for teaching and instruction in the classroom. The current study examined the degree to which teachers' ratings of students' self-regulation were associated with lab-based measures of EF and their prediction of math and reading achievement in kindergarten (Teacher n = 18; student n = 102; mage = 5.76 years). Survey items were teacher ratings of working memory, response inhibition, and attentional control using a modified version of the CBQ (Putnam & Rothbart, 2006). Teacher-reported working memory and response inhibition were associated with lab-based EF measures of these skills. In addition, all three teacher-reported EF measures predicted math and reading skills. These results indicate that teachers can accurately rate students' EF similarly to widely used lab-based assessments, and that these ratings also predict academic achievement. These results can be leveraged to optimize academic outcomes for elementary school students.

2-B-9   Changes in Multisensory Processing Across the Lifespan

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¹The Ohio State University

The present study examined multisensory processing across the lifespan. In Experiment 1, young adults were presented with two spoken words, two pictures, or two word-picture pairings and had to determine if the two stimuli/pairings were exactly the "same" or "different." Pairing words and pictures together slowed down visual but not auditory processing and also delayed latency of first fixations, both

of which are consistent with a proposed mechanism underlying auditory dominance. Experiment 2 examined cross-modal facilitation and interference effects in children, young adults, and older adults. While cross-modal presentation attenuated auditory and visual accuracy for children and young adults, visual response times and first fixations were slower/delayed when images were paired with words. Older adults showed the opposite pattern, with cross-modal presentation facilitating visual processing and attenuating auditory processing. Mechanisms underlying modality dominance and multisensory processing more generally are discussed.

2-B-10   **"A-maze-ing" Problem Solving: Motor Demands Impact Young Children's Strategy Choices**

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How do young children discover and choose effective problem-solving strategies? We investigated this process by studying 4-to-6-year-olds' strategy choice and patterns as they solved motor tasks. 24 participants rolled a ball through a maze board in two conditions (manual, pedal). Task difficulty varied according to the number of levels the ball had to pass through. Coders documented types of maze-solving strategies and frequency of transitions between strategies. Overall, children used significantly more strategies and transitioned more often between strategies for pedal trials than manual trials. There were no age differences on easy or difficult trials, but younger children transitioned more often between strategies than older children on the moderate trials. Older children used only a few strategy types, even when transitions were frequent. For younger children, type and transition increased in the pedal condition. Older children honed in on efficient strategies and sequences of those strategies, whereas younger children tended towards trial-and-error. Motor demands of the novel pedal task meant that the younger children could not simultaneously attend to planning and other higher-level cognitive skills associated with efficient problem-solving, such as transferring successful strategies from familiar to novel tasks. Making problem solving observable revealed real-time planning in a population for whom more typical cognitive or reasoning tasks would be age-inappropriate.

2-B-11   **Working My Way Back to You, Mom: Wariness of Strangers Reliably Proceeds Crawling**

Ariana Patrick[1], Rebecca Brand[1]

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Two notable milestones of infancy both tend to occur around 7 months: stranger wariness and crawling. Rather than being a coincidence of maturation, one achievement may in fact promote the other. Extending prior research (Escobar & Brand, 2015), we collected weekly surveys from 119 mothers of infants between 6 and 10 months, in order to chart milestones as they occurred. Significantly more infants (66%) reached stranger wariness before hands-and-knees crawling, sign test p = 0.002. Of subjects reporting dates for both milestones, stranger wariness preceded crawling by an average of 44 days, paired t(23) = 2.81, p = 0.01. Ages of milestone achievements were significantly correlated with one another, r (24) = 0.47, p = 0.02, and the relationship remained relatively strong (r = .30) with age of an unrelated milestone (babbling) partialled out. We suggest that stranger wariness may heighten

infants' awareness of their surroundings, encouraging the development of an adaptive response (crawling). These findings emphasize the intersection of social/emotional, motor, and cognitive development in infancy.

2-B-12   **The role of similarity in toddlers' Visual Working Memory representations**

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We examined Visual Working Memory (VWM) representations in toddlers. 17 toddlers (age:28;0-36;0) performed 12 trials of a "Matching-to-Sample" game in an eye-tracker. In each trial, three (virtual) to-be-memorized cards were exposed, then turned face-down: Match, Mis-match (which differed in shape or color from the Match), and Non-match (which differed altogether from the Match). Subsequently, a Sample, identical to the Match, entered, and toddlers were rewarded for 'correct' anticipatory looks to the (face-down) Match (Delayed Match Retrieval, Kaldy et al., 2015). We found that participants made their first fixation to the Match significantly above chance (mean=44%; chance=33%; t(16)=2.55, p=0.022) and performance increased with age (R=0.4, p=0.059). Interestingly, similarity did not play a role in toddlers' incorrect responses: the Non-match was chosen as often as the Mis-match (t(16)=0.50, p=0.626). It seems that incorrect responses come from either a failure to retain featural information altogether, or a failure to utilize a degraded representation.

2-B-13   **Memory binding and forgetting across development**

Kevin Darby[1], Vladimir Sloutsky[1]

[1]Ohio State University

Memory is an essential aspect of cognition, enabling us to retain information that can be used to guide decision-making and future planning. However, we often forget information due to proactive and retroactive interference from similar, competing memories. Proactive interference occurs when new learning is more difficult as a result of previously acquired memories, whereas retroactive interference occurs when it is more difficult to remember previously acquired information as a result of new learning. Recent work has presented evidence that children are more vulnerable to interference effects than adults, experiencing dramatic levels of forgetting due to new learning (Darby & Sloutsky, 2015). An essential question is what mechanisms modulate interference and changes in the magnitude of these effects across development. Some researchers have suggested that interference may be reduced by binding, or closely associating, multiple aspects of an experience in memory (Darby & Sloutsky, 2015; Hedden & Park, 2003). The idea is that forming complex binding structures in memory may reduce interference by including information unique to different experiences. The current work investigates the hypothesized relationship between complex memory binding and interference effects in order to better understand the mechanisms of forgetting and memory development. To test this hypothesis we created a task in which 5-year-olds, 8-year-olds, and adults learned and were tested on two blocked sets of contingencies, which consisted of associations between objects (varying by shape and color) and cartoon characters. We measured proactive interference by determining whether testing accuracy was decreased for the second compared to the first set of contingencies. Following these learning and testing phases participants were again tested on the first set of contingencies, and we measured retroactive interference by determining whether accuracy for the first set was decreased following new

learning. Finally, we measured memory binding by presenting participants with partial information about each contingency presented in the experiment and measuring their accuracy and pattern of errors when asked to identify the completed contingency. We developed a multinomial processing tree (MPT) model to estimate memory binding structures of varying complexity within age groups as well as individuals. The results indicated robust retroactive interference in all age groups. Additionally, using the results of the MPT model we found clear developmental improvements in memory binding, and although more simple forms of binding appear to be mature by 8 years of age, we found evidence of protracted development for complex binding. Critically, we found novel evidence that more complex memory binding in individuals predicted reduced susceptibility to retroactive interference. This suggests that complex memory binding helps protect information from retroactive interference. However, we found little evidence of a relationship between memory binding and proactive interference, suggesting the possibility of dissociable mechanisms between proactive and retroactive interference. This work, therefore, provides insights into the nature of interference effects and how memory changes across development.

2-B-14 Building a knowledge base across languages; self-derivation of knowledge in a dual-language classroom

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For children to build a knowledge base, they must integrate and extend knowledge acquired across separate episodes of new learning. Surface similarity facilitates this process by aiding recognition of material that is related and can be integrated. However, teaching children under high surface similarity conditions is not always possible nor desirable. The conditions of an increasingly common model of education limit surface similarity between lessons and should theoretically present challenges to productive integration and extension of knowledge. Specifically, dual-language education provides content through two languages and is thought to be the most efficient way of learning a second-language for both minority- and majority-language speakers. Academic content is not only presented through two languages, but often by different teachers, in different classrooms, with different materials. This requires children to integrate and build a knowledge base across two languages and educational environments that lack the surface similarity young children often depend on to recognize material is related and can be integrated. In the present study, we investigated the impact of this educational model on productive knowledge extension. Participants were recruited from an English/Spanish dual-language program in an impoverished rural agricultural community in the United States. The school offers both dual-language and traditional education models side-by-side within the schools and all classes are comprised of native speakers of both languages. In dual-language, instruction is split equally between English and Spanish. Dual-language children were matched for comparison with a traditionally educated child of the same native language, grade, non-verbal intelligence score, English vocabulary, and parent/guardian education level. Children's performance was assessed in a task requiring them to self-derive new factual knowledge via integration of novel facts presented through separate lessons in the classroom. All children participated in a control condition in which all information was presented by the same speaker in English. In the manipulated condition, children in traditional education were presented both lessons through English, but by different speakers. Children in dual-language also had different speakers, one who presented one lesson through English and one who presented the related lesson through Spanish. One hundred matched third and fourth graders heard novel facts in two separate learning sessions. Across sessions, facts were related and could be integrated to allow for self-

derived new knowledge. Third grade showed an education program by condition interaction such that children performed equivalently in the control condition, but children in the dual-language program had lower performance in the cross-language condition compared to traditionally educated peers who received the same information through one language, $F(1, 41) = 5.56$, $p = .02$, eta squared = .12. However, 4th graders had no statistically significant main effects of interactions, $Fs(1, 48)$ less than .01, ps greater than .91. A one-year follow-up is currently under analysis. The results inform our understanding of knowledge base construction, conceptual representation, and cognition. They also have applied relevance for instruction in traditional and dual-language classrooms, highlighting the importance of contextual support for integration and knowledge extension.

2-B-15   The Contribution of Early Childhood Emotion Regulation to Executive Functioning at Age 6

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Previous research has suggested the primacy of emotion regulation (ER) over executive functioning (EF) in early childhood (Calkins & Marcovitch, 2010). We wanted to know if ER across early childhood contributed to later EF. Typically developing children (n=164; half girls) and their mothers visited the lab at ages 2, 4, and 6 years. ER at 2 and 4 was measured behaviorally during mother-child interaction tasks. ER at 6 was measured via maternal report (ERC Emotion Regulation Scale). EF composite at 6 included backwards digit span, DCCS, and number Stroop. The regression equation was significant, $F(3,160)=9.82$, $p < .001$. ER across age collectively accounted for 16% of the variance in EF at 6, with ER at ages 4 and 6, but not age 2, contributing unique variance. Our findings demonstrate that early ER at specific ages is important for later EF development, thus suggesting a critical association between these two aspects of self-regulation.

2-B-16   Effects of instructor gesture and prior knowledge on children's visual attention to math instruction

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Adding gesture to spoken instruction helps naïve learners solve mathematical equivalence problems (e.g., 3+4+5=_+5) (e.g., Singer & Goldin-Meadow, 2005). Yet in a classroom setting, children watching a math lesson may have varying levels of experience and pre-existing knowledge. Here we use eye-tracking technology to ask how gesture may differentially affect visual attention in two populations: children who already know how to solve equivalence problems ("knowers") and children who do not ("non-knowers") (8-10 year-olds; N=71). Results indicate that the way in which children watch mathematics instruction is more heavily influenced by the presence or absence of gesture, than by their prior knowledge. In general, non-knowers are more attentive than knowers (p<.05), but both non-knowers and knowers allocate significantly more attention to the problem if they watch instruction with speech and gesture, than if they watch instruction with speech alone. Finally, there is some evidence that non-knowers follow along better with speech when gesture is present (p<.01), but gesture does not have the same effect for knowers (p=.09).

2-B-17 **Emotion Regulation in Preschoolers: Comparing Pretend Play to Another Activity**

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Emotion regulation may be a function of pretend play (Bretherton, 1989; Fein, 1989). Barnett and Storm (1981) found that engaging in pretend play following a stressful video helped children resolve their distress. However, they did not address whether pretend play is more effective than other activities; it might be that the mere passage of time resulted in anxiety reduction. In addition, they used an outdated measure of physiological arousal (Palmar Sweat Index). The current study resolved these issues. Following two baseline measures (play and video), thirty-one 3- and 4-year-olds (M = 48.28 months, SD = 6.40 months; 16 female) watched a stressful video and then either engaged in free play with video-relevant toys or worked on a puzzle for an equivalent amount of time, then saw the stressful video's resolution. Respiratory sinus arrhythmia (RSA), a well-validated measure of emotion regulation (Cui et al., 2015), was collected throughout the study. RSA decreased significantly between baseline (M = 5.87, SD = 1.39) and the end of the video, (M = 5.39, SD = 1.34), indicating that the video successfully induced stress, t(30) = 2.63, p = .013. Although RSA approached baseline levels following both condition experiences, the conditions were not significantly different from each other. These findings suggest that, contrary to previous findings, pretend play is no more effective than another activity in facilitating children's emotion regulation immediately after a stressful event.

2-B-18 **Precursors of Uncertainty Monitoring**

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The ability to monitor uncertainty is intuitively critical for learning; however, little is known about whether infants and young children can monitor and respond adaptively to uncertainty. The present study examined whether toddlers demonstrate sensitivity to uncertainty by slowing down or gathering additional information during a perceptual identification task. To date, 116 26- to 32-month-olds were asked to identify a target item (e.g., a dog) from two partially occluded images which were either similar (dog vs. bear), or dissimilar (dog vs. apple). Accuracy was lower for similar compared to dissimilar trials. Toddlers responded more slowly on inaccurate trials (M=4518ms, SD=.2479) compared to accurate trials (M=3958ms, SD=.1742), ps<.05. Toddlers also switched their gaze between options more frequently on inaccurate trials (M=1.44, SD=.69) compared to accurate-similar trials (M=1.24; SD=.69), which in turn were more frequent than those for accurate-dissimilar trials (M=1.11; SD=.58), ps< .05. Of these toddlers, 74 have returned for a second visit 1 year later for a new perceptual task. Preliminary analyses revealed that gaze switches during their first visit predicted the extent to which children provided lower confidence ratings to inaccurate relative to accurate responses (r=.48, p<.001) Overall, these results indicate that toddlers respond to uncertainty by delaying decisions and seeking information, which predicts later ability to explicitly judge uncertainty.

2-B-19 **Early-developing causal perception is sensitive to physical constraints on collision events**

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By six months of age, human infants automatically perceive causality in certain simple interactions between objects (Leslie & Keeble, 1987). The best-studied causal event is "launching", in which a moving object (A) approaches a stationary object (B) until they are directly adjacent, at which point A stops and B immediately starts moving. In the real world, such events (collisions) are subject to certain specific Newtonian physical constraints. For example, regardless of mass, B cannot move at more than double the speed of A from the collision alone (mathematically provable), and B cannot travel at a 90º angle relative to the direction of A's motion. Building off of work with adults (Kominsky et al., in press), we show that infants are sensitive to these constraints: 7- to 9-month-old infants habituated to a launching event will dishabituate when presented with either of these physical violations, but not when presented with a physically plausible change matched for low-level visual features (e.g., A moving faster than B), and not when presented with minimally matched non-causal events. These results indicate that causal perception, from early development, is sensitive to approximations of real-world physical constraints.

2-B-20   How do Toddlers Make Memory Decisions in the Face of Novelty Preferences?

Sarah Leckey¹, Elliott Johnson¹, Simona Ghetti¹

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Novelty preference has long been used as an indicator of memory in infants and young children who are passively viewing old and new items. The present research examines whether this preference changes if memory demands are explicitly introduced in the task. In the current study, 2-year olds (N=62) completed two memory tasks: a passive viewing task (covert task) and an explicit memory task (overt task). An overall novelty preference (novelty preference = >.50) was found in both the covert task (M = .59, SD = .09), p < .001, and in the overt task, (M = .56, SD = .08), p < .001. This indicates the goal of selecting old items does not result in an overall suppression of the novelty preference. Toddlers' accuracy in the overt task as a group was at chance, (M = .46, SD = .12). However, there was substantial individual variability. Toddlers who performed above chance in the overt task (M = .69, SD = .12) did not exhibit a novelty preference in this task (M = .48, SD = .08), but did in the covert task (M = .60, SD = .10). In contrast, toddlers who performed the overt task at or below chance exhibited similar novelty preference scores across both the covert (M = .58, SD = .06; M = .58, SD = .07) and the overt (M = .54, SD = .04; M = .61, SD = .07) tasks. These results suggest that an emerging inhibitory ability may help toddlers resolve a conflict between their tendency to inspect novel items and their current memory goals.

2-B-21   Evidence for Memory Development of Multimodal Naturalistic Stimuli

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Previous research has shown improvements in memory from ages 4 to 6 for object and background pairings (Lloyd, Doydum, & Newcombe, 2009; Sluzenski, Newcombe, Ottinger, 2004). The current experiment was conducted to investigate memory binding for animal sound pairings. The present data extend earlier findings to naturalistic stimuli that are cross modal. Children (N=92) aged 4, 6, 8 and college students (N=42) studied a set of 24 animal sound pairings and were then given a recognition memory test. The test included intact and rearranged pairs to assess memory binding. To test item memory, participants had to discriminate studied and novel animals and sounds presented in isolation. Overall, 4-year-olds had lower hit rates and higher false alarm rates except for recognizing intact pairings. This is consistent with a shift from reliance on familiarity to recollection for recognition memory decisions.

2-B-22   Children ignore words for novel objects that are socio-culturally irrelevant

Haykaz Mangardich[1], Mark Sabbagh[1]

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Young children are selective word learners. For instance, they resist learning the names for novel objects they were told were purchased faraway compared to when they were told the objects were purchased nearby (Henderson et al., 2013). What remains unanswered is how, mechanistically, children block word learning in this context. At least two possibilities exist. Children can block learning by ignoring the speaker's labeling event or by attending to the labeling event but then blocking the formation of a conventional semantic representation. Here, we conducted an electrophysiological (ERP) study to test between these two possibilities. Thirty-six children (21 girls, Age = 6.5 years) first experienced novel word training in which they were provided with labels for novel objects that were said to be purchased from either nearby (downtown) or faraway (Japan). ERPs were subsequently recorded to determine whether children created perceptual and semantic representations for the novel words, as indexed by the N200 and N400 components, respectively. Results showed that, whereas children in the nearby condition demonstrated both an N200 and N400 effect, children in the faraway condition showed neither. These results suggest that children in the faraway condition ignored the irrelevant information and did not encode either a perceptual or semantic representation. We discuss how these findings contrast with other studies of the mechanisms underlying selectivity in alternative contexts.

2-B-23   The Role of Regulation in Reasoning: Why Cognitive Regulation, not Behavior Regulation, Predicts Inductive Reasoning and Learning

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Why are some individuals more effective in reasoning than others? Is self-regulation the answer, or are there distinct facets of self-regulation that might contribute differently? I examined two kinds of self-regulation - cognitive and behavioral - as predictors of individual differences in young adolescents' (ages 11-13) inductive reasoning and inquiry learning skills. Across four studies, two on low-SES samples (n=21; n=16), one on a high-SES sample (n=32) and one on a middle-class sample (n=135), cognitive regulation, not behavior regulation, predicted effectiveness on both inductive reasoning and inquiry learning. These preliminary results suggest that (a) cognitive regulation is the more consequential predictor of both inquiry learning and inductive reasoning, and (b) cognitive regulation and behavior

regulation, while related, are distinguishable facets of self-regulation. But do these relationships persist across adolescent development? We move forward discussing a current study on larger sample (n=696) of low-SES adolescents (ages 11-19), looking closely at how and why inhibitory control, and other cognitive regulatory processes, might explain learning and reasoning effectiveness, and why such processes influence inquiry learning and other critical metacognitive strategies.

2-B-24   Visual Habituation in Deaf and Hearing Infants

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Sensory experiences are critical for the development of general cognitive processes and learning. Current accounts of neuroplasticity assume that a lack of sensory input results in atypical cortical reorganization and cascading effects throughout other modalities. Deaf infants offer a unique opportunity to investigate the resulting hypothesis that early auditory experiences contribute to the development of general cognitive skills. The current study compared habituation--an early form of cognitive processing--to abstract visual objects between deaf and hearing infants (ages 8-22 months). Findings revealed that the deaf infants habituated more slowly, and had lower look-away rates, to visual stimuli than the hearing age-matched controls. Further, we explored relations between habituation and clinical outcome measures in the deaf infants, and found correlations between rates of habituation and performance on language assessments. These findings have implications for the role of early auditory experiences in the development of general cognitive and learning abilities.

2-B-25   Emotional Design and the Training of Executive Functions in Adolescents: Influence of Hot vs. Cool Game Characters

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This study seeks to understand the effects of Emotional Design (Plass et al., 2014) in a game-based training targeting the executive function (EF) subskill of switching in adolescents. Participants (N=239, mean age=14.13, SD=1.35) played a game for 20-minutes that was designed with game characters composed of either emotionally salient ("hot") features (i.e., warm colors, round shapes, and strong facial expressions), or emotionally neutral ("cool") features (i.e., neutral colors, square shapes, and neutral facial expressions), see Figure 1. Before and after the game-play session, participants completed the DCCS, a standard measure of switching from the NIH Toolbox. Comparing posttest scores revealed a significant difference between conditions, t=3.04, p<.001, d=0.17, favoring the hot condition (M=7.74) over the cool condition (M=7.25). Additional analysis of the DCCS posttest score using a two-way ANCOVA with DCCS pretest score as a covariate, and treatment and age as predictors, revealed a significant three-way interaction between DCCS pretest score, treatment, and age, F(2,205)=8.42, p<0.01, $\eta p2$=0.04. Further analyses indicate that the "hot" design was particularly effective for older children and for children with higher pretest DCCS scores. These findings support the hypothesis that game designs that induce high emotional arousal may enhance targeted EF skills, and that the effects of training may vary by age and prior ability.

### 2-B-26	The Role of Preference on Visual Search in Infancy

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To examine the factors that govern infants' attention, we tested 6-month-old infants (N=49) in a visual search task on two sessions, separated by 1 week. We recorded infants' eye movements as they viewed arrays of 4 items containing one target and 3 identical distractors. The arrays were constructed so that either the target was preferred over the distractor (established previously) or the target and distractor were equally preferred. In a previous study with 6- to 8-month-old infants, we found that an odd-ball target in a visual array holds infants' attention even if it is not preferred, and that preferred targets are more effective at capturing and holding infants' attention. Our current sample replicated these previous results. On both testing sessions, the proportion of the total looking time devoted to the target was greater than chance for both type of arrays, ps < .01, and infants directed a greater proportion of their first looks to the target when the target was preferred for session 1, $F(1,48) = 14.43$, $p < .001$, and session 2, $F(1,48) = 55.45$, $p < .001$. Comparison of the two types of arrays revealed infants spent a greater proportion of time looking at the preferred targets at both sessions, ps < .001, and they directed a greater proportion of their first looks to the target when the target was preferred at both sessions, ps < .001. Thus, infants' eye movements in visual search are influenced by top-down factors.

### 2-B-27	Age-Related Improvements in Mnemonic Discrimination during Childhood: Development of Pattern Completion and Pattern Separation

Leslie Rollins[1]

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Mnemonic discrimination (i.e., the ability to discriminate between previously encountered and novel stimuli) is a foundational cognitive ability that is argued to be supported by the processes of pattern completion and pattern separation (Yassa & Stark, 2011). Pattern completion activates stored memory representations when provided with partial or degraded input. This process is important for learning and memory because it supports recognition in suboptimal conditions or when the stimulus is presented with minor changes. Pattern separation differentiates overlapping memory representations and supports the formation of unique memories. Little is known about how pattern completion and pattern separation develop during childhood. However, because these processes are hypothesized to be reliant on subregions of the hippocampus that show prolonged structural development (Lee, Ekstrom, & Ghetti, 2014), there is good theoretical reason to expect both processes to develop during childhood. Consistent with this hypothesis, Ngo, Newcombe, and Olsen (2017) recently showed that pattern separation improves between 4 and 6 years. No significant difference was observed between 6-year-old children and young adults. The current study examined the development of pattern completion and pattern separation from early childhood through young adulthood. Five- and 6-year-old children (n = 18), 8- and 9-year-old children (n = 20), 11- and 12-year-old children (n = 20), and young adults (n = 20), completed a child-friendly version of the Mnemonic Similarity Task (Stark, Yassa, Lacy, & Stark, 2013). Participants encoded 100 stimuli and, at retrieval, judged whether 50 repeated stimuli, 50 lures (i.e., stimuli similar to targets), and 50 novel stimuli were "Old," "Similar," or "New." Lures varied in level of similarity to targets. Results suggest that pattern completion and pattern separation improve during childhood. Pattern completion, indexed by the proportion of lures misidentified as "New" minus the

proportion of targets misidentified as "New," improved with age, F(3, 78) = 3.73, p =.02 (see Fig); adults were less likely to misidentify lures as "New" than 5- sand 6-year-old children (p = .02). Additionally, the level of mnemonic similarity between lures and targets impacted "New" judgments in 5- and 6-year-old children and 8- and 9-year-old children but not 11- and 12-year-old children and adults. Pattern separation, indexed by the proportion of lures identified as "Similar" minus the proportion of lures identified as "Old," gradually improved with age, F(3, 78) = 8.4 , p < .01 (see Fig); 5- and 6-year-old children performed more poorly than 11- and 12-year-old children and adults, and 8- and 9-year-old children performed more poorly than adults. Level of mnemonic similarity interacted with age group to impact the index of pattern separation; although all age groups incorrectly identified the most similar items as "Old" rather than "Similar", older age groups were more likely to correctly classify less similar items. The current findings suggest that pattern completion and pattern separation both improve during childhood. Pattern completion improved after early childhood and pattern separation improved linearly from early childhood to young adulthood. This result differs from aging research which suggests an age-related decline in pattern separation but not pattern completion (Ally, Hussey, Ko, & Molitor, 2013; Stark et al., 2013).

2-B-28   How subjective experience guides children's memory decisions beyond memory accuracy

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Memory signals and subjective assessments of these signals are often highly correlated, making it difficult to establish whether subjective assessments causally contribute to decision-making or are epiphenomenal. In the current research, we dissociated memory accuracy from subjective recollection and examined children's (6-7 and 9-10 year-olds) and adults' decisions to select their best memories in anticipation of a reward. Results revealed a larger dissociation in adults relative to children but subjective recollection guided decision-making beyond accuracy in all age groups (Experiment 1: N=114). When limits were placed on how many responses could be selected for a future reward, subjective recollections continued to guide decision-making, but young children (6-7 year-olds) showed a cost in accuracy particularly on trials associated with subjective recollection (Experiment 2: N=80). Furthermore, adults were more likely to select subjectively recollected trials for future reward than young children, suggesting developmental improvements in decision-making. Overall, these results suggest that subjective memory states support memory decisions but this process improves throughout middle childhood and comes at a cost in accuracy for young children.

2-B-29   See it, like it, learn it: Exposure and attention at 3 months predict face discrimination at 3 and 6 but not 9 months

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Infants' early attention to and high density experience with frequent social stimuli, faces, likely tunes a foundational perceptual-cognitive ability: discrimination of individuals. To measure the influence of exposure and attention on discrimination, 29 3-month-olds (14 female, M=87.17 days, SD=10.69) recorded their natural, daily experience for one week using a miniature infant-perspective camera. This

video was coded frame-by-frame for faces; female were more frequent than male faces. At 3, 6, and 9 months, infants completed face attention and discrimination tasks. Female face discrimination at 3 months was predicted by infants' overall face exposure, exposure to mom's face, and attention to faces, R2A=.620 (see Table 1); 6 and 9 month discrimination was not. Male face discrimination at 3 months was predicted by attention to faces, R2A=.231 and, at 6 months, by exposure to dad's face, R2A=.191; 9 month discrimination was not. Thus, attention and exposure likely predict discrimination only after sufficient exposure is accrued.

2-B-30   When a spoon is not a spoon: The role of executive function in young children's divergent thinking

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Although creativity is increasingly recognized as a critical skill, its development remains poorly understood. Our study began to explore whether the development of executive function (EF) contributes to young children's divergent thinking, a core component of creativity. By manipulating the familiarity of objects used in the Alternate Uses task (Wallach & Kogan, 1965), we tested the proposal that generating diverse, original ideas requires inhibiting the most obvious idea that comes to mind - an ability that theoretically relies on EF (Cassotti et al., 2016). Typically developing 4- and 6-year-olds (N = 103) were randomly assigned to complete the Alternate Uses task with either very familiar, somewhat familiar, or novel objects. Results showed a significant effect of object familiarity on divergent thinking: children generated a greater number of original ideas for novel objects than for objects they recognized (partial eta squared = .09). Follow-up analyses indicated this effect was not significantly moderated by individual differences in EF or age, and there was no main effect of age on originality. These findings suggest that familiarity with a stimulus impairs young children's divergent thinking, although further research is needed to determine whether this is due to differing EF demands. Additional follow-up analyses will explore the contribution of EF to early creativity by examining children's EF and divergent thinking in relation to IQ and temperament.

2-B-31   Brain and Behavioral Correlates of Error Monitoring in Young Children

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Executive Functions (EF) (e.g., response inhibition, working memory) develop rapidly in early childhood and have been linked with various academic outcomes. Though post-error slowing (PES) has been widely considered a behavioral indicator of response monitoring, different theories regarding its functional significance debate on whether PES represents adaptive response inhibition for a better performance. Less is known about the development of PES in young children, and few developmental studies have linked PES with neurological correlates of children´s EF. Data from three separate but complementary investigations of 3- to 7-year-old children were analyzed to address these questions. Children´s behavioral performance and the event-related potential (ERP) correlates of response monitoring were recorded from a Go/No-Go task. Preliminary results from 72 children (Mage = 5.5) revealed that the magnitude of PES increased as a function of age (r(71) = .47, p <.001). All children performed better at the beginning of the task compared to the end (t(122) = -3.5, p <.001), however, children who slowed

more after error commission had less rapid decline in their accuracy rates (t(122) = 2.15, p = .03). In addition, larger PES was associated only with bigger amplitudes (more positive) of the correct-related negativity (CRN) on correct trials (r(71) = .23, p <.05). No relationship was found between PES and amplitudes of the error positivity (Pe) on correct or error trials.

C - Concepts, Categorization, Casual Learning

2-C-32   Time to Clean Up: Assessing Categorization by Engaging 24-Month-Olds in a Sorting Task

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Toddlers' have difficulty integrating perceptual and cognitive information to guide their actions. We recently showed that in some tasks toddlers' performance is improved if they wear weighted wristbands. The advantage of weighted wristbands, however, does not apply equally to all tasks. In Experiment 1, we found that categorization performance by 24-month-old children tested with weights was no different when tested without weights using the sequential touching procedure. In Experiment 2, we developed a task to test categorization in a context that was more similar to other tasks that showed an advantaged for weighted arms. To that end, we engaged 24-month-olds in a "clean up" game that involved sorting objects into bins. Children completing this task wearing weighted wrist bands showed significantly better performance than children wearing unweighted wristbands. Thus, the effect of weighted wristbands may be restricted to contexts that involve a spatially directed response, engagement with an experimenter, and/or feedback on performance.

2-C-33   Costs of Selective Attention in Category Learning

Nathaniel Blanco[1], Vladimir Sloutsky[2]

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Previous research has shown that when learning categories, adults and young children allocate attention differently. Adults utilize selective attention extensively, focusing primarily on the most relevant information, while young children distribute their attention widely. While selective attention is useful, over-reliance on selective attention has its downsides. In addition to ignoring information that may be useful later, it can lead to learned inattention. In our experiments, adults and four-year-olds learned two categories of creatures composed of binary features. One feature deterministically predicted category membership, five were probabilistically predictive, and one was fixed (i.e. did not differ between the categories). The fixed feature is critical in that selective attention to the predictive feature could lead to learned inattention to the fixed feature, distinguishing this task from the Wisconsin Card Sort Task. Halfway through the task, an unannounced switch occurred: the previously deterministic feature became fixed, and the fixed feature became deterministic. Our results show that adults incur a greater switch cost than children, who more often quickly learned to use the new deterministic feature to categorize the creatures than adults. Distributing attention may be adaptive in young children, making them flexible to changing contingencies and facilitating exploration, both of which are useful when general knowledge about the environment is more limited.

2-C-34   The role of social and verbal information in developing avoidance behaviors towards threatening animals

Megan Conrad[1], Zachary Walden[2], Emily Kim[2], Vanessa LoBue[2]

[1]William Paterson University, [2]Rutgers University

Responding to threat quickly and efficiently is critical for survival. Because of the significant reproductive benefit associated with the avoidance of threatening stimuli, many prominent theories propose that humans evolved psychological mechanisms that facilitate the detection and subsequent avoidance of potential threat. However, despite widespread theorizing, very little research has examined how avoidance behaviors towards threatening stimuli develop. In the first of two studies, we presented 3- to 5-year-olds with positive or negative social (i.e., happy/fearful faces) or verbal information about threatening (snakes/spider) and non-threatening (turtle/frog) animal toys. We found that negative verbal information encouraged avoidance responses, but only for the threatening animals (see Figure). In a second study, we documented the types of verbal information 3- to 8-year-old children typically receive about threatening versus non-threatening animals in natural parent-child conversations at a local zoo. We found that parents provide more negative verbal information about threatening animals than non-threatening animals, and that the information they provide about threatening animals is more likely to be negative than positive. Altogether, this work highlights the importance of verbal input for the acquisition of avoidance responses toward threatening stimuli, and most importantly, that the input children typically receive about threatening stimuli is quite negative.

2-C-35   Overhypothesis Formation in Capuchin Monkeys (Cebus apella) and Children

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The use of abstract higher level knowledge (e.g., overhypotheses) is acquired early and may allow human children to learn quickly from sparse data, and make predictions in new situations. To investigate the evolution of overhypothesis formation, we developed a forced choice task, based on a study of abstract rule learning in infants (Dewar & Xu, 2010), to test this ability in capuchin monkeys (Cebus apella) and 3- to 5-year-old human children. After seeing sampled evidence from three containers sorted either by type or by size, participants are presented with two new test containers and respective example items (a small, high-valued and a large, low-valued reward). Subsequently, subjects can choose between two covert samples from these containers. Depending on the observed evidence, different choices are expected to maximize the chances of receiving a large over a small and a high-valued over a low-valued item. None of ten capuchin monkeys showed this pattern, instead choosing indifferently in each condition. Further, performance was at chance level in a follow up task with reduced cognitive demands. These results hint towards a recent evolutionary emergence of this ability. Data collection with children is ongoing but preliminary results suggest better performance when compared to monkeys.

2-C-36   Using a continuous measure to study transgender children's gender identity

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Research has found that young transgender children's gender identities show remarkable similarities to gender-typical children who are of the same gender, as opposed to children of the same natal sex (i.e., opposite gender). However, these studies have used categorical measures of gender identity, and might not have captured the diversity of gender identities among transgender vs. gender-typical children. We presented 100 transgender children (Mage=8.20) a continuous gender identity measure, and compared their responses to 105 gender-typical controls (Mage=8.47). Participants were asked to mark a line to represent the gender they felt inside, with one end of the line indicating feeling totally like a boy, the other end indicating feeling totally like a girl, and the middle indicating a mix of both. These marks were converted to a 0 to 100 scale, where higher scores indicated feeling like the gender they present as, and lower scores indicated feeling like the opposite gender (for transgender children, their natal sex). Consistent with recent research, we found that transgender children (M=85.36) did not differ from controls (M=83.17) in how they identified, $F(1,201)=0.77$, $p=.381$. For both groups of children, this new measure of gender identity was significantly correlated with gendered toy, peer and clothing preferences (transgender: $r(91)=.23$, $p=.03$; controls: $r(95)=.26$, $p=.01$) and similarity to own gender (transgender: $r(88)=.45$, $p<.001$; controls: $r(93)=.49$, $p<.001$).

2-C-37 The Role of Parent-Child Conversation in Young Children's Developing Understanding of Animals

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Parent-child conversations may contribute to children's efforts to organize the conceptual space of the animal domain. This poster will describe targeted findings from three studies relating information shared in parent-child conversations to children's understanding of living and nonliving kinds. Study 1 (N=67 families) was a diary study documenting that families' everyday conversations about nature were most frequently focused on animals (34% of reports). Most conversations about animals included talk about biological properties; fewer mentioned psychological or sensory properties. Study 2 (N=36 dyads) was an investigation of parent-child talk about animals and animal imposters (e.g., a robot), findings showed that families did not limit their attribution of biological, psychological and sensory capacities to actual animals. This conflicts with children's reasoning in a property attribution task in which domain-distinctions were more clearly defined. Finally, Study 3 (N=30 dyads) examined parent-child talk about animals that vary in their featural and dynamic characteristics (e.g., apes, bees). Parents' use of animate and inanimate pronouns suggest an animal hierarchy rather than an understanding of animals as a single ontological category. Taken together, these studies suggest that parent-child conversations can be both scientifically informative and misleading, and raise questions about how children process parent testimony to inform their conceptual understandings.

2-C-38 Food categorization and food neophobia in preschoolers (3-4 years of age)

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The present study investigated the relationship between food categorization and food neophobia in preschoolers (N=109, mean age= 46.9). We tested the following hypotheses: (i) food neophobia is connected to both discriminability and inductive reasoning performances in the food domain (ii) inductive reasoning strategies are based on color in the food domain and based on shape in the artefact domain. We first measured the intensity of food neophobia for each participant with the Child Food Rejection Scale. Then the participants performed: i) an induction task on food and artefact triads in which category membership conflicted systematically with perceptual similarity (color or shape match), and ii) a discrimination task between edible versus inedible items. A linear mixed model revealed that food neophobia predicts inductive reasoning performances. We also obtained a negative correlation between food neophobia and performances on food triads but not on artefact triads. Finally, we observed that children generalized properties preferentially according to shape in the artefact domain, but we did not observe any particular strategy (either shape based or color based) in the food domain. We conclude that these results uncover a circular (and potentially vicious) relationship between food categorization and food neophobia. Further research will then have to address this circular mechanism before designing public health interventions targeting preschoolers' food behavior.

2-C-39   Asking children to "be helpers" instead of "to help" leads to less helping and more negative attitudes following setbacks

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The implications of describing children's behaviors in terms of their identity-as opposed to their behaviors-is not yet fully understood. While some have suggested that describing pro-social behaviors in this way motivates children by encouraging them to maintain membership in a positive identity category (Bryan et al., 2014), we hypothesized that such an approach may backfire once children experience setbacks (similar to Cimpian et al., 2007). To test this possibility, we conducted an interactive study with 4- and 5-year-old children (n = 75) in which each child was asked to either "be a helper" or "to help" and then faced two setbacks (tasks that were rigged to result in failure-e.g. a request to move a box that contains Ping Pong balls but has a loose bottom). Following the setbacks, children were asked to help with three non-rigged tasks and were then asked to reflect on their attitudes toward helping. Our results revealed that, following setbacks, children in the identity-focused (Helper) condition helped less on the pro-social solicitations that followed (M = .30, CI = .21-.42) than those in the behavior-focused (To Help) condition (M = .47, CI = .37-.59), Wald $X^2(1)$ = 4.54, p = .03. Furthermore, children in the Helper condition who subsequently refused to help also reported less positive attitudes toward helping (F(1, 68) = 4.17, p = .045). These findings lend important insight into the nuanced effects of using identity-focused language to describe children's behavior.

2-C-41   Young children shift expectations of category homogeneity in response to language cues

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Research has shown that young children tend to view categories as homogeneous, generalizing properties of an individual (e.g., this dax has wings) broadly to all category members (e.g., all daxes have wings). Here, we explore whether the language used to describe individual category members can attenuate or strengthen children's expectations for category homogeneity. Using an induction task, 48 4 to 6-year-olds predicted the distribution of properties among members of unfamiliar animal categories. We varied between-subjects the language introducing the target property (neutral: "this markhor has twisted horns"; unique: "This markhor is special because it has twisted horns"; explanatory: "This animal has twisted horns because it's a markhor"). Our findings suggest that kids are sensitive to these cues and shift their expectations of homogeneity accordingly. Kids in the explanatory group made the broadest generalizations, responding that "all" members of the category have the target property significantly more often than kids in the other conditions. Conversely, kids in the unique group made the narrowest generalizations, responding most frequently--and significantly more than the other two groups--that "just some" category members possess the target property. These results suggest that while young children may have a general expectation that categories are homogeneous, they appropriately adjust this expectation in response to language cues in their environment.

2-C-42   Perceptual features count under difficult task demands

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Categorization depends on the ability to rely on relevant perceptual features while ignoring others. Children as young as 5-6 can form and generalize a new category based on a rule feature. The present study asks under what circumstances children and adults can best learn and generalize a novel rule in a categorization task. Five- to 7-year-olds and adults completed a categorization task in which they were asked to sort novel creatures into one of two categories based on the proportion information provided. We manipulated the perceptual properties, such that participants saw either the 'full' creature or a 'minimal' version of the creature. In Ex. 1,we found that children were more accurate when given a minimal presentation rather than the full presentation, whereas adults displayed equal performance across conditions. In Ex. 2, we investigated the role of task demands by creating a more difficult task for adults (timed) and an easier task for children (a more general rule). Under higher task demands, adults mirrored children's performance in Ex. 1, with highest accuracy apparent for minimal stimuli. In contrast, we find that children, given easier task demands, looked like adults in Ex. 1, showing no difference across conditions. These results suggest that perceptual features play an important role when children and adults form difficult novel categories, but that this may interact with task demands, such that 'less is more' only when the task is most difficult.

2-C-43   One size fits all

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An influential body of categorization research suggests that exceptional items may be represented in a different way than the regular category members (e.g. Palmeri & Nosofsky, 1995, Sakamoto and Love, 2004). Here we report a study that contradicts this assumption, showing this may not be true for all the

exceptions, nor may it be our default approach in representing deviant items. Four-year-olds and adults were taught to group two categories with exceptions. For regular items, out of their 6 features, one was fully predictive (rule feature) and 5 were probabilistic. Exceptions were individuals - all their features were fully predictive. Despite the objective differences in the structure of the regular items and exceptions, they tended to be represented in the same way. Younger participants (4-year-olds), who tended to form similarity-based representations, had similarity-based representation for both regular and exceptional items. Adults, on the other hand, tended to form rule-based representations for regular items, but surprisingly, for exceptional items, too. Beyond the group differences (F(1,194)=26.64, p<.001, η=.13) we found strong correlations in individual memory patterns, for both adults (r=72, n=56, p<.001) and 4-year-olds (r=.62, n=41, p<.001). Our results offer a new insight into how cognitive system deals with the information that violates its expectations and how conflicting information becomes integrated.

2-C-44 All together now: The role of overlapping relations in the development of semantic knowledge

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Human semantic knowledge is organized according to meaningful relations among concepts. Semantic knowledge influences many aspects of cognition; thus, understanding its development is key to understanding human cognition. Prior research examined knowledge of single relations (e.g., taxonomic and thematic relations); yet, entities in the world are often related in overlapping ways. For example, 'chair' and 'table' are related thematically and members of the same taxonomic category. We propose that this overlap plays a key role in semantic development by facilitating taxonomic category learning. We examined this possibility using an implicit measure of relational knowledge, in which we tested the degree to which performance inchildren (aged 4 to 9) was disrupted by the presence of related vs. unrelated items when looking for a target in a visual array. Related distractors wereThematically related only, Taxonomically related only, or Both. Disruption was indexed by slowing down in identifying the target (Study 1) and increased eye gaze to distractors (Study 2) compared to baseline. In both studies, items that were Both thematically and taxonomically related (but not Taxonomically related items) disrupted performance in younger children; whereas older children's performance was disrupted by Both as well as Taxonomically related items. These findings suggest that overlapping taxonomic and thematic relations bootstrap the learning of relations between items of the same category.

2-C-45 The development of intuitions about the structure of mental life

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From early in life, attributions of mental states govern interactions with people and other beings and inform judgments about their moral status. But the notion of mental life is complex: How do we come to make sense of the many emotions, sensations, thoughts, etc. that make up mental life? Previous work suggests that US adults organize mental life into bodily, social-emotional, and perceptual-cognitive components, and that this conceptual structure is in place by elementary school. We explored the development of these intuitions by asking 4- to 9-y-old children about the mental capacities of a variety

of characters (e.g., robot, doll, beetle, mouse, elephant). We replicated the finding that, like adults, older children (7-9y, N=128) organize mental life into bodily, social-emotional, and perceptual-cognitive components. A similar structure seems to underlie younger children's responses (4-6y, planned N=120, 93% complete)--but with a somewhat weaker distinction between the social-emotional and bodily components. Attributions of mental life to different characters differ across age, particularly in the social-emotional domain: While previous studies have shown that adults rarely attribute emotions to such "edge cases" as beetles and robots, the current studies suggest that 7- to 9-y-olds freely do--but that 4- to 6-y-olds do not. This curvilinear pattern raises interesting questions about the role of early childhood experiences in shaping children's intuitions about the mind.

2-C-46   Chinese Children Learning Higher-Order Generalizations through Free Play: The Influence of Parenting Style

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Abstract Constructivism holds that children build large conceptual structures for understanding the world in the process of cognitive development, and develop these through active learning. Recently, Sim and Xu (2017) have demonstrated that 2- and 3-year-old children successfully acquired higher-order generalizations using self-generated evidence during free play, but it remains an open question if this conclusion is true cross cultures. Using the same methods, we found that 2.5- to 4-year-old Chinese children also acquired higher-order generalizations under two different learning conditions, however, unlike U.S. children, their performance in the didactic condition was better than that in the free play condition. Furthermore, parenting styles affected children's learning, but only in the free play condition: children with authoritative parents performed significantly better than children with authoritarian parents. Key words: free play, active learning, higher-order generalization, parents' cultural belief systems, parenting style

D - Cultural Learning

2-D-47   The role of attention in learning from overheard conversations: Individual and cultural variation in 18-month-old infants

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When infants learn words in directed interactions their attention is monitored for them; their partner uses social cues to focus infants' attention. In overheard conversations infants are responsible for monitoring their own attention. A child must monitor speakers in order to follow conversation. Therefore, infants who show this pattern should be superior overheard word learners. Thirty-two 18-month-old US infants were tested in a within-subjects word learning paradigm. They were taught a novel word in two contexts: Child-directed and Overheard. Infants' attention to word learning training was coded for attention to both experimenters and number of switches made between experimenters. We replicated previous work that children can learn words in both Child-directed and Overheard contexts. Our analysis showed infants attended to Experimenter 1 and 2 for the same amount of time in

both contexts; however, for the Overheard condition only, infants made more switches between experimenters and more switches was related to better word learning (See figure). Next we tested 32 Mayan infants in the same paradigm. We wanted to explore Mayan infants' attention in a similar way given that most of their early input is overheard speech. In our analysis, Mayan infants showed no condition differences in overall attention and their switches did not vary by condition or relate to their word learning. Future work will explore the factors that influence individual patterns of attention.

2-D-48   The Effects of Theory of Mind on Children's Source Monitoring of Testimony

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Children readily believe in entities that cannot be seen, but how much children endorse an entity's existence varies by patterns of testimony children receive. Children do not always remember the source of knowledge for how they learn something, and this lack of epistemological reasoning might be related to developing theory-of-mind (ToM) abilities. To examine the relations between source monitoring and ToM, children (3.5- to 6-years; N = 118) from several religious affiliations were asked about God's reality status and how they knew if God possessed 9 humanlike characteristics. Responses were coded for children's citation of 5 sources of knowledge: person (family, self, other), religion (God, religious text), other, don't know, no source. Children also completed perspective-taking, knowledge access, and appearance-reality tasks. Children who passed ToM tasks were less likely to list a religious source and were more likely to say, "I don't know" when asked about their source of knowledge about God. Thus, as children develop ToM, they are better at recognizing their own limits in their epistemological knowledge.

2-D-49   Sometimes Hesitancy is Key: Effects of Moral Deliberations on Children's Interpretation of Credibility Cues

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Children often treat confident individuals as more credible sources of information. Yet, confidence may differentially signify credibility depending upon the domain. We tested children's judgments of models who differed in their level of confidence (confident, hesitant) in two domains (factual, moral). In a between-subjects design, 28 children (6-8 years, M=7.07 years, SD=.60) listened to a confident or hesitant model make either factual (e.g., which animal has the longest tail?) or moral claims (e.g., which animal should get the last piece of fish?). Across eight trials, children rated the model on a 4-point scale (0=not at all, 3=a lot) in terms of liking, smartness, and agreement with her answer. A 2 (confident, hesitant) x 2 (factual, moral) ANOVA indicated significant interactions between domain and level of confidence in children's ratings of liking ($F_{(1, 24)}=10.280$, $p=.004$, $\eta2=.30$), smartness ($F_{(1, 24)}=12.003$, $p=.002$, $\eta2=.33$), and agreement ($F_{(1, 24)}=12.532$, $p=.002$, $\eta2=.34$). That is, children judged the confident model higher than the hesitant model in the factual domain, whereas they judged the hesitant model higher than the confident model in the moral domain (Figure 1). Thus, children understand that confidence is a relevant credibility cue when one is dealing with factual information, whereas hesitancy may be more appropriate when making moral deliberations. Future work will examine the emergence and reasoning underlying this understanding.

2-D-50   **Two-year-olds prefer to use adult over peer testimony: Comparing pointing comprehension and gaze following across social contexts.**

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Throughout the second year of life, infants' and toddlers' encounters with age-mates provide opportunities for social learning that are strikingly different from the structured interactions they have with adult caregivers. In turn, children's experiences with peer and adult partners are likely to shape the expectations about, and the value they ascribe to information provided in both social contexts. Testing two-year-olds with adults and age-mates under matched conditions has the potential to elicit behavior that is reflective of such early acquired learning biases. Following this approach, we tested whether dyads of two-year-olds would be able to produce and comprehend informative pointing gestures with peer and adult partners in a cooperative object-choice task. Children pointed equally accurately for adult and peer partners but more often for an adult interlocutor. In comprehension, children were significantly more likely to use information provided by adults and were at chance when following the pointing gestures of peers. In order to rule out that such an effect could result from differences in in-test experience, we designed a follow-up study in which two- and three-year-olds were tested in the same task with video recordings of peer or adult partners in a semi-interactive set-up. This approach enabled us to match the stimulus material very carefully and at the same time allowed for the employment of looking time measures. The second study replicated our previous finding showing that children at two years of age are prefer to use pointing gestures from adults in a simple object-choice task. The eye-tracking data indicate that children's bias for adults cannot be explained by differences in the allocation of attention and rather suggest that two-year-olds value information differently when peer and adult partners provide it. On the other hand, the three-year-old age group did not differentiate between social contexts but used pointing gestures in both conditions. This would support an experience-based developmental account arguing that peers become more important sources of information as children become to sustain longer and more structured interactions with age-mates typically beginning around three years of age (Eckerman & Peterman, 2001; Smiley, 2001). In a third study, we investigated another form of social reference and tested two-year-olds' gaze following with videos of peer and adult models. Adopting predictive (Tummeltshammer, Wu, Sobel, & Kirkham, 2014) and preferential (Kano & Call, 2014) looking paradigms, we found that two-year-olds follow gaze cues from peer and adult partners equally. As in study two, toddlers appear to be generally interested in their age-mates' focus of attention. In an ongoing study, we are now using gaze cues from peer and adult partners in a word learning paradigm in order to test whether social context would mediate children's learning performance. Taken together, our studies demonstrate that at two-years-of age, children are equally attentive to peer and adult partners' gaze and pointing gestures but value testimony more when provided by adults. The findings will be discussed in the light of work on children's early preparedness for and active contribution to social learning in infant-caregiver interactions.

2-D-51   **The effect of in-group rituals on the perceived instrumental function of tools**

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The use of artifacts in group rituals is widespread across human cultures, yet little is know about how children perceive the function of objects that have been used ritualistically. This study examines the effect of ritualistic tool use on 4-6-year-olds' (N = 118) perceived instrumental function of the tool. In two between-subjects conditions, participants were shown a video demonstration of a female actor interacting with objects. To manipulate group ritualization (ritual condition), we assigned children in-group membership (i.e., wearing colored wristbands and a hat), and told them "this is how the red group does it" prior to the video of a red group member demonstrating an action sequence. In the control condition, children were told "this is how she does it" prior to the video of an actor demonstrating the same action sequence. Children were then given a chance to interact with the objects used in the video. Children were then presented with an instrumentally oriented puzzle box and were instructed to retrieve a toy from the box using an array of tools. Sensitivity to group ritualization increases with age. Older children were less likely to solve the puzzle box in the ritual versus control condition. Older children were also more likely to try alternatives to the ritualized tool to solve the puzzle box in the ritual versus control condition. These results provide insight into whether children's experience using a tool ritualistically imbues it with a ritual "essence".

2-D-137   Culture vs. Visual Environment - Cultural and Ethnical Similarities and Differences in Attention

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Previous research has investigated cultural differences in attention between East Asian cultures (e.g. Japan) - holistic perception and Western cultures (e.g. the U.S.) - analytic attention. However, previous studies have investigated mainly Caucasians as Western representatives and the origin of these differences has not been investigated thoroughly. The purposes of this study are to investigate the origin of cultural differences in attention (Holistic and Analytic perceptions) and whether an ethnical difference in attention exist within a culture. Specifically, this study examined the possible similarities and differences between Japanese preschoolers from Japan, Caucasian preschoolers from the U.S., and Hispanic preschooler from the U.S. Two hypotheses were drawn based on two theories of cultural transmissions: Cultural theory and Visual Environment theory. Based on Cultural theory, we expected that Japanese and Hispanic preschoolers to perform similarly because both of the cultures are considered interdependent cultures compared to Caucasians - independent culture. Based on Visual Environment theory, we expected Caucasians and Hispanic preschoolers to perform similarly due to similar visual environment they live compared to Japanese preschoolers. Using previously used methods for cultural differences in attentional (e.g. visual search task), our results suggest that Visual Environment theory may be stronger transmission vector than Cultural theory for attention.

E - Language Development

2-E-52   Bilingual Children are More Efficient When Processing Linguistic Competitors

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Early life experiences are thought to alter children's cognition and brain development; here, we investigate whether bilingualism impacts word processing. When listening to speech, multiple lexical items whose names begin with a similar phonological onset may come to mind (e.g., for /c/, candy, candle), and bilinguals may experience doubled competition. Using functional Near-Infrared Spectroscopy, the present study investigated whether bilingual and monolingual children (N=92; ages 7-9) exhibit differences in brain activity when processing linguistic competitors in one language (e.g., car/cat vs. car/pen). We presented children with two images, and instructed them to match a word to one of the images. Results revealed that all children responded slower when linguistic competitors were present. Importantly, monolinguals engaged greater brain activity in left frontal regions than bilinguals. These results suggest that while left frontal regions support language processes, group differences may result from bilinguals' efficiency in managing linguistic competitors in their daily life.

2-E-53   Do Children Learning Verbs Attend to the Variation of Elements Across Events?

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To learn a verb, children could benefit from comparing objects with similar relations across events. This study asks whether children can use variation of tools or affected objects across a set of events as they learn verbs. Two½- (n=32) and 3½- (n=33) year-olds were shown three learning events and two test events for two novel verbs. Children saw three different tools across events, or three different affected objects, or no variation (control). Looking to AOIs (tools, affected objects) was captured with Tobii x30 eyetracker; they pointed to extend the verb at test. A repeated measures ANOVA with age (2 ½, 3 ½) and condition (3: Tool Change, Affected Object Change, Control) as between subjects factors, and AOI type (tool, affected object) as a within-subjects factor; dv= difference in looking to an AOI (Trial 3 minus Trial 1) showed AOI type x Condition was significant, $F(2, 60)= 17.84$, $p< .001$, $\eta p2=.37$. In both variation conditions, children maintained or increased interest to objects that varied, and decreased attention to objects that did not. The control condition differed. At test, an ANCOVA analysis showed children in the Tool Change condition performed best (main effect of Condition, $F(2, 61) = 3.18$, $p= .050$). Results show children can compare objects across events, and can adjust their visual attention. Theoretically, children can learn from variation across examples, but research is needed to fully understand the role of variability in verb learning.

2-E-54   Speech sound categories emerge slowly over development

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Much research has asked when during development children can distinguish between minimal-pair phoneme contrasts (e.g. b vs. p) in their native language. Careful studies suggest that infants narrow down, and probably sharpen, their native-language sound contrasts during the first year of life. The assumption has been that minimal-pair discrimination reflects establishment of native speech sound categories, permitting efficient storage of words' sound patterns during vocabulary acquisition. Yet, 6-month-olds show some knowledge of word forms despite immature speech sound categories (Bergelson & Swingley, 2012), suggesting mature phonemes are not necessary for learning. Nor are they sufficient:

15-month-olds, who can discriminate minimal-pair sounds, do not easily learn novel minimal-pair words (e.g. bih vs. dih) as labels (Stager & Werker, 1997). Some studies even suggest ongoing non-adultlike minimal pair processing through the early teens (e.g. Hazan & Barrett, 2000). This suggests a different interpretation: that infants' early learning signals beginnings of a gradual accretion of sound pattern knowledge, out of which speech sound categories emerge. If children have fully established their native-language sound system and can thus store words as phoneme sequences by age 1 year, or even 2 years, then at least two things should be true of even-older, preschool-aged children. First, they should have difficulty acquiring vocabulary when words contain phonemic variability--the same object is called both "vosh" and "vush." Second, they should relatively easily learn minimal pairs--one object is "vosh" and the other "vush." The current research tested 3-5-year-old children's word-learning abilities in both cases. In each experiment, in the learning phase, children heard a cartoon picture labeled 16 times each (twice per trial x 2 pictures = 16 learning trials). They then completed an eye-tracked 2-alternative test phase. In Experiment 1, each child (N=63) learned two phonemically-inconsistent labels (e.g. object1=vosh/vush, object2=teev/tiv), and two phonemically-consistent labels (object3=zoof, object4=tedge). For 32 children, inconsistent labels differed in onset-consonant voicing (buv/puv); for the rest, inconsistent labels contained similar vowels (vosh/vush). Accuracy was higher for consistent than inconsistent labels (78% vs. 70%; p=.02) but did not differ between consonant and vowel inconsistency (p=.15). Further, consistent and inconsistent conditions were well above chance (both ps<.0001). This suggests that phoneme inconsistency only mildly affects children's word learning. In Experiment 2, children (N=32) learned the same words as in Experiment 1, but as minimal-pair contrasts (object1=vosh, object2=vush). Each child learned one consonant minimal pair and one vowel minimal pair, with order counterbalanced across children. Overall accuracy was above chance (p=.002) but low (59%; adult controls approached ceiling, 96%). Vowel and consonant minimal pair accuracy did not differ. This suggests that minimal-pair word learning, which is difficult for young toddlers, continues to challenge young children. These findings are hard to reconcile with early solidification of phoneme categories. Results are more consistent with protracted perceptual learning of word forms or phonemes. A possibility is that phoneme categories emerge from word learning itself. Implications for continuity of developmental change and preliteracy are discussed.

2-E-55 Preschoolers' Learning from eBooks: Parent Perceptions and Practices

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It is well known that children are able to learn novel words from joint book reading (Ard & Beverly 2004; McLeod & McDade, 2011) and that reading aloud to young children is associated with many benefits, including growth in language skill, vocabulary, literacy, and school success (Bus et al., 1995; Mol et al., 2008). According to the most recent Nation's Report Card, only about one third of fourth- and eighth-grade children are reading at a proficient level (National Assessment of Educational Progress, 2015). Consequently, many scholars, practitioners, and parents have turned to digital media with both hesitation and hope for promoting early development (Guernsey et al., 2012). The pervasiveness of mobile screen devices has introduced eBooks into the home, yet many parents are skeptical about the educational value of eBooks (Rideout, 2014), and children from lower-income homes may have less access to this media (Holloway et al., 2013). In order to maximize the effectiveness of educational eBooks for all children, it is critical to establish whether and how different families use eBooks with their children. Thus the current study collected survey data using Amazon Mechanical Turk on parent behaviors and attitudes while reading print versus eBooks with their young children. Data collection was

very recently completed (N=2,261), with plans to analyze demographic and attitudinal differences that moderate children's exposure to, use of, and learning from eBooks.

2-E-56   Eye gaze reveals where verb learners trip

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Children use an unfamiliar verb's linguistic context to learn its meaning, but linguistic context can be hard to process. In a recent study, we found 3-year-olds learned novel verbs introduced with unmodified subjects (e.g., "the girl is fezzing"), but failed with modified subjects (e.g., "the tall girl is fezzing"). This is puzzling because in some tasks 3-year-olds can process modified nouns (Thorpe & Fernald, 2006). We hypothesize that children can process the modified nouns, but do not have enough cognitive resources left to complete the learning task. The current study used a preferential-looking/pointing task to jointly examine children's eye gaze during the learning process (to assess their processing of the modified nouns) and their pointing choices after learning (to assess their ultimate verb representation). Results support the hypothesis: children successfully identified the scene labeled by a modified noun during familiarization, but failed to identify the target scene at test.

2-E-57   The Emergence of a Stable Lexicon: Ecological and Iconic Affordances

Laura Horton[1], Susan Goldin-Meadow[1]

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We document the emergence of a stable set of signs - a lexicon - in homesign systems: gestural communication strategies developed by children who cannot hear the spoken language in their environment and are not learning a sign language. Our participants (N=9, 3 Female, Mean Age at First Visit = 10;4) are children who are deaf and live in Guatemala. They have deaf relatives, deaf peers from school, or no known deaf acquaintances. We present longitudinal results from a photo elicitation task collected over 5 years. We consider two factors that affect the stability and conventionalization of lexical signs across development. First, the "imageability" of an object, or its iconic affordances. We assess imageability with a measure of how many different homesigners converge on the same iconic representation for the object, even those who are not in contact. Second, we consider features of participants' communicative ecology that could affect the stability of the lexicon in a homesign system. Specifically, we compare homesigners who have deaf adult relatives to homesigners who attend school with other deaf students, and have deaf peers. We find that homesigners with deaf peers, who attend school together, have more stable lexicons, but that there is a significant level of conventionalization across all systems. We suggest this underlying conventionalization comes from the co-speech gestures homesigners observe hearing people using in their social environment.

2-E-58   Effects on children's gesture: Age and verb type influence successful communication

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English speakers tend to describe motion using manner verbs (run, walk) rather than path verbs (enter, ascend). This effect extends to gesture; adult English-speakers are more likely to use gestures that conflate manner and path than speakers of other language. We examined children's silent gestures to see when they start using conflated gestures and how well those gestures convey meaning. Thirty-two children (ages 3;0 to 10;0) used silent gesture to communicate simple sentences that contained a manner or a path verb. We coded quantity and type of gesture. Children produced significantly more manner gestures than path gestures, regardless of age and sentence type (t(30) = 3.66, p < .01). Older children produced more conflated gestures (t(29) = -2.47, p < .05). Adults then watched videos of children's gesture, interpreted their meaning, and gave confidence ratings. Adults correctly interpreted gestures more often (F(1, 29) = 5.49, p < .05) and more confidently (F(1, 29) = 6.75, p < .05) from older children. A mixed model accounting for participant and sentence also demonstrated that adults were more confident in their answers for older children's gestures but that difference was lessened for sentences with a path verb. This study is the first to our knowledge to both examine the plasticity of manner bias in children's gesture and examine the communicative success of silent child gestures.

2-E-59   Understanding that Others Draw Implicatures

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The ability to make pragmatic inferences is a crucial feature of mature communication. Research shows that 5-year-olds can compute scalar implicatures (Skordos & Papafragou 2016), but it is unclear whether they understand that others make the same inferences. Since children don't realize that others make inferences based on syllogism before age 7 (Sodian & Wimmer 1987), the current study tested whether 5- and 7-year-old children can (1) draw scalar implicatures and (2) recognize that others draw the same implicatures. 87 children heard a critical statement (e.g. "I blew up some of the balloons"). In self trials, they were asked whether they thought all the balloons were blown up, or if they couldn't tell. In other trials, children saw that all the balloons were blown up by two people. Then they saw a third person, who did not know the outcome, hear the critical statement. Children were asked whether she would think all the balloons were blown up, or if she wouldn't know. Preliminary analyses show that 69% of 5-year-olds and 80% of 7-year-olds correctly inferred the outcome in self trials, both age groups above chance (binomial test, p < .05). When asked about others' inferences, performance was at chance (binomial test, p > .05); only 24% of 5-year-olds and 47% of 7-year-olds recognized others' inferences. This suggests that despite their ability to draw implicatures, 7-year-olds' understanding that these inferences lead to knowledge is still developing.

2-E-60   Event-Related Potential Markers of Syntax and Language Development in 7yr Olds

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106 children were tested within two weeks of their seventh birthday. Participants were instructed to look through a wordless storybook and provide an oral narrative of the story. Narratives were recorded and later transcribed and analyzed for type/token ratios of various word-class items. EEG/ERP data was collected from participants as they listened to a series of consonant-vowel speech syllables. These stimuli varied by consonant (/b,g/) as well as speech formant bandwidth (speech formant structure vs. 1

Hz). Correlational analyses of brain areas with word-class item usage and ERP components identified ERP temporal areas that correlated with aspects of syntactic word classes, and were used to create scalp localization maps (Hahne, 2004). Consonant discrimination occurred later in the brainwave than speech sound discrimination, indicating a continuance of processing beyond the initially rapid processing of the stop-consonants. Analyses also identified a decrease in the N1 and P2 amplitudes in individuals with high frequency usage of closed-class words, indicating faster processing and increased proficiency in these individuals (Weber et al., 2003; Redmann et al., 2014).

2-E-61   Two languages or one: Children's use of language in talker identification

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A central question in development is when and how bilingual children form separate representations of the languages they speak, allowing them to use their two languages appropriately. One relatively-untested idea is that children associate individuals with particular languages. Based on previous findings suggesting that young children use extralinguistic information (i.e., talker age/gender) in speaker recognition and comprehension (Borovsky & Creel, 2014; Creel & Jimenez, 2012), we ask here whether the language someone speaks can serve as a cue for talker identification, and whether bilinguals are especially skilled at associating their two languages with different talkers. To investigate this question, we used the visual world eye-tracking paradigm (Swingley et al., 1998; Tanenhaus & Trueswell, 1995) along with pointing accuracy to assess online speaker recognition in 3- to 5-year old children. We tested Spanish-English bilinguals (n=15 of 32); bilinguals that speak English and a language other than Spanish (n=32); and English monolinguals (n=32) in a two-phase talker recognition task. In the learning phase, children were presented with two cartoon characters (8 trials, 4 per speaker), each of whom spoke a different language (Spanish or English; either two female or two male talkers). In each trial, one character appeared on-screen and spoke a short passage in their respective language. The learning phase was followed by 16 two-alternative forced choice trials, in which one of the characters spoke a novel sentence and the child was asked to point to the character that said the sentence. Eye movements were recorded throughout the test phase. Mean accuracy was high (84%) and significantly above chance (p<0.001) within each language group, but a mixed-effects logistic regression on test accuracy showed no main effects or interactions. ANOVAs were conducted on the mean difference in empirical-logit-transformed looking times to target character minus competitor in early (200-1200ms) and late (1200-2200ms) time windows, with Language Background and Age as factors. In the earlier time window no effects were significant. The later time window showed a main effect of language background (p=0.023). Post-hoc comparisons revealed that Spanish-English bilinguals showed greater looks to the target speaker relative to monolinguals, (p=0.002), and relative to other bilinguals (p=0.022). Spanish-English bilinguals showed greater looks than other children for both Spanish-speaking and English-speaking characters. An effect of Age (p=0.012) indicated greater looks among older children, with no interaction. Our results suggest two things. First, language is a highly salient vocal feature, even to monolingual children. Ongoing work is showing that language, rather than voice characteristics, drives children's responses. Exploring features underlying recognition (intelligibility, phonotactics, speech sounds) will speak to monolinguals' developing native language representations, building on earlier findings in infants (Nazzi et al., 1998; Mehler et al., 1988) and, more recently, young children (Potter & Saffran, 2015). Second, bilingual children familiar with both languages appear more adept than monolinguals at using language to identify talkers. Associating languages with individuals has important implications for

when and how bilingual children keep their two languages separate and in turn use each language in appropriate contexts.

2-E-62   Sign Language, but not Pointing and Eye-Gaze Alone, Supports Infant Object Categorization

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Language has a powerful effect on the human mind: during the first year of life, spoken language boosts core cognitive capacities including object categorization (Ferry, Hespos & Waxman, 2010). Here we ask: Does signed language exert the same cognitive advantage? Fifty-five hearing 4- to 6-month-olds were familiarized to 8 members of a single category. These were introduced by a smiling woman who either gazed and pointed at them (POINT condition) or who also labeled them American Sign Language (SIGN Condition). At test, infants viewed two objects side-by-side: one from a novel category, the other from the now-familiar category. Infants in the POINT Condition performed at chance levels (p's> .3). In contrast, 4- and 5-month-olds in the SIGN Condition revealed robust novelty preferences (p's<.05); yet 6-month-olds performed at chance (p=.80). This suggests that for infants younger than 6 months, 1) both signed and spoken language support categorization, and 2) this advantage is specific to language, not pointing or eye-gaze alone.

2-E-63   Grasping What the Speaker Does Not Mean: Measures of Reaching and Looking Reveal Children's Processing of Negation

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Two main theories describe the process by which negation is understood. The first theory states that processing negation does not involve additional mental representations beyond those required to process affirmative statements. In contrast, the second theory claims that processing negation involves, first, mentally representing the negated content (e.g., an open window for the sentence "The window is not open"), then rejecting that representation, and, finally, representing the actual state of affairs (e.g., a closed window). There is empirical evidence for both theories in the adult language processing literature. We investigated which of these theories best describes how negation is processed by young children, who are just becoming proficient in understanding negation. Participants were 78 4- to 5-year-old children. We used the Shopping Task, a variant of the visual world paradigm, wherein participants listen to a puppet's directions to select and grasp one of two grocery items (e.g., apple, orange) and place it into the shopping cart. Across trials, the puppet directs participants using both negated ("The next item is not an apple") and affirmative ("The next item is an orange") sentences. Results showed that children took longer to reach for and grasp target objects following negated statements, and looked more to the nontarget object (e.g., apple) when processing negated statements. These findings are consistent with a multi-stage theory of negation understanding.

2-E-64   Does Talker Variability Impact Infants' Discrimination of Easy Versus Difficult Sound Contrasts?

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Variation in training exemplars often leads to more robust learning of categories, including for infants' learning of phonological categories. Infants' learning of similar-sounding words at 14 months (Rost & McMurray 2009) and phonotactic strings at 4 and 11 months (Seidl, Onishi, & Cristia, 2014) is facilitated when words/strings are spoken by multiple talkers during training. We asked whether talker variability would also facilitate infants' sound discrimination. A prior account of word learning (Apfelbaum & McMurray, 2011) argued that variability served to reduce the association between irrelevant acoustic dimensions (e.g., pitch) and visual referents, preventing them from competing with phonological dimensions. Like word-form learning, sound discrimination requires forming and differentiating sound categories using phonological (vs. irrelevant) dimensions. However, it does not involve mapping sounds to meanings, so may not benefit from talker variability in the same way. Young infants discriminate native and non-native contrasts, then narrow to native-language consonants by 10-12 months of age. However, even young infants fail to discriminate /n/-/ŋ/, which does not occur in onset position in English (Narayan, Werker, & Beddor, 2010). Thus, we compared /n/-/ŋ/ to /b/-/p/, a native contrast that is also more acoustically salient. We hypothesized that talker variability might show a stronger facilitative effect for /n/-/ŋ/, the more difficult contrast. We employed a visual-habituation paradigm. Experiment 1 tested 37 7 ½-month-old infants' discrimination of /pim/-/bim/. The ongoing Experiment 2 has tested 28 infants' discrimination of /nim/-/ŋim/. During habituation, infants saw a red-and-black checkerboard while hearing one of the two words eight times per trial (habituation word was counterbalanced across infants within experiment). Roughly half of children in each experiment heard a single talker during habituation; the other half heard four different talkers. Infants who did not habituate within the 24 trials were excluded (N=2). The test phase used a novel talker, equating (non)experience with the talker. It consisted of two "same" trials, repeating the habituation word, and two "switch" trials (interleaved), switching the word, e.g., from /ŋim/ to /nim/, and one final novel trial, where the word differed completely from habituation. Infants in Experiment 1 overall successfully discriminated /bim/ vs. /pim/, looking longer in switch trials (M=7.2 sec; SD=2.3) than same trials (M=6.4 sec; SD=2.3; p=.02). Both groups of infants showed this pattern, but it reached significance only for the infants trained with multiple talkers (p=.03). Thus, talker variability may have provided slight facilitation, but conclusions must be tentative. Infants in Experiment 2 did not successfully discriminate /nim/-/ŋim/, showing slightly shorter looking in switch trials (M=6.5 sec; SD=2.8) than same trials (M=7.0 sec; SD=2.6; n.s.)--regardless of the number of habituation talkers. Thus, multiple talkers did not facilitate discrimination of a difficult contrast. Discrimination was significantly better for /bim/-/pim/ than /nim/-/ŋim/ (p=.01). We therefore find weak, if any, facilitation from talker variability. We will contextualize this result within prior findings of facilitative effects of variability on phonological learning, both in referential and non-referential tasks (phonotactics, word segmentation), discussing the relevance of task difficulty.

2-E-65   Storybook Format Can Support Children's Initial Learning of Challenging Verbs

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English manner verbs can be especially challenging and may require extra support for children to even initially map their meanings. Using what we know about noun learning through shared reading, this

study manipulated storybook format to investigate ways to support verb learning. We tested whether 3- to 5-yr-olds (n=30) could remember the mappings of difficult new verbs when presented as essential actions within a narrative story but with differences in placement. Children were randomly assigned to either a rhymed condition, in which target verbs were heard at the end of rhyming stanzas making them maximally appreciable, or a control condition, where the verbs were presented in the same story, but not in final position or within a rhymed stanza. After hearing the story, each child was given three sets of retention questions testing their identification, demonstration, and production of the target verbs. Children identified and successfully demonstrated more of the target verbs in the rhymed than the control condition, and only in the rhymed condition did children's initial verb mapping exceed chance. No differences between conditions were found in children's ability to produce the target verbs, in part because of how often they reverted to more generic terms to describe the actions in the story. Nonetheless, these findings support the hypothesis that giving children maximal support within a storybook reading context can facilitate an initial grasp on very challenging words.

2-E-66 Intention matters: Longitudinal relations between parent pointing, child pointing, and developing language ability

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In the current study, we asked whether the intention behind parents' points might differentially relate to their children's pointing or language development. We measured parents' and infants' pointing during a 10-minute free-play at child age 12-months (n=55). Points were categorized according to intention: for the self (individualistic imperative), to direct behavior (cooperative imperative), to share emotion (expressive declarative), and to share information (informative declarative). We collapsed infant pointing into imperative and declarative categories due to the small number of total points produced. Infants' receptive language was measured at 18-months (n=47), and again at 5 years (n=18). Only parents' use of expressive declarative pointing was significantly related to infants' own declarative pointing (r=.32, p=.02), and was also the strongest predictor of infants' language at 18-months (r=.29, p=.04). Infants' declarative pointing was related to their language at 18-months (r=.28, p=.05), whereas their imperative pointing was not. Mediation analysis suggests that child declarative pointing mediates the relation between parent expressive points and child language. Further infants who had produced any declarative points at 12-months exhibited stronger language skills at 5-years (t=-3.93, p=.001). Thus, parents who point more with the intention of sharing emotion have children who use more declarative points and have stronger language skills later on.

2-E-67 The Metacognitive Disambiguation Effect

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When asked to pick the referents of novel labels, children favor unfamiliar over familiar kinds. Accounts of this tendency do not address children's awareness of how the kinds differ. In this experiment (N=48), preschoolers received a test of the metacognitive disambiguation effect, which involved deciding whether the referent was located in a bucket of things "I know" or bucket of things "I don't know." Most

4-year-olds passed and most 3-year-olds did not. Children's ability in reporting whether various familiar words and pseudowords were ones they knew predicted performance, even after age and vocabulary size were controlled. These findings are consistent with the claim that as children develop an awareness of their own lexical knowledge/ignorance, they also develop a metacognitive representation of their tendency to map novel labels onto unfamiliar rather than familiar kinds.

2-E-68   Tell me how you really feel: Speaker reliability influences preschoolers' attention to emotional prosody

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We explored whether children would adjust their use of emotional prosody as a cue to reference, as a function of speaker reliability. Using a between-subjects design, 4- and 5-year-olds (n = 140) were introduced to either a Reliable Speaker who demonstrated congruent use of linguistic and affective cues, an Unreliable Speaker who demonstrated incongruent use of these cues, or an Unreliable Speaker who children were additionally told "says things in a strange way". Test trials consisted of displays containing pairs of objects that belonged to the same category, but that differed in terms of their likelihood to be associated with negative or positive emotional prosody (e.g., broken doll/intact doll), and were accompanied by referentially ambiguous instructions (e.g., "Look at the doll") spoken in either a positive- or negative-sounding voice. Results indicated that children in the Reliable Speaker condition directed a greater proportion of looks to the negative object during negative emotional prosody trials (M = .58), compared to positive emotional prosody trials (M = .41), p < .001. In contrast, there was no effect of emotional prosody in either Unreliable Speaker condition (ps > .10). These results demonstrate that children's use of emotional prosody to disambiguate utterances can be disrupted by an unreliable speaker, and thus provide compelling evidence that social-pragmatic reasoning underlies children's flexible use of emotional prosody during language processing.

2-E-69   Same or different? Heard words change young children's ability to visually discriminate objects

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We test the hypothesis that words influence visual processing by activating information about the objects to which they refer. By this hypothesis, identifying a target in clutter should be more difficult if the target is labeled as the same category as the distractors vs. if it is labeled as a category other than the distractors. We presented children (N=32) with a visual target that could be perceived as a cake or a hat; this ambiguous target was named as a member of the same category as the distractors (e.g. "hat" amid hat distractors) or as a member of a category other than the distractors (e.g. "cake" amid hat distractors). Hearing the ambiguous target named as the same category as the distractors disrupted children's ability to find the target relative to when the target was labeled as a category other than the distractors - despite the visual information being the same in both conditions. This suggests that words, by activating categorical information, changed the perceived similarity between target and distractors (Goldstone, 1995; Jonides & Gleitman, 1972). A second study (N=32) replicated these results with only visual category information. This work shows that words activate category-level information, which

influences how children momentarily process a visual scene, extending prior adult work on categorical perception. We will discuss the implications of these results to understand the effects of language on other cognitive processes.

2-E-70   Communicative pressure leads to language that supports learning

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Infants prefer to listen to and learn better from child-directed speech (Thiessen et al., 2005). This speech might support learning in part due to communicative pressure: parents must use language that their children understand (Bruner, 1977). In past analyses of parent-child interactions, we have shown that parents' referential communication (pointing, labeling, or both) is sensitive to their children's linguistic knowledge. We designed a Mechanical Turk study to experimentally validate this idea, putting Turkers in the role of parents talking with children who knew a novel language less well (non-parents produce similar child-directed speech [Snow, 1972]). Participants could communicate in 3 ways: pointing--expensive but unambiguous, labelling--cheap but knowledge-dependent, or both. They won points only for communicating successfully; using pointing and labelling together was costly, but could teach, allowing cheaper communication on later trials. As in natural parent-child interactions, participants were sensitive to their own and their partner's knowledge, labelling when they expected their partner to know the word, pointing when they or their partner did not know the word, and teaching when they expected to play repeatedly. While language is more than reference games, this work validates the hypothesis that communicative pressure alone can lead to supportive language input. Child-directed speech may support learning in part because it needs to communicate successfully.

F - Moral Development

2-F-71   Moral Understanding and Executive Function in the Resolution of Preschool Peer Conflict

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Children's moral understanding (MU) of aggression may play a role in how children respond when faced with conflict, particularly when coupled with executive function (EF)- cognitive control of behavior. For example, a child with high EF can inhibit aggressive behavior while a child with low EF may need to rely on high MU to accomplish this. The current study investigated the joint contributions of both EF and MU in peer conflict situations. Seventy-two 4- to 5-year-old children completed an EF task battery, an MU task that required evaluation of aggressive actions (from the SIPI-P, Ziv & Sorongon, 2011), and the Challenging Situations Task (CST) that assessed responses to peer conflict (Denham et al., 2013). A standard categorization technique revealed three groups of children- high EF (n=36), low EF-high MU (n=18), and low EF-low MU (n=18). The three groups significantly differed in the number of competent responses chosen on the CST, $F(2, 71)=21.66$, $p < .001$. Post hoc tests ($p <.05$) revealed that children in the low EF-low MU group (M=2.94, SE=0.42) scored lower than those in the low EF-high MU group

(M=4.42, SE=0.41), while those in the high EF group (M=5.56, SE=0.23) scored the highest. These results suggest that MU is critical for managing peer conflict when children have low EF.

2-F-72   Morally-Embedded Theory of Mind Predicts Moral Evaluations

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Recent research has shown a link between children's Theory of Mind (ToM) and their moral development (Mulvey et al., 2016; Rhodes & Wellman, 2016; Smetana, et al., 2012). These studies typically assess how children's ability to pass a False-Belief (FB) ToM assessment relates to their moral judgments, reasoning, and expectations of future behavior. Other research, however, suggests that children's understanding of others' mental states may be influenced by the presence of morally-relevant outcomes (Leslie et al., 2006; Killen et al., 2011). In the present study, 4- to 10-year-old children (N = 122) heard about an accidental transgression, evaluated the transgression on four measures (Judgment, Intention Attribution, Punishment, and Expected Teacher Punishment), and received a standard FB and an embedded, morally-relevant ToM (MoToM) assessment. Hierarchical Linear Regressions revealed that, while the standard FB ToM assessment predicted moral assessments beyond age (all ps < .05), MoToM performance predicted moral assessments beyond both age and FB ToM performance for 3 of the 4 assessments (all ps < .01). These findings provide novel insight into the relation between children's social-cognitive capacities and their moral development. Performance on the embedded ToM assessment provided the best predictor of children's moral evaluations, suggesting the importance of contextualizing assessments of social-cognitive capacities when studying children's moral development.

2-F-73   Getting Help for Others: An Examination of Indirect Helping in Preschool Children

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The aim of the current study was to examine preschool children's ability to get help for a person in need. Forty-eight 3-year-old children were presented with a helping task in which they could not provide direct help themselves: a person wanted a toy from a high shelf that was out of her (and the child's) reach. We examined not only whether children would ask an adult to intervene, but whether they could take into account capability to help when deciding who to ask. Twenty-five children intervened on behalf of the person in need, with 23 (correctly) getting help from the capable actor rather than one who was incapable (binomial test, p < .001). Though the other children in our sample did not engage in indirect helping, the majority indicated that the physically capable actor could help in a subsequent interview (binomial test, p = .013). Two factors appear to have prevented these children from actually intervening: 1) some failed to detect which actor could provide help in earlier parts of the study, and 2) many were too shy to approach either actor. Overall, we found that preschool children can detect who is capable of providing help to a person in need, and additionally, half of the children in our sample were able to use their understanding of who could help to effectively intervene on behalf of the person in need. At this age, however, hesitancy to approach unfamiliar others may dissuade children from engaging in indirect helping.

2-F-74   **The influence of observers on children's conformity when dealing with moral conflicts: Examining the impact of observers' status.**

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The current studies explored whether children's conformity increases as there are more people watching. Three-year-old Korean children participated in Study 1 where there was just one experimenter (control condition) or one experimenter and two additional adults who were simply watching them (experimental condition). During the pretest phase, the experimenter showed 6 pictures of prosocial behaviors and asked children whether the behaviors were acceptable. During the test trials, participants watched 6 video scenes where three informants watching the same pictures unanimously claimed that the behaviors were (not) okay. After each scene, the child was asked to judge the acceptableness of the prosocial behavior. Children conformed to the informants' opinion significantly more in the experimental condition than in the control condition. Study 2 examined the nature of observers' influence by having the observers wear headsets or hang around their necks. Children's conformity rate significantly increased when the headsets were hung around the observers' necks

G - Number, Spatial Cognition, Relational Reasoning

2-G-75   **Spatial Frames of Reference in Language and Thought: Evidence from Two New Tasks**

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To what extent does learning language-specific coordinate systems, or frames of reference (FoR), shape spatial cognition? An influential set of studies documented a striking correlation between the system speakers use in their language and how they recreate spatial arrays after turning to face a new orientation (Levinson, 2003). Speakers of languages like English that use an egocentric frame (left/right) rotated the array with their bodies, while speakers of languages like Tseltal Mayan that prefer a geocentric frame (uphill/downhill) maintained the array's geocentric orientation. While some researchers concluded that language restructures nonlinguistic spatial representations, others suggest it could reflect pragmatic inferences - speakers interpret open-ended tasks based on how their community talks about space. When given tasks that did not require guessing the experimenters' intent, Tseltal-speakers performed equally well using either reference frame (Li et al., 2011). These experiments, however, were not beyond reproach, including complaints that participants had visual or physical access to the stimuli as they moved (Bohnemeyer & Levinson, 2011). In Experiment 1 we therefore tested 24 10-12 year-old Tseltal-speaking children on a more difficult and robust transitivity task. In the original task (Brown & Levinson, 1993), the relationship between three symmetrical objects is revealed two at a time across two tables, with 180º rotation between them. For example, if A is near left/north of B at table 1, and C is far right/north of B at table 2, then either CAB or AB_C are possible solutions at table 1. In our task, we used models of fronted buildings so their facing orientation indicated which FoR participants should use, egocentric or geocentric depending on condition. The two groups showed no difference in performance (ego=66.7%, geo=52.5% correct; $t(22) = 1.29$, $p = .21$). Their ability to comprehend left/right terms when applied to their bodies, however, did not differ from chance (M =

58.9%, p = .27). In Experiment 2 we tested the claim that the acquisition of a geocentric FoR strengthens speakers' cognitive maps (Levinson, 2003). In the same session, the children were asked to create a model of their town plaza using small-scale models of actual buildings. The children faced 90º from the main plaza axis at a test site 1.3 km away. 42% aligned the buildings geocentrically while 29% aligned the main axis with their own front/back, suggesting an egocentric representation. Next, we showed the children three of the town buildings in their geocentrically correct orientation. The children then turned to face the second table where we placed one of the buildings so it rotated with the child (egocentric condition) or did not (geocentric). The children then placed the other two. Again, we found no difference between conditions (ego=79.2%, geo=90.0% correct; t(22) = 1.55, p = .14). We plan to test Spanish speakers residing in the same community as well as Tseltal-speakers at a more distant location. Experiment 1 confirmed that Tseltal-speaking children can use an egocentric FoR even on a more robust task while Experiment 2 found no evidence of enhanced cognitive maps. These studies suggest that learning language-specific FoR does not play a strong role in determining which FoR is easier to use. Although the children did not know left/right words, they did just as well using egocentric versus geocentric FoR on spatial tasks.

2-G-76   Longitudinal Support for the Stability of Cross-magnitude Associations across Development

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There is general agreement that humans represent numerical, spatial, and temporal magnitudes from early in development. However, there is disagreement about whether different magnitudes converge within a general magnitude system and whether this system supports behavioral demonstrations of cross-magnitude interactions at different developmental time points. Using a longitudinal design, we found a relation between children's cross-magnitude interactions assessed at two developmental time points with different behavioral measures. More specifically, children who showed stronger cross-magnitude interactions as infants (M = 9.3 months) showed a stronger cross-magnitude effect at preschool age (M = 44.2 months), even when controlling for performance on measures of inhibitory control, analogical reasoning, and verbal competence at preschool age, r(30) = 0.36, p = .04. The results suggest a common mechanism for cross-magnitude interactions at different points in development as well as stability of the underlying individual differences. We argue that this mechanism reflects a nonverbal general magnitude system that is operational early in life and that displays continuity from infancy to preschool age.

2-G-77   How many apples make a quarter? The challenge of discrete fraction formats

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Past research suggests that fractional quantities are easier for young learners in continuous rather than discretized formats (e.g. liquid in a beaker vs. in a beaker with markings). We investigated two questions: (1) are truly discrete formats yet harder? (2) do format effects interact with fraction knowledge? We studied 565 children (7- 12 years) on their ability to match equivalent proportions across continuous, discretized, and discrete fraction formats. Children also completed a fraction

assessment. Overall, performance followed the ranking of continuous > discretized > discrete. However, this effect interacted with fraction knowledge. Children with low fraction knowledge did best in continuous formats. Medium knowledge children were more able to work with discretized formats but continued to have problems with discrete ones. There were no format differences in the high-knowledge group. These findings suggest the possibility that curricula should present fractions first in continuous, then discretized, then discrete formats.

2-G-78   Thinking outside the box: Divergent thinking tasks promote the generation of new ideas

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Children who are variable in their strategy use are more likely to learn from a lesson than children who rely on a single strategy (Church & Goldin-Meadow, 1986). Thus, activities that encourage children to be variable could be integral to educational interventions designed to increase learning. In the current study, we tested whether completing a divergent thinking (DT) creativity task increased the number of different justifications 5 and 6 year olds' gave during subsequent Piagetian conservation tasks. DT tasks have been shown to increase variability in adult's causal reasoning (Quillien & Koutstaal, 2016), so we predicted that DT tasks would increase variability in children's conversation justifications. 37 children completed a session that included a pretest, a creativity intervention, a midtest, a brief video lesson, and a posttest. During the intervention, 19 children completed a DT creativity task, and 18 children completed a convergent thinking (CT) creativity task. Children who completed the DT task were more likely to add a new rationale from pretest to midtest compared to children who completed the CT task (p = 0.05). Children in the DT condition were also more likely to add a new, correct rationale at midtest (p = 0.04). These findings suggest that DT tasks may encourage children to entertain new ideas and that these ideas are sometimes correct. Future analyses will address whether condition and variability affected learning from the lesson.

2-G-79   Is less always more? How the contextual presentation of number in counting books affects childrens learning

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The early math knowledge gap is linked to variation in parent's number talk. Because adults are more likely to embrace literacy, one powerful way to introduce math learning into the home is through shared book reading. But, it is not clear which types of counting books are most effective to promote children's number development. The current project assessed the effects of two contrasting ways numbers are contextualized in counting books: either through a narrative and visually complex scenes that support it or simple representations that only highlight the number relevant information. Children's number knowledge was measured during a pre-, mid-, and post-test, each scheduled two weeks apart. Families were randomly assigned to one of three conditions and asked to read the experimenter-created book at home in between the testing sessions: rich counting book (visually rich scenes with a narrative), bare counting book (sets presented on a white background with prompts to count and label) or a control color book (all numerical input replaced with color words). Analyses measure the effects of the three

practice conditions on children's number learning over the 4 week intervention period as well as enjoyment of the books. Results have implications for the most effective ways that shared book reading can support children's early numerical development.

2-G-80   The association between basic number processing and symbolic approximate arithmetic

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Two tasks that measure number processing abilities--number comparison and number line estimation-- are significantly correlated with children's arithmetic performance. However, whether these tasks contribute differently to arithmetic remains unclear. The current study (63 preschoolers, mean age 5 years 9 months) compared contributions of number comparison and number line estimation to symbolic approximate arithmetic of different levels of difficulty. The results showed that performance on both tasks was significantly correlated with approximate arithmetic. As the difficulty of arithmetic increased, the number line estimation explained more variance in arithmetic, whereas the contribution of the number comparison gradually decreased. These results indicate that strength of contribution of different types of numerical processing ability depends on arithmetic's difficulty.

2-G-81   Neural development of visual-spatial line bisection ability: What's right?

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Spatial representations underlie many cognitive tasks, including visual estimation of relative length. Research often attributes spatial abilities to right hemisphere (RH) parietal brain areas, but little research has asked whether RH-lateralized patterns also appear in children. We measured fMRI activity in typically developing children (N = 12, 8?11;11 yrs) while they performed a visual line bisection task. This task is strongly RH-lateralized in adults (Jansen et al., 2006; Greenwald et al., 2017). We computed a lateralization index (LI), where left vs. right activation is quantified ($p < 0.001$) as a ratio; an LI of 1 indicates complete left lateralization and a LI of ?1 indicates right lateralization. We found a negative correlation between age and LI (r = ?.60, $p < .05$). Older children were more likely to have LIs closer to ?1 (more RH-lateralized), but younger children were more likely to have LIs closer to 0 (more bilateral). Linear regression confirmed that this relationship remained unchanged when controlling for accuracy, response time, IQ, or motion. No such relationship was found for the Control condition, which involved visual comparison of colored patches overlaid on either end of the line. Overall, these findings indicate that early in life, spatial skills are more bilaterally represented and become increasing lateralized with development. This mirrors our own recent findings on language and suggests a common maturational pattern of hemispheric specialization.

2-G-82   Children's Spontaneous Use of Gesture in a Numerical Task

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Gesture can be a robust learning tool for language, mathematics, and problem solving, though the specific function of gesture is subject to theoretical debate. Here we sought to characterize individual differences in preschoolers' use of spontaneous gesture as a mental scaffold while solving a cognitively difficult numerical task. We analyzed video data from 225 preschoolers (ages 2.47-5.79 years) who participated in the standard "Give-a-Number" task (Wynn, 1992), which is used to assess children's number knowledge and understanding of cardinality. During this task, 97 children (43.1%) spontaneously gestured at least once, with an average of 5 gestures per child overall. A qualitative description of gesture type, gesture and speech mismatches, as well as other gestural indicators were recorded. Number knowledge was a significant predictor of gesture (even when controlling for age; beta= 0.334, p<0.001). Age alone did not predict the use of gesture (p=0.84). Our findings suggest that the spontaneous use of gesture tracks with numerical abilities, potentially serving as a scaffold for performance on cognitively difficult tasks. An ongoing training study is looking at whether training children with gesture may lead to improvements in a subsequent numerical task.

2-G-83   Sub- and supra- second timing follow unique developmental trajectories in childhood

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Two distinct cognitive systems are implicated when timing short (< 1000 ms) and long (>1000 ms) durations. However, it is unknown whether these systems follow similar developmental trajectories. Further, timing abilities have been linked to formal math and reading skills, yet it is unclear what role these systems play in predicting academic achievement. In this study, six to nine year olds (n = 109, Mage = 7.35 years) completed a reading assessment, a temporal discrimination task assessing sub- and supra-second timing, and an arithmetic task. While temporal discrimination for both short and long durations was ratio-dependent (p's < .001), a distinct developmental pattern emerged such that younger children (6-7 year olds) performed comparably when timing short and long durations (p's > .2), but 8 year olds were significantly better at timing long durations compared to short ones (p < .03). Linear regressions revealed that variance in reading ability was not explained by the addition of sub- and supra-second timing in the model above and beyond age (R2 change =.008, p >.7). Temporal discrimination uniquely explained arithmetic ability above and beyond age (R2 change =.115, p = .001), though neither sub- or supra-second timing were significant in the model (p's >.05). This suggests that each system follows a unique developmental trajectory and that overall timing abilities predict arithmetic, though neither system contributes independent variance to math performance.

2-G-84   Aligning Fractions and Decimals with Distinct Contexts in 3rd to 5th Grade Children

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Fractions and decimals are important notations for rational number information, but people tend to treat these notations as being conceptually distinct. Previous research suggests that adults prefer to align fractions with discrete and easily countable contexts, rather than continuous ones, but this preference is not seen for decimals. In the current study, children (3rd to 5th graders) were presented pictures of everyday objects and were asked to indicate which of the pictures they could use to teach

someone about fractions or about decimals. Generally, children indicated discrete items (e.g., eggs) were more useful for both fractions and decimals than truly continuous items (e.g., ribbon), which were not useful for either. Moreover, children aligned fractions with discrete, countable objects and decimals with measurement contexts (e.g., a ruler). Furthermore, children who thought a specific context would be useful for both fractions and decimals tended to be in higher grades and show better performance with rational number notation than children with distinct context preferences for fractions and decimals. Overall, these data suggest that children, like adults, show preferences for aligning fractions and decimals with distinct contexts but these preferences may change with education and experience.

2-G-85   Fraction Errors in a Digital Mathematics Environment: Latent Class and Transition Analysis

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For young mathematics learners, struggles with fractions are especially concerning, because of the importance of fractions to later mathematics achievement (NMAP, 2008; Siegler et al., 2012). Although prior research has investigated characteristics of students who struggle and how fractions relate to later mathematics, this provides an incomplete picture about how fraction competency develops. Understanding what errors students make with fractions can provide us more information; however, prior research into fraction errors has often been conducted with open-ended and/or researcher-administered tests, making it difficult to understand the structure of student fraction errors when measured with more authentic educational tasks (e.g., Ashlock, 2001; Malone & Fuchs, 2016). Additionally, as students learn about fractions, it is important to evaluate how the types of errors they make change. This study focuses on understanding patterns of student fraction errors and how these patterns evolve after a year's instruction on fraction concepts. Data were student errors on fraction problems in pre and posttests in a digital mathematics environment. Error types were defined a priori based on theory and as emergent from data. Students (N=1,431) were grouped by prevalence of error types using latent class analysis. In the pretest, the majority of students (67%) belonged to a class defined by seemingly random errors that may indicate a general lack of fraction knowledge or carelessness (Distributed Class)--this group scored the lowest on the pretest. The second largest class (19%) had a large occurrence of the Whole Number Ordering (WNO) error--made when students relied on knowledge of ordering natural numbers and did not order fractions based on the relationship between the numerator and denominator (Malone & Fuchs, 2016). Lastly, some students (14%) made Few errors on the pretests; making specific errors only once or twice. Pretest error classes represented student profiles before instruction. Posttest error patterns may provide a better picture of problematic areas as they occur after a learning opportunity. Of the pretest classes, only the Distributed class remained and continued to represent the majority (56%). Thirty percent of students were classed together because they primarily made the Reciprocal error--flipping the numerator and denominator of the correct fraction. The remainder (16%) made the Illogical Sizing/Spacing (ISS) error most often, i.e., the misunderstanding that fraction parts must have equal sizes and consistent spacing (Ashlock, 2001). Although Reciprocal and ISS classes were distinct, the two errors tended to co-occur. In addition to determining the new structure and member of classes in the posttest, latent transition analysis indicated how students move from pre to posttest class. This allowed for a more accurate understanding of how learning impacted students with different pretest error patterns. Although students from all pretest classes moved into the Distributed class, the Few and WNO classes largely coalesced in the ISS and Reciprocal classes respectively. Among these students, the majority continued to make distributed

errors even after fraction lessons. Higher performers continued to make Reciprocal and ISS errors. Results shed light on which errors may prove most resistant and provide a possible method of identifying students for targeted instruction.

2-G-87   Sequencing events in a preschool day: Effects of age and pattern reasoning

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Children's ability to sequence daily activities has long been studied in the context of the development of children's time understanding. The predictable order of events also constitutes a recurrent pattern. This study examined the development of preschool children's sequence knowledge and how it relates to pattern reasoning ability. 154 children, (3:0 to 6:0 years) sequenced picture cards depicting five daily activities. On trial 1, children sequenced the events canonically ("what comes first in the day, what is next etc."); on trial 2 they were asked to sequence events "for you yesterday" or "for you tomorrow." Children also completed the pattern reasoning subtest from Kaufman ABC-II. Although some children from the age group 3:7 to 4:0 (M=45 months) were able to order the events correctly, it was not until 5:1 to 5:6 (M=62 months) that more than 50% of the children were able to do so. Pattern reasoning scores were highly correlated with sequencing performance on both trials, controlling for age (r1=0.23, p1=.003; r2=0.25, p2=.002). These findings suggest that pattern reasoning is important for the development of children's time understanding.

2-G-88   Increases in Set Labeling Performance Mediate the Effect of Counting Book Practice on Preschoolers' Understanding of Cardinality

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How children construct an understanding of cardinality is unclear. Here we investigated the role of set labeling (1-6) without counting in the development of children's understanding of cardinality. Preschoolers (N = 107) participated individually with an experimenter once a week for six weeks. They were randomly assigned to one of three conditions: (a) counting-book-only, where counting books were used to count and label sets of objects arranged in canonical patterns for all weeks, (b) set-labeling-first, where flashcards were used to pair cardinal labels to canonically arranged sets without counting for three weeks prior to three weeks of the counting book practice, (c) control, where the focus was print awareness. Both experimental conditions improved understanding of cardinality better than control (p < .05), but the two experimental conditions did not differ. The PROCESS macro (see Figure; Hayes, 2013) revealed that the labeling-first effect was mediated entirely by improvements in set labeling after the first three weeks. Set labeling also mediated the counting-book-only effect, but this indirect effect was smaller and a direct effect remained after controlling for the indirect effect (p < .05). The benefits of the experimental conditions on understanding of cardinality did not extend to counting skill or print awareness. Results highlight equifinality in development and suggest that understanding of cardinality can be constructed through more than one pathway.

2-G-89   The Role of Metaphors, Manipulatives, and Gestures in Supporting Children's Developing Understanding of Fractions

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Although developing a sound understanding of fractions is vital because it supports success in algebra (NMAP, 2008) and beyond (Siegler et al., 2012), young children often have difficulty learning fractions. For example, on the 2007 NAEP, only ~1/3 of 8th-graders placed fractions in the correct ascending order (Lee et al., 2007). Concrete manipulatives often accompany instruction on fractions, but success has been inconsistent (e.g., McNeil & Uttal, 2009), due in part to dual representation (e.g., DeLoache, 2000)--the manipulative is both an object and a representation of an abstract mathematical concept. Although making this connection can be difficult, beginning with concrete manipulatives can enhance learning (Fyfe et al., 2015; Nathan, 2012). Further, gesture (Kita et al., 2017) and metaphor (Lakoff & Núñez, 2000; Núñez, 2008) may serve as bridges to abstract mathematical ideas. Our goal is to explore children's developing understanding of fractions by merging three strands of research: concrete manipulatives, metaphor, and gesture. We examine 3rd- and 4th-graders' explanations during problem-solving activities with manipulatives and track their spontaneous gestures as they relate to metaphor. Results suggest that specific activities drive the types of gestures children produce, and in turn, drive their learning. This study aims to identify those potentially fruitful activities and gestures that lead to flexible and generalizable conceptual development.

2-G-90   Hippocampal-Dependent Eyeblink Conditioning Predicts Children's Strategies for Spatial Reorientation

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The hippocampus is an area of the human brain known to support the formation of spatial and episodic memory abilities, which develop in a protracted fashion across childhood. Pavlovian eyeblink conditioning (EBC) is a measure of associative learning frequently used with children to study the underlying function of certain brain areas (i.e., cerebellum, hippocampus). The current study employs a hippocampal-dependent (i.e., trace) EBC paradigm to determine whether children's abilities to reorient by different types of spatial cues (i.e., landmarks, geometry) reflect individual changes in their hippocampal-dependent learning and memory skills. Three- to six-year-old children (N=50) participated in a trace EBC paradigm, a spatial reorientation task, a picture sequence memory test, and a processing speed test. Bivariate correlations revealed positive correlations between age and spatial reorientation (r=.329; p=.021), episodic memory (r=.582; p<.001), and processing speed (r=.798; p<.001). In addition, episodic memory scores were positively correlated with EBC (r=.303; p=.037) and spatial reorientation (r=.320; p=.025) performance. Furthermore, multiple regression analyses revealed that EBC predicted children's combined use of landmark and geometric cues to reorient (B=.214; p=.038), independent of age and performance on all other tasks. Results implicate the hippocampus in children's developing use of spatial strategies to reorient toward goal locations.

2-G-91   The Development of Spatial Navigation: Importance of Cue Integration

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Prominent memory theory posits that cognitive maps of spatial experience drive successful navigation (Tolman, 1948). Across experiences, a cognitive map is formed by integrating environmental relationships, such as distal and proximal cues (O'Keefe & Nadel, 1978). Between the ages of 6 and 12 years, there is a key shift in children's navigational ability, which becomes more adult-like as children begin to make use of distal cues (e.g. Acredolo, Pick & Olsen, 1975; Buckley, Smith & Haselgrove, 2015; Laurence, Learmonth, Nadel & Jacobs, 2003; Overman, Pate, Moore & Peuster, 1996). However, the precise age at which this developmental shift in navigational ability emerges is currently debated. Here, we investigated the developmental trajectory of children's ability to integrate the relationships between different types of spatial cues as they navigated in novel, virtual environments. We modified a virtual navigation task from adult research (Doeller, King & Burgess, 2008) for use in children (6-12 years old) and adults (18-22 years old). The environment consisted a circular grassy arena, four extramaze, distal cues (distinct mountains), and an intramaze, proximal cue (traffic cone). After initial exposure to the environment, participants completed an object-location learning task, in which they were required to find and replace objects, four friendly monsters, that were either associated with the intrazmaze or extramaze cues (Figure 1). Navigational accuracy was measured by distance error and response time (RT) when participants actively navigated to the learned object locations. In addition to the navigational measures, we also collected data on participants' task strategy and way finding, perspective taking, and sense of direction abilities. Developmental improvements were shown in participants' ability to locate the objects in the virtual environment (indexed as lower error distances). A main effect of cue revealed participants were more accurate at using the intramaze cue compared to the extramaze cues to locate the objects. A significant interaction between cue type and age revealed that this effect was driven by 6-7 year olds; the accuracy of 8-12 year olds and adults was not affected by cue type. A developmental shift was also found in the RT data. Participants became systematically quicker at finding the monsters as a function of age, without an effect of cue type in any age group. These results suggest that the developmental time course of navigational ability is younger than previously reported. To further disentangle the developmental time course, we will also present ongoing work investigating how children integrate different cues within the virtual environment. We predict individual differences in performance will be driven by children's ability to create an integrated representation of the environment to find the target object. Integration ability will be indexed by participants' positional errors in relation to the different cues available, perspective taking ability, and how they describe their navigational strategy. Altogether, we will provide a developmental account demonstrating when children start to use relational information to create a spatial map of their environment.

2-G-92　　　　Effects of spontaneous spatial comparison on incidental word learning

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Young children can learn new words via incidental learning, without direct pedagogical interaction (e.g. Carey & Bartlett, 1978; Akhtar, 2005). Our research investigates the role of alignability in such learning. In a series of studies, we presented 3-and 4-year-olds with two objects and asked them to "point to the chromium one, not the blue one" (as in Carey & Bartlett, 1978), while varying the perceptual similarity (and thus the alignability) of the objects (Shao & Gentner, 2016). Although nearly all children pointed correctly, only those who saw highly alignable pairs learned the novel color word chromium (as assessed on a later yes-no classification test). We suggest that the highly alignable examples induced

spontaneous comparison, so that the relevant property naturally "popped out" as a potential referent for a novel adjective. In past studies, alignability was manipulated by presenting different object pairs to the high (HA) and low alignment (LA) groups. The current study extends the test of alignment in incidental word learning by varying alignability in a new way: spatial alignment. We showed 3-and 4-year-olds in the HA and LA groups the exact same pictures of keys. However, we varied the spatial alignability of the keys by presenting them in either an easy to align, parallel configuration (HA) or a harder to align, orthogonal configuration (LA). As in previous studies, during the initial exposure, we asked children in both groups to "point to the chromium one, not the blue one". We later assessed children's learning of the word with a classification task. Children in both conditions successfully pointed to the chromium object during the initial exposure. However, performance on the classification task revealed differences in how well they had learned the meaning of the novel word. Although the HA and LA groups did not differ overall, there was an unexpected interaction between gender and alignability, $F(1,49) = 4.00$, $p = .05$. Boys in both HA and LA conditions learned the meaning of the novel word equally well (Hits: M(LA)= 1.86, M(HA)= 1.75, t(24) =0.25, p=.60; d': M(LA)= 0.42, M(HA)= 0.59; t(24) =0.36, p=.64). However, girls in the HA group performed significantly better than those in the LA group, as demonstrated by both their higher rates of hits (M(LA)= 1.18, M(HA)= 1.81; t(25) =1.58, p=.06) and higher d' scores (M(LA)= -0.42, M(HA)= 0.63; t(25) =2.65, p=.007). One possible explanation for the gender and alignability interaction in this study is that spatial abilities moderated the fluency of spontaneous alignment, and thus how easily the alignable difference of color was detected. A large body of research suggests that males outperform females on spatial tasks such as mental transformation (e.g. Levine et al., 2005). In the current study, children with lower spatial abilities may have had more difficulty spontaneously mapping between the keys during the initial exposure when the keys' spatial orientations did not facilitate alignment (LA). We are currently examining the relationship between individual spatial abilities in males and females and performance in the low-alignment condition in incidental learning.

2-G-93   Better Understanding of Rational Number Multiplication with "of" Expression

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Many students and pre-service teachers hold the misconception that multiplying two rational numbers always yields an answer bigger than the operands. Such misconception may come from the instructional practice of conceptualizing whole number multiplication as repeated addition, which implies that multiplication makes bigger. The current experiment explores whether describing multiplication as "some number of some amount" mitigates this misconception. We found that when judging whether multiplying a whole number and a rational number between 0 and 1 produces an answer bigger than the whole number, 6th and 8th graders performed more accurately with problems presented as a rational number "of" a whole number (e.g., 3/5 of 27) than with problems presented as a rational number "×" a whole number (e.g., 3/5 × 27). However, when the rational number was bigger than 1, students performed better with the "of" format than with the multiplication sign format only when the rational number was a percent, but not when it was a decimal or a fraction. Such findings suggest that interventions using the "of" expression might facilitate conceptual understanding of multiplication with rational numbers, especially with percents.

2-G-94   More than meets the eye: Discriminating relational and perceptual judgements in toddlers

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The ability to represent same-different relations is an important condition for abstract thought. However, there is mixed evidence for when this ability develops, both ontogenetically and phylogenetically. It is clear that both human and non-human animals are able to perceive the similarity of objects and events in their environment. However, noticing similarity does not necessarily imply the existence of the conceptual representation, same. This distinction is difficult to make, and this point has been widely debated in the comparative literature (Penn, Holyoak, & Povinelli, 2008). In particular, it is possible that apparent success on relational reasoning tasks may be mediated by attention to perceptual factors, like symmetry, contrast, and variance of the stimuli. One candidate for such a strategy is a low-level heuristic, called "perceptual entropy," that has been proposed to facilitate relational recognition (e.g., Wasserman, Fagot, & Young, 2001). According to this proposal, any visual display can be reduced to a continuous analog estimate of the degree of perceptual variability among the elements. Because there is a lower amount of variability for 'same' (AA') than for 'different,' (AB) learners may succeed on the task by recognizing and applying the following rule: <if the variability of the sample display is low, select the test display with low variability>. Here we introduce a novel method designed to pit the perceptual and conceptual accounts against one another. The method involves a contrast between one condition relying upon a traditional match to sample task involving same-different relations and a "fused" object condition. Exactly the same objects are used in the two conditions, but in the "fused" condition the objects are physically joined to create a single object. Importantly, the amount of perceptual entropy, or variance, as well as other perceptual features such as symmetry is matched between the two conditions. However, only the unfused/relational condition also provides evidence for the higher-order relation 'same.' In the fused/single object case, there is no relation between objects to learn. Young children (N=54, 18-30 months) were randomly assigned to one of these two conditions. In both conditions, children observed as "fused" blocks or pairs of blocks were placed on a toy that activated only for low entropy ('same') objects. We hypothesized that if children are relying upon the perceptual heuristic, they should select the low entropy pair in both conditions. However, if children learn the abstract relation 'same,' they should select this pair only in the relational condition. In contrast with the perceptual account, children in the "fused" condition selected at chance between test pairs (41%), p = .44 (two-tailed), while children in the "unfused" condition selected the 'same' test pair more often than chance (70%), p=.05 (two-tailed), with a significant difference between conditions, $\chi^2(1)$=4.8, p=.03. These results with toddlers in a causal relational reasoning task provides evidence for genuine conceptual understanding. This technique offers a simple manipulation that may be applied to a variety of existing match-to-sample procedures used to assess same-different reasoning to include in future research with non-human animals, as well as human infants.

H - Social Cognition

2-H-95   **Children's recognition of and reasoning about observed imitation**

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We know that children learn a great deal about cultural artifacts and social norms through engaging in imitation. Observed imitation can also potentially act as an important source of information, both for indirect learning and for uncovering social relationships between others. However, the important question of when children notice imitation as outside observers is currently unanswered. Here, we test children between three and five years to find out when children recognize imitation in third-party contexts. Further, we examine the influence of the type of action involved, and the level of scaffolding provided in the task. In addition, we probe children's inferences about affiliation, following up previous work showing that five-year-olds think that an imitator prefers the target of her imitation to the non-target (Over & Carpenter, 2014). In Experiment 1, children viewed imitation across three sequences of different actions: vocalizations (e.g. saying 'shay-shay'), bodily movements (e.g. bending forward), and object preferences (e.g. picking between two different hats to wear). Each sequence involved three characters and began with an introduction trial in which the copier performed all the actions she would have the chance to imitate, thereby demonstrating her ability to perform both the target's and the non-target's actions. Children then saw two warm-up trials with only the target and non-target present, and their memory of these actions was probed. Following this, children viewed five imitation trials. In each, the target and non-target acted sequentially, followed by the copier. Subjects' memory of the copier's action was tested on the first two imitation trials (e.g. "Did Jenny move her head like Alice, or her leg like Zoe?") On the test trial, the target and non-target acted. Then, children were asked about imitation (whether the copier would perform the same action as the target or non-target), and affiliation (whom the copier preferred). We tested three-, four-, and five-year-olds (total n=120). While all age groups were significantly better than chance when asked about imitation and affiliation, three-year-olds were significantly less successful than four- and five-year-olds, who did not differ from each other. There was a marginal effect of action type, such that children were more successful on bodily movements than preferences. Subsequent experiments explore the robustness of children's success. In Experiment 2 (n=120), children received less scaffolding when asked about the copier's actions (e.g. "Did Jenny move her head or her leg?"), and were asked about affiliation before imitation. Participants between three and five years were not successful on either affiliation or imitation at any age, and performance was significantly different from that in Experiment 1 for both questions. Experiment 3 (to be completed by August 2017) provides less scaffolding (as in Exp. 2), but asks children about imitation first (as in Exp. 1). Taken together, these studies suggest that children infer affiliation whenever they notice imitation and vice versa. Further, their performance is susceptible to variations in scaffolding. Overall, while children as young as three can use observed imitation to predict a copier's future actions and infer her preference for her target, this ability is still considerably improving with age.

2-H-96 Individual Differences in Confidence Monitoring Correlate with Selective Social Learning

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In this project, we aim to investigate whether individual differences in confidence monitoring relate to children's selective social learning. We predicted that children who can finely discriminate between confidence states (e.g., "sure" vs. "very sure") will be more likely to notice the variability in accuracy of potential teachers. 4-7-year-old children (N=72) completed a selective social learning task based on Einav and Robinson (2011) in which both teachers are incorrect, but one's answer is closer than the other's. Children then completed a confidence monitoring task in which they reasoned about the relative difficulty of two questions. We found strong correlations between the social learning task and

age (r = .45, p < .001), and between the social learning task and confidence monitoring (r = .42, p < .001), a correlation that remains strong when controlling for age (r = .39, p < .001).

2-H-97   Joint Music Making Makes Preschoolers More Likely to Help a Previously Unknown Adult: Examining the Role of Lyrics, Joint Movement, and Synchrony

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Research has shown that active musical engagement promotes prosocial behavior in preschool-age children under some conditions but not others (Kirschner & Ilari, 2014; Kirschner & Tomasello, 2010). The current study tested whether an active musical interaction between a four or five-year-old child, an experimenter, and a research assistant would result in more sharing and helping behavior than a matched, nonmusical interaction. Additionally, verbal content was manipulated to compare didactic and neutral content. Results from 62 participants showed that musical play was associated with more unprompted helping than non-musical play, but not more unprompted sharing. There was no evidence of an effect of verbal content on children's behavior, despite uniformly high retention for the content of the song or poem across conditions. Behavioral coding of synchrony and joint movement within the experimental interaction showed that musical play resulted in significantly more joint movement and movement synchrony than nonmusical play, but that even in musical conditions, joint movement was only perceptibly "in synch" for a fraction of the length of the interaction (27% on average). These findings provide further evidence that joint music making can facilitate preschoolers' helping behavior.

2-H-98   Early exposure to gender inequity shapes children's beliefs about gender and job status

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Both adults and children hold gender stereotypes associating masculine jobs with high status (e.g., Signorella et al., 1993). Here, we investigated if early exposure to gender inequality (e.g., gender pay gaps) favoring males over females leads people to develop these beliefs. Study 1 tested two groups of 4- to 8-year-olds: one from a city with a high gender pay gap (Champaign-Urbana, IL; N = 80), and another from a city with a low gender pay gap (New York, NY; N = 80). Children rated the status of a novel male-dominated job and a novel female-dominated job. We found that children from Champaign-Urbana (but not New York) perceived the male-dominated job as being more difficult than the female-dominated job (ps = .031 and .900, respectively), suggesting that gender inequity in children's environments tracks the extent to which they form stereotypes about gender and job status. Study 2 revealed that the relationship between the gender pay gaps observed in childhood and one's gender stereotypes about jobs persists into adulthood (N = 400): The gender pay gap of participants' childhood city predicted the perceived status difference between novel male- and female-dominated jobs (b = .18, p = .028), above and beyond the gender pay gap of one's current city and other demographic factors (e.g., diversity). In conclusion, our two studies suggest that early exposure to gender pay gaps may foster the development of stereotypes associating masculine jobs with high status.

2-H-99   Cognitive and Behavioral Characteristics of Preschool Children Based on Theory of Mind and Morally-Relevant Theory of Mind Performance

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Theory of Mind (ToM), the ability for an individual to understand another's mental state, undergoes protracted development during early childhood. This is an important skill necessary for understanding intent and motive during ambiguous situations, such as those that might arise in everyday interactions. Recent research has examined how the development of a morally relevant theory of mind (MoToM) influences children's moral judgments, and how these moral judgments in turn impact MoToM (e.g., Smetana et al., 2012). In the current cross-sectional study, we were interested in examining the differences between children based on their ToM and MoToM capabilities to determine underlying cognitive and behavioral characteristics of children who may have developed ToM understanding but lack understanding of MoToM, and vice-versa. We expect that children with greater ToM and MoToM would outperform their peers and that in turn that low ToM/low MoToM performers would receive worse scores across myriad indices. 120 preschool age children (37-78 months, Mage=54.40 months, SD=9.69) from a Midwestern sub-rural community completed five ToM tasks (Wellman & Wooley, 1990; Wellman & Liu, 2004; Flavell, 1986; Baron-Cohen, et al., 1985; Harris, et al., 1986), Killen, et al.'s (2011) MoToM task (which assessed children's understanding of intent and judgment of wrongness) and the day/night Stroop task (Gerstadt, Hong, & Diamond, 1994) as a measure of executive function (EF). Children indicated preferences for moral and immoral behaviors (Sengsavang, Willemsen, & Krettenauer, 2015) and completed the PPVT-4 (Dunn & Dunn, 2007). Parents reported on family demographics. Based on performance on the ToM battery and the MoToM task children were divided into four clusters: (1) low-ToM/low-MoToM (n=58; Mage=48.50 months, SD=7.00; (2) high-ToM/low-MoToM (n=77; Mage=56.49 months, SD=9.01); (3) low-ToM/high-MoToM (n=19; Mage=45.68 months, SD=6.67); and (4) high-ToM/high-MoToM (n=21; Mage=61.52 months, SD=10.78). A series of ANCOVAs (controlling for age) revealed several group differences. For instance, low-ToM/high-MoToM children were more likely to indicate agreement with an intentional transgressors act [F(3,116)=2.69, p=.04, .05]; and were more likely to give preference to reactive-physically aggressive acts [F(3,116)=4.15, p=.007, .07], and reactive-relationally aggressive acts [F(3,116)=4.11, p=.008, .07]. No group differences emerged for proactive-physical or proactive-relational aggression, nor were there group differences with regard to indices of EF. These results indicate that there may be a larger developmental pattern with regard to the interplay for ToM and MoToM. For instance, for young children to perform well on measures of intent, while failing multiple indices of ToM, is surprising. Given the linkages found here with aggression it is possible that children perform well on MoToM tasks not due to cognitive maturation, but in line with explicit feedback from parents and teachers. With specific regard to reactive aggression, multiple interpretations are likely. For instance, some children who have a developed understanding of MoToM may be underdeveloped with regard to morality and thus may not understanding the impacts of aggressive behaviors. Alternatively, there are likely cognitive underpinnings which allow for success on EF tasks (as shown here), which may not be reflected in behavioral inhibitions. Limitations and future directions will be discussed

2-H-100   Teachers' Nonverbal Behaviors Influence Children's Stereotypic Beliefs

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Previous research shows that around the age of 6, children begin to endorse academic stereotypes about race and gender. How do children come to think that some groups are smarter than other groups? Here we test whether differences in teachers' nonverbal behaviors influence 5- to 7-year-old children's attitudes about individuals from different groups. Participants (N=88) learned about a school with three groups of students (marked by shirt color) and were randomly assigned to one of the groups themselves. Then they viewed videos where students in one color shirt received positive nonverbal teacher behaviors ('positive group'), and students in a different color shirt received negative nonverbal teacher behaviors ('negative group'). One group did not appear in the videos. Participants were then asked three types of test questions about new students from the positive and negative groups. On 'smart trials' participants were asked which student was smarter and all participants selected students in the positive group (p.<001). On 'partner trials,' participants were asked to select a reading partner, and all participants selected students in the positive group (p=.034). On 'friend trials' participants were asked whom they would prefer to befriend and only participants assigned to the positive group selected students from the positive group (p=.005). These data suggest that differences in a teacher's nonverbal behaviors can influence children's stereotypic beliefs about peers.

2-H-101   Children's sharing after peer vs. adult models depends on baseline donation

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Recent work has shown that both adult and peer models can influence children's costly behavior (Blake et al., 2016; Salali et al., 2015). However, measuring the individual effects of social learning requires comparison of baseline to post-model behavior. Here, we tested children (N=54, 3-5 years) using Dictator Games (DG) at baseline and after seeing two models (adult and peer, counterbalanced) give resources on separate days. Children were randomly assigned to 3 model conditions: Equal (3-3), Generous (1-5) or Stingy (5-1). Models were shown on video and all DGs used 6 resources and an anonymous recipient. Lastly, children judged whether hypothetical characters acted fairly in equal, stingy or generous sharing scenarios. An ANOVA of difference scores (baseline DG vs 2 post model DGs) revealed no main effects of model or condition. However, examining individual differences by baseline donation (gave 0, 1-2 or 3) revealed a main effect of donation amount [F(2,48)=8.20, p<.0008]. Children who gave 0 at baseline (N=12) gave more after seeing any model. In comparison, children who either gave 1 or 2 (N=12) or gave 3 (N=30) at baseline, gave less after seeing any model. These findings suggest that, for preschoolers, the impact of an altruistic model depends on the child's own starting point. Children who are completely selfish are the most likely to give something after seeing a peer or adult give anything.

2-H-102   More than one way to fail: Preschoolers' error patterns in the Sally-Anne task.

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The analysis of error patterns plays an outsize role in the study of underlying cognitive processes. Such data is unavailable to researchers of theory of mind because in typical false belief (FB) tasks there is only

one way to fail. This binary pass/fail structure means there are no error patterns to explore. We analyze new data from multiple agent FB tasks, where each agent has a distinct FB about an object's location. Possible responses are beliefs, B, raised to the number of agents, A, (B^A). In a task with 4 agents and 5 beliefs (locations), there are 625 possible response patterns and 625 ways of failing (Fig1). Figure columns show individual subjects' responses. In "high demand" (HD) tasks the target object remains (hidden) on scene; in "low demand" (LD) the target object is eventually moved off scene to an indefinite location. Even with 4 agents, 11 out of 50 3-yr-olds have perfect LD performance (binomial p<.0001). In both age groups "complete" TB errors are also common (p<.0001). Other patterns of error are less common but most involve FB contents attributed to the wrong agent. In a 4-agent HD task, 16% of 4yr-olds have perfect performance and TB errors become more common and for 5 agents even with LD only 18% of 4yr olds are perfect, suggesting working memory space is running out. The poster will discuss further error patterns.

2-H-103   Prompting children to count promotes proportional moral evaluations

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Young children readily engage in moral evaluations of others. By the preschool age, children evaluate a person's sharing behavior not only with respect to how much he or she shares, but also with respect to that person's initial endowment (someone who shares 1/2 is nicer than someone who shares 1/4 of their resources). However, preschoolers fail to integrate absolute sharing and initial endowment. We explored whether prompting children to count would enhance using proportion during moral evaluation. Following prior work (McCrink et al., 2008), preschoolers (N = 96) completed 4 trials in which they evaluated which of 2 puppets was nicer. The trials pitted puppets whose giving behavior was absolutely equal but proportionally different (one puppet gave 2/4 and another gave 2/8), proportionally equal (1/4 vs. 2/8), whose proportional and absolute giving were in conflict (1/2 vs. 2/8), or whose proportional and absolute giving showed no conflict (3/8 vs. 1/12). Children were randomly assigned to either a numerator + denominator counting condition in which they were prompted to count both the puppet's initial endowment as well as the stickers the puppet shared, denominator counting condition in which they counted only initial endowment, or a control (no counting). The numerator + denominator counting condition promoted selection of the puppet with the smaller endowment. These results show that training children to count promotes proportional reasoning in moral evaluations.

2-H-104   I pray like you, but do I prefer to learn from you too?: Examining the role of religious group membership in children's informant preferences

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[1]Boston University, [2]Yale University

Children are sensitive to social group membership and prefer to learn information from ingroup (e.g., race, accent, gender) over outgroup individuals (e.g., Kinzler et al., 2011). Here, we examine children's recognition of religion as a social group and their use of religion to make inferences about whom to trust. We present Catholic and non-religious children with informants displaying one of two cues to religious group membership--an artifact (necklace: Catholic = cross, control = two lines) or a behavior

(Catholic = sign of cross, control = arm swiping). Both informants provide information about novel objects and children are invited to endorse one of the two informants. Preliminary data collected with 63 4- to 6-year-old children indicates that Catholic children (86%) are more likely to identify the sign of the cross as a religious behavior than non-religious children (7%; $\chi^2(1, N = 28) = 17.37$, $p < .001$) but children from Catholic (81%) and non-religious backgrounds (63%) are equally-likely to identify the cross necklace as a religious artifact ($\chi^2(1, N = 35) = 1.26$, $p = .261$). Thus, children's religious background impacts their recognition of a behavior, but not an artifact, as a marker of religious group membership. These different markers do not seem to impact children's learning preferences, however, and neither Catholic nor non-religious children displayed an informant preference across both cue conditions (comparisons to chance, all p's > .05, see Figure 1).

2-H-105   Theory of Mind skills are linked to infants' ability to detect emotional unreliability

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Infants detect unreliable informants, and thus engage in selective trust. However, the underlying mechanisms are currently under debate. Therefore, the objective of the present research was to examine whether Theory of Mind (ToM), a potential mechanism of selective trust, was related to 14-month-olds' ability to detect an unreliable informant. A sample of 102 infants were randomly assigned to a reliable or an unreliable condition. Infants observed an adult display happiness while looking inside a container with a toy (reliable) or a container that was empty (unreliable). A ToM task that assessed infants' ability to make knowledge inferences was also administered. Results revealed that infants in the unreliable condition took significantly longer to examine the content of the container across trials. Furthermore, infants who passed the ToM task took significantly longer to examine the contents of the container compared to infants who failed. This suggests that infants with superior ToM abilities may be better at detecting a person who shows unreliable emotional referencing.

2-H-106   Children's Personality Explains Some of the Variance in Selective Imitation

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This study investigates the impact of model-based (parent model versus unfamiliar experimenter) and child-based (child's personality) factors on children's likelihood of adopting ineffective behaviors, also exploring how parenting style influences selective imitation. After a free-play period, 32 3-5-year-olds saw a parent and 32 saw an unfamiliar experimenter choose an inefficient tool over an efficient alternative for a task. Children then chose between the two tools to perform the task. Finally, they were asked demonstrate the task to a puppet using one of the tools. Parents completed short forms of the Children's Behavior Questionnaire (CBQ) and the Parenting Styles and Dimensions Questionnaire (PSDQ). Children who had an unfamiliar model were more likely to teach the puppet using the inefficient tool. Children who imitated scored higher on "perceptual sensitivity" (CBQ), lower in "high pleasure" (CBQ), higher in parental "indulgence/ permissiveness" (PSDQ), and were more likely to imitate and less likely to protest during the play period. These results show that children's intrinsic properties influence the social learning experience they have, and provide insight into the variance seen within selective imitation studies.

2-H-107   Knowing who is in charge: Preschoolers identify high-status individuals across domains

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¹University of Washington

Social status is ubiquitous, and while there is initial evidence that children understand status, it remains unclear whether children differ in their ability to recognize status based on different domains (ie. physical dominance, wealth, decision making power, and prestige), and whether social status influences children's preferences. In the current study, we investigated these questions in 4- and 5-year-old children. Participants (N=48) heard vignettes describing a high- and low-status child. Four types of social status were assessed: wealth, physical dominance, decision-making power, and prestige. Overall, children were accurately able to identify who was in charge in all four status domains: wealth $t(47) = 5.93$, $p < .001$, physical dominance $t(47)= 7.32$, $p < .001$, decision making power $t(47)= 7.94$, $p < .001$, and prestige $t(47) = 5.60$, $p < .001$. However, even though they understood status, they did not have systematic preferences for high or low-status individuals: wealth $t(47)= 1.804$, $p=.078$, physical dominance $t(47)= 1.108$, $p=.273$, decision making power $t(47)= .694$, $p=.491$, and prestige $t(47)= 1.213$, $p=.231$. Taken together, these results show that by 4 years of age, children can identify who is in charge in multiple domains. However, even though children can identify who is in charge, they do not appear to use this information as the basis for preferences for high or low-status individuals.

2-H-108   Intersectional Categories: Measuring the effect of racial non-discreteness on children's essentialist thinking about gender

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Perceptions of race and gender influence one another (Johnson, Freeman, & Pauker, 2012). We explore how these categories intersect when children consider them. Research shows essentialist views about language relate to essentialist beliefs about animal sounds and traits (Byers-Heinlein & Garcia, 2015). From adult literature we know exposure to biracials has been shown to reduce race essentialism (Sanchez, Young, & Pauker, 2015). We hypothesized that exposing children to biracial children (compared to monoracial White or Black children) would lead them to see race as not discrete. This would then lead them to be less gender essentialist as reflected in their use of gender stereotypes, especially in older children. We analyzed preliminary data from 36 5-6 year olds (yo), 33 7-8 yo and 24 9-10 yo. We find no main effect by target race. We find a target race by age interaction ($F(4,178)=2.44$, $p=.048$), and a planned comparison revealed that within the biracial target condition, 9-10 yo were unexpectedly more likely to engage in gender stereotyping compared to other age groups ($t(89)=2.49$, $p=.015$). Furthermore, 5-6 and 7-8 yo did not show a difference in stereotyping by target race but 9-10 yo used stereotypes significantly more with biracial than Black targets ($t(23)=2.10$, $p=.047$). While results did not support our hypothesis, this data is preliminary and we consider the possibility that future work may need a stronger intervention to highlight that race is not discrete.

2-H-109   Children's Understanding of Verification as a Necessary Condition for Helpful and Effective Teaching

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Children are heavily dependent on knowledge transmitted by others, and thus must learn to be judicious, employing epistemic vigilance when evaluating others' claims (Harris, 2012; Harris & Koenig, 2006; Brosseau-Liard & Birch, 2011). This is especially true in cases where the truth value of a claim cannot be ascertained, and children must decide whose claim to trust. The current research examines whether 4- to 7-year-olds understand that in learning new information, one ought to selectively learn from others who make claims based on verified evidence. As a familiarization, children saw four trials in which two puppets accurately or inaccurately labeled familiar objects. They then saw four test trials in which two new puppets made claims about the contents of unfamiliar boxes, having either verified or failed to verify their contents. In both parts, children were asked who a naïve third puppet should listen to. Both 6- and 7-year-olds (M=3.66, t (23) = 12.8, p<.001), and to a lesser degree 4- and 5-year-olds (M=2.88, t (23) = 2.95, p=.007), reliably selected the puppet who had verified their claims above chance. However, both 4- and 5-year-olds (t (23) = 2.44, p = 0.0227) and 6- and 7-year-olds (t (23) = 2.63, p = 0.0149) performed significantly better at selecting an informant on the basis of accuracy than on the basis of verification, suggesting room for improvement. A follow-up to this experiment with 3-year-olds is currently underway.

2-H-110   Measuring preschool children's introspection on uncertainty using a short picture-identification task: Establishing age trends and relation to parent reports of knowledge understanding.

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Recent studies have found that children's introspective ability to monitor uncertainty develops during the preschool years (Coughlin, Lyons, & Ghetti, 2014; Lyons & Ghetti, 2013). Assessments usually consist of picture identification tasks with dozens of trials, and children's certainty ratings on correctly identified items are compared to certainty ratings on incorrectly identified items. The current study (N = 103) evaluated a novel, short version of these tasks in which 3- to 6-year-olds reported their certainty on three trials with easily identifiable pictures and three trials with hard-to-identify pictures. Children reported higher certainty on easy trials than hard trials, and the differences in certainty ratings increased with age. Certainty differences were also positively correlated to parents' reports on the knowledge subscale of the Children's Social Understanding Scale (Tahiroglu et al., 2014). Together, these findings suggest that the short version of the uncertainty monitoring tasks possess the same properties as the longer form tasks used in previous studies.

2-H-111   The Curse of Knowledge Bias and the Mechanisms Involved

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Social perspective-taking is a set of processes involved in inferring and reasoning about the mental states of others, such as their knowledge, beliefs and intentions. Perspective-taking is critical for making

sense of others actions and is called upon in virtually every aspect of social interaction. Individuals who exhibit more accurate perspective-taking demonstrate a host of positive outcomes (e.g., fewer relationship problems, higher academic achievement, more prosocial behavior, and increased social competence; Hughes & Leekman, 2004). Despite the early emergence and pervasiveness of perspective taking, it remains remarkably prone to error across development. For instance, the curse of knowledge bias (COK) refers to difficulty in reasoning about an alternative perspective due to being biased by ones own knowledge or perspective. Although there is an abundance of evidence demonstrating the bias across a wide variety of judgments, there is still relatively little known about the specific mechanisms that contribute to the COK. Researchers have proposed a multitude of factors (or mechanisms) that may contribute to the bias (e.g., Birch, 2005). However, the exact nature of the mechanisms underlying the COK bias is still a matter of immense interest and discussion (Groß & Bayen, 2015), as when people are reasoning about the knowledge of others there may be several contributing factors at play. One proposed mechanism is an inhibitory control account. Accordingly, it is the difficulty with inhibiting or suppressing the privileged content of ones own knowledge that results in the COK bias. However, some researchers suggest that inhibitory control does not mediate the relation between the COK and perspective-taking (Bernstein et al, 2007). Therefore, although there is research supporting inhibition as an explanation for the COK, age differences in inhibitory function may not fully account for the age differences seen in the bias. A second proposed mechanism, a fluency misattribution account, argues that the subjective feelings of fluency associated with familiar, or easy-to-process, information becomes misattributed as the information being objectively easy or obvious to others. A handful of studies have shown that feelings of familiarity contributed to the COK in conceptual tasks with adults and children (e.g., information shown repeatedly led to judgments that those items were more widely known than items shown only once) (Harley et al., 2004; Birch et al., accepted). A third proposed mechanism, an anchoring and adjustment account, (Pohl & Hell, 1996) suggests that our own point of view is the best starting point or anchor for inferring others knowledge and then we adjust according to other information we have available. However, a whole host of factors have been shown to influence ones degree of adjustment while making judgments of what others know (e.g., nodding or shaking your head, how like me the target it; Pohl & Hell, 1996). Identification of the mechanisms underlying the COK will advance our understanding of how people reason about and infer the knowledge of others and will shed light on possible de-biasing techniques, which have largely been unsuccessful or impractical (Sanna et al., 2002). Gaining more insight into the specific mechanisms that underlie the bias may help identify more effective ways to de-bias the COK, which should in turn result in corresponding improvements in other facets of social competence.

2-H-112   Children Forgive Previously Deceptive Sources Under New Contexts

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Children excuse past inaccuracies when informants lack access to relevant perceptual knowledge (Nurmsoo & Robinson, 2009). The current research aims to determine whether children will similarly excuse past dishonesty in a new context that does not incite deception. Four-to-six-year-olds (N = 109) played 2 sticker-search games with a puppet who was motivated to provide deceptive advice in a competitive game, and subsequently, honest advice in a cooperative game. Participants decided whether or not to accept the puppet's suggestion about the sticker's location in each context. Five- and six-year-olds systematically distrusted deceptive advice (p=.005 and p<.001, respectively) while four-year-olds were at chance. However, all children increased their trust of the puppet in the subsequent

cooperative game (p<.001), taking context into account. Results suggest children forgive past dishonesty based on context, indicating awareness of how context may influence an individual's trustworthiness, and updating their selective trust accordingly.

2-H-113   Children's Memory for the Moral and Conventional Actions of Ingroup and Outgroup Members

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Children remember negative actions significantly more than positive ones (Baltazar et al., 2012). Is this due to a negativity bias (Rozin & Royzman, 2001) that applies to all types of actions and to all individuals or is it specific to certain contexts? We presented 3 to 8 year-old participants (current N=109) with pictures of four target children who varied in terms of their group membership (ingroup=English-speaking; outgroup=French-speaking). Each target was paired with an action that varied in valence (positive vs. negative) and in domain (moral: e.g., "He pushed someone", or conventional: e.g., "She broke the rules of the game"). At test, participants were asked to recall which target preformed each action. Preliminary results suggest that although younger children (<5.5 years) did not demonstrate any memory biases, older children's (>5.5 years) memory was influence by domain, valence, and group membership. In the moral condition, older children were significantly more likely than chance to remember an ingroup member's positive or negative actions (ps=.05). In the conventional condition, older children remembered positive actions of ingroup members (p=.01) and negative actions of outgroup members (p=.001). Thus, rather than showing a general tendency to remember negative information, older children may be biased to remember moral actions of ingroup members, and to associate ingroup members with following social conventions.

2-H-114   What cues do we use when determining the emotion of another person?

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The ability to quickly and accurately determine the emotion expressed by another individual is an important milestone. Children as young as 4 years of age use objects in the environment when determining the emotion by a target character (Kuwabara, et al., 2011). Masuda et al. (2008) established that adults use the facial expressions of the individuals surrounding the target character when determining emotion. The present study extends upon past work to establish the developmental trajectory of using these two cues. The present study also varied cue valence and congruency. The present study uniquely required participants to rate the strength of the emotion, to examine the effects of congruency. The participants were 26 children between 3 and 5 years of age and 24 adults. Participants completed 20 trials. Initial analyses (repeated measures ANOVA) revealed significant main effects of Age, $F(1,49) = 5.76$, $p = .022$, Gender, $F(1,49) = 8.10$, $p = .007$, and Valence, $F(1,49) = 40.88$, $p = .001$). The Valence main effect was subsumed by a Valence by Cue Type interaction $F(1,42) = 8.21$, $p = .006$). Additional analyses will provide important insight into the development of accurate emotion recognition and will have interesting implications for atypical populations.

2-H-115   Preschoolers Stereotype Social Traits More Readily than Epistemic Ones

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Children prefer individuals who have previously demonstrated desirable characteristics (e.g., accuracy, benevolence). The current study asks whether 4- and 5-year-olds prefer an individual they know nothing about other than she belongs to a group that previously demonstrated desirable characteristics. Children in the epistemic condition (N=17) heard a group wearing red shirts label familiar objects correctly and another group wearing blue shirts label them incorrectly. Despite identifying which group said "the right thing" more often than chance, $t(16)=12.94$, $p<.001$, $d=6.47$, children in this condition did not prefer the red group's novel labels, nor did they extend selective trust to a new person who also wore a red shirt. They only preferred the new person when explicitly told that she was part of the red group, $t(5)=2.74$, $p=.041$, $d=2.45$. Children in the social condition (N=13) saw the red group demonstrate familiar nice behaviors (i.e., sharing) and the blue group demonstrate mean ones (i.e., stealing). After correctly identifying which group did "the nice thing", $t(12)=25.00$, $p<.001$, $d=14.43$, these children claimed the red group's novel behaviors and the new red person's novel behaviors were the nice ones, $ts >3.59$, $ps <.005$, $ds>2.06$. Unlike the epistemic condition, this was also true when group membership was not explicit, $t(5)=10.21$, $p<.01$, $d=9.13$. Children generalize group information about social traits to unfamiliar individuals more readily than epistemic traits.

2-H-116   "Because it's a girl thing": Four-year-old children offer situational explanations for gender-stereotypical behavior

Rebecca Lange[1], Paul Muentener[1]

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The current study examines the development of social causal attribution as it relates to gender representations. Previous research has shown that children offer dispositional reasons for behavior that varies by person, explaining behaviors as caused by personal rather than situational features. Research also shows that children as young as 18 months are aware of gender-stereotypical toy preferences, and that 5-year-olds treat gender-stereotypical behavior as an inborn characteristic impervious to environmental influence. Will children, then, offer dispositional explanations for gender-stereotypical toy choice behavior? We asked 4-year-olds (n=49) to provide explanations for a pattern of two characters' behavior. The pattern always varied by person, but either aligned with gender stereotypes (a girl plays with dolls and a bunny but a boy plays with neither) or did not (a girl plays with dolls and a bunny but another girl plays with neither). We found that overall, explanations were more often dispositional than structural (p<.001), and that children more often attributed behavior to gender when the behaviors aligned with gender stereotypes (p<.01). Surprisingly, we found that these gender-referencing explanations were significantly more likely to be situational (e.g., "because it's a girl toy") than other explanations (p<.001), as shown in Figure 1. These findings suggest that children may represent gender differences as situational, rather than dispositional, in nature.

2-H-117   Children´s own belief trumps testimony from an inaccurate adult: Effects of informant reliability on preschoolers´ belief revision

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Although children preferentially trust an accurate informant over an inaccurate one when given a choice between the two, they are quite willing to trust a single inaccurate informant alone. For example, when there is no other speaker to propose an alternative in a learning context, preschoolers not only learn novel labels from the single inaccurate speaker (Vanderbilt et al., 2014) but also extend the newly learnt labels to other similar objects (Kim et al., 2016). However, even though preschoolers seem to ignore speakers´ reliability when acquiring new knowledge in a single informant context, it is unknown to what extent children trust a credible or non-credible source when hearing information that is pitted against their own prior knowledge or beliefs. The current study examined whether 3- and 4-year-olds selectively revise their initial beliefs depending on the speaker´s past history of accuracy. Fifty 3-year-olds (35-47 months; 33 males) and 50 4-year-olds (48-61 months; 29 males) watched an adult female speaker label a series of familiar objects (apple, ball, and book) correctly or incorrectly (labeling the above three objects as dog, tree, and chair, respectively). Subsequently, children were presented with four test trials. In each test trial, children were asked to label an ambiguous hybrid object that has features of two familiar objects (e.g., car-shoe) and then heard the previously accurate or inaccurate speaker label the hybrid object differently (e.g., if a child labeled the object as a "car", the speaker would label the same object as a "shoe"). Next, children were asked to label the same hybrid object again to test whether they would revise their initial label of the hybrid object when given conflicting but acceptable testimony. In addition, children were asked to explicitly judge whether the speaker was good at labeling and whether the speaker would be a good person to ask for the label of a novel object. Figure 1 shows how often children revised their initial label and accepted the speaker´s different label by condition and age group. An ordinal logistic regression was conducted to test the effects of condition (accurate vs. inaccurate) and age group (3- vs. 4-year-olds) on children´s label revision. We found a significant main effect of condition, odds ratio = 0.063, Wald $\chi^2(1)$ = 21.43, p < .001, such that children were more likely to revise their answers, thus accepted the speaker´s different label, in the accurate condition (M = 3.39, SD = 0.91) than in the inaccurate condition (M = 1.31, SD = 1.50). There was no significant main effect of age, or interaction of condition and age, ps > .83. Analyses of the explicit judgment question yielded a significant difference between conditions; more children agreed that the speaker was good at labeling in the accurate condition than in the inaccurate condition (90% vs. 51%). However, children overwhelmingly judged that the speaker would be a good person to ask about novel objects, regardless of whether the speaker had previously been accurate or not (88% vs. 84%). Results suggest that preschool-aged children take into account an informant´s reliability when deciding whether to override their initial beliefs about the name of an ambiguous object in light of conflicting but not completely implausible testimony. These findings provide novel understandings of the circumstances under which 3- and 4-year-olds may or may not learn from non-credible sources of information.

2-H-118   Two worlds of childhood: Children's reasoning with their mother vs. peers

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Reasoning is often viewed as an individual process. However, recent accounts focused on its function of enabling partners to exchange and evaluate arguments to reach joint decisions (Mercier & Sperber, 2011). Since Piaget (1932), it has been proposed that unlike mother-child interactions, in which there is a power asymmetry, peer-interactions are a "safe haven" for children to reason with equals particularly

about moral issues. Despite the importance of these two worlds for children's cognitive, social and moral development, so far hardly any study systematically compared the structure of young children's peer-to-peer and mother-child reasoning (but see Kruger & Tomasello, 1986 for school-aged children). In our study, we investigated how 4- and 6-year-olds reasoned about 3 moral dilemmas depicted in picture books with either their peers or mothers. These dilemmas involved two characters: One character breaks a promise to a friend in order to help another child; the other keeps the promise to a friend and thus cannot help the child. Then, the dyads were asked to distribute five gemstones between these two characters and jointly decide "who did the right thing". We looked at the dyads' discussions on how to solve the task. We identified the justifications produced by the children and their partners (e.g., "She kept her promise", "Helping is more important"). We investigated 1) how often they were produced spontaneously; 2) how often they were produced to counter the arguments to their partners; and 3) what different kinds of justifications mothers and children used in their discussions. Looking at how spontaneously children produced justifications we found an interaction of age group and partner (X^2 = 11.43; df = 1; p < .001): children in both age groups produced more spontaneous justifications with peers than with their mothers. This difference is more pronounced in the 4-year-olds (p < .001) than in the 6-year-olds (p < .01). We further found that both age groups produced more justifications that argued against the partner's standpoint with peers than with their mothers (p < .001). The kinds of justifications children produce did not reveal any partner difference. Looking at way mothers provided justifications, we found that they referred to generic rules (e.g., "Helping is more important.") with both age groups. However, with 4-year-olds they provided more additional factual statements (e.g., "She helped.") than with 6-year-olds (X^2 = 4.81; df = 1; p < .05). Our results suggest that already at age 4, children do distinguish between their two worlds of childhood: they reason differently with peers than with their mothers. The equal structure of peer interactions allows children to be more active and challenge the partner's point of view more often than in mother-child interactions. This partner difference is more pronounced in younger children. Six-year-olds not only produce more spontaneous justifications than 4-year-olds with both partners, but they also perceived their interactions with mothers less asymmetric than 4-year-olds. By providing more scaffolding in the form of factual statements, mothers also contributed to a more pronounced asymmetry with 4-year-olds. Overall our results support the view that joint reasoning with peers provides an important context for children's social and cognitive development already at preschool ages.

2-H-119   The development of false belief reasoning in deaf children with cochlear implants

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Deaf children growing up in hearing families display difficulties in the development of false belief (FB) reasoning. Here we examined FB skills among deaf children with cochlear implants (CIs). Thirteen deaf children with CIs (M = 6y 5m) and 18 hearing children (M = 5y 7m) participated. The children were administered three FB tasks: (1) a verbal elicited-response task, i.e. the Sally-Anne task; (2) a non-verbal elicited-response task, i.e. a picture-completion task; (3) a non-verbal spontaneous-response task, i.e. an implicit looking time task. There were no significant differences between the two groups on tasks (1) and (2), the deaf children performed as well as the hearing children. There was a significant difference between the groups on test (3), the hearing children outperformed the deaf children. Our findings suggest that deaf children with CIs, who have access to a conversational environment, nevertheless have difficulties with some FB-tasks (the implicit task). They show delayed development on tasks that require a fast and spontaneous response, while they seem to perform well on tasks with prolonged

processing time. It seems to be less important whether a FB-task is linguistically framed, as they pass both the verbal and non-verbal elicited-response tasks. Deaf children's success on some FB-tasks (the Sally-Anne task) cannot therefore be explained by verbally mediated reasoning that has been suggested to help with an explicit task structure and instructions.

2-H-120   Children's Evaluation of the Evidential and Interpersonal Factors in Selective Trust

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Learning from others is critical but risky. However, evaluating the source can mitigate the risks. Evidential factors, such as informant expertise, reliability, and confidence, are used to identify good sources by early childhood. Yet, children also appear to use less relevant, interpersonal information such as attractiveness, strength, and benevolence. The current project examines this apparent contradiction. Specifically, we asked whether children's goals affected how simultaneously presented evidential and interpersonal factors are evaluated. Five and seven year olds were introduced to two individuals: a gruff truth-teller, who provided accurate information but was not nice, and a white liar, who provided inaccurate information nicely. Following familiarization half of the participants were asked to select an individual to help them complete a difficult puzzle (accuracy condition), the other half were asked to select an individual to play with (interpersonal condition). The younger participants did not demonstrate a systematic preference for either of the informants in the accuracy condition but they showed a preference for the white-liar in the interpersonal condition. Older participants, however, systematically preferred the truth-teller in the accuracy condition and the white-liar in the interpersonal condition. These results suggest children's goals influence their social evaluations and that the ability to effectively seek information develops into middle childhood.

2-H-121   Infant Discrimination of Emotion from Biological Motion

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Social cognitive development in infancy has been studied by probing infants' perception of actions in point-light displays (PLDs), produced by affixing a small number of illuminated dots on the joints of a human actor. Here, we ask if infants discriminate between distinct emotions in walking PLDs. Emotions in PLDs were produced by asking adults to imagine emotional scenarios to induce anger, happiness, or sadness (or neutral) prior to walking on a treadmill as gait was recorded. In Study 1, 26 infants (Mage=14.7 mos; SD=2.0) viewed 18 side-by-side pairs of 10s videos: angry/neutral, happy/neutral, and sad/neutral PLD walkers as the infants' eye movements were recorded. Infants looked more at angry > neutral ($t(25)=3.167$, $p=.004$), happy > neutral ($t(25)=3.312$, $p=.003$), and neutral > sad ($t(25)=-4.132$, $p< .001$). Study 2 presented a new group of 26 infants (Mage=15.0 mos; SD=2.4) with inverted versions of the same PLD pairings and yielded similar findings (Angry > neutral: $t(25)=3.811$, $p<.001$, Happy > neutral: $t(25)=2.724$, $p=.012$, Neutral > sad: $t(25)=-2.238$, $p=.034$), indicating that results of Study 1 could have been driven by a low-level motion preference. Study 3 (ongoing) directly compares angry/happy, angry/sad, and happy/sad walk motions to elucidate whether infants can discriminate PLDs from emotional content independent of a motion preference. Taken together, results imply that infants at 15 months may not discriminate emotions in human motions as well as in human faces.

2-H-122   **Counterfactual Thinking and Children's Judgments of Relief and Credit**

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We examined age differences in the understanding of positive counterfactual emotions (i.e., relief) and related social judgments (i.e., giving credit) using two counterfactual thinking biases: commission and temporal order.Only a few studies investigated how these biases affect children's counterfactual thinking which are limited to either negative outcomes or judgments of emotions.We presented 6, 8, and 11-year-olds, and adults with two scenarios in each of which two characters make a choice that results in the same positive outcome; the only difference between the characters is their decision process.In the commission scenario, the target character's decision is as an act of commission whereas the nontarget's is as an act of omission.In the temporal order scenario, the target character makes his decision second whereas the nontarget makes his decision first.Following each scenario, participants judged which character would feel better and would be credited more by others.The results (Table 1) revealed that, for both stories, adults were more likely than the younger age groups to judge that the target character would feel better and be credited more than the other character except for the temporal order story, where 11-year-olds were as likely as adults to judge that the target character would receive more credit.These findings indicate that some counterfactual thinking biases do not affect children's judgments of relief and credit until late childhood.

2-H-123   **What makes it special? Children consider history for functional objects, but not for attachment objects.**

Madison Pesowski[1], Ori Friedman[1]

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Regard for an object often depends on its history. For example, your favorite coffee mug may be special to you because you acquired it on an exciting vacation. However, this link between specialness and history may not hold for all objects. In four experiments, we show that 4-7-year-olds (N = 320) consider object history when judging whether functional objects (e.g., keychains) are special, but not when considering attachment objects (e.g., plush animals). In the first two experiments, children judged that functional objects with various types of interesting histories are more special than those with mundane histories (Experiments 1 and 2). The next experiments replicate these findings, but also show that children judge that attachment objects with interesting and distinct histories are no more special than those with mundane histories (Experiments 3 and 4). Together, these findings reveal that the link between judgments of specialness and history depends on object type.

2-H-124   **Infants infer dominance relations from social alliance strength**

Anthea Pun[1], Susan Birch[1], Andrew Baron[1]

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Preverbal human infants, like non-human primates, attribute greater social dominance to competitors from larger numerical groups (Pun, Birch & Baron, 2016; Wilson & Wrangham, 2003). However, it is unclear whether infants understand the functional role that allies play in affording a dominance advantage to a group member. Specifically, do allies need to be aware of a conflict between their own and other group members (ie. present during that conflict) to actually confer a benefit? Two studies (N = 96; 6-12 mos), using a violation of expectation paradigm, investigated whether alliance members' ability to witness a conflict influences infants' expectations of dominance. Social dominance was established through a right of way competition between two agents of the same physical size. One agent had two teammates, while the other agent only had one additional teammate. When all agents were able to view a conflict, infants inferred that the agent from the numerically larger group should prevail, and therefore was considered socially dominant (p = .003). However, when neither of the additional teammates were able to witness the conflict (as their vision was obstructed by a physical barrier), infants did not expect either of the competing agents to be dominant over the other (p= .29). This suggests that infants understand that the presence of social allies only confers a dominance advantage if those allies have been able to witness the conflict between competing group members.

2-H-125   Children's Inductive Learning of Norms and Regularities

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Do young children differentiate prescriptive norms from descriptive regularities? The distinction between what is and what ought to be is far from clear even for adults; these studies investigate the extent to which children conflate these concepts. In Study 1, 4-8 year-olds explicit beliefs about the association between a behavior's frequency and normative status were tested. Children observed animated videos in which novel behaviors' frequency (high or low) or normative status (norm or choice) were depicted. They then judged either the behaviors' normative status or frequency. Younger, but not older children assumed all frequent behaviors were norms and infrequent behaviors were choices (and vice versa). In Study 2, children's implicit associations between regularities and norms were tested through their memory errors. 4 to 8-year-old children saw videos depicting novel behaviors that were described as either a norm or a choice and either frequent or infrequently practiced. After a delay, children were asked to recall a behavior's frequency and normative status. All age groups of children were more likely to make memory errors associating frequent behaviors with norms and infrequent behaviors with choices than vice versa. Together the results demonstrate that children infer what ought to be on the basis of regularities.

2-H-126   Can infants discern the goals and intentional actions of a humanoid robot?

Diane Poulin-Dubois[1], Kara Olineck-Jolin[1], John Corbit[1], Alexa Ruel[1]

[1]Concordia University

From a very young age, infants have been shown to understand goal-directed actions. Although a large body of work has examined the cues that infants rely on in humans and non-human agents to understand goals, there remains a debate surrounding how this representational ability develops in infancy. The present study examined 11-month-old infants' ability to detect the goal of a self-propelled humanoid robot. The infants completed a goal-detection task as well as an action parsing task with a

humanoid robot acting as the agent. In contrast to infants' performance on both tasks with a human agent, infants failed to attribute goals to the robot. In combination with previous work, these findings provide evidence for the human-first hypothesis, which holds that infants first reason about goals from their experience interacting with other humans, with this ability only later extended to non-human agents. The implications of these results are discussed.

2-H-127   Intuitive archeology in childhood: Detecting social transmission in the design of artifacts

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Children grow up surrounded by human-made objects (artifacts). These artifacts are useful not only as tools, but as a source of social information - a type of reasoning we term intuitive archeology. We ask: When deriving social information from objects, do children perform rich, explanation-based reasoning? Or use heuristics based on perceptual similarity? In particular, when observing two similarly designed objects created by different individuals, when do people infer social transmission of information (person 2 copied person 1)? To test this, we formalized artifact reasoning in a Bayesian model, which predicts that perceptual similarity should not be strong evidence of copying when functional constraints exist such that only a small range of designs would solve the problem. Adults' data were as predicted by an explanation-based model: When the shapes of the tools were functionally constrained, similarity between them was 'explained away', and adults were less likely to think the tool's design had been socially transmitted (16% constrained, 53% unconstrained; p<0.01). In children (N=33, ages 4-7), we found preliminary support for developmental change in the extent of explanation-based reasoning: At the youngest ages, children seemed to reason largely based on perceptual similarity, whereas older children showed signs of explanation-based reasoning. This work provides insight into the richness of children's reasoning about the social history of people from their objects.

2-H-128   Five-month-old infants attend to responsive caregivers

Annie Spokes[1], Tara Venkatesan[2], Elizabeth Spelke[1]

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Toddlers are sensitive to comforting interactions in animated events with geometric forms of different sizes that first move together, then separate, prompting the smaller form to emit a baby's cry (Johnson et al., 2007), and they expect adults who comfort the same crying baby to engage with one another (Spokes & Spelke, 2017), but an earlier sensitivity to comforting interactions is unknown. Two OSF-preregistered experiments (N=32) asked if 5-month-old infants prefer an adult who comforts a crying baby over one who does not. In Experiment 1, infants viewed alternating events in which a baby cried, and two adults responded by approaching or fleeing the baby, moving the same distances in different directions. When the adults then appeared together without the baby for one 20-sec visual preference trial, infants looked longer to the responsive adult, $M = 0.608$, $SD = 0.206$, $t(15) = 2.167$, $p = 0.047$, Figure 1. Experiment 2 replaced the crying baby with a car emitting a siren noise, comparable in salience to a baby's cry. Infants looked as long at approach and avoid events as in Exp. 1 but showed no test preference for the adult who approached the car, $M = 0.486$, $SD = 0.212$, $t(15) = 0.264$, $p = 0.795$, Figure 1. Infants' looking patterns in Exp. 1 thus cannot be explained by a general preference for an

approaching over avoiding adult and suggest that infants attend to more responsive caregivers before they can approach or use language to communicate with their own social partners.

2-H-129 Language, Executive Function, and Theory of Mind in Socioeconomically Disadvantaged Minority Children in Japan

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Japan has seen an increase in children from ethnically and linguistically diverse backgrounds, but there has been limited investigation into how such minority children develop in the face of socioeconomic and educational challenges. The present study assessed 18 socioeconomically disadvantaged Brazilian children in Japan twice in measures of language (vocabulary and sentential complements) in Portuguese and Japanese, executive function, and theory of mind (ToM) over a period of 13 months. At Time 1 (63 months), the Brazilian children were delayed in language and ToM, but performed similarly in executive function compared to age-matched Japanese children. From Time 1 to Time 2 (76 months), the Brazilian children showed significant improvements in vocabulary and sentential complements in both Japanese and Portuguese, but no significant changes in ToM with the majority of the children continuing to fail in ToM tasks. Multiple regression analyses revealed that, at Time 2, the understanding of sentential complements predicted ToM even after controlling for age, vocabulary, and executive function.

2-H-130 Young children prefer optimists when choosing social partners

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Optimism - a bias to overestimate the likelihood of positive future events and underestimate the likelihood of negative future events - positively affects how one views the world. Being optimistic may also positively affect how one is perceived by others, which is important when forming social relationships. Adults are more interpersonally attracted to optimists over pessimists (Vollman & Renner, 2010), but when these preferences emerge is not yet known. The present study investigated whether 3-to-6-year-old children from diverse socioeconomic and racial backgrounds choose optimists over realists and/or pessimists as social partners. Children (N=140) were first taught the likelihood of an event happening. Two agents then offered optimistic, realistic, or pessimistic predictions of that event happening. Children were asked to select the agent they wanted to be friends with. Children chose to befriend optimists significantly more often than realists or pessimists (M=.85), t(139)=3.376, p<.001. This finding indicates that a preference for optimistic social partners emerges in the preschool years and raises questions about the social costs of non-optimism. Follow-up studies that test if children can identify the most accurate agent, and analyses to assess how age, race, or early experiences affect children's social choices, are currently underway.

2-H-131 Influence of hindsight bias and theory of mind on young children's moral judgments

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Hindsight bias (HB) is the "I knew it all along" phenomenon, where people deem outcome information to be more predictable once they know the outcome of an event. This bias decreases in children as theory of mind (ToM) develops (Bernstein et al., 2007). ToM is related to children's moral judgments (Killen et al., 2011). Do children show HB in their moral judgments, and is ToM a factor? Children (N = 93), 3-6 years, in one of two conditions (hindsight, where the outcome of a transgression is known; or foresight, where the outcome is unknown), participated in 3 tasks: an assessment of ToM in a morally relevant context, an accidental (A) and an intentional (I) transgression task. In transgression tasks, children judged whether a child who pushed another did something good or bad and rated the degree of trouble a child would be in. Children, in the absence of ToM (n=38), showed HB by judging the transgressor more negatively in hindsight than in foresight, without regard to type of transgression (A: t=2.23, p=.032; I: t=2.69, p=.011). Children with ToM did not show HB; however, they did judge intentional transgressions more negatively than accidental ones (t=3.91, p=.000). For children without ToM, outcome information is more salient than type of transgression. The reverse holds true for children with ToM, where the intent of the transgressor is more salient than outcome. Young children show HB in their moral judgments, but only in the absence of ToM.

2-H-132 A Cross-Cultural Investigation of Children's Using Categorical Label to Make Inductive Reasoning About Nonobvious Weight

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Preschool is an important period for the development of understanding the invisible property of weight (Wang, Williamson, & Meltzoff, 2015). The current two experiments investigate when children can use categorical labels to make inductive reasoning about weight. The experimental materials included three identical-appearance objects (e.g., two heavy, one light) in each of two sets. The experimenter labeled one object (e.g., one heavy). Then 2- to 6-year-olds (American, n=100; Chinese, n=60) were asked to say which one of the other two objects have the same label. Children extended the categorical label to the same weight object increased significantly with age in both American, F(4,95) = 15.52, p<.001, and Chinese children, F(2,57) = 13.73, p<.001. Both American and Chinese 4-year-olds performed significantly above chance. Overall, this study provides a timeline for the development of children's using the categorical label to reason invisible weight from the cross-cultural perspective.

2-H-133 Theory of Mind and Inhibitory Processing in Mexican and Mexican American Children

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Bilingual children have been found to possess an advantage over monolinguals in inhibitory skills, a component of executive functioning (Bialystok, 2017), and on some theory of mind (ToM) tasks (Goetz, 2003); however, some researchers have failed to find bilingual advantages (Kousaie & Phillips, 2012). Discrepant findings across studies might be explained by differences in tasks, or participant characteristics such as degree of bilingualism (Roselli, Ardila, Jurado, & Salvatierra, 2014), age, or sociocultural factors relating to language use (Weimer & Gasquoine, 2016). The present study explored relations between performance on ToM and executive functioning tasks, including inhibitory processing,

among Mexican and Mexican-American children. Participants included 130 Spanish- and English-speaking bilinguals ages 7-to-11-year-old (70 girls, 60 boys), residing in Mexico and the United States. Parents completed demographic surveys and children were assessed on several measures, which included an assessment of picture vocabulary in Spanish and English, followed by tests of inhibitory processing, visual-spatial problem solving, and theory of mind development in the child's dominant language. Table 1 shows comparisons across bilinguals from both locations. Tables 2 and 3 show interrelations among ToM and executive functioning skills. Findings suggest that cultural and other individual factors might play an important role in social and cognitive development.

2-H-134   Children's Attention to Semantic Content versus Emotional Tone: Differences between Two Cultural Groups

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People from varied cultural backgrounds differ in their attention to particular aspects of emotional cues. Whereas semantic content explicitly expresses feelings, vocal tone conveys implicit information regarding emotions. This study examined the attention to different emotional cues in European American and Chinese children. Participants were 121 European American and 120 Chinese children (4-9 years old). They played two games in which they listened to spoken words and judged the pleasantness of the semantic content while ignoring the vocal tone (meaning game) or judged the pleasantness of the vocal tone while ignoring the semantic content (tone game). Results showed that European American children paid more spontaneous attention to semantic content than did Chinese children. Additionally, older (8-9 years old) Chinese children attended more to vocal tone than did their European American counterparts. Furthermore, European American children were more sensitive to semantic content than to vocal tone, whereas Chinese children tended to pay more attention to vocal tone than to semantic content. The results suggest that children acquire culturally specific attention bias by 8-9 years old.

2-H-135   Is Selective Trust Real? Do Children Accept and Subsequently Use the Communicative Cues of an Accurate or Inaccurate Speaker?

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Children show sensitivity toward a speaker's history of credibility and selectively trust the testimony of a reliable versus an unreliable speaker in the context of learning new words (Koenig et al., 2004; Nguyen, Gordon, Chevalier, & Girgis, 2016). Recent research also suggests that such selective trust extends to communicative gestures, such as pointing, where children tend to choose a speaker who previously pointed correctly to a box over another speaker who previously pointed incorrectly to an empty box when asked which speaker could help them find or identify a hidden object (e.g., Palmquist & Jaswal, 2015). However, in word learning studies, it was found that, when presented with only one speaker, children would also trust the inaccurate speaker as long as no other informant proposed an alternative (Vanderbilt, Heyman, & Liu, 2014). No study has examined whether children would similarly trust a single speaker who previously provided unreliable communicative gestures. The current study seeks to explore whether children would accept and use communicative cues (e.g., point and gaze) provided by an accurate or inaccurate speaker in a subsequent task. Sixty-nine 4-year-olds (M = 4.57 years, SD = .28;

38 males, 31 females) first interacted with an experimenter who was either accurate or inaccurate in pointing and gaze direction during a familiarization phase (i.e., the experimenter either consistently pointed to or looked at one of two transparent boxes that contained a sticker or consistently pointed to or looked at the empty box while asking for the sticker; n = 33 for accurate condition and n = 36 for inaccurate condition, randomly assigned). This was followed by a test phase, where the experimenter told the children she hid a sticker in one of two opaque boxes. The experimenter then either pointed to or looked at one of the boxes and asked the children to select the box that had the sticker in it. We recorded whether children followed the experimenter's referential cues to pick the box she pointed to or looked at. ANOVA revealed a significant main effect of Condition, $F(1, 67) = 46.34$, $p < .001$, partial eta squared = .41. Children in the accurate condition followed the experimenter's point and gaze significantly more at test ($M = 1.63$, $SE = .08$) compared to children in the inaccurate condition ($M = .85$, $SE = .08$) (see Figure 1). One-sample t-tests revealed that children in the accurate condition followed the experimenter's referential cues significantly above chance, $t(32) = 8.42$, $p < .001$, $d = 1.44$. Children in the inaccurate condition, however, performed marginally below chance, $t(32) = -1.72$, $p = .094$, $d = -.29$. In conclusion, we found that preschoolers showed selective trust toward an accurate but not an inaccurate informant's referential cues and applied this judgement on a subsequent finding task (even when the inaccurate informant was the only one present at the time). The results raise questions about whether children do indeed trust an inaccurate speaker when no other informant provided an alternative testimony, as suggested by previous studies, or whether this display of selective trust applies only to specific contexts (e.g., word learning vs. referential cues). The results also implied that a simple preferential selection of a speaker's testimony in traditional selective trust paradigms might not provide a full picture of children's true acceptance of information provided by the speaker in a subsequent related task.

2-H-136   Leaving choice to others: Children's understanding of social mindfulness

Xin (Alice) Zhao¹, Xuan Zhao², Hyowon Gweon³, Tamar Kushnir¹

¹Cornell University, ²Brown University, ³Stanford University

Being mindful of others' needs and interests is an important skill for navigating the social world. Prior research on social mindfulness has shown that adults tend to develop more favorable judgments of those who leave opportunities for others to make autonomous choice than those who don't leave choice for others. In this study, we investigated the development of the understanding of social mindfulness by asking whether children would evaluate a person who leaves choice for others to be nicer than a person who limits choice for others. Children (Age: 4-6, N=67) heard a story about Sophie who had two opportunities to choose a snack after her friends: one after Friend A and another after Friend B (friend name counterbalanced). Given a choice between 2 fruits of the same kind and 1 unique fruit (e.g. 2 apples and 1 banana), Friend A chose the common item (e.g. 1 apple) thus leaving Sophie one fruit of each kind (e.g. 1 apple and 1 banana) to choose from. In a similar situation, Friend B chose the unique item, leaving Sophie two fruits of the same kind. Children were asked "Who is nicer, A or B?" Overall, 65% of the children favored the friend who left Sophie a choice, and this trend increased with age (r= .36, p=.02). Older children were also more likely to provide qualitative explanations referring to the concept of social mindfulness than younger children. These findings suggest that children gradually develop their understanding of social mindfulness in early childhood.

Saturday October 14, 2017

Plenary Address

The role of personal and social identities in academic achievement: The Case of African American Adolescents"

Jacquelynne Eccles, University of California, Irvine

In this talk, Dr. Eccles will present the argument that both individual and group differences in something like academic achievement is influenced by both expectations for success and the subjective task value attached to success in challenging task. Furthermore both individual and group differences in expectations for one's own likely success and the subjective task value are influenced by the specific contents of one's personal and social identities. She defines personal identities as those identities that make one unique and social identities as those identities that serve one's belongingness needs. To the extent that excelling in academics is part of either one's personal or social identities, then the probability of engaging the behaviors necessary to excel in academics will be increased. Dr. Eccles will then summarize the results of a large scale longitudinal study that has followed a population of African American youth from age 12 to age 27. this summary will focus on processes related to African American Identities, experiences of racial discrimination in school, and developmental changes in academic achievement.

Plenary Symposium 2 – The Relational Mind

Analogical comparison and language in the development of relational cognition

Dedre Gentner, Northwestern University

Relational processing is the keystone of higher-order cognition. It is essential to learning in mathematics and science, and equally essential in social and ethical domains. Yet learning relations is challenging, because, unlike concrete objects, relations are typically not obvious in perceptual experience. My thesis is that analogical processes and relational language combine to support allow young children to acquire relational knowledge. Analogical comparison engages a process of structure-mapping that highlights commonalities, especially common relational systems. The common relational structure then becomes more salient and more available for transfer—in short, a portable abstraction may be formed. There is evidence that the same kinds of structure-mapping processes occur in adults and children, and even in infants—implying that powerful learning processes are at work even in the first years of life. The power of analogical comparison is amplified by language learning. For example, hearing a common label for two situations invites comparison between the situations, engaging a structure-mapping process that yields insight into the meaning of the term. Further, semantic systems initially learned through language can foster the development of the corresponding conceptual system. I will discuss work on how comparison fosters relational learning and on how structure-mapping processes interact with relational language in the development of higher-order cognition.

The development of relational processing in infancy

Sue Hespos, Northwestern University

Analogical ability—the ability to make relational comparisons between objects, events, or ideas, and to see common relational patterns across different kinds of things—is a cornerstone of higher reasoning abilities, and one in which humans are vastly superior to other primates. What is the nature of this ability, and how does it develop? To address these questions, we tested whether and how relational learning takes place in infants. This research traces the development of relational processing over the first year of life. In this talk, I will start with a recent demonstration that 7- and 9-month-old infants can form abstract same and different relations, and apply them to new pairs of objects. The infant results fit the patterns of analogical learning found across development. As in older children, facilitating comparison across exemplars promotes abstracting the common relation; and rendering individual objects salient disrupts relational learning. Next, I will present evidence that 3-month-old infants are capable of relational learning with an important difference. These young infants failed to abstract the same-different relations when presented with six exemplars, but succeeded with two exemplars. Finally, I will present evidence about how language is a powerful mediator in learning relations in the first year of life. These findings lend new insights to the nature of our basic learning processes concerning higher-order cognition. Taken together, these studies reveal information critical to understanding analogical processes in general.

Social Relational Learning

Stella Christie, Swarthmore College

If cognitive development partly concerns learning relations, so must social development. The social world is fundamentally characterized by relations between people, with common relational structures—such as kinships and hierarchies—forming social units that dictate social behaviors. How do we acquire and process these social relational concepts? In this talk, I outline a new account for understanding social cognitive development as a relational learning problem. Longstanding work in analogical learning has delineated specific problems of acquiring relations, as well as cognitive tools that learners use to overcome these problems. While these explain relational development in many domains—such as spatial thinking, verb learning, acquiring relational categories—we are yet to draw an analogical account for social relational learning. I will chart 1) how relations which we know are useful in other domains are also impactful in the social domain, 2) how the tension between relational vs. object similarity applies in social learning, and 3) how learning by comparison can potentially help learners acquire complex social relational structures.

Do you notice a pattern? Patterning, relational reasoning and mathematics knowledge

Bethany Rittle-Johnson, Vanderbilt University

Young children often notice and create patterns (e.g., a blue-yellow-blue-yellow-blue-yellow Lego tower), and parents and teachers report engaging their children in multiple patterning tasks a week. Relational reasoning is a core component of patterning, but the development of patterning skills has received little attention in the literature until recently. This talk will focus on the development of patterning skill in preschool, including its relation to other cognitive skills and to mathematics knowledge. Patterning skills include identifying and extending predictable sequences in objects, sounds

or numbers. In preschool, children learn to copy and extend repeating patterns (i.e., linear patterns that have a unit that repeats). They eventually learn to think more abstractly about the relations between objects within a pattern, figuring out how to create the same kind of pattern using new materials. Individual differences in patterning skills are related to several other cognitive skills, including relational reasoning, working memory capacity, cognitive flexibility and spatial skills. Further, patterning skills in preschool are predictive of mathematics knowledge at the end of preschool and of elementary school. Fortunately, there are several methods for improving preschool children's patterning skills, including promoting children to generate explanations and labeling the unit of repeat in the pattern using abstract labels. Overall, children develop important patterning skills in preschool that are related to later academic success.

Poster Session 3

A - Cognition in Applied Contexts

3-A-1   How Are Working Memory and Processing Speed Associated with Child Pedestrian Safety?

Brooke Bailey[1], Scarlett Ridley[2], David Schwebel[2]

[1]Tulane University, [2]University of Alabama at Birmingham

Introduction. According to NHTSA, 8,000 child pedestrians were injured in traffic crashes in 2015. One risk factor for child pedestrian injury is immature cognitive development. We examined relations between working memory and processing speed and the number of virtual street crossings resulting in collisions with vehicles among a sample of 7- and 8-year-old children who participated in a series of street-crossings within a virtual pedestrian environment. Methods. As part of a larger study, 67 seven- and eight-year olds completed 4 subtests of the WISC-V: digit and picture span (working memory assessment), and coding and symbol search (processing speed assessment). Children also completed three sets of seven street crossings in a virtual pedestrian environment delivered through a smartphone placed in View-Master goggles. Results. Correlation analyses showed significant negative relations between digit span ($r(65)=-.33$, $p<.01$), picture span ($r(65)=-.39$, $p<.01$), and coding ($r(65)=-.25$, $p<.05$) subtest scores and children's collisions with vehicles in the virtual pedestrian environment. Discussion. Working memory and processing speed are associated with children's ability to cross the street. Working memory correlated more strongly to pedestrian safety, perhaps because pedestrians must remember the traffic environment in one direction while looking in the opposite direction to successfully judge street-crossing safety.

3-A-2   Project Hope: Development of a Digital Game-based Educational Intervention for Syrian Refugee Children

Bruce Homer[1], Jan Plass[2], Sinem Vatanartiran[3], Teresa Ober[1], Maya Rose[1], Tzuchi Tsai[1]

[1]The Graduate Center, CUNY, [2]New York University, [3]BAU International University

Over 2.5 million children have fled the war in Syria, with many settling in Turkey, the top refugee-hosting country in the world. A recent survey of the educational and mental health needs of Syrian refugee children in Turkey found that an overwhelming majority are not enrolled in school, partly due to language barriers, and about half suffer from PTSD and/or depression (Sirin & Rogers-Sirin, 2015). In response to this crisis, a collaborative team of researchers and service providers in the USA and Turkey developed Project Hope, an intense, online, game-based intervention to improve children's Turkish language proficiency, executive functions, and teach basic coding skills, while decreasing sense of despair. Project Hope modified existing digital learning tools to create a 4-week intervention (40 hours total) intended to allow a small number of service providers to work with a large number of children (Fig 1). Results from a pilot study with 147 Syrian refugee children in Turkey, ages 9-14 (M = 11.75; SD = 1.23) are reported. Approximately half (n = 75) received the intervention, with the rest serving as a "business-as-usual" control group. Results indicated improved language skills, executive functions, and coding skills, and a significant decrease in hopelessness in the intervention group of children, and support the idea that a game-based, playful learning approach can be an effective, cost-efficient way to provide educational and psychological support to refugee children.

3-A-3   Teaching Children How to Avoid Getting Sick

Emily Kim[1], Megan Geerdts[2], Zachary Walden[1], Vanessa LoBue[1]

[1]Rutgers University-Newark, [2]William Patterson University

Picture books are a common part of children's daily informal learning experiences. Although children learn about factual, biological properties from reading picture books, little work has investigated whether changes in children's behavior can result from book reading. Here we explore whether children's experiences with books about contagion affect their illness-avoidance behaviors. In Study 1, we presented children with a book that had a biological, physical, behavioral or no explanation for how a fictional character became sick. Children were later asked to choose between a toy from a child who had a "cold" (contaminated) or a "toothache" (non-contaminated). In Study 2, we used a similar procedure to ask whether using the word "germs" alone elicits avoidance, or whether children need the specific mechanism for illness transmission to avoid a contaminated toy. Results suggest that preschoolers can learn to avoid contaminated objects from books that provide specific information about illness transmission.

3-A-4   Development of Control of Variables Strategy abilities in preschool children

April Moeller[1], Beate Sodian[2]

[1]Ludwig-Maximilians-Universität München - Munich Center of the Learning Sciences, [2]Ludwig-Maximilians-Universität München

In developmental psychology, children's abilities to control variables have been investigated as one component of scientific reasoning. However, there is limited research on preschool children's abilities in Control of Variables Strategy (CVS) tasks. Further, many CVS tasks are influenced by prior knowledge and may be too complex for children aged four to six. The present study aims to develop a context-free CVS task. In this novel task, children are shown confounded evidence (a stick of three differently colored legos makes a box light up) and then provided with three more sticks. They must pick one to place on the box in order to find out if a particular lego lights up. One choice, the correct one, controls two of the

original colors and varies the color in question, the second controls one of the original colors and varies two colors, and the third introduces three novel colors. Preliminary results show that young preschool children (n = 12, M = 57 months) did not differentiate between the choices. Older preschool children (n = 13, M = 72 months) showed a choice tendency toward the correct CVS choice. A majority of adults (control group, n = 14, M = 27.3 years) chose correctly and those who did not realized their mistake independently and then chose correctly. These preliminary results suggest our CVS task appears to be appropriate for investigating the development of CVS in young children and may indicate a beginning competence at CVS in preschool age.

3-A-5   **Fostering Interdisciplinary Research on Education: Cognitive Science and Educational Research**

Gregg Solomon[1], Jan Youtie[2], Seokbeom Kwon[2], Stephen Carley[2], James Dietz[1], Alan Porter[2]

[1]National Science Foundation, [2]Georgia Institute of Technology

In the study of interdisciplinarity, the relationship between Educational Research and Cognitive Science is an unusual one. Unlike, say, Biology and Mathematics, the fields have for decades addressed what are often the same scientific questions about learning and social interaction. That they exist as separate disciplines is as much a matter of the history or sociology of science as of content - both are, for the most part, social, behavioral, and cognitive sciences. But, pointedly, they have often pursued their shared questions within different theoretical frameworks, focusing on different factors, in different contexts, with different methodological and analytic tools, and even arriving at different conclusions. In this talk, we draw on analyses of proposals funded by the US National Science Foundation (NSF), bibliometric studies of the research literature, and examinations of seminal publications such as How People Learn in order to describe the extent of integration between the fields and point to hopeful signs for the future. Our analysis of NSF programs, the ROLE and REESE programs in particular, showed them to be more multidisciplinary than other NSF educational research funding programs. For example, cognitive scientists had rarely been PIs in NSF-funded education research in the 1990s, whereas they made up about 15 percent of PIs in ROLE and REESE. The proposal references themselves show a significantly greater multidisciplinary influence. Among the effects that this influx of disciplines into education research had was a change in the range of research methodologies employed. In a departure from previous programs, the PIs were more likely to do experiments and other methods that allowed causal claims. About 90 percent of education research funded by NSF prior to ROLE involved descriptive (e.g., case studies and ethnography) and other non-experimental methods, with virtually no experiments or quasi-experiments. In the ROLE and REESE portfolios, more than half of the projects involved experiments or quasi-experiments. In a sign of the range of methods and kinds of research funded, more than half of projects employed still descriptive methods (n.b., many projects involved mixed-methods, both experimental and nonexperimental). Our benchmark studies of citation patterns in these fields between 1994 and 2014 showed a marked increase in the citation of Cognitive Science articles by Educational research articles beginning around the year 2000. They also show a similar increase in citation by Educational research articles of articles appearing in Border field journals (i.e., Educational Psychology, Learning Sciences, Human-Computer Interaction, and Applied Linguistics). Border field articles, in turn, show a relatively high percentage of citation of articles in both Education research and Cognitive Science, suggesting that they may serve as a pathway for the flow of knowledge between fields. Finally, we discuss the role of publications that have a special role in mediating knowledge flow between disciplines and we lay out a framework for the measurement of the

development of human and social capital and the critical importance of fostering connections between these fields.

3-A-6   Differences between Tablet Learning and Traditional Learning in Elementary School Children

Natalie Suchy[1], Stuart Marcovitch[1]

[1]University of North Carolina at Greensboro

Prior research has produced mixed results on the effectiveness of interactive technology on learning in different domains (e.g., Hung, Sun, & Yu, 2015; Takacs, Swart, & Bus, 2014). In the current study, we investigated whether 5- to 8-year-old children recall more information when novel concepts are learned via interactive technology as compared to when the information is presented in paper form during a face-to-face lesson. Sixty-five participants were randomly assigned to either the iPad condition, in which they learned about an animal and a country using researcher-designed websites, or the face-to-face condition, in which the researcher presented the same information and images in hard copy form. Participants then received a quiz on the material. A marginal interaction between condition and age group was revealed; the older cohort (i.e., 82 months and older) produced higher standardized quiz scores in the iPad condition (M = 0.65, SE = 0.20) as compared to the face-to-face condition (M = 0.16, SE = 0.20), while neither condition was advantageous for the younger cohort (iPad M = -0.65, SE = 0.14; face-to-face M = -0.53, SE = 0.18). Results suggest that website learning shows benefits by the end of the 7th year.

B - Cognitive Foundations: Memory, EF, Attention, Action

3-B-7   Executive function and academic achievement: Differential relations across socioeconomic status

Manna Shintani[1], Sammy Ahmed[1], Frederick Morrison[1]

[1]University of Michigan

Executive functions (EF) are powerful predictors of children's academic success. Yet, there are few studies that explore the protective role of EF for socioeconomically disadvantaged children's academic achievement. Specifically, whether the relation between EF and academic achievement varies across social class during early childhood is less understood. The current study examined the moderating role of working memory (backward digit span) on the association between socioeconomic status (SES) and math achievement (applied problems, Woodcock-Johnson III) in kindergarten (n=105). The effects of two different SES measures - maternal education and household income -were separately tested. Results revealed a main effect of EF on math achievement (β=4.30, t=4.62, p=.00), however, interactions between SES and EF were not significant, which points to the importance of EF across the socioeconomic spectrum. Further research, with larger samples, and a greater range of measures is needed to understand the role of EF for young children's academic achievement.

3-B-8   Does the value of an object influence children's memory for object features?

Jessica Beal¹, Peter Blake¹, Melissa Kibbe¹

¹Boston University

In a classic study, Bruner and Goodman (1947) found a link between the subjective value of coins (based on income level) and children's memory for the size of the those coins. We sought to replicate this finding in two experiments. In Experiment 1, we adapted Bruner and Goodman's original method for a tablet, and asked 3-10-year-old children (n=250) and adults (n=860) to resize a rectangle or a disk to match the remembered size of a $1 bill, a $20 bill, or a quarter. We failed to replicate Bruner and Goodman's result, finding no relationship between household income or currency value and remembered currency size. In Experiment 2, we artificially induced the subjective value of two novel toys by telling 3-7-year-old children (n=40) that the toys were highly valuable (e.g. "It cost $50! It's really fun!") or not valuable (e.g. "It only cost $1. It's really boring"; between subjects). Children were asked to recall either the size or the color saturation of the toys by selecting the matching size or color from a series of pictures. We found that, when we told children that the toys were highly valuable, children remembered them to both be larger (p=0.03) and more saturated (p=0.02) than when we told children that the toys were of no value. Together, our data suggest that while Bruner & Goodman's original result may not obtain in 2017, the value of an object can indeed influence memory for object features.

3-B-9 Exploring how Temporal Memory Develops and the Underlying Neural Processes that Support it using ERP

Kathleen Bettencourt¹, Laurel Everett, Yixin Chen, Thanujeni Pathman²

¹University of North Carolina at Greensboro, ²York University

Episodic memory is memory of past events from a specific place and time (Tulving, 1984). Relatively little is known about the development of memory for time (when events occurred) and the underlying neural processes that support it. In the present research, we examined temporal memory in middle to late childhood (7-9-year-olds, n=29 and 10-12-year-olds, n=29) in comparison to young adults (n=31). Participants studied two lists of objects separated by a break, and later wore an ERP cap during a temporal recognition test where participants identified objects as being from list 1, list 2, or were new. Behaviorally, 7-9-year-old children had fewer source hits (correctly identified list) than 10-12-year-olds and adults. Also, 7-9-year-olds had more source errors (identified list 1 items as list 2 or vice versa) than 10-12-year-olds and adults. ERP analyses showed temporal source memory effects in two separate time windows. Across age groups, there was a more negative ERP waveform for source hits than for correct rejections (correctly identifying new items) in frontal, central, and parietal electrode clusters. For adults only, an additional earlier time window emerged showing differential neural processing of source hits and correct rejections. Implications for episodic memory development will be discussed. This is the first published study to our knowledge to examine temporal memory using ERP with both school-age children and adults.

3-B-10 The Foundations of Lie Telling: Exploring Executive Functions

Carmen Brown¹, Ansley Tullos Gilpin¹, Rachel Thibodeau², Alexandra Nancarrow¹

¹University of Alabama, ²University of Missouri

This study investigated relations among executive function (EF) skills, social skills and lie telling in young children. Preschoolers ages 3-5 (N = 73 of 100 total currently) completed a set of EF tasks examining inhibitory control (Grass/Snow; Gerstadt, Hong, & Diamond, 1994), attention shift (Dimensional Change Cart Sort; Zelazo, Muller, Frye, & Marcovitch, 2003), and working memory (Forward Digit Span; Davis & Pratt, 1996), along with the Animal Guessing Game task (Talwar & Lee, 2002) to explore lie telling. Teachers reported on children's social skills (Children's Social Understanding Scale; Tahiroglu et al., 2014, and Social Competence and Behavior Evaluation in Children; LaFreniere & Dumas, 1996). As hypothesized, children who did not peek had the highest EF and social skills, followed by children who peeked and lied; however, those who peeked and told the truth had the lowest EF and social skills; ($F_{ef}(2,70)$ = 2.06, p = .14; $F_{ss}(2,56)$ = 4.50, p = .02). See Figure 1. In a model together, EF and social skills were both significant main effects in predicting children's performance on the Animal Lie Task, however there is no evidence of moderation. These findings suggest that both cognitive and social skills individually contribute towards facilitating growth in advanced social skills such as lying during the preschool years, which seems to be a different predictive model than in later ages when cognitive and social skills may be more interactive (Bussey, 1992).

3-B-11 Sensorimotor body experience accelerates mirror self-recognition

Lisa Chinn[1], Claire Noonan[1], Lauren Deblanc[1], Jeffrey Lockman[1]

[1]Tulane University

Early self-concept is often measured as mirror self-recognition. It appears to be present in about half of children by around 18-20 months of age (Amsterdam, 1972; Brownell et al, 2010). Mirror self-recognition is commonly tested by placing a spot of makeup/face paint on infants' faces, and then seeing whether they attempt to wipe off or point to the spot upon looking in the mirror. This ability is likely related to noticing a contingency between one's own movements and a reflection (Bahrick & Watson, 1985). We attempted to accelerate self-recognition by providing earlier contingent mirror and sensorimotor body experience using a tactile/visual stimulus (1.5 cm vibrating buzzer). Experimental group infants came in for monthly visits starting at 14 months of age (N=10, data collection ongoing). They touched or removed the buzzer after it was applied to the face away from and then when facing a mirror. Subsequently, we tested whether they responded to a spot of green face paint when looking in the mirror. The average age of self-recognition was 16.6 months. Five out of six infants in an age-matched control group (data collection ongoing) did not match the experimental group performance (Fisher's exact test p-value <.05). Results suggest that additional tactile/visual stimulus experience before a mirror accelerated self-recognition, and that mirror self-recognition appears related to sensorimotor body knowledge.

3-B-12 Knowing is Some of the Battle: Metacognitive Awareness Improves Self-Derivation Performance

Jessica Dugan[1], Margo Menkes[1], Alena Esposito[1], Patricia Bauer[1]

[1]Emory University

Self-derivation of new factual knowledge through integration of related episodes is a key learning mechanism. We tested whether metacognitive awareness contributes to success in adults. In Experiment 1, we found relations between self-derivation and the Metacognitive Awareness Inventory

(Schraw & Dennison, 1994). The relation was specific to conditional knowledge (r=.52, p=.01), suggesting that knowing what steps to take and when to take them is important for successful self-derivation. In Experiment 2, this relation was apparent in an increase in performance across blocks of trials in which adults read pairs of facts that could be integrated and then were tested for self-derivation. Performance increased after the first block, F(3,93)=5.43, p=0.002, consistent with the suggestion that knowing the steps to take facilitated performance. Taken together, these results suggest that metacognitive awareness plays an important role in self-derivation of new knowledge and contributes to greater success in the process.

3-B-13   Musical moments in infants' everyday environments are brief and bursty

Jennifer Mendoza[1], Caitlin Fausey[1]

[1]University of Oregon

Most parents (60%) report singing and/or playing music to their infants on a daily basis (Custodero et al., 2003). How do infants encounter this music, among the many other sounds that shape their brains in the first year (Werker et al., 1981)? Do they encounter extended interludes (songs from start-to-finish) or briefer phrases accompanying everyday activities? We present a new corpus of musical moments available to young infants. Infants (N=35; ages 6-12 months) wore a lightweight audio recorder at home (LENA; Ford et al., 2008) for up to 16 hours (Median=13.13 hours). Trained coders identified music bouts within this everyday soundscape: live and/or recorded singing, instrument playing, and vocally produced pitched, rhythmic patterns (e.g., humming). Fully annotated recordings reveal that infants encounter brief and bursty musical phrases throughout the day. Individual musical bouts are very short (Median=8.65 seconds), occur close together in clustered patterns across time (Median pause duration=14 seconds; Median Burstiness=.34) (Goh & Barabasi, 2008), and cumulate to just under an hour of music per day (Median=48.6 minutes). Ongoing analyses will reveal the similarity structure of voices, words, melodies, and tempos across bouts. The brief, bursty daily profile may helpfully engage young attentional systems (Ruff & Capozzoli, 2003) as infants begin to identify and organize into coherent units the many sounds in their world. (Prelim subset of corpus presented at BCBL)

3-B-14   Fantasy Orientation: Measuring Individual Differences, Improving Imaginative Play, and Assessing Mechanisms of Cognitive Development

Ansley Gilpin[1], Rachel Thibodeau[2], Alexandra Nancarrow[1], Carmen Brown[1]

[1]University of Alabama, [2]University of Missouri

Many researchers have speculated that children with rich imaginations have developmental advantages, yet there have been few studies investing this question experimentally. Specifically, there is a dearth of research on individual differences in children's imagination, as well as the effects of children's imagination on developing cognitive functions. There are also limited measures of children's imagination, with few of the existing measures having psychometric properties. Thus, the purpose of the present study is to identify a battery of Fantasy Orientation (FO) measures that assess all hypothesized subconstructs of FO, as identified by PCA. Additionally, with the PCA results we created a comprehensive measure of FO for use by parents and teachers to report on young children, and currently have data from approximately 550 teachers and 200 parents. Data collection for the parent sample is ongoing. Additionally, we have data from approximately 500 typically developing preschoolers

on comprehensive battery of FO along with related variables, including vocabulary, Theory of Mind, executive functions, and socioemotional skills. These data are being collected in two cohorts, with the second cohorts' currently in the final phase of data collection. Preliminary analyses of the new 22-item parent/teacher measure indicates that its Cronbach's alpha is .925, and that the questions load onto 3 subscales: (1) sociodramatic play, (2) imagination companions and impersonation, and (3) fantastical play. Forthcoming psychometrics from the Item Response Theory (IRT) analysis will be reported. To assess the impact of children's play on their cognitive development, we designed a 4-condition (control, non-imaginative play, sociodramatic play, fantastical play) RCT intervention. Children participated in one of the 3 intervention conditions listed above for 15 minutes every day for 5 weeks. A comprehensive battery of imagination, cognitive, and socio-emotional skills was measured by pre- and post-assessments. Data from the final cohort is being collected now, with preliminary analyses revealing that children in the fantasy play condition demonstrated gains in executive functions, whereas children in the realistic and control conditions did not (data from the sociodramatic play condition is forthcoming); see Figure 1. Findings will be advantageous to both our understanding of the role of imagination/fantasy in human development as well as applications such as designing optimal curricula and interventions for at-risk and atypically developing children. Legislators and education specialists investing in children's academic success should be interested in learning about the effects of a low-cost intervention involving fantastical play to enhance cognitive development.

3-B-15 The Impact of Food Advertising Literacy on Children's Food and Brand Logo Decision-Making

Oh-Ryeong Ha[1], Amanda Bruce[2], Haley Killian[1], Alex Francisco[1], Jared Bruce[1], Seung-Lark Lim[1]

[1]University of Missouri - Kansas City, [2]University of Kansas Medical Center

Exposure to food commercials can increase the importance of "taste" in children's food decisions. We examined whether food advertising literacy could influence food decision-making. Seventeen children between 8-12 years completed four learning sessions watching food commercials embedded with factual and evaluative narratives during one week in the laboratory and at home (Fig. 1). Before and after the four sessions, children made binary eating choices for 60 foods and 60 brand logos using a mouse tracking method (Fig. 2), and rated each on health, taste and preference. After learning sessions, taste attributes in food choices represented by estimated regression coefficients as well as perceived taste and preference ratings for unhealthy foods were significantly decreased (ps < .05) (Fig. 3). Mouse trajectories revealed that area under the curves representing real-time cognitive processing were increased when children chose not to eat foods associated with brand logos (ps < .05) (Fig. 4). Our findings suggest that developing food advertising literacy may decrease the relative importance of taste attributes and increase effortful cognitive processing in children's food decisions.

3-B-16 Variety Matters: What Can We Learn About Infant Walking From Soccer-Playing Robots

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

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

Traditionally, developmental researchers have studied infant walking using standard gait--a simplified walking task that requires infants to take continuous steps along a straight, forward path. However,

during natural locomotor activity, infants' walking is immensely variable. They take forward, backward, and sideways steps with many starts and stops. If straight line walking is the gold standard, then is the omnidirectional quality of spontaneous infant walking a feature or a bug? Movement variability during walking may be a byproduct of deficits such as poor strength or balance control. Alternatively, the natural variability of infant walking may be beneficial to the process of learning to walk. We address this issue by training soccer-playing robots on the walking paths generated by 115 infants during free play. First, we trained a team of robots on infants' paths. Other teams were trained on non-variable paths such as straight-lines, squares, and circles. Across 1000 soccer games, the infant team beat the straight-line team by an average of 2.63 points, the circle team by .94 points, and the square team by .47 points. Furthermore, we find that robots trained on more variable infant walking paths (curvier bouts, omnidirectional steps, many starts and stops, and larger areas covered) outperformed less variable training teams. We propose that variability plays a crucial functional role in learning to walk and can inform more efficient translational research.

3-B-17 Development of adult-like gaze behavior in infants and children when viewing video media

Kellan Kadooka, John Franchak[1]

[1]University of California, Riverside

Over the first two years, eye movements when watching video media become more adult-like; infants increasingly fixate the same locations at the same time as adult observers (Franchak, Heeger, Hasson & Adolph, 2016). However, because only infants were tested and only a single video stimulus was used, two outstanding questions remain. First, what is the trajectory of adult-like gaze development from infancy through childhood? Second, does this trajectory depend on specific video content? The current study measured eye movements of 85 children (6 months to 10 years) and adults who freely viewed seven child-friendly TV/movie clips. Video clips were selected to present complex, dynamic scenes that varied on several features: number of agents, types of actions, presence of non-agentive movement, and image salience. Findings indicate that children's gaze became more adult-like with age, but the rate of change varied across videos. Adult-like gaze when watching three of the videos followed a linear trajectory with age. Change in gaze patterns in three other videos was better fit by a power function, with rapid increases in infancy followed by slower gains in childhood. One video showed no age-related change. Findings suggest that the development of adult-like gaze is not uniform across age and stimuli but rather is dependent upon video content. Ongoing analyses examine the role of different content features in video media that account for different developmental patterns.

3-B-18 Dwell-time patterns show that preschoolers privilege goal structure over motion trajectory

Jessica Kosie[1], Dare Baldwin[1]

[1]University of Oregon

Despite the complexity of human action, even young children are sensitive to the goal structure of a variety of everyday events. For example, preschoolers systematically attend to junctures within events that coincide with transitions between completion of one goal and initiation of the next (i.e., segment boundaries). We used Hard, Recchia, & Tversky's (2011) dwell-time paradigm to explore the extent to

which variation in the motion trajectory of actions influence preschoolers' processing as events unfold in time. Preschoolers used a computer mouse to advance at their own pace through one of three slideshows: two in which the actor reaches in a well-formed path to achieve a goal (but varied in reach trajectory) and a third in which the path of the actor's reach is ill-formed (though trajectory of the reach matches one of the well-formed events). Across the three slideshows preschoolers' dwell-times were longer to slides depicting segment boundaries than slides depicting non-boundary content, replicating previous research. Importantly, though, dwell-time patterns were robust to variations in reach trajectory. These findings provide new evidence that preschoolers prioritize goal-related over motion-related information in the online processing of events and further illuminate how children gain fluency in understanding dynamic human action.

3-B-19   The Impact of Attention on Early Mathematical Learning in Young Children Aged 5-6

Zhengqing Li[1], Jingjing Xu, Xin Zhou, Dan Kang, Lili Tian

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Mathematical cognitive development is an important area in child development, which is associated with later achievement. The relationship between mathematical cognitive development and process cognitive factors has been concerned by researchers, particularly the factor of attention. Thus, it is very important to discuss the impact of attention on early mathematical learning and understand the relation between different parts of attention and early mathematical ability. This study used Test of Early Mathematics Ability-III, Attention Network Test and Conners Teacher Rating Scales to explore the relationship between attention and early mathematical ability in 149 children aged 5-6 (with 86 boys and 63 girls, average age was 67.4-month-old). Results indicated that: 1. Compared with typical-achievement (TA) and high-achievement (HA) group, the low-achievement (LA) group showed significantly higher conflict score, but no significant difference in alerting and orienting scores. The children in LA performed a longer reaction time and lower accuracy in all the incongruent trials. The accuracy of reaction, not the speed, was more sensitive to the three achievement groups. 2. The Conners score of LA group was significantly higher than TA and HA group. Conners score was significantly correlated with the conflict score, other than alerting and orienting scores. Particularly the inattention score of Conners is not only significantly related with mathematical ability, but also could predict the score of TEMA with PPVT score, SES, and alerting score. Results indicated that the behavioral rating of attention was more sensitive to mathematical learning difficulties than cognitive test.

3-B-20   Errors on a Computer Task and Subclinical Symptoms of Attention-Deficit Hyperactivity Disorder (ADHD)

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Children with Attention-Deficit Hyperactivity Disorder (ADHD) tend to have decreased academic success and increased error rate on response time (RT) computer tasks. Conducting a concurrent analysis using data from children (N = 203) living near Madison, Wisconsin, we attempted to replicate two studies: one regarding associations between children with varying levels of ADHD symptoms and the frequency of commission/omission errors and another study examining post-error adjustments using the same task. Despite an unsuccessful attempt to directly replicate the first study, we found a correlation between age

and commission errors. Younger children with a lower ADHD symptom score were more likely to make commission errors, while low scoring older children and high scorers from both age groups were less likely to do so. Conversely, our successful replication of the second study found that as ADHD symptoms increase, RT slowing is less likely; and children were more likely to commit further errors.

3-B-21   Using Photo-Narrative Reflections to Foster Children's Learning and Remembering

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This project investigates whether and how the opportunity to reflect on an informal educational experience influences children's memories of the experience. 64 children ages 4 to 9 (Mage = 6.91; 30 girls) were video recorded as they built a skyscraper with their parents in a children's museum. Right after they were done building, families were randomly assigned to one of two conditions: (a) Photo-Narrative or (b) No Photo-Narrative condition. Those in the Photo-Narrative condition were prompted to reflect on their building experience using photos that were taken during their building activity. All families were asked to record two conversations about the museum experience 1-day and 2-weeks later. Children in the Photo-Narrative condition talked more about engineering and made more associations to relevant prior experiences and general knowledge two weeks after their museum visit. The work provides information about ways to foster children's STEM learning and remembering across informal environments.

3-B-22   The Relation Between Visuomotor Skills and Mathematical Achievement: The Relative Contributions of Attention and Spatial Skills

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Recent research yielded a link between visuomotor integration skills and academic learning. However, the relative contributions of specific components involved in visuomotor tasks remain unknown. Visuomotor integration is typically assessed in figure-copying tasks, which involve fine-motor skills, but also spatial reasoning and attention. With the current sample of 5- to 7-year-olds (N = 387) of an ongoing study (Grob & Hagmann-von Arx, in prep.), we investigated whether attention and/or spatial skills influence the relation between visuomotor and mathematical skills. Attention, spatial and verbal reasoning, visuomotor and math skills were assessed using the Intelligence and Development Scales - 2. Factor scores for tests measuring attention, spatial, and verbal reasoning were computed and entered as predictor variables in the regression analyses. We found that after accounting for age, sex, maternal education, and verbal reasoning ($R2 = .62$, $p < .001$), visuomotor skills predicted math ($\beta = .17$, $p < .001$). However, when adding attention and spatial skills in a separate step, visuomotor skills did no longer predict math ($\beta = .07$, $p > .05$). Importantly, attention ($\beta = .28$) and spatial skills ($\beta = .20$) were both strong predictors of children's math skills (both $ps < .001$), indicating that they contributed to the relation found between visuomotor skills and math. Our findings extend discussions on the mechanisms underlying relations between motor and school performance.

3-B-23   Co -Development of Mathematics, Executive Function Skills, and Visual-Motor Integration from Prekindergarten to First Grade

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Short-term longitudinal studies demonstrate significant associations between children's executive function skills and visual-motor integration and their mathematics achievement in early childhood. Our current understanding of the development of these skills in early childhood is limited, however, by a lack of clarity concerning whether association are causal in nature or could be explained by other unmeasured characteristics shared among the constructs. Using a latent state-trait approach, we examined the development of mathematics achievement, executive functions, and visual-motor integration from the beginning of prekindergarten to the end of first grade (N = 1138). Findings of stability and instability in relative rankings in children's skills across four time points suggest that children's growth in mathematics skills is a product of both persistent unmeasured stable influences and time-specific effects. Importantly, visual-motor integration related to subsequent mathematics achievement and executive function skills, which were also bidirectionally related, even when accounting for stability in each construct. These results suggest that future experimental research should consider executive function skills and visual-motor integration as well as specific mathematics skills as potential targets for early mathematics instruction.

3-B-24 Infant Social Referencing Behavior After a Ten-minute Delay

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Twelve-month-olds demonstrate social referencing (SR) and show approach/avoidance immediately after the emotion expression, but little is known about infants memory for SR experience. We examined 10- to 14-month-olds encoding of SR experience (happy, fearful, and neutral information) and retrieval after a 10-minute delay via visual and overt behaviors. Infants looked longer at novel objects paired with positive emotion than novel objects paired with negative emotion during encoding. At retrieval, infants interacted more with the objects paired with negative emotion than objects paired with positive or neutral emotion. Longer looking at the target object during encoding related to shorter latencies to touch the target object during retrieval (across conditions). Further examination of these data will continue to explore encoding and retrieval relations.

3-B-25 Mothers' Negative Focus During Memory-Sharing Conversations is Linked to Negative Interpretation and Memory Biases in Young Children

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Parent-guided reminiscing fosters the development of children's autobiographical remembering skills. In this study, we explore whether naturally occurring variations in the way that mothers frame and guide conversations about shared emotional experiences is associated with children's independent interpretation and memory for ambiguous events. First, mothers and their children (aged 3 to 6 years) reminisced about three recent events that elicited one of three negative emotions (anger, scared, mad).

Next, children were read aloud a set of ambiguous stories that could be interpreted in either a benign/positive or negative manner, and asked to invent an ending to each story. Later, children's story recall was elicited using a series of open-ended and specific questions. Children whose mothers made more mention of negative emotion or negative information about an individual's character or behavior during the reminiscing task were more likely to invent negative story endings and produce distortions in story recall that incorporated the meaning of their previous negative ending. These findings suggest that mothers who frame memory sharing conversations with their children in a negative manner may put them at risk for developing negative interpretation and memory biases. Given that such biases are not merely associated with emotional disorders but also contribute to them, it is important to explore what sorts of early experiences might contribute to their development.

3-B-26   **Eye movement study of relational memory development**

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This study examined the development of relational memory by assessing eye movements to repeated, manipulated, and novel scenes in 4-year-old children and adults. In previous studies young adults, but not amnesic patients (Ryan et al., 2000) view critical regions of manipulated scenes more than repeated and novel scenes. We hypothesized that adults would show the relational manipulation effect but that 4-year-old children would not. Consistent with the results by Ryan and colleagues (2000), manipulated scenes were fixated on fora longer proportion of time, Fs(2, 48) = 20.125, ps < .001, and received a larger proportion of fixations, Fs(2, 48) = 13.915, ps < .001, relative to repeated and novel scenes. However, this effects did not differ between children and adults, Fs(2, 48) < .148, ps > .863. Future research is needed to reconcile this finding with current knowledge on relational memory and hippocampal development during early childhood.

3-B-27   **Sleep Protects Memories from Interfering Information in Early Childhood**

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Introduction. Sleep after learning strengths memory in adults, making representations more robust and less susceptible to interfering information (Drosopoulos et al., 2007). Comparable research has not yet been conducted with infants and young children, however, despite data indicating that sleep is associated with enhanced memory in these populations (Gómez et al., 2006; Hupbach et al., 2009; Kurdziel et al., 2013). The present study was conducted to determine whether sleep efficiency, as assessed using actigraphy, was associated with increased susceptibility to interfering information on a recall memory task in early childhood. Hypotheses. Children were tested in an elicited imitation version of an interference-no interference procedure similar to the one used in Wiebe and Bauer (2005). We predicted that children randomly assigned to participate in an interference condition (IC) would demonstrate better memory after an overnight delay relative to children in a no interference condition (NIC). We also expected that children who reproduced the distractor action in the IC after the delay would have experienced reduced sleep efficiency the night before, as indicated by actigraph recordings, relative to children in the IC who did not reproduce the distraction action and relative to children in the NIC. Method. Forty-six children between the ages of 20-30 months served as participants (mean age =

26 months). The first study session was scheduled after participants took their daily nap. After informed consent was obtained, children were trained to a learning criterion (two exact reproductions; Bauer et al., 2011) on two 3-step event sequences using an elicited imitation procedure. Participants were then fitted with an actigraph around one of their ankles; parents kept a record of their child sleep during the overnight. The children returned to the university the next morning, before their first naps. Children in the NIC were tested on their memory for the two events shown at the first session. Children in the IC were trained to a learning criterion on two events that included a shared element with the events shown at the first session. Children in the IC were then tested on their memory for the events presented at the first session, with the prop used to complete the distractor element present on the table. Results. Children in the IC who reproduced the distractor item at test (n = 7) produced fewer target actions relative to children in the IC who did not reproduce the distractor item at test (n = 9) and relative to children in the NIC (n = 20). Children in the IC who reproduced the distractor item at test had marginally reduced sleep efficiency relative to children in the IC who did not reproduce the distractor item and significantly reduced sleep efficiency relative to children in the NIC (sleep efficiency did not differ between the latter groups of participants). Discussion. Although data collection is ongoing, these preliminary results suggest that children who succumb to interfering information in a recall memory task also experience poorer sleep efficiency relative to children who are not susceptible to interfering information and those tested in a control condition. These findings suggest that sleep may also help stabilize memories - and make them less susceptible to interference - even in the first years of life.

3-B-28 **Spin at your own risk: individual differences in preschooler's decision-making strategies**

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Imagine two children being pushed on the swing by their parents. One child keeps asking to be pushed higher and higher, while the other requests to be pushed lower because they hope to stay close to the ground. This example highlights that even young children have different preferences when it comes to taking risks. Research on risk-taking behavior in older children and adults suggests that as people get older, we tend to avoid risks more. But not much is known about risk-taking in preschoolers. However, the handful of studies investigating preschool-aged children's risk taking preferences generally focus on group means opposed to individual differences. Although this approach generally works very well for large number of topics in developmental research, it makes sense to look at the individual level when studying at risk and decision making in preschoolers. The current set of studies use a gambling paradigm with spinner wheels to investigate the individual decision-making strategies used by 81 preschool-aged children (3-to-6-year-olds). Using latent-mixture models and Bayesian methods of inference, we are able to identify the strategies children were using (risk seeking or risk aversion) while also identifying the children that don't quite understanding the task and are guessing. In Study 1, children made several choices between a safe spinner wheel and a risky spinner wheel to win sticker prizes for themselves (see figure). Each wheel had two compartments and an arrow in

3-B-29 **Verbal feedback is key when training executive control in preschool-age children**

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Executive control is an umbrella term for a set of cognitive abilities that underlie flexible goal-directed behavior. The development of executive control during early childhood is predictive of important developmental outcomes, including math and reading skills in preschool and early school grades. Interventions to improve executive control in preschoolers are therefore of great interest, but previous studies yielded inconclusive evidence. In a series of experiments, we showed that a very brief intervention (verbal feedback) can improve executive control in preschool-age children significantly. We studied the effects of feedback on preschoolers' sorting behavior in a computerized version of the Dimensional Change Card Sorting (DCCS) task. A paradigm frequently used to study executive control in preschool-age children. In the first phase of this task (the pre-switch phase), children are asked to sort two bivalent test cards repeatedly on two sorting stacks according to one dimension of the cards (e.g., color). Then they are asked to make a switch and sort the same test cards according to the other dimension (e.g., shape). Most three-year-olds have difficulty making the switch and continue to sort according to the pre-switch rules in the post-switch phase. In the first three experiments the feedback children received consisted of a combination of verbal feedback, demonstration of the correct way of sorting by the experimenter and computer feedback. Results showed that children receiving this combined form of feedback on their post-switch sorting behavior performed better than children administered a standard (no feedback) DCCS task. This effect transferred to a subsequent standard DCCS task (with different stimuli) after 5 minutes and after 1 week. In Experiment 4 the three feedback factors, verbal feedback, demonstration of the correct way of sorting and computer feedback, were studied separately and in all possible combinations with a full factorial design. Results showed that children receiving verbal feedback performed better than children administered a standard (no feedback) DCCS task and children receiving only demonstration of the correct way of sorting or computer feedback. This effect transferred to a subsequent standard DCCS task (with different stimuli) after 5 minutes and after 1 week. There was no difference in performance between children receiving verbal feedback and children receiving a combination of feedback factors including verbal feedback on all three time points. Experiment 5 showed that the effect of verbal feedback also transferred to a subsequent standard DCCS task with different sorting rules. Children receiving feedback on their post-switch behavior in a DCCS task in which they switched from sorting according to shape to sorting according to size performed better than children administered a standard (no feedback) DCCS task. And this effect transferred to a subsequent standard DCCS task (with different stimuli) in which they switched from sorting according to color to sorting according to number. Results of this series of experiments together suggest that executive control in preschool-age children can be trained using a very brief intervention, verbal feedback on their post-switch sorting behavior. Implications for education and for the different accounts that have been offered for the developing cognitive processes that underlie age-related behavioral changes on the DCCS task will be discussed.

3-B-30   The Effect of Posture on Touching Frequencies of Chinese and American Three-Month-Old Infants

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Parenting practices vary culturally and may affect infants' object exploration behaviors. The current study compares how frequently 3-month-old Chinese (N = 19) and American (N = 19) infants touched toys. Infants were presented with toys when reclining in bouncy seats and sitting upright on parents' laps. Traditional Chinese parenting practices advise against positioning infants in an upright, seated

posture before infants turn six months old. Behavioral data showed that both groups of infants touched toys more frequently while reclining compared to sitting, $t(37) = 2.80$, $p = .008$. Further t tests revealed Chinese infants' touching frequencies differed significantly in the reclining compared to the sitting posture (M = 9.82, SD = 15.24, $t(18) = 2.81$, $p = .012$). In contrast, the difference in American infants' touching frequencies between postures did not reach significance (M = 6.29, SD = 20.18, $t(18) = 1.36$, $p = .191$). Results will be discussed in light of parental reports of infants' familiarity with reclining and sitting postures and infants' daily experiences interacting with toys. Other factors considered include the effect of gravity on infants' limbs and the postural control required to successfully manually contact toys in these two postures.

3-B-31 Decomposing Different Sources of Interference in Recognition Memory Development - a Computational Modeling Approach

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Previous studies have pointed out that there are different sources of interference (noise) that affect recognition memory performance. For example, it can be difficult to recognize whether I had eggs for breakfast today if there were other items on today's breakfast menu (these difficulties stem from item-related noise: item-noise), if I had eggs for breakfast in the past (i.e., these difficulties stem from context-related noise: context-noise), or if other items and other contexts are stored in memory (i.e., background-noise). Although often overlooked, background-noise has been shown to make the most substantial contribution to memory performance in adults. On the other hand, there has not been a systematic examination on how different sources of interference change across development. Therefore, in the current study, we examined how different sources of interference contribute to recognition memory across development by utilizing a recently developed computational model. The model is embedded in a hierarchical Bayesian framework and is capable of parameterizing different sources of interference in a given task. Preliminary data testing 4- and 7-year-olds with a source recognition task showed a decreasing trend in item and context noise, whereas the change in the contribution of background noise was minimal (see Figure 1). The results imply that, at least between the ages of 4 and 7, the major contribution of recognition memory development stems from item and context noise.

3-B-32 CRT-D: A Cognitive Reflection Test for School-Age Children

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The CRT is the among the most widely used instruments in adult heuristics-and-biases research. It measures a person's tendency to override an intuitive, but incorrect, response with an analytical correct response. We developed and tested a CRT version appropriate for school-age children, the CRT-D. The measure consisted of 10 'brainteaser' questions that elicited intuitive prepotent responses (e.g., "What do cows drink?"). In a sample of 5- to 12-year-olds (N = 168), the CRT-D was correlated with performance on several rational thinking measures, including denominator neglect, base-rate sensitivity, need for cognition, and actively open-minded thinking (Toplak et al., 2014). A subsample of 74 children completed additional measures of cognitive ability and understanding of two conceptual domains:

biological reasoning (Zaitchik et al., 2013) and mathematical equivalence (McNeil & Alibali, 2005). Regression modeling revealed CRT-D to be a strong and significant predictor of children's biological reasoning and mathematical equivalence, even after controlling for executive functioning (NIH Toolbox DCCS & Flanker), working memory (Backward Digit-Span), verbal fluency, and age. As a novel instrument, the CRT-D should prove valuable in studying the development of children's cognitive reflection and reasoning in domains involving the revision of intuitive beliefs.

C - Concepts, Categorization, Casual Learning

3-C-33   The Effects of Linguistic Labels on Visual Attention in Children and Young Adults

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Existing theoretical accounts of how labels influence what we learn range from facilitation to overshadowing, with changes occurring over development. Research examining the effects of labels on learning outcomes are well-established; however, real-time effects of labels while learning are mixed. We used a novel word learning paradigm where members of three categories were either presented with the same label, unique labels, or no labels (silent), and we examined real-time fixations to category relevant and irrelevant features. Both children and adults were not instructed to make category-based judgements and no feedback about category membership was provided. Findings in children and adults highlight that common labels (same label applied to multiple category members) appeared to push attention to category-relevant features over time, and specific to adults, unique labels promoted visual exploration of objects as indexed by more fixations when each item was paired with a different label. Underlying mechanisms are discussed.

3-C-34   Cross-cultural variation in the development of folkecological reasoning

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Never in history have humans been as isolated from the natural environment as they are today. This poses a challenge for understanding reasoning about folkecology, or interactions between plants, animals, and humans given that much of the research on ecological knowledge has been conducted with Western, Educated, Industrialized, Rich, Democratic (WEIRD) populations. Two studies examined children's reasoning about biological kinds in populations that varied in experience with the natural world, industrialization, and education, a Western (urban, majority culture U.S.) and a Non-Western population (Vanuatu). Study 1 examined children's concepts of ecological relatedness between species (N=97, 5-13-year-olds). Overall, ecological explanations were most common in both cultures. Ni-Vanuatu children provided more ecological, physiological, and utility explanations, and fewer taxonomic explanations than U.S. children. Older children provided more ecological explanations than younger children across cultures. In Study 2, children (N=106, 6-11-year-olds) sorted 12 pictures of natural kinds into groups. U.S. children were more likely than Ni-Vanuatu children to categorize a human as an animal, and the tendency to group a human with other animals increased with age in the U.S. The

results from these studies provide insight into the way cultural variation structures our understanding of the natural world.

3-C-35   Chinese children's justification of the existence of unobservable entities

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Previous research has highlighted striking similarities in the justifications that U.S. children and adults offer for the existence of unobservable and religious phenomena (Harris et al., 2006; Shtulman, 2013). Here, we explore whether such similarities are found in a predominantly atheistic culture. Chinese 5-6 year olds (N = 38) and Chinese 10-11 year olds (N = 40) from non-religious families justified the existence/non-existence of 6 unobservable entities, 2 high-consensus scientific (Germs & Electricity), 2 low-consensus scientific (Alien & Hypnotist) and 2 religious (God & Angel). Justifications were coded into three non-mutually exclusive categories: Encounter (having seen or experienced the entity), Source (source of testimony about the entity), and Elaboration (describing a property of the entity). There were three main findings. First, like Harris et al. (2006), secular 5-6 year olds justified high consensus scientific and religious entities similarly. They produced Elaboration more often than Source and Encounter justifications (p<.05). Second, for all entity types, 10-11 year olds provided more Elaboration (Mean proportion=0.68) than 5-6 year olds (Mean proportion=0.43), F(1, 40) = 12.83, p <.01. Third, 10-11 year olds justify scientific high-consensus entities differently from religious entities, F(2, 40) = 3.6, p<.01. Whereas they overwhelmingly justified scientific entities using Elaboration, their justifications for religious entities were more mixed, ps<.05.

3-C-36   Normative beliefs shape representations of animal categories in early childhood

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People often think of categories in terms of best examples (e.g., robin for BIRD). Such "typical" examples are more easily brought to mind and are thought to provide more generalizable information. Thus, how people determine which examples are typical has broad implications for cognition. In our recent research, children's typicality judgments were biased towards more extreme values than adults'. For example, children (ages 5-8) picked the fastest cheetah as most representative and informative, whereas adults viewed the average cheetah in this manner. To test the cognitive mechanisms underlying these age-related changes, we introduced children (ages 5-8) to novel animals. Exemplars varied along a key property dimension (e.g., snout length). When children were told that this variation had implications for fulfilling category goals (e.g., that the animal eats insect in underground holes, so longer snouts are better for digging up food), they selected more extreme values as most representative and informative. In contrast, when children were not told that variation held these implications, they picked average values. Data were inconsistent with an alternative possibility that children pick exemplars with extreme values only because they are easiest to identify as category members. Overall, these data suggest that normative beliefs shape early representations of animal categories and highlight the importance of early attention to teleological information for category structure.

3-C-37   Children learn better from (some) fantastical stories

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Prior research has shown inconsistent effects of fantasy content on children's learning from fictional stories. Some studies found that children are less likely to learn from stories that contain fantastical events, but others found that children's learning can benefit from the presence of fantasy. In two studies, 3-5 year old children were presented with stories that contained either high amounts of fantasy or no fantasy. Each included a novel fact. In both studies, children who heard the fantastical story were more likely to accept the novel fact as true in reality: Study 1 $\chi^2(1, N = 60) = 4.10$, $p = .04$; Study 2 $\chi^2(1, N = 72) = 3.50$, $p = 0.06$. What might underlie this effect? Recent work suggests that impossible events in particular may positively impact children's learning by heightening attention and leading to deeper processing (Hopkins & Lillard, under review; Stahl & Feigenson, 2015). Study 3 tested this by measuring 4- and 5-year-olds' knowledge of a novel scientific principle before and after they heard a story that illustrated that principle. Children showed significant improvement from pre- to post-test when the story included physically impossible events (e.g., levitating), $t(29) = 3.91$, $p < .001$, $d = 0.71$, but not when it included biologically impossible events (e.g., aging backwards), $t(29) = 1.32$, $p = .20$. Taken together, these studies add to a growing body of work showing that fantasy, particularly physically impossible events, can benefit children's learning.

3-C-38   Furry hippos and scaly sharks: blind individuals' concepts of animals

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How do we know what we know? For any given piece of knowledge, several possible sources of information exist. For example, we can know what a giraffe is from seeing giraffes or hearing people talk about them. Studying the concepts of blind individuals provides insight into the contribution of vision to knowledge acquisition. Previous studies suggest that individuals who are blind have surprisingly rich knowledge about categories which at first glance appear to be 'visual', such as verbs of perception (e.g., look and see) and colors (Landau & Gleitman, 1985; Shepard & Cooper, 1992). One hypothesis is that such information is gained through language. Are there types of knowledge that are uniquely or preferentially acquired through vision? To investigate this question, we asked whether knowledge about the appearance of animals is different in individuals who are blind. 20 congenitally blind and 20 matched sighted control participants made judgments about the physical properties of common animals. For shape, texture, and color, participants sorted cards with animal names written on them (Braille or print) into groups based on each dimension separately (n=30 animals). Similarity matrices were generated for each participant and sorting rule. To further test shape knowledge, participants performed an odd-one-out task with triplets of animals. For texture, participants were asked to choose between feathers, scales, skin, or fur, with follow-up questions on skin smoothness, fur length and coarseness (n=33 animals). Finally, participants performed a rank-ordering task with 15 animals based on their size and height. As controls, participants sorted objects based on where they are stored and animals based on where they live. Similarity matrices from objects and animal habitat sortings were indistinguishable across groups (sighted-subject-to-sighted-group (S-S) correlations vs. blind-subject-to-sighted-group (B-S) correlations, t-tests over rho's: p>0.3). For shape, despite significantly correlated group average matrices (rho=0.83, p<0.0001), blind participants made less fine-grained distinctions, as revealed in the

sorting (S-S vs. B-S correlations, t(37)=1.71, p=0.09) and triplets tasks (blind vs. sighted accuracy: t(37)=6.06, p<0.0001). With texture, group differences were even more pronounced in the sorting (S-S vs. B-S, t(36)=4.16, p=0.0002) and feature choice tasks (e.g., given hippo, 95% of sighted said skin, while 42% of blind chose fur). Blind individuals relied on taxonomy to make judgments about shape and texture. For color, the ratings of blind people were entirely uncorrelated with those of the sighted (group matrix correlation: rho=0.34, p=0.25; S-S vs. B-S, t(37)=11.66, p<0.0001). A possible explanation is that unlike shape and texture, color is not well predicted by taxonomy. Notably, a few blind individuals' answers came close to those of the average sighted in all tasks except color. When ordering animals based on their size or height, blind participants were more inconsistent than sighted for small size distinctions. In summary, we find that unlike some other types of visual information, knowledge about the appearance of animals is different in blindness, and certain features are more affected than others. Overall, these results suggest that certain types of knowledge about physical attributes are learned predominantly through vision and are not captured in linguistic communication.

3-C-39   Cue abstraction processes in children's decision making.

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In many decisions the outcome of interest cannot be predicted with certainty. Instead, available cues can be used to predict outcomes with a certain probability and to maximize choice outcomes. Knowledge about the relations between cues and choice outcomes can either be acquired gradually by learning cue-outcome contingencies over a series of choices or they can be provided in a summarized form through description. In either case, adults are able to abstract explicit knowledge about cue-outcome relations and to mentally integrate this information in order to predict and maximize choice outcomes. However, it is unclear when this ability develops in children. In four studies we measured 6-year-olds' and 9-year-olds' knowledge of cue-outcome relations in a decision making task. We confronted children with three probabilistic cues making predictions about two options. Children were informed in a child-friendly way how well each cue predicted outcomes (p = .5, .66, .83). Over a series of choices, children could then use cue predictions for choices while we additionally manipulated the feedback from choices: children were either immediately informed about choice outcomes or did not receive feedback information. The former additionally allows to experience cue-outcome relations over the course of choices. We assessed knowledge of cue-outcome relations before and after choices. Children predicted outcomes for different fictional characters who relied in all choices on one specific cue. Knowledge of cue-outcome relations should inform these predictions, for example, predictions for following the low valid cue (p = .50) should be lower than for following the high valid cue (p = .83). Knowledge of cue-outcome relations was reflected in predictions of half of participants by age 9 but absent at age 6. This was the case regardless of whether this information was only described or could also be experienced during choices (Study 1, N = 109). It was not altered when observing cue-outcome relations during choices was simplified (Study 2, N =131) or when the number of choices was increased to provide more experience with cues (Study 3, N =159). Study 4 (N = 42) further demonstrated that children in both age groups encoded differences of cues accurately and could reliably reproduce those differences on multiple dimensions, but did not use this information to make predictions. On the other hand, children whose predictions reflected knowledge of cue-outcome relations also outperformed their peers in decision quality and use of appropriate cue-based decision strategies. Although children are sensitive to cue-outcome contingencies from an early age on, the ability to utilize this information to predict and to maximize choice outcomes is not yet developed at preschool age and not fully

consolidated at elementary school age. This considerably limits their ability to make good decisions in probabilistic environments.

3-C-40   4- to 8-year-olds balance exploration and exploitation

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Research in recent decades has found that children often learn through direct interaction with their environment. However, little is known about how children choose when to explore. In the present research, we investigate how children balance information-seeking and reward-seeking behavior (exploration and exploitation). Children aged 4, 6, and 8 (N = 190) chose to play with one of two boxes, both filled with 12 plastic eggs. In the control condition, children were told that one box had one sticker in each egg, and the other box had one sticker in each of six specified eggs and no stickers in the other six eggs. In the experimental condition, children were not told which eggs in the six-sticker box contained stickers, allowing information to be gained (at the expense of external reward) if this box was chosen. A logistic regression model predicting children's choices revealed a significant main effect of condition, analysis of deviance: $X^2(1) = 28.72$, $p < .001$, and a significant main effect of age, $X^2(1) = 17.73$, $p < .001$. Children in the experimental condition were more likely than those in the control condition to choose the box with fewer stickers, and older children were more likely than younger children to choose the box with fewer stickers. Therefore, while the reward children derive from stickers may vary across age, children are generally sensitive to the potential for information gain and often choose to sacrifice external reward for the chance to explore.

3-C-41   Assessing Young Children's Concept of Animals: Instrument Development and the Relationship to Pet Ownership and Gender

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Research has illustrated that children who help care for a pet or have reciprocal social experiences and play with pets are likely to recognize characteristics and needs of animals similar to those they have experienced (Geerdts, et al., 2015; Inagaki, 1990; Myers, et al., 2004). Research has also shown, however, that young children living in urban environments develop anthropomorphic thinking and lower levels of biological reasoning than those living in nature rich environments (Herrmann et al, 2010; Ross et al., 2003). The present study examines the impact of pet ownership on children's understanding of animal biological, habitat, and diet needs as well as anthropomorphic thinking in a group of 29 low-income urban 3- to 5-year-olds. We designed a measure based on tasks by Coley (2000) and Myers, Saunders, & Garrett (2003; 2004) that required simple pointing instead of verbal answers. A significant interaction was obtained where girls with pets performed better than girls without pets. Boys scores were unaffected by pet ownership. This suggests that girls may have fewer opportunities to learn about animal biology than boys if there is no pet in the home, but frequent interactions with animals may offer a route to this information regardless of gender. These results suggest that the new instrument operated reasonably with this very young urban group and might offer an option for researchers interested in examining children's conceptual understanding of animal.

3-C-42   **The nature of concepts of ability in early childhood: Overturning conventional wisdom**

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Classic theories on the development of ability concepts suggest that young children cannot conceive of ability as a trait-like capacity and instead conflate ability with effort (for reviews, see Cimpian, 2017). In studies supporting this view (e.g., Nicholls, 1978), young children judged a character who worked intermittently on a test to be less smart than one who worked really hard to get the same grade. We identify two methodological flaws that may have masked the sophistication of children's concepts: (1) The first question was always about how hard each character worked, which may have primed children to use effort to judge ability. (2) Although the vignettes were intended to convey that one character needed less effort than the other to get the same grade, the intermittent working pattern of the former could also signal difficulties (and thus low ability). To disambiguate this paradigm, we manipulated (1) whether children were first asked about the characters' effort vs. how difficult they found the test, and (2) whether the character who put in less effort worked intermittently vs. quickly. We hypothesized that these changes would result in more "mature," ability-as-trait responses. Results from two studies with 288 4- to 9-year-olds suggested that these cues allowed children to give more ability-as-trait responses. Even 4- to 6-year-olds gave more ability-as-trait responses than expected by chance. Thus, young children don't always equate ability with effort.

3-C-44   **The Role of Shape and Specificity in Young Children's Object Substitution**

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During play, children often substitute one object for something else - a stick for a sword or a box for a car. Studies show that shape is important when considering possible substitutes, with like-shaped objects being favored over others. Little is known about the importance of specificity, the degree to which a possible substitute already resembles some other object. The purpose of this study was to examine the roles of shape and specificity in children's choice of object substitutions. Three-, 4-, and 5-year-olds (N=66) saw four objects that varied in shape and specificity (two circles, one plain and one painted like a clock, and two rectangles, one plain and one painted like a book) and were asked to help a story character find four things (a phone, button, juice box, and tire). As expected, all ages favored like-shaped objects (Ms>3.55/4), ps<.01. In addition, 4-year-olds (M=2.5/4) and 5-year-olds (M=3.0/4) favored plain, generic objects over specific ones, ps<.01. So, despite being exactly the same size and shape, 4- and 5-year-olds favored the plain circle over the clock as a substitute for the button. In fact, 5-year-olds frequently used the same generic object for multiple substitutions (e.g., the plain circle as a substitute for both the button and the tire) while simultaneously avoiding its more specific counterpart. Overall, findings suggest decreased object specificity may broaden the set of possible substitutions children consider for that object.

3-C-45   **Adults and children are intuitive empiricists**

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Where does human knowledge originate? This question has centrally animated philosophical and scientific inquiry, with lively debate over what aspects of knowledge are innate versus learned through experience. Although we often view science as providing impartial answers, the experiments we run and interpretations we draw may be distorted, if we have naïve biases about human knowledge origins. To test this, we probed several hundred adult participants' beliefs about origins of perceptual and cognitive abilities. Adults uniformly agreed that some perceptual abilities are innate (like the ability to see) and that some cognitive abilities are learned (like reading). Critically, for a suite of "core cognition" abilities that have been demonstrated in very young infants (like knowing that objects exist when hidden, discriminating approximate numerosities, discriminating faces from non-faces), adults strongly endorsed empiricist origins. This was also true of professional scientists, and of 5-8 year old children. Hence, people are intuitive empiricists.

3-C-46   The effect of identity- and action-focused language across domains

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By elementary school, identity-focused language about "scientists" decreases girls' persistence in science tasks. The present research aims to understand how younger children, who are still developing beliefs about the social world, are affected by identity- versus action-focused language, as well as how these effects might differ across domains. In a study, 4- and 5-year-olds (N = 332) were told that the same task was either a "science" or a "caring" game, each domain associated with varying gender stereotypes, and children were introduced to the game using either identity- or action-focused language. Among younger children (M age = 4.38) who were told about a science game, there was a main effect of language (Wald $\chi^2(1)$ = 7.94, p = .005) with children persisting more after hearing action-focused language (Fig. 1). Among older children (M age = 5.18), there was an interaction between language and gender (Wald $\chi^2(1)$ = 4.25, p < .05) with only girls persisting more after hearing action-focused language (M = 4.75, 95% CI [3.88, 5.81]) than when they heard identity-focused language (M = 3.40, 95% CI [2.68, 4.31]). Children's persistence was not affected by language when they were told the task was a caring game. Implications for the role of cultural input in children's persistence across domains are discussed.

D - Cultural Learning

3-D-47   Cross-cultural views on human's impact on the natural world

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Given the grave environmental issues that species throughout the world face, it is crucial to understand how individuals across cultures reason about the impact of human behavior on the environment. This

study explores how children from two countries judge various human actions, and explores the reasoning they use to support those judgments. Children (ages 8-13) from Madagascar (n=65) and the U.S. (n=96) judged 10 actions (such as planting trees or burning trash) as either good or bad; for each item they justified their choice using either human-centered (e.g., "It could harm people") or environment-centered (e.g., "It could harm the plants and animals") reasoning. On average, children in both countries more often used environment-centered than human-centered reasoning (M's=59% vs. 41%), t(160)>4.0, p<.01. However, the extent to which such reasoning was used varied by participants' location and judgment--a 2(Judgment: good vs bad) X 2(Location: Madagascar vs. U.S.) ANOVA revealed a significant interaction of Location X Judgment (F(1,159)=20.87, p<.01). Children in Madagascar more often provided environment-centered reasons for items that they had judged as bad compared to items that they had judged as good; whereas U.S. children provided more environment-centered reasons for items they judged as good as opposed to items that they had judged as bad. We will discuss how such results reflect cultural differences in common messages that children hear about the environment.

3-D-48   Innovators have many friends: Investigating the relationship between children's social network properties and the propensity to copy or innovate

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Innovation and social learning are the dual pillars of cultural evolution. Currently, we know very little which individuals are likely to innovate new behaviours and which individuals are likely to acquire behaviours through social learning. We examined whether, when faced with a novel problem, children's individual-level social network characteristics influenced their propensity to generate solutions individually or observe others. Two hundred and eighty-two 7-11 year olds were presented with a novel multi-method tool-use puzzlebox (Figure 1). All participants were offered the option of simply 'going it alone' (asocial learners) or to watch a social demonstration first (social learners). Then each child had ten attempts at retrieving sticker rewards from the box. Node-level regressions showed that degree - denoting the number of connections (or 'friends') an individual has - was consistently linked to innovation and exploration. For social learners, those with many friends (high degree) used more tools, entrances and exits, and imitated less (p = .029) than those with lower degree scores. Similarly, for 'asocial learners', those who had many friends were less likely to repeat previously used techniques (p = .021) across their ten attempts. This is, to our knowledge, the first study to document individual differences in children's learning strategy use, shedding light on what may differentiate individual problem solvers from those that look to others.

3-D-49   When is confidence a justified credibility cue?

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We investigated children's and adults' understanding of 'confidence calibration' (how one's level of confidence corresponds with their knowledge) by testing differentiation between well- and poorly-calibrated sources. Study 1 (3-12 years, N=502; adults, N=46) compared well- and poorly-calibrated models in two conditions. A confident and hesitant model made claims in either the 'Informed' or 'Uninformed' condition. Participants preferred to learn from the confident (well-calibrated) model when

she was Informed (p<.05). Children (with age) and adults also judged the well-calibrated model as smarter (ps<.02). Thus, children and adults appreciate confidence calibration, and with age overcome hesitancy-avoidance to view a justifiably hesitant individual as more credible. To test whether children avoid overconfident sources or favor justifiably hesitant ones, we compared two confident models (Study 2, 4-8 years, N=62) and two hesitant models (Study 3, 5-9 years, N=40) - one 'Informed' and one 'Uninformed'. Children avoided the overconfident source, judging the justifiably confident model as more credible and smarter (ps<.05; Figure 1). Yet, they did not favor the justifiably hesitant source: The informed hesitant model was considered more credible and smarter by older children (8-9 years) (ps<.05); younger children (5-7 years) were at chance. Thus, although by age 4 children avoid overconfident individuals, their understanding of hesitancy appears to be a later developing.

3-D-50   Is the Curious Child Universal? Examining the Frequency and Types of Questions Asked by Turkish Preschoolers from Middle-class and Low-income Families

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Research with preschoolers growing up in the US and UK highlights the importance of young children's questions as a tool for learning from others; but research in different sociocultural contexts is needed to examine both the universality and variations of this phenomenon. The current study addressed this need by examining the frequency and the types of questions asked by preschoolers from middle-class and low-income Turkish families. We presented a total of 105 3-, 4-, and 5-year-olds (55 middle-class) with novel animals and objects in an experimental context to see whether they ask information-seeking questions (fact-seeking 'what' and explanation-seeking 'why'). We controlled for the quality of the answers children receive by giving them scripted informative vs. non-informative answers across two experimental conditions. The results revealed that Turkish preschoolers from both socioeconomic backgrounds asked questions to gather information and they asked more questions upon receiving informative answers than non-informative answers (F(1, 99)=12.67, p<.001). Preschoolers from middle-class families asked more 'what' and 'why' questions than preschoolers from low-income families (F(1, 99)=14.19, p<.001). In comparison to previous studies with Western samples, the results indicated that the proportion of 'why' questions asked by Turkish preschoolers (22 % middle-class and 10% low-income) was lower than the proportion reported for Western children (26-30% middle-class).

E - Language Development

3-E-51   Developmental differences in the structure of monolingual and bilingual children's semantic representations

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Semantic fluency tasks, in which speakers name as many examples of a category (e.g., fruits) as possible within a set time, are often used to assess word retrieval efficiency, but they can also be used to assess the structure of semantic representations by examining how speakers explore their mental spaces as they try to name exemplars within a category. Though bilingual children typically produce fewer words

than monolinguals on such tasks and performance on such tasks changes with age, how bilingualism and age affect the structure of children's semantic representations is unclear. Thus, to examine how the structure of children's semantic representations varies by bilingualism and age, we examined 200 monolingual and bilingual 6- to 11-year-olds' performance on a semantic fluency task. Children named as many fruits or animals in English as they could in 30 seconds, and the number of unique words produced was measured. Word frequency norms for each word produced were examined, and semantic similarity between each word produced was computed using Latent Semantic Analysis. The number of words produced increased with age only for monolinguals (r=.27, p=.001), but with age, bilinguals produced more uncommon words (r=-.32, p=.02) and more semantically similar exemplars in sequence (r=-.26, p=.05), whereas monolinguals did not. These findings provide new insights into how the structure of monolinguals' and bilinguals' semantic representations may develop in different ways.

3-E-52   Sensorimotor influences on perception of native and non-native speech in infancy

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Speech perception is multisensory from early infancy. Recent work indicates that sensorimotor information is also important: inhibiting relevant oral-motor movements disrupts discrimination of never-before-heard speech sounds in prelingual infants (Bruderer et al., 2015). In Experiments 1 and 2, we replicated Bruderer et al., (2015), and in Experiments 3 and 4 we tested the generalizability of this effect using a native speech contrast. We tested infants aged 6-months on precisely controlled synthetically produced speech sounds, using the alternating/non-alternating looking time procedure to test discrimination (16/24 infants per group tested to date). The first experiment in each set tested discrimination without a teething toy, and the second tested with the toy. Results of Experiments 1 and 2 replicate the reported findings in Bruderer et al. (2015) that suppressing tongue-tip movements by having the mother gently hold a flat teething toy in their baby's mouth, disrupts discrimination of dental /da/ vs retroflex /Da/. Results from Experiments 3 and 4 indicate that when given a gummy teething toy that restricted the movement of the lips - the same teething toy that did not disrupt in discrimination of dental /da/ vs retroflex /Da/ in Bruderer et al., (2015) - infants' discrimination of the native bilabial /ba/ vs alveolar /da/ contrast was disrupted. Together these results confirm both the generalizability and specificity of motor influences on auditory speech perception.

3-E-53   The development of semantic organization across early childhood

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How does vocabulary structure develop in early childhood? Adults tend to associate words based on paradigmatic relationships (e.g., category matches, such as morning-night). Additionally, there is evidence that children develop this type of association between 5 and 9 years of age (Nelson, 1977). We investigated the early development of lexical-semantic networks in toddlers. Thirty-two children (3-8 year olds) and 21 adults participated in a verbal free association task and responses were coded as paradigmatic or non-paradigmatic. The proportion of paradigmatic responses differed by age group, F(2, 47) = 14.13, p <0.001. Tukey post-hoc comparisons revealed that adults responded with more paradigmatic words than older (p = 0.03) and younger (p < 0.001) children. The comparison between

older and younger children approached significance (p = 0.069). The results support the theory that category-based semantic organization develops slowly over early childhood. Data collection is ongoing, and we plan to create a database with word associations for children that is accessible to the public.

3-E-54   Every And All Are Easy, But Each Is Hard

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Universal quantifiers like all, each, and every specify abstract relations between entities or properties. For example, "All dogs are animals" indicates that dogs are a subset of animals. Since these quantifiers do not refer to entities in the world, they cannot be learned by ostension. How do children acquire such abstract relational concepts? To explore this, we contrasted all, each, and every. While past approaches have tested children's comprehension of one of these quantifiers at a time (Inhelder and Piaget, 1964; Crain, et al., 1996), By contrasting these words within one paradigm, we asked which aspects of their meanings created the greatest challenge for children. Whereas all is a universal quantifier that can modify either count nouns ("All the dogs") or mass nouns ("All the water"), every and each are restricted to count nouns. Each differs from every and all in that it is necessarily distributive (Roberts, 1987) - i.e., the predicate applies to each atomic individual in the quantified set separately, rather than to the set collectively. Previous studies of each in particular have assumed that children treat it as a universal quantifier from the outset, and focus on when each becomes distributive (e.g. Pagliarini, Fiorin, and Dotlacil, 2012). However, this assumption has never actually been empirically verified. More generally, previous research has not differentiated the time course for learning about the universal and distributive aspects of universal quantifiers, and whether these emerge in synchrony or are instead dissociable semantic features that are acquired separately. We begin to ask this question with this study. In Experiment 1, we used the Give-A-Quantifier task (Barner, Chow, & Yang, 2009), and asked children to give each, every, all, some, a, or dax objects. We found that 4- and 5-year-olds (N=20 each) gave the maximum number of objects for all and every, but not some, dax, or a (Fig. 1). However, they did not distinguish each from dax or some. Experiment 2 examined each specifically. Using a Truth Value Judgment (TVJ) task, we showed Cookie Monster biting 0, 2, or 3 out of a total 3 cookies, and asked 4-year-olds (N=20): "Did Cookie Monster bite the/each/two/dax (of the) cookies?" In answer to each questions, they said "yes" equally often whether 2 or 3 cookies were bitten, and did the same for dax and the (but not for two). Using a modification of this method, studies underway are testing whether, despite failing to treat each as a universal, 4-year-olds nevertheless treat each as distributive. In this first direct comparison of the acquisition of universal quantifiers, our findings suggest children comprehend the universality of each years later than all and every. Preliminary corpus analyses suggest this difference is not due to relative input frequnecy, since each is no less frequent than either every, or quantificational uses of all (as opposed to, e.g., all done). This raises the question of whether distributivity renders each more difficult to acquire, or whether, as we are currently testing, distributivity is acquired before universality in the case of each.

3-E-55   Event nominal acquisition benefits from linguistic context

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Event nominals--nouns that denote events (e.g., party, nap)--constitute a distinct word class. They may pose special challenges to learners because they cut across the canonical mappings between grammatical categories and meanings (e.g., noun-object, verb-event). The current study asks what cues may guide learners' interpretation of a novel event nominal toward an event rather than an object denotation. In particular, we focus on three linguistic cues that distinguish event-denoting from object-denoting nominals: (a) ambicategoriality--appearing both as a noun and a verb (e.g., a nap, napped); (b) temporal language--occurring with temporal expressions (e.g., yesterday); and (c) light verbs--occurring with semantically bleached verbs (e.g., have a party, take a nap). A forced-choice pointing task with 40 children (mean age: 46 months) confirmed that they used these cues to determine that a noun denotes an event with 90% success, suggesting that acquisition of event nominals benefit from linguistic context.

3-E-56   The Implied Shape of an Object: A Developmental Analysis

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When hearing an object label, we likely have a specific image of that object in our mind. This linguistic representation depends on the implied shape of an object. When we hear, "The eagle is in the sky" compared to, "The eagle is in the nest," our representation of eagle will vary based on the implied shape of the eagle (wings spread vs. perched). The current research investigates whether the implied shape of an object affects the recognition of the object, and we are analyzing this developmentally. Participants heard sentences (The eagle is in the sky) and had to compare it to visual stimuli (flying eagle, perched eagle, or distractor). The participants answered yes/no as to whether the object was mentioned in the sentence. Adults (Study 1, n=82) were more accurate and faster when the sentence and the implied shape were congruent compared to when they were incongruent, paired samples t's(81)>2.5, p's<.05. Preschool children's responses (Study 2, n=33) were also more accurate when the sentence and implied shape were congruent, paired samples $t(32)=3.2$, p<.01; however, children's reaction times did not differ (p=.16). Adults and children had the same pattern of response accuracy across the three trial types, indicating that children are already fairly advanced in this linguistic representation process. This research has implications for understanding how adults and children are conceptualizing words in the process of language comprehension.

3-E-57   Effects of syntax of children's verb interpretation

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In English, most descriptions of motion events use manner verbs (such as run and walk) and prepositional phrases (such as into the house) to describe motion events. However, events can be described using path verbs (such as enter or ascend) if a transitive sentence structure is used, such as "She enters the house." Preschool children watched videos of a person performing an action along a path paired with a novel verb in a sentence with either a transitive sentence (no preposition) or an intransitive sentence (with a preposition). They were then presented with two possible interpretations of the verb (manner or path). This work expands previous research that has used animated or still pictures as stimuli. The children demonstrated overt preferences for manner interpretations of the verb by pointing to the manner options more frequently than the path options overall. However, they did

show some effect of path sentence by pointing to the path interpretation more frequently during the path sentences than the manner sentence (t(10) = -2.47, p < .05). That is, children were more likely to choose manner interpretations but that preference was smaller when the verb was presented in a path sentence. We will discuss these results in comparison with similar results and looking time data from older children.

3-E-58   **The Influence of Memory on Word Learning in Bilingual Children**

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Introduction. Children learn thousands of new words per year upon entering grade-school. This exponential vocabulary growth is greatly attributed to word learning from surrounding linguistic context. Prior research focused on monolingual speakers indicates that vocabulary and reading comprehension predict word learning. The goal of this work is to understand how bilingualism affects word learning. Methods. Eighty-seven children (30 Spanish-English Bilingual; 57 Monolingual) between 8-15 years old completed a word learning from context task and a battery of assessments examining vocabulary, reading comprehension, working memory, and phonological memory. Results. Monolingual children performed better than bilingual children on the word learning task F(1, 79)= 6.34 p = 0.01 even when covarying for maternal education, vocabulary, reading, and age. Mediation analysis revealed the impact of bilingualism on word learning from context is mediated by phonological memory and working memory (ab: -.028 [-.073, -.0039]). Conclusions. These findings reveal differences in word learning for monolingual and bilingual children that is not explained by typical predictors of vocabulary growth. Bilingual children tend to perform worse on phonological memory tasks. When that is combined with poor working memory it negatively impacts word learning outcomes. Strengthening phonological and working memory skills in bilingual populations may lead to better word learning outcomes in children.

3-E-59   **Testing the limits of children's ability to recognize words in ecologically valid background noise**

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Children's environments shape their language development (e.g., Hart & Risley, 1995; Weisleder & Fernald, 2013) and both the quality and the quantity of speech children hears affects their language development (Hirsh-Pasek et al., 2015). However, children's homes are more dynamic than a single talker teaching a single word. Children are particularly vulnerable to extraneous noise in their environment (e.g., McMillan & Saffran, 2016; Newman, 2004). Previous studies have used multitalker babble featuring up to nine concurrent talkers. This research has been useful in helping us define the perceptual limitations of children, but it is not very naturalistic. How do children handle more naturalistic background noise that is sampled from their own homes? One factor that may facilitate children's ability to contend with background noise is their familiarity with the noise. To assess whether children are distracted by their own electronic background noise, 46 28-30 month old children were tested on their ability to use verb informativeness (e.g., "eat the cake" vs "find the cake") as a cue when processing speech while listening to either familiar or unfamiliar electronic noise. Children who heard familiar background noise failed to take advantage of verb informativeness, indicating they were

distracted by the familiar noise. These findings point to attention as a key mechanism that is manipulated by background noise.

3-E-60 **Simulations of early word learning environments: Insights into sampling, analysis and sources of individual differences**

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Individual differences in children's early language environments are predictive of vocabulary size, as well as various linguistic, cognitive and educational outcomes later in life. For these reasons, investigations of early language environments and the associated learning outcomes are increasingly becoming an important and well-studied topic in developmental psychology. However, analyses of word learning environments that aim to identify important sources of individual variability may be more complicated than they appear. This is because word frequencies in a language, or words in a sample of language are not normally distributed. If word frequencies were distributed normally, some words would be very frequent, some very infrequent, and most would at middle frequencies. Word frequencies are instead power law distributed - a small number of words are very frequent, and most words occur with low frequencies. This fact about the distributions of word frequencies has profound consequences for how language environment data should be collected, analyzed and interpreted, as well as consequences for long-standing debates regarding the relative contributions of linguistic quantity and quality (particularly when defined as lexical diversity) to language outcomes. To better understand the mathematical properties of the distribution of words in a language, and potential sources of individual differences, we analyzed about 6.5 million words of speech directed at children under the age of 5 years, from the CHILDES corpus. Our simulations show a number of important facts about the distribution of words in a language. As a first step, we replicate the well-known observation that the number of unique word types increases as the total number of word tokens increases, but at a rate that slows at larger token sizes. Given this mathematical relationship between word types and tokens, we propose that the function that relates word type and token counts, and the speed at which a child moves along this trajectory may provide important insights into how learning environments differ and matter to the rate of vocabulary growth. To this end, a series of simulations explored how different environments lead to differently shaped type-token curves, and the rate of movement on those curves. The main finding is that the lexical diversity, and the diversity of conversational contexts determines the type-token curve, and the amount of talk determines rate of movement along that curve. More specifically, we show how the slope of the function relating word type and token counts shifts as a consequence of 1) Reducing the vocabulary size from which the samples of speech are drawn and 2) Including in the sample the words from different contexts (in the simulations, text from picture books). Next, we show that the individual conversational contexts from which speech is sampled contributes to the observed lexical diversity. This suggests that the set of contexts from which speech is sampled can have consequences for the observed lexical diversity of that sample. Finally, we analyze longitudinal speech input to three children in the CHILDES corpus to show how understanding the contributions of sample size and variability of contexts can affect interpretations of the language environments of these children, as well as the utility of the type-token function in the interpretation of individual differences in language environments.

3-E-61 **Twelve-month-olds respond to names of hidden inaccessible objects**

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By engaging in search behavior, infants around 1 year of age can demonstrate their understanding of words that refer to absent objects. Infants primarily do so when objects are easily accessible, and much less often when objects are out of reach. The current research investigates the role of infants' estimation of motoric accessibility of hiding locations in their responding to language. Infants played with a toy, saw the toy being hidden in an ottoman, and after a brief delay were asked to find the toy. In Experiment 1 the ottoman was placed on a cabinet out of infants' reach (quite high, but in full view). Almost all infants (17 out of 18) responded to the mention of the hidden toy by looking and pointing at the ottoman or by approaching the cabinet when there were portable steps leading to the ottoman. The same infants were less likely to engage in these behaviors when there were no steps (9 out of 18 infants responded, p<0.01). This suggests that infants take into account potential accessibility of out-of-reach hiding locations in responding to object names. To test if the steps were helpful for a perceptual rather than the motoric reason (they highlighted the right corner of the room) in Experiment 2 the steps were covered and turned around. Therefore they were not making the ottoman accessible, rather just highlighting its location perceptually. Infants searched for a toy in the inaccessible location highlighted with covered steps less than for a toy that was hidden in an accessible location on the floor (9 out of 18 and 16 out of 18 respectively, p<0.05). This suggests that infants' estimation of the motoric accessibility of a hidden object likely affects their responding to its name independently of concomitant perceptual factors.

3-E-62   Learning Verbs Across Multiple Examples Separated By Delays

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Verbs pose a challenge to learners because they must analyze dynamic scenes and link verbs to elements and subevents within them. Several studies show that children benefit from seeing and comparing several examples of events. Within structural alignment theory (e.g., Gentner, 1989), observers learn how to compare by first comparing similar examples (progressive alignment). The present study asks whether this helps children compare events, and also asks whether this process is affected when events are separated in time. Two-1/2- (n=12), 3 ½- (n=23), and 4 ½- (n=30) year-olds were shown events linked to two verbs. For each verb, children watched three events. In one condition, they saw two similar and then a varied event (PA) and in the other, they saw all varied events (All Far or AF); they pointed at test. Within each condition, events in the learning phase were presented with no delays, or were separated by 1 or 3 minute delays. A 3 (Age: 2 ½-, 3 ½-, 4 ½-year-olds) X 2 (Delay: 1, 3 minutes) X 2 (Condition: PA, AF) univariate ANOVA showed no main effects or interactions. One sample t-tests showed 3 ½ and 4 ½-year-olds succeeded (3s: $t(28) = 4.38$, $p < .001$) and 4s: $t(29) = 3.49$, $p = .002$), while 2 ½-year-olds performed at chance levels. The present study shows that verb learning improves with age. These studies provide insights into how children use information across instances during verb acquisition.

3-E-63   The influence of gender and language on Spanish-English bilingual kindergarten and first grade children's use of social words and clout.

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Background. Gender differences in language, including women's reduced clout and greater use of social words, is well researched in adults, but not in children. Also, little is known about the effect of bilingualism on these differences. In a prior study we found that, in English, girls used more social words and clout than boys. In this study, we examined the speech of Spanish-English bilingual children to learn whether these differences persist across languages. Methods. Twenty kindergarten and first grade children (10 girls, 10 boys) narrated wordless picture books in English and Spanish. The Linguistic Inventory and Word Count was used to calculate clout and social word usage in each language. Proficiency was measured as number of different words (NDW) used in each language. Results. NDW was significantly higher in English and did not differ by gender in either language. When using English, girls used more social words on average (M=16.26, SD=1.94) than boys (M=13.52, SD=3.27), F(1, 18)=5.20, p<0.05 and greater clout (M=93.08 SD = 2.74) than boys (M=88.24, SD=4.97), F(1,18)=7.24, p<0.05. In Spanish however, this was not so. Conclusions. Spanish-English bilingual girls use more social words and clout in English than Spanish, while boys exhibit no language differences. As a result, gender differences are only observed in English. This suggests that the complex development of gender specific patterns of clout and social word use is influenced by the language spoken.

3-E-64   A cross-cultural comparison of mother-preschooler autobiographical conversations

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The present study examined the influence of cultural background on communication styles of mothers and their four-year-olds. Narrative samples from 20 American English monolingual mother-child dyads and 20 Thai monolingual mother-child dyads were elicited using a prompted reminiscing task. Results revealed differences in conversation focus and styles between the two groups. Conversations in American dyads focused more on the child and the child's experiences, whereas Thai dyads focused more on people other than the child. Thai mothers' and children's narratives included more teachers and classmates than did the narratives of their American counterparts. Thai children also talked more about immediate family members than American children. Comparisons of maternal language showed that Thai mothers used praises related to the child's personal characteristics (e.g., "You are so smart!") more than American mothers, whereas American mothers used more praises related to the child's actions (e.g., "You did a great job!") relative to Thai mothers. These findings suggest that differences in cultural norms are reflected in conversation styles, as early as in the preschool years. We conclude that children learn linguistic and cultural conventions via interactions with more competent social partners, and assimilate communication styles specific to their culture. Future work will differentiate linguistic and cultural effects by comparing Thai-English bilingual dyads across languages.

3-E-65   A threshold for regularization: When children will and will not regularize inconsistent language input

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Children receiving inconsistent language input regularize these inconsistencies in their productions (Hudson Kam & Newport, 2005, 2009). Regularization occurs when one form (dominant) appears in at least 40% of its grammatical contexts, with other forms less frequent; but we have not investigated whether regularization occurs when the dominant form is less widespread. Here we clarify when children will and will not regularize by exposing children to artificial languages in which the dominant form occurred at a variety of input frequencies. We found that children did regularize when the dominant form was present in at least 40% of appropriate contexts. However, when the dominant form was present only 33% of the time, children no longer regularized; instead they produced the dominant form significantly less than was it was presented in the input. Our results suggest that there is a threshold for regularization, with strong underuse when input falls below this threshold.

3-E-66   Self-generated Variability in Object Images Predicts Later Vocabulary Size

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Early language learning is important for child outcomes including school achievement (e.g., Walker, Greenwood, Hart, & Carta, 1994). Correlational findings suggest relations between motor development and early language learning (e.g., James et al., 2015; LeBarton & Iverson, 2016), however the mechanisms underlying these relations remain unclear. The present study proposes a mechanistic account of one way in which motor development, specifically manual object manipulation, facilitates word learning: by generating unique variability in objects' visual images. Infants' object name learning begins with continually changing 2-dimensional images on the retina. To learn an object name, infants must visually find and recognize an object within these images. However, the image level has received little attention in word learning research. Most theories of early object name learning focus on infants' detection of constancies in mappings between heard words and seen objects, from which perspective it might seem reasonable that little variation in visual objects would facilitate these mappings. However, if image variation is required to learn to identify objects across viewing conditions (Cadieu & Olshausen, 2008; Földiák, 1991), then infants who experience more variable object images may have a stronger visual basis for object name learning. We test the specific hypothesis that the amount of object image variation generated by the infant's own object manipulation is an important predictor of word learning. Data were collected from 17, 15-month-olds using head-mounted eye-tracking while infants and parents played with toys. We used a single algorithmic measure, mask orientation (MO), to capture the frame-by-frame variation of objects infants fixated (Figure 1). Critically, MO measures the orientation of the most elongated axis of whatever object pixels are in view, not the orientation of the real-world object. To measure object image variation, we calculated Shannon entropy (H) of each infant's MO distribution, both for frames in which the infant manipulated (H_{manip}) and did not manipulate ($H_{no\ manip}$) the gazed object. H measures uncertainty such that flatter distributions have higher H. Six months later we measured infants' vocabularies using the MCDI. The object images infants observed, and the entropies of the MO distributions, were highly variable both when infants were and were not manipulating objects. Together, H_{manip} and $H_{no\ manip}$ explained significant variance in vocabulary size ($R^2=.37$, $p<.05$). This effect was driven by H_{manip}, which was a significant positive predictor of vocabulary size ($B=.79$, $p<.05$); $H_{no\ manip}$ was not a significant predictor ($B=-.42$, $p=.15$). Infants who experienced greater variation in the object images produced by their own object manipulation at 15 months tended to have larger productive vocabularies at 21 months. Further analyses confirmed that this effect was not driven by affordances of individual objects, or by other characteristics of the play session such as the entropy of object images generated by parents' object manipulation, the amount of time infants looked

at or manipulated objects, or objects' visual sizes. These findings suggest that infants make use of highly variable natural visual data. Elucidating the visual statistics of the views infants experience in everyday toy play may constitute a crucial missing link in our current understanding of the developmental trajectory of object name learning.

3-E-67   Lexical recognition in 9-month-olds: What factors matter?

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Recent evidence suggests that before their first birthday infants already recognize the names for common objects (Bergelson & Swingley, 2012). Interestingly, real-time comprehension ability exhibits nonlinear improvements in infants' second year (Bergelson & Swingley, 2015), raising questions about whether the factors that support very early lexical recognition processes differ from those that support infants who are more experienced with language. In the current study, we tested whether three key factors that predict lexical recognition in infants 18 months and older - vocabulary size as assessed with the MacArthur-Bates Communicative Development Inventory (CDI), maternal education, and how much their caregivers talked to them - also predict lexical recognition in 9-month old infants who are first beginning to learn words. Replicating previous work, we found that 9-month-olds understood the words on the lexical recognition task, $p < .05$, and that recognition was not related to vocabulary size, $p > .05$. The lack of a relationship between these factors, which are strongly related later in infancy, may be due to insensitivity of parental report measures for infants at this age. However, we found that infants whose mothers were more educated, and heard more speech, performed better on the lexical recognition task ($ps < .05$). This suggests that there is continuity in the factors important for language development from the earliest word learning to the vocabulary burst.

3-E-68   Preschoolers Do Not Learn Novel Words in Pretend Play

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Pretending and language abilities are correlated, but it is unclear whether this relationship is causal and how pretending compares to other contexts which foster vocabulary acquisition. This experiment tested if children can learn words in pretending and compared play to known effective contexts, book reading and direct instruction. Preschoolers were taught 4 novel nouns in a pretending, book reading, or direct labeling condition. All children saw 12 objects (4 target novel, 4 unnamed novel distractors, 4 familiar), and all children heard the target novel objects labelled 3 times. In the play condition, children were invited to pretend with the experimenter and 3 objects (1 target) at a time. In the book condition, children were read an illustrated story depicting all objects. In the direct labeling condition, the experimenter handled each object one at a time. Children were tested with the same recognition paradigm. Predetermined sets of the novel objects (target, named distractor, and unnamed distractor) were presented one at a time, and the child was asked which one was "the [target]." Performance in the storybook and direct labeling conditions was significantly above chance, while scores in the pretending condition were at chance. These data suggest that pretend play is not a reliable context for word learning in preschoolers. Perhaps the cognitive demands of pretending are too high or perhaps children ignore information in pretending because they assume it is not real

3-E-69   **Choosing words wisely: Infants sample more informative 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 the current research, 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. We then 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 on the screen. Once infants fixated one of the objects, it was labeled. Across two studies, we found that the likelihood of infants' sampling an object increased with the relative informativeness of the object-label pair (calculated based on the relative frequency of the infant's previous exposure to each object-label pairing) (Study 1: n = 25, z = 4.65, p < .001; Study 2: n = 28, z = 3.42, p < .001). Overall, our findings indicate that infants differentially sample object-label information dependent on their previous exposure to the object-label pairing.

3-E-138   **Built-in questions support parent-child talk during shared reading of an electronic text**

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Parent-child talk during shared reading of print books is associated with children's language growth and story comprehension across a variety of settings and interventions (Reese, Sparks & Leyva, 2010). However, parents report discussing stories less with their children when reading electronic books compared to print books (Strouse & Ganea, 2017a; 2017b), which may lead to less learning in digital contexts. We investigated features of electronic books that may promote parent-child talk. Parents and preschoolers (n=54) were assigned to read one of 4 storybooks together: 1) a commercial e-book with audio narration, 2) the same e-book with the narration turned off, 3) an enhanced version with a pop-up character who asked questions about the story, or 4) a print copy of the book. Children who were read the e-book with the questioning character spoke 3-4 times more utterances and more than twice as many unique words as those in the other 3 conditions (F(3,40) = 15.67, p < .001; F(3,40) = 9.70, p < .001). Parent talk in condition 3 vs. 1 showed similar differences and order of magnitude (t(21) = 4.90, p < .001; t(21) = 4.81, p < .001, analyses of other conditions ongoing). Parent and child enjoyment did not significantly differ across conditions. We conclude that building questions into e-books is one method for supporting parent-child talk during reading.

F - Moral Development

3-F-70   **Your Trip Around Mexico! A Storybook Study Exploring the Effects of Helping and Outgroup Exposure on Children's Empathy Development**

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How can we foster children's openness toward outgroup members? In this study, American children ages 5 to 8 (n=30) were read one of four storybooks. Books were overall identical except involved travel in either America or Mexico and were either high or low in modeling helping behaviors. Before and after the story, children answered questions that measured change in desire to interact with or help children from different cultures. Results showed a significant increase in overall empathy toward outgroups after exposure to the stories with helping behavior but no change based on country. This increase was driven by an improvement of attitude toward members of other cultures. Results suggest that simply exposing children to outgroups may not be effective in promoting positive outgroup attitudes, but encouraging positive interactions may be effective. Future research should explore the durability of the changes demonstrated in children's beliefs.

3-F-71   "I only want one!" Choosing to take less than your fair share

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How limited resources should be distributed is one of the most vexing problems in society. While an equal distribution may be ideal, there are circumstances under which inequality can be acceptable. Here, we asked whether 6-year-olds would evaluate inequality as permissible if an individual chooses to take less than her fair share. In one condition, 6-year-olds (n=16) watched a series of cartoons involving two characters and a pool of four pieces of candy. One character expressed a desire for just one piece of candy and took just one, and the other character took the remaining three. Afterwards, children were asked whether the distribution was 'okay' or 'not okay' and most indicated it was 'not okay'. In another condition, 6-year-olds (n=16) saw the same scenarios except that the candies were owned by the first character who chose to keep just one and then generously gave the remaining three away. Surprisingly, most 6-year-olds continued to indicate that the unequal distribution was 'not okay'. Together, the results from these two studies suggest that 6-year-olds have a strong aversion to unequal outcomes and do not integrate other factors, including desire, choice, and generosity into their judgments.

3-F-72   The costs and benefits of moral condemnation: A developmental investigation

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Moral condemnation is ubiquitous and appears early in development, but its function is still unclear. We propose that condemnation is a signal that the condemner does not engage in the condemned behavior. Such a signal has clear benefits and costs. It benefits the agent by leading others not to suspect the condemner of that behavior. However, the condemner will be judged more harshly if they are caught engaging in the condemned behavior. In experiment 1, children (n=121, 4- to 11-years old) were told about two classmates, one who condemns stealing and one who does not. Children were asked who was more likely to steal, and who should be punished more if caught stealing. By the age of 7, children assume that the classmate who condemned stealing would not steal and also thought that person

should be punished more harshly if caught stealing. Experiment 2 further demonstrates children's inferences about moral condemnation by providing a more difficult test than experiment 1. Children (n=119, 4- to 11-years old) were this time told about two classmates, one who condemns stealing and one who denies ever stealing. Results further demonstrated older children's robust ability to use condemnation as a signal: they still assume the condemner would not steal, even above the classmate who directly says they never steal. However, children significantly desire harsher punishment for the denier than the condemner, suggesting a hierarchy in children's judgment of wrongdoing.

3-F-73   Can ownership rules be suspended?

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Children frequently encounter rules about what they are obligated to do, and these obligations influence their behavior (Kalish & Shiverick, 2004). Ownership rights and obligations are interesting because they occupy the middle ground between moral and conventional domains. Critically, conventional rules can be suspended while moral rules cannot (Smetana, 1981; Smetana et al., 1993), but prior studies mix rule violations involving property with violations that do not. The current study investigates how children judge violations of ownership rights at different ages. We presented younger (N=20, Mage=4.94, SD=.73) and older (N=19, Mage=6.90, SD=.33) children with scenarios depicting ownership and conventional transgressions. Children judged how "bad" each transgression was, and then re-judged the transgression after the relevant rule was suspended. Data collection continues, but a repeated-measures ANOVA revealed a significant main effect of rule suspension, $F(1, 37)=14.72$, $p<.01$, $\eta p2=.29$, and a marginally significant main effect of scenario-type, $F(1, 37)=3.49$, $p=.07$, $\eta p2=.09$, embedded in a significant three-way interaction between rule suspension, scenario-type, and age group, $F(1, 37)=7.089$, $p<.05$, $\eta p2=.16$. Younger children treated ownership transgressions as moral transgressions, but older children treated ownership transgressions as conventional.

G - Number, Spatial Cognition, Relational Reasoning

3-G-74   Who Benefits From Explicit Comparison in Science Instruction?

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To understand fundamental space science, observations from Earth's surface must be attributed to processes such as Earth's rotation. Comparing Earth- and space-based perspectives can help children grasp relevant causal correspondences (Jee & Anggoro, 2017). The current pretest-posttest study explored comparison-based instruction for children with different levels of initial understanding. Participants (N=80, mean age=8.6) received several sessions of instruction about the day-night cycle. Half were randomly assigned to the Comparison condition in which children simultaneously viewed and compared videos of Earth- and space-based perspectives. The other half saw the videos sequentially without comparison (No Comparison). A multiple regression analysis predicted posttest understanding from pretest understanding, condition, and a pretest x condition factor, controlling for participants' spatial skill and vocabulary. The model accounted for 29% of the variance in posttest understanding,

p<.01. Most notable was a pretest x condition interaction (β=-.47, p<.01, sr2= .11), indicating that children with below-average pretest scores achieved higher posttest understanding in the Comparison vs. the No Comparison condition. However, this pattern reversed for above-average scorers. Thus, explicit comparison may benefit children with sparse knowledge of Earth- and space-based connections. Children with high initial knowledge may benefit from determining further correspondences themselves.

3-G-75   Can Gesture Help Students in Bilingual Classrooms Learn Math?

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Children often face challenges when learning abstract math concepts. Previous studies have shown, however, that when teachers gesture, children's math learning improves. Spanish-speaking children in the US face extra challenges in the classroom, and US schools typically use bilingual programs to help Spanish-speakers overcome their challenges. There has been little research, though, on gesture's effect on math learning in bilingual classrooms. This study seeks to fill that gap. Ninety Chicagoland second-graders from bilingual programs were given a pretest to measure their understanding of mathematical equivalence problems (i.e. 3+4+5=__+5). They then received speech-only or speech+gesture instruction on equivalence in either English or Spanish. There were four instruction conditions in all: 1) English speech-only, 2) English speech+gesture, 3) Spanish speech-only, or 4) Spanish speech+gesture. Students were then given a posttest consisting of problems like those on the pretest. Learning was compared among children from all instruction conditions. In contrast to prior studies, which focused on English-only classrooms, preliminary results showed that for native Spanish-speakers in bilingual classes, only 20-30% learned, and gesture did not improve learning--regardless of whether instruction was in Spanish or English. These findings may help researchers understand the limits on the positive effects of gesture in bilingual classrooms.

3-G-76   Early Conceptualization of Negative Numbers: Assessing Second Graders' Numerical Cognition

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Negative numbers are not introduced in most curricula until middle school, yet some argue that children develop mental models that include negative integers far earlier, and early exposure may have positive implications for future numerical cognition (Bofferding, 2014; Booth & Siegler, 2008). The current study utilized a battery of negative-number measures including counting-on, order of magnitude, number line estimation, and zero zone to 14 second graders (M = 8.15 years). The measures were designed to assess students' mental representation of the number line, numerical magnitude representation, and counting procedures. Students' performance on negative integer items was significantly lower than positive on the order of magnitude ($t(8) = 3.00$, $p = .015$) and counting-on ($t(7) = 3.41$, $p = .011$) measures. The number line estimation task yielded no significant difference between accuracy ratings of positive and negative items, $t(8) = -0.764$, $p = .467$. The data suggest that without any formal instruction, most second graders have established mental number line representations that include numbers below zero.

3-G-77   One-to-One Correspondence Allows for Exact Number Representation Without Counting Words

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Previous research has shown that young children are capable of using one-to-one correspondence before they are proficient at counting which suggests this principle can be used without the ability to use number words. We hypothesized that if one-to-one correspondence develops in humans independently of language or culture, then animals might be capable of using it. One-to-one correspondence is a method of number representation used by pairing each object in set A, with an object in set B to determine if the two sets are equal. We predicted that, when set values were too close to discriminate by estimating, monkeys and young children would be better at identifying which of the two sets was greater if the sets were presented in one-to-one correspondence over other presentation types. Rhesus monkeys and young children (ages 3-5) were shown two differently numbered sets of objects on a touch screen computer and were rewarded for choosing the greater set. Objects were either presented sequentially (one set then the other set, one object at time) or in one-to-one correspondence (one object from each set, one at a time, simultaneously). The results show that monkeys perform significantly better on one-to-one correspondence trials over sequential trials when sets became too difficult to estimate. Additionally, initial data show that children perform similarly to monkeys and both children and monkeys perform significantly worse than adults, who are at nearly 100% accuracy.

3-G-78   Early Language and Mathematics: Relations between contextual sensitivity to lexical ambiguity and early mathematics performance in 7 year olds

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By definition, homonyms are words with different meanings, but their referents can be inferred from context. Likewise, ambiguous referents of number words (e.g., the exact quantity they indicate) can vary across contexts (e.g., four eggs vs. four dozen eggs). Here we ask whether children's early math ability is related to their sensitivity to the context in which ambiguous words occur. We asked 185 second graders (90 boys) to infer meanings of words during a story task, including words that were familiar but ambiguous (i.e., homonyms), or novel but unambiguous. We predicted that homonym interpretation (HI) accuracy would account for unique variation in children's Test of Early Math Ability (TEMA) scores over and above variability accounted for by scores on a Wechsler Vocabulary subtest, whereas novel word interpretation (NWI) scores would not. Although Vocabulary, HI, and NWI predicted TEMA scores, vocabulary fully mediated the relation between NWI and TEMA scores (Figure 1a), but it only partially mediated the significant HI-TEMA association (Figure 1b). That is, the HI-TEMA relation remained significant with Vocabulary in the model. These findings support the notion that contextual sensitivity is a construct that is relevant to, but distinct from, general vocabulary, and that it influences early math development. Future studies should explore how children's sensitivity to the contexts in which number words occur affects their number concept development.

3-G-79   Demographic differences in early number competencies: Effects of gender and income status

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Children from low-income families enter school with less developed number knowledge than their middle-income peers. These disparities are likely to increase over the school years (NMAP, 2008), so early identification of strengths or weaknesses is crucial. The present study, which is a part of a larger project focused on number development from pre-k through first grade, examined knowledge of number, number relations, and number operations in pre-k and kindergarten children (N= 300) from diverse backgrounds. As expected, low-income children demonstrated less number knowledge overall than middle-income children. However, a significant gender by income level interaction in kindergarten revealed that low-income kindergarten girls had difficulty on certain symbolic number skills, specifically verbal counting and numeral naming. Moreover, analyses on a subset of items given at both grade levels showed a grade by income level interaction on items assessing cardinality and magnitude; there was a SES gap on these items at pre-k, but not at kindergarten. The findings suggest that a lack of environmental support for learning some early number skills may be overcome by kindergarten instruction although group differences may emerge in kindergarten for other skills.

3-G-80   Recursion in Monkeys, Children, Tsimane' and US Adults

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Recursion is a procedure that calls itself, or a constituent that contains a constituent of the same kind. It is thought to be important for a wide range of human skills including number acquisition, language (grammar), and complex motor actions. One key feature of recursion is center embedding, or the ability to embed like elements within one another, which allows for long-range relations. Here we used a novel non-linguistic task to test center embedding abilities in monkeys, children (age 3-5 yrs.), US and Tsimane' adults. Subjects were required to order sets of brackets in a center-embedded fashion (e.g. "< [ ] >"). Importantly, we were able to test whether subjects used simpler strategies like rote memorization or associative learning by testing transfer to novel stimuli. We found that all human groups spontaneously used a center embedding, recursive like strategy with limited exposure to the task. Monkeys did not initially use a center embedding strategy, but with additional exposure learned to use a center embedding strategy and transferred this to novel stimuli. Thus, our results show that humans as young as 3 years old have a strong natural tendency to use a center-embedding strategy. Additionally, center embedding is within monkeys' capacity to learn and may be a precursor to recursive grammar abilities.

3-G-81   Inhibitory control and the development of fraction concepts: The role of the whole-number bias

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Executive functions (EF) correlate with math skills (Cragg & Gilmore, 2014), but few studies have examined mechanisms by which EF influences fraction concepts (Hecht et al., 2003). A major difficulty in learning fractions is the whole number bias (e.g., children think 1/5 is more than 1/3 because 5 is more than 3). We hypothesized that inhibitory control (IC), a component of EF, would be particularly important for children to inhibit this whole number bias. In a longitudinal study, children (N=121, 65 girls) completed an IC task in spring of 2nd/3rd grade (T1) (Hearts & Flowers; Wright & Diamond, 2014), and a fraction magnitude comparison task in fall (T2) and spring (T3) of 3rd/4th grades. Switch trials in the mixed block of the Hearts & Flowers task indexed IC. The fraction comparison task included 3 item types: incongruent items (incorrect using a whole-number strategy) were expected to require the most IC; congruent (correct using whole-number strategy) and ambiguous items (whole-number strategy yields unclear response) less so. In a binomial regression, switch trial accuracy (B=1.62, SE=0.73, p=.026) and RT (B=-1.00, SE=0.37, p=.007) significantly predicted T3 incongruent fraction comparison accuracy, controlling for T2 fraction accuracy and grade. This relation was specific: switch trials did not predict congruent or ambiguous fraction accuracy. These results suggest that inhibitory control may help children to overcome the whole number bias in fraction learning.

3-G-82   The role of number line unidimensionality in young children's fraction magnitude learning

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Fraction number line (NL) estimation skill is strongly related to algebra (Booth & Newton, 2012). Estimating fractions on a NL leads to better fraction magnitude comparison skill than estimating fractions on a circle (Hamdan & Gunderson, 2017). Unidimensionality is thought to be a critical feature of the NL because it captures the fact that rational numbers are continuous and can be ordered on a single dimension. We directly test this by experimentally manipulating this feature. Second-3rd-graders (N=69; 32 girls) were taught fraction estimation in a 15-minute session using an area model or one of three NLs: unidimensional, hybrid, or square (Figure 1). The outcome was fraction magnitude comparison, an untrained transfer task. Controlling for pretest fraction comparison, age, and verbal ability, posttest fraction comparison significantly differed by condition, $F(3, 62)=2.81$, $p=.046$, $\eta p2=.12$. The hybrid NL group performed better at comparing fractions (adjusted M=60.2%) than the square NL (adjusted M=47.2%, p=.030) and the square area model (adjusted M=45.0%, p=.010); the unidimensional NL did not significantly differ from the other conditions (adjusted M=52.0%). The unidimensional NL was not effective, likely because children incorrectly view hash marks as countable objects. Instead, the hybrid NL, which directs attention to the spaces between hash marks while preserving conceptually-important aspects of the unidimensional NL, scaffolded fraction learning and led to transfer.

3-G-83   The Mediating Role of Number-to-Magnitude Mapping Precision in the relationship between Approximate Number Sense and Math Achievement Depends on the Domain of Mathematics and Age

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Approximate number sense (ANS) refers to the ability to approximately estimate and manipulate numerical quantity representations. An accurate ANS can be expected to facilitate a precise mapping between symbolic numbers and their corresponding magnitude and thereby can lead to an advantage in representing and working with symbolic numbers. In the present study, we aimed to examine whether the mediating role of number-to-magnitude mapping precision differs depending on the domain of mathematics in adults and children. We found that mapping precision fully mediated the relationship between ANS acuity and math achievement in certain domains (Quantitative Reasoning in adults and Calculation in children). These results suggest that ANS acuity indirectly affects only certain domains of math achievement through its contribution to number-to-magnitude mapping precision, and that mapping precision differentially contributes to distinct domains of mathematics throughout development.

3-G-84   The Role of Gesture in Math Learning: Do Boys Benefit More Than Girls?

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Teachers naturally use multiple modalities in math instruction. One instruction modality of particular interest is co-speech gesture. Many researchers have found that when teachers gesture math learning is enhanced. Despite the fact that gestural information is spatial, and boys show greater spatial and math skills than girls, almost no research has examined whether gestured instruction affects boys and girls differently. The current experimental investigation expands upon previous research by examining whether gender mediates the effect of gesture produced during math instruction. We used carefully controlled video or live instruction designed to teach children how to solve pre-algebraic problems, like 3+4+5=__+5. Elementary school students' understanding of the equal sign improved significantly more when gesture accompanied verbal instruction. Moreover, boys were significantly more likely to learn from speech with gesture instruction than girls, suggesting that verbal instruction accompanied by spatial information (in gesture) particularly benefited boys. This research is important for understanding how gesture's influence in communication may be heavily mediated by individual differences such as gender.

3-G-85   Evidence of mental rotation processes in infancy

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In adults, the time required to rotate two objects into alignment in mental space linearly relates to the angular disparity between the two objects, demonstrating a mental analog to physical object rotation (Shepard & Metzler, 1971). Although previous studies have documented rudimentary spatial abilities in infancy, it is not known whether infants engage in mental rotation processes similar to those observed in adulthood (Frick, Möhring, & Newcombe, 2014). We assessed mental rotation in infants aged 6 to 12 months via a change-detection task that compared their looking to two side-by-side stimulus streams. Both stimulus streams consisted of a static 2-D stimulus that appeared in different orientations along the picture-plane. In one stream, orientations were constrained to an arc of 180 degrees, whereas in the

other stream, the stimulus variably appeared within the expected 180-degree arc and in unexpected orientations (i.e., outside of the expected 180-degree arc and flipped to its mirrored image). Infants' ability to discriminate between the stimulus and its rotated mirrored image, as indexed by their relative looking times to the two stimulus streams, varied as a function of the angular disparity between the expected and unexpected orientations contained within those streams. These results provide preliminary evidence that analog mental rotation processes are present during the first year of life.

3-G-86   How language and gesture use during spatial tasks provide novel insights into spatial processing

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Children's spatial word production predicts their spatial task performance, which has been interpreted as evidence for verbal encoding. We propose an alternative explanation, that children's attention to task-relevant information underlies both spatial language and spatial skills. However, most prior studies have assessed language and attention in contexts outside of the tasks when evaluating spatial skills. This study tested how children's production of language and gestures (a non-verbal measure indexing attention) during a spatial task related to their spatial performance. We tested 41 children (4.5-6 years old) in a spatial analogies task, which required finding analogous spatial relations between figures. After completion, the experimenter reviewed children's responses and asked, "How did you know that was the right one?" Verbalizations and gestures during explanations were coded for (1) quantity of spatial words and gestures and (2) trial-specific relevance. We found that the trial-specific relevance of speech (b=-.28, p=.008) and gesture (b=-.67, p<.001) predicted children's spatial performance above and beyond the quantity of spatial words and gestures. Our results show that children's production of potentially-relevant spatial words is not the central factor in supporting spatial performance, contrary to a verbal encoding interpretation; rather children's general attention to relevant cues in the moment of the task is the strongest predictor of spatial skills.

3-G-87   Is math anxiety associated with math achievement over and above number line estimation in early elementary school?

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Performance on a number line task is a strong predictor of arithmetic learning and math achievement, over and above other symbolic and non-symbolic tasks (Booth & Siegler, 2008; Sasanguie et al., 2013; Lyons et al., 2014). That is, children with a more accurate linear representation of numbers perform better in more complex math tasks. However, little is known about whether emotional factors influence math achievement controlling for number line representation. To address this question, we assessed a diverse sample of 587 first graders from 22 Chicago area schools at the beginning and end of the school year on their math anxiety, math achievement, and number line estimation. We calculated percent absolute error (PAE) and linear R^2 to assess performance on the 0 to 100 number line task (Siegler & Opfer, 2003). We found that first graders with higher math anxiety perform worse in math, even after controlling for number line representation. These results suggest that although representations of numerical magnitude influences future math achievement, math anxiety contributes to this relationship

even after controlling for this foundational math skill. These findings underscore the importance of fostering positive math attitudes in addition to foundational math skills during elementary school.

3-G-88 **Encouraging Spatial Talk: Bolstering Spatial Reasoning Within Children's Museums**

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Exposure to spatial play and language can promote the development of spatial skills in children (Verdine et al., 2014; Jirout & Newcombe, 2015). This study investigated the effects of spatial language and play on 4-year-olds' performance on a spatial reasoning task. Parents at a children's museum were provided spatial language prompts that emphasized formal shape terms or open-ended spatial goals to use during an interaction with their child at a block play exhibit. Other parents were instructed to play at the exhibit without provided prompts. Children completed an identical pre and posttest puzzle surrounding the interaction. Results revealed that a) parents use more spatial language when prompted (Shape Terms: $M_{spatialwords}=41.51$; Spatial Goals: $M_{spatialwords}=18.29$; No Prompt: $M_{spatialwords}=10.96$; $F(2,97)=48.4$, $p<.001$), b) parental spatial language production predicts child spatial language production ($\beta=.30$, $t(102)=3.15$, $p=.002$), and c) children whose parents were provided prompts improved in their completion of a challenging, previously presented puzzle at posttest (Shape Terms: 17.0sec vs. 7.3sec; $M_{difference}=9.67sec$, $SD=4.65sec$, $p<.01$; Spatial Goals: 25.3sec vs. 7.3sec; $M_{difference}=18.08sec$, $SD=4.88sec$, $p=.04$; No Prompt: 13.6sec vs. 7.8sec; $M_{difference}=5.83sec$, $SD=4.65sec$, $p=.21$; Figure 1). Children's spatial language production during the playful and educational interaction seems to facilitate their recall of the learned spatial information at a later time.

3-G-89 **Pointing to specific elements may enhance learning during a mathematics lesson**

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To be successful in mathematical problem solving, children need to understand links between different representations of mathematical concepts. For example, children learning about linear relations need to understand links between graphical and equation representations of slope and intercept. The National Council of Teachers of Mathematics states that students should be able to "select, apply, and translate among different mathematical representations," (2000, p.67, as cited in Alibali et al., 2014). One promising tool for supporting learning of links between representations is hand gesture. When expressing linking relationships, classroom teachers frequently use both speech and gesture (Alibali et al., 2014). Moreover, gesturing during linking can support students' learning. When teachers receive instruction on effective gesturing, their rate of linking gestures increases, and students subsequently learn more from this enhanced gesture lesson (Alibali et al., 2013). However, spontaneous linking gestures vary on a number of dimensions, including the number of hands, the hand shape and the spatial precision of the gestures. For example, some linking gestures refer to individual parts of each representation while others refer to each representation as a whole. It is not clear whether all gestures equally support learning. We hypothesized that viewing gestures that link specific corresponding elements would enhance learning, because appropriate mathematical knowledge requires specific links. To test this hypothesis, we created a lesson in polynomial multiplication delivered by an animated teaching avatar. The avatar explained polynomial multiplication using three examples. Each example

included an equation representation, a rectangle area model, and a linking episode where the two different representations were linked. The avatar gestured throughout the lesson, and we varied the gestures during the linking episode, while controlling all other nonverbal behavior. In the specific condition, the avatar gestured to specific elements and in the general condition the avatar gestured to each representation generally. Sixty-four 11- to 13-year-old children first competed a paper and pencil pretest, and then watched the lesson containing either specific or general gestures. Following the lesson, children completed a paper and pencil post-test. We analyzed performance using a multilevel binomial model with fixed effects for pretest and condition and random intercepts for participant, item and grade. There was not a significant effect of condition (ß = -0.06, p > .1). To further examine learning, we conducted an exploratory analysis including an interaction of condition and problem type. There were significant differences between the two groups on two of the five problem types: calculating the area of a rectangle (ß = -1.63, p = .035) and factor multiplication problems (ß = -1.61, p = .041), with children in the specific condition performing better. These results provide support for two important hypotheses about the role of gesture during math learning. First, because manipulating gesture during linking episodes is related to subsequent learning, these results support the hypothesis that linking episodes are important for learning. Second, the benefit associated with specific gestures provides evidence that the spatial precision of gesture may be important for learning.

3-G-90   Relative Saliency of Number: How quantitative information and task demands impact children's spontaneous focusing on number

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[1]Boston College

Previous research has established that the degree to which children spontaneously focus on number (SFON; Hannula, Lepola, & Lehtinen, 2010) is positively related to their arithmetic skills. Our interest lay in investigating what factors affect children's propensity to SFON and specifically to what extent other quantitative information may take children's attention away from number. The current study tested 2-5 year olds using multiple SFON tasks including an imitation game and two matching games that measured to what extent children spontaneously chose to match based on number vs. another quantitative dimension (cumulative surface area or proportion). We found that when number was pitted against cumulative surface area, children showed a significant preference for number (p<.001), and this was positively correlated with children's number knowledge, even when controlling for age (r = .30, p <.05). Furthermore, preliminary data suggests that spontaneously attending to number was not independent of task features. Children who were less likely to focus on number when pitted against proportion were more likely to focus on number in an imitation game (r = -.42, p < .01) and slightly more likely to focus on number when pitted against cumulative surface area (r = -.33, p = .10). Taken together, our data suggest that number, proportion, and cumulative surface area may show distinct levels of preference and attention in 2-5-year-old children.

3-G-91   Investigating flexibility in young children's spatial recall strategies through probabilistic modeling

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We investigated 4- to 6-year-old children's weighting of different reference frames by analyzing a series of spatial recall studies using probabilistic modeling. Children were presented with a rotating table that included 5 cups as hiding locations; for half of the children, the table also included 4 unique landmarks. To test which reference frame children used, we changed the position of the child and/or table during a memory delay on each trial. Their search patterns could indicate their weighting of table-, room-, or body-centered reference frames. Experiment 1 results suggested that 5-year-olds weighted information differently in the presence versus absence of landmarks; 4- and 6-year-olds did not differ across landmark conditions, with 4-year-olds performing poorly and 6-year-olds performing well. In Experiments 2 and 3, we tested only 4-year-olds to investigate which task details could support use of landmarks to improve their search performance. Hiding the toy in a consistent location (Exp.2) improved performance slightly, but the largest boost came from viewing the transformation of the entire layout (Exp.3a) or only landmarks (Exp.3b) while the table rotated. Our behavioral results show that young children are sensitive to small changes in task context, suggesting flexibility in developing spatial skills. We are currently modeling these results to gain insight into potential explanations for children's sensitivity to the task details and changes over development.

3-G-92　　　　　　Measuring Parent Spatial Anxiety: Related to Child Spatial and Math Outcomes?

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Does parental spatial anxiety influence children's spatial skills? Early spatial skills predict later math skills (Verdine et al., 2017; Mix & Cheng, 2012) and success in STEM fields (Newcombe, 2010). Previous research has demonstrated a relationship between parental math anxiety and child mathematics skill (Maloney et al., 2015), and teachers' spatial anxiety with students' spatial skills (Gunderson et al., 2013). However, less is known about the relationship between parental spatial anxiety and child spatial and math skills. To explore this relationship, we developed a spatial anxiety questionnaire for parents focusing on a wide range of spatial tasks. 32 parent-child dyads (16 F, Mage = 53.91mo, 84.4% high-SES, 84.4% white) completed space and math assessments. Results indicate that our spatial anxiety questionnaire is an effective tool in evaluating parental spatial anxiety, which was correlated with math anxiety, mental rotation, and perspective taking ability. Furthermore, parental math anxiety was not significantly related to any of these measures (see Table 1). Preliminary analyses on a subset of our data suggest that parental spatial anxiety may not relate to children's spatial or math scores. However, parents' perspective-taking ability (a lower PT/SOT is better) is negatively correlated with their child's mental transformation skill (a higher CMTT score is better) (see Table 1).

3-G-93　　　　　　Matching Spaces: Relating Negative to Positive Space in Object Fitting Tasks

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Most object fitting work has focused on selecting a shape (positive space) that corresponds to an aperture (negative space). Less attention has focused on the reverse problem of fitting negative space (an aperture embedded in a surround) onto positive space. Here we looked at two versions of negative to positive space fitting. In one version, children (N=64; 18-36 months) selected amongst three

differently shaped apertures (each embedded in a surround) to fit onto a tower that matched the shape of only one of the apertures. In the other version, children were shown a single compound shape, and selected amongst three differently shaped towers to accomplish fitting. Results indicated that children experienced more difficulty distinguishing amongst negative apertures (former condition) than positive spaces (latter condition) when matching negative to positive space. Results are discussed in terms of how more complex forms of object perception can support advances in object relational skills.

3-G-94   **Tackling training: An analysis of performance on spatial instruction in preschool**

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Spatial skills in preschool and early childhood predict later achievement in mathematics (e.g., Mix & Cheng, 2012) and the STEM disciplines (Newcombe, 2010). Spatial skills are also malleable (Uttal et al., 2013), differ by SES at age 3 (Verdine et al., 2014), and predict both spatial and mathematics skill at age 5 (Verdine et al., 2017). This study used a randomized control trial pre- and post-test design to explore potential links between early spatial skills training and changes in spatial and mathematical skills. Children were tested and trained on constructing puzzles to match a model composed of various geometric shapes (2D Test of Spatial Ability (TOSA); Verdine et al. 2017). Three specific training regimens were given over 5 weeks (see Table 1). Preliminary data was collected from 152 3-year-olds (78 F, Mage = 42.12mo, 72.1% high-SES). When controlling for child sex, age, and performance on session 1 training to control for initial capability, only low SES children who received additional gesture or spatial language instruction performed better during the last training session compared to those in the Modeling and Feedback condition, p=.015, β=.28. Post-test 2D TOSA scores were predicted by pre-test 2D TOSA score, p<.001, β=0.56, but not by condition. There were no significant improvements in the two post-mathematics assessments. These preliminary results suggest that children's performance during spatial training may differentially benefit low-income learners

H - Social Cognition

3-H-95   **Negotiation in children: exploring developmental origins of the wage gap**

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In the USA, there is an unfortunate yet pervasive gender gap in wages: women tend to make less than men for doing the same work. One prominent account for why this wage gap exists is that women and men negotiate differently. However, we currently do not know understand whether differences in negotiation are the product of extensive experience or are more deeply rooted in development. Here we bring data from children to bear on this important question. In an ongoing study, we tested an initial group of 80 6- to 9-year-olds. Children participated in various lab tasks and were then given a chance to

negotiate with a male experimenter for a bonus. We asked whether girls and boys differed in the number of bonus stickers they requested from the experimenter. Preliminary results suggest that boys ask for more stickers than girls (GLM, effect of gender, $\beta = 1.375$, $p = 0.0461$). This initial finding suggests that gender differences in negotiation are early emerging in childhood. In our ongoing work, we are addressing this question in younger children (4- and 5-year-olds) and are additionally testing whether children negotiate differently with male versus female experimenters.

3-H-96 Relations Between Infants' Social Attention, Risk Status for ASD, and Parental Measures of ASD-Related Characteristics

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It is estimated that 1 in 68 children have Autism Spectrum Disorder (ASD). Because most children in the US are not diagnosed until age 4 or later, there is a pressing need to identify early behaviors that may indicate heightened risk for ASD. One of the most distinctive early features of ASD is impaired social attention. This study assessed social attention in 6- 9- and 12-month old infants with an older sibling with ASD [high risk (HR)] and those without an older sibling with ASD [average risk (AR)]. Infant social attention was also assessed in relation to parental Broad Autism Phenotype (BAP). Infants' attention to social and non-social videos was coded; parents completed the BAP questionnaire to assess ASD-related characteristics. Across all ages, AR infants spent significantly more time attending to the social videos than the nonsocial videos, $t(98) = 10.89$, $p <.0001$, and demonstrated more overall attention towards both video types than the HR group, $t(107) = 2.85$, $p =.005$. Across all 6-month olds, higher parental BAP scores were associated with lower overall attention, $r(16) = -.69$, $p = .003$; this relation was strongest for the Aloofness subscale, $r(16) -.76$, $p =.001$. These preliminary results suggest that differences in social attention can be detected in infants as young as 6 months of age, and occur as a function of risk status and parental BAP characteristics. These findings suggest that early social attention might be indicative of future ASD diagnostic status.

3-H-97 Joint goal representation in infants: an fNIRS study

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Infants' goal attribution, and subsequent prediction of future goals of others, is restricted to actions that are efficient. If infants observe agents taking unnecessary detours towards a target, infants do not attribute nor predict agents' future goals (Hernik & Southgate, 2012). In contrast, adult studies, investigating coordination of two agents, have shown that trajectories detouring from the optimal path can have a communicative function, serving the joint goal of coordination (Candidi et al, 2015). Using fNIRS, we investigate whether 9-month-olds would perceive individually inefficient actions as goal-directed, if these actions are performed in the context of two agents coordinating towards a common goal. Analysis was focused on activity in the left anterior parietal region, which, analogous to adult data (Hamilton & Grafton, 2006), showed repetition suppression for repeated goals and a release from suppression for new goals in infants (Southgate et al, 2013). Preliminary results indicate a release from suppression in left anterior parietal region, when infants observed two agents coordinating towards a new goal, and repetition suppression when the goal was repeated. These results suggest infants

attributed a joint goal to the agents, despite both agents' actions being individually inefficient, indicating that infants may represent joint actions differently to the sum of individual actions, and appear sensitive to the same cues to cooperation as adults are.

3-H-98   Children's and adults' essentialist beliefs about "scientists" and their endorsement of the "scientists=males" stereotypes

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Children as young as age 4 demonstrate essentialist reasoning about some social categories, such as gender (e.g., Gelman & Taylor, 200), race (e.g., Hirschfeld, 1995), ethnicity (e.g., Birnbaum, Deeb, Segall, Ben-Eliyahu, & Diesendruck, 2010) and religion (Segev, Yoav, & Diesendruck, 2012). Essentialism of social categories has also been shown to have pernicious consequences, leading people to develop stereotypes about social groups (e.g., Bastian & Haslam 2006). Here, we examined (1) the developmental trajectory of people's essentialist reasoning about "scientists", and (2) whether these essentialist beliefs predict the extent to which people acquire the "scientists=males" stereotypes. In three studies, we assessed both 5- to 7-year-olds' (Study 1) and adults' (Studies 2 and 3) essentialist beliefs about scientists and their endorsement of the "scientists = males" stereotypes. We found that people's essentialism of scientists declined with age, but their beliefs associating scientists with males increased. More importantly, individual differences in people's essentialist beliefs about being a scientist predicted their tendency to endorse the stereotypes associating scientists with males (Studies 1-3), above and beyond their general essentialism. Overall, our findings suggest that both children and adults hold an essentialist view of being a scientist, and this essentialism may serve the basis for the acquisition of the "scientists = males" stereotypes.

3-H-99   Neural Correlates of Belief- and Desire-Reasoning in Preschool Children

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Children demonstrate accurate, explicit reasoning about desires (~ age 2 years) before beliefs (~ age 5 years). We examined the neural mechanisms supporting this robust and universal developmental progression. While prior research investigated neural correlates of belief- and desire-reasoning in school-aged children, we investigated critically younger children to examine how the brain supports the progression from desire- to belief-reasoning as it first emerges. Event-related potentials (ERPs) were recorded from 4- to 6-year-old children (N=33) while they engaged in desire-reasoning, belief-reasoning and non-mental reasoning (control) tasks. Results suggest that neural specializations for belief-reasoning, beyond desire-reasoning, and even beyond non-mental reasoning are not yet fully formed in this younger sample. Unlike school-aged children, younger children did not show any distinction in the neural timecourse between desire- and belief-reasoning. Moreover, mean ERP amplitude for belief-reasoning also did not differ from non-mental reasoning. However, performance accuracy for the belief-reasoning condition was positively predicted by individual differences in children's belief ERP amplitude (but was not predicted by ERP amplitude for either desires or the control condition), suggesting that children's transition from accurate desire-reasoning to accurate belief-reasoning may be paced by changes in underlying neural circuitry supporting belief-reasoning specifically.

3-H-100 Features of Natural Parent Teaching that Benefit Toddlers' Learning

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Young children learn a great deal in interactions with social partners. Much research has focused on the importance of joint attention for learning, but beyond this, relatively little is known about the aspects of social interactions that support toddlers' learning. The present study explores features of and patterns in parent teaching that benefit toddlers' learning using micro- and macro-level coding of natural parent and child behavior. Thirty-two two-year-olds were taught to use multifunctional toys by a primary caregiver, then were tested on their knowledge of the taught toy functions compared to baseline untaught toys. Surprisingly, preliminary data from 18 toddlers show that test scores are unrelated to teaching duration or the total number of toy steps accomplished by the parent and child. While most interactions feature parent and child turn-taking, children in "child-focused" interactions (where children more often act independently) score higher at test than those in "parent-focused" interactions (where parents more often act alone). Different strategies may support learning within each interaction style: Physical assistance from parents uniquely predicts success in child-focused interactions while children's independent performance of toy steps uniquely predicts success in parent-focused interactions. Findings from the full sample could further our understanding of patterns in teaching that support young children's learning.

3-H-101 Investigating science together: Pedagogical approaches for parent-child scientific learning interactions

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Parents play a vital role in their children's early science education (Crowley et al., 2001), varying in the extent to which they provide scientifically accurate explanations to their children (Shtulman & Checa, 2012). Here, we explore the effectiveness of a short intervention aimed at enhancing the quality of parental talk during a science activity. Forty-six parent-child dyads completed a series of science games in a science museum in the Northeast. Following baseline phase, an experimenter modeled either a fact-based or an inquiry-based approach for interacting with the apparatus. To explore generalization, dyads were asked to use the approach themselves on a new apparatus. In the generalization phase, intervention condition impacted the number of parental utterances that were statements and questions, $\chi2(1) = 37.18$, $p<.0001$. Parents used more statements (137 vs 61) in the fact-based condition but more questions (129 vs 78) in the inquiry-based condition. Follow-up planned comparisons indicate the most frequent utterance in the fact-based condition were procedural statements, whereas the most frequent utterance in the inquiry condition were information-seeking questions (all $ps < .05$; see Figure 1). We discuss how such a short intervention might impact future science learning.

3-H-102 Emotional Facial Expressions and Visual Exploration of Novel Objects

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Adults provide crucial information for infants and young children about objects in the environment. Emotional facial expressions impact object processing and the ability to learn from facial cues is an important building block of social cognition. The present study investigated the effect of emotional facial cues on visual exploration of novel stimuli. During an eye-tracking task, 61 children, ages 2-5, viewed images of novel toys that were cued by emotional (fearful, happy, neutral) facial expressions. Results indicate a significant interaction of emotional expression and visual exploration of novel objects, $F_{(1.968, 118.104)} = 3.27$, $p = .04$, $\eta p2 = .052$. Post-hoc t-tests showed significant visual exploration of novel objects when cued by neutral facial expressions ($t_{(60)} = -2.55$, $p=0.013$), but not when cued by fearful or happy expressions. These findings suggest that emotional facial expressions disrupt visual exploration of novel objects in young children.

3-H-103   Implicit Theory of Mind in Older Adults: Are There Two Systems for Mindreading?

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Based on prior studies of Theory of Mind (ToM) in old age (German and Hehman, 2006; Phillips et al., 2011), the elderly seem to have difficulty in the ability to infer others' mental states, and their decline of executive function (EF) might be an influential factor explaining their decline in ToM. However, most of the prior studies that investigated the development of ToM in old age used elicited-response ToM tasks which need more non-ToM processing compared to spontaneous-response tasks (Baillargeon et al., 2013) so that it leaves the possibility that some mindreading capacity might still be intact in the elderly. How might the elderly perform on spontaneous-response ToM tasks, and what would this suggest about the computational organization and development of ToM? First, Apperly and Butterfill (2009) proposed two distinct ToM systems: an implicit, early-developing system (fast and independent of EF) and an explicit, later-developing system (flexible but effortful, and dependent on EF). Considering this account, if the implicit system is independent of EF, with spontaneous-response ToM tasks, older adults might show intact belief-like reasoning ability. Alternatively, if the implicit ToM system draws on EF processing resources (Schneider et al., 2012), older adults might show deterioration in implicit ToM processing due to declining EF. Finally, on a one system account, a specialized ToM system draws on EF but can support belief reasoning in EF-compromised populations if performance demands are sufficiently reduced (Leslie et al., 2005), predicting that spontaneous-response tasks, with their reduced EF demands, might reveal intact ToM competence in the elderly. These three accounts were tested to explain how ToM develops with age. The purpose of this study is (1) to explore how ToM develops with age when using a spontaneous-response measure, and (2) to gain insight into which one out of three competing ideas (EF-free implicit ToM vs EF-dependent implicit ToM vs one-system account) can support the development of ToM with age. In this study, younger adults (18-30 years old, n=32) and older adults (age 60 and above, n=18) participated in a spontaneous-response ToM task without any instruction to track mental states. With an eye tracker, we used an anticipatory looking paradigm to see if participants show more anticipatory saccades to the location consistent to an agent's belief about the location of an animal regardless of its actual location. Using a Bayesian analysis, the preliminary results showed that the Bayes Factor (BF) for the hypothesis that both age groups implicitly tracked the agent's belief compared to the null that they did not is 15454.6:1 in favor of belief tracking. Also, a BF of 3.24 favored the null hypothesis of no age difference in belief tracking compared to the hypothesis of an age difference. This study provides evidence to support the claim that decline of ToM with age comes from the high EF

demands of elicited-response ToM tasks, not from the elderly's 'real' decline of ToM processing. These findings point toward an empirical and theoretical convergence between ToM in the elderly and in infants and toddlers, groups whose ToM competence appears to be masked by high performance demands of elicited-response tasks. Of the three accounts considered, the results were inconsistent with only the EF-dependent implicit ToM account because older adults showed intact implicit ToM competence despite their decline of EF.

3-H-104   How Informant's Qualities Influence Children's Attitudes Toward Novel Social Groups

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Initial work on children's acquisition of social information via others' claims has revealed that even brief negative messages from adults can influence children's attitudes toward novel groups (Lane, Conder, & Rottman, in prep). We examine whether children's sentiments toward novel social groups are more influenced by the negative claims of children or adults, inspired by work demonstrating young children's understanding that children and adults hold different types of knowledge (VanderBorght & Jaswal, 2009). Children ages 4-8 years (N=31) overheard an unexpected Skype call (actually, a pre-recorded video) from either an adult or child caller. In experimental conditions, the caller made negative claims about a novel social group. In control conditions, the informant provided no claims. We measured children's explicit and implicit attitudes toward the social group during the initial testing session and again 2-weeks later. Negative information provided by an adult had the most influence on children's attitudes. For example, children chose to donate less of a resource to a member of the new group following an adult's claims (M=2.44, SD=3.47) relative to children in the control conditions (M=5.63, SD=2.56), t(15)= -2.13, p=.05. This difference was not found following a child's claims (M=4.00, SD=2.00 vs. M=5.29, SD=2.43), t(12)=-1.08, p=.30. Effects persisted to a lesser extent 2-weeks later. Developmental differences between ages 4-8 years will be discussed.

3-H-105   Cognitive Basis of Children's Early Self-Esteem: A Case Study of Mechanisms of Developmental Social Cognition

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Self-esteem is one of the cornerstones of early social-cognitive development. Despite the wide acceptance of the importance of self-esteem, there are variations in theoretical conceptions of how self-esteem functions within the larger network of children's social cognition. Here we propose that self-esteem is the central element of a cognitive network that links self with social categories and group attitudes. Across 3 studies with preschoolers and early elementary school students, we investigated these cognitive aspects of early self-esteem. Young children (ages 4-7) can provide verbal evaluations (explicit measures) of themselves in terms of particular cognitive abilities ("I know the alphabet") or physical abilities ("I can tie my shoes") (Harter & Pike, 1984), but using these explicit measures, young children show no evidence of integrating the domain-specific self-evaluations into a higher-order, overall evaluation of themselves (Harter, 1999). Study 1 (N = 39) developed a novel implicit tool for measuring children's self-esteem and showed strong, positive implicit self-esteem in most 5-year-olds (this corresponds to the finding that most typically developing older children and adults also have

positive self-esteem). Classical theories of social psychology describe mechanisms by which adults and older children bring their representations of self and social groups into balance or a state of "cognitive consistency" (Festinger, 1957; Heider, 1946). Although preschoolers may exhibit a variety of self-representations, they may not have organized them yet in a balanced or "cognitively consistent" fashion. Study 2 (N = 156) demonstrated that children as young as 5-years-old already have a strong tendency to keep their self-representations (including their self-esteem, gender self-concepts, and in-group attitudes) in cognitive balance with each other. Study 3 extended this work by examining the behavioral consequences of early self-esteem for students' academic achievement. How children perform at school and deal with everyday failures in school is intertwined with their representations of themselves (including self-esteem), their social groups, and their academic self-concepts (Eccles, Wigfield, Harold, & Blumenfeld, 1993). In a large study with diverse sample of Native American and European American kindergarten and early elementary school children (N = 188), we found that, in Grades K-2, implicit self-esteem was predictive of actual academic achievement more strongly than was children's academic self-concept, and that self-esteem added predictive power above and beyond other relevant variables (e.g., gender, race, teacher's ratings of classroom behavior, and absences). Together, these findings suggest an important role of children's self-esteem for (i) the achievement of cognitive consistency for balancing thoughts/attitudes about self and social groups, (ii) the development and maintenance of social identities, and (iii) children's ability to deal with everyday micro-failures that occur when they endeavor to cognitively master new topics at school and deal with groups of social peers.

3-H-106   Children prefer reasonable partners over unconditionally cooperative ones

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Children are vigilant social learners who trust some information sources more than others. In particular, recent studies have shown that children pay attention to the reasons that informants provide. It has been shown that starting at preschool ages, children selectively trust partners who use strong instead of weak arguments (Corriveau & Kurkul, 2014; Koenig, 2012, Mercier et al., 2014). In contrast to these studies, in which candidates to partner choice showed good versus bad argument production, we investigated whether 5- and 7-year-old children prefer partners who show critical versus uncritical argument evaluation. This required children to evaluate both the arguments' strength and how partners judge them. Importantly, these partners heard the arguments from informants who had false beliefs about the correct answer. Thus, regardless of which argument was chosen, both partners were going to be unsuccessful, and children's preference could not be explained by ascribing knowledge to either partner in addition to argumentative skill. Five- and 7-year-old children (N=127) were introduced to a cooperative game in which adequate evaluation of evidence and arguments was key to winning. Children needed to select a new partner from two candidates presented in a picture story. In this story, a sought-after item, the brush, was missing. Candidates together heard two arguments from two disagreeing informants about where the brush is. Crucially, with respect to the brush's actual location, candidates were ignorant, and their informants had a false belief. In the experimental condition, one informant produced a strong argument, an eyewitness argument ("Go search the red box [incorrect location] because I saw it there yesterday"), and the other informant produced a weak argument, a preference argument ("Go search the yellow box [incorrect location] because yellow is my favorite color"). In the control condition, one informant produced the same strong eyewitness argument for the same incorrect proposal, and the other informant produced another strong argument, a rule-based argument ("Go search the yellow box [incorrect location] because we always put it there"). In both

conditions, one candidate agreed to the witness argument and the other agreed to the respective other argument. We asked children to choose one of the two candidates to continue the cooperative game with them. In the test condition, seven-year-olds chose significantly more often the candidate who agreed to the strong argument than the other candidate who agreed to the weak argument, whereas they showed no significant preference in the control condition. Only these older children also explained their choice to a meaningful extent with recourse to argumentative differences between candidates or between informants (e.g., "Because the favorite color has nothing to do with it"). Five-year-olds showed a tendency in the same direction, although they did not explain their choice at a comparable depth. Also, 5-year-olds had a harder time answering probe questions about the informants' false belief. Overall, these results suggest that starting between 5 and 7 years, children prefer to cooperate and reason with reasonable partners who agree to good arguments, based specifically on their quality as arguments. Only at age 7 do they begin to verbalize their line of thought in judging how reasonable other people are.

3-H-107   Differential Predictor Patterns for False Belief Tasks

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Language and executive functioning (EF) relate to false belief understanding (FBU) (Devine & Hughes, 2014, Milligan, Astington & Dack, 2007). Some researchers suggest that both complementation syntax and inhibitory control are necessary for FBU (de Villiers & Pyers, 2002; Slade & Ruffman, 2005). Most of these studies have used a global composite assessment of FBU. However, there is some evidence that different FB measures may be differentially related to language and EF (e.g., Ng et al., 2010). The current study systematically examines whether there are different predictors depending on the particular FB measure. Fifty-eight children's, aged 4 to 5, performance on a variety of FB tasks (unexpected locations, unexpected contents, and appearance-reality), language (PPVT, CELF, complementation) tasks, and EF (inhibitory control, working memory) tasks were assessed. A series of hierarchical regressions revealed that depending on the FB task, different language and EF measures predicted performance as reflected in Table 1. For instance, complementation was related to only one FB task. Overall, these results challenge the assumption that particular language and EF achievements are required for FBU. In contrast, the findings indicate that FBU has multiple pathways (Farrar, Benigno, Tompkins, & Gage, 2017).

3-H-108   Children's cultural judgments about food selection

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Do young children have different expectations of what cultural ingroup and outgroup members eat? In this study, monolingual English speaking 5-year-olds were introduced to two people: An ingroup member (English speaker) and an outgroup member (French speaker). One group of children (n=16) saw pictures of 16 food items (conventional, unconventional, nonfoods, disgust elicitors; see Figure 1) and assigned each item to either the ingroup or outgroup member. Children assigned more conventional foods to the ingroup (56/64) than the outgroup member (8/64; p<.001, binomial test), yet distributed more disgust elicitors to the outgroup (46/64) than the ingroup member (18/64, p<.001). For

unconventional foods and nonfoods, they did not differentiate between ingroup and outgroup members (Unconventional: p=.71; Nonfoods: p=.26). Another group of children (n=16) assigned the same items to the ingroup member, the outgroup member, or to no one. Here, children distributed the majority of items to no one (172/256), rather than assigning them to either person (84/256; p<.0001). However, children still distributed more conventional foods to the ingroup (43/64) than the outgroup member (16/64, p<.001). These results suggest that children link conventional food choice with cultural group membership, yet there are limits to children's judgments of edibility even across group lines.

3-H-109   Imaginary companions differ from pretend play in their manifestations in children's lives

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Imaginary companions (ICs) are considered a form of pretend play (PP). However, anecdotally, parents sometimes misinterpret children's initial references to ICs as talk about real/present others, not as pretense. We investigated systematic differences in how ICs vs. PP manifest in relation to context (marked as fantasy or incorporated into interactions with real others). Parents of preschoolers (N=71) reported on their child's PP or IC interactions for 10 episodes or 14 days. Logistic regression of 401 reports revealed reports of ICs were less likely than PP to be labeled as pretend (p=.009) and more likely to occur within the here and now (p=.001), be connected to previous events in reality (p=.023), emerge in a non-play context (p=.001), and to have a narrative (versus enacted) form (p=.001). Because children know that their ICs are not real and understand the fantasy/reality distinction, IC-related imagination appears purposefully embedded in real social behavior, whereas PP-related imagination is removed from the here-and-now. ICs might play a role in managing real-world social cognition.

3-H-110   Possessed by the land: Young children use territory to infer object ownership

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Children often decide who owns an object by considering people's interactions with it. We investigated a cue that might allow children to infer ownership when they lack knowledge of such interactions--we investigated if they infer object ownership from information about ownership of territory. In Experiment 1, 3-year-olds (N = 28) were more likely to agree that a man owned the objects on his own lawn than the objects on his neighbor's lawn. In Experiment 2, 3 to 5-year-olds (N = 168) believed that a man liked beautiful flowers and disliked ugly plants regardless of whether they grew on his lawn or on his neighbor's lawn. However, they only judged that he owned the flora on his own lawn, and did so regardless of likeability (see Figure 1). Young children are therefore capable of using territory to infer ownership, and these judgments do not stem from their inferences about liking and preferences.

3-H-111   What types of active experience shape 10-month-old infants' understanding of cooperation?

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Prosocial behaviours such as cooperation are critical to human survival, yet we know little about how they develop. Here, we investigate the relationship between lab-based versus home-based active cooperative experience and infants' cooperative understanding. We also test whether infants' cooperative understanding is robust enough to generalise to other action contexts. One-hundred and twenty 10-month-olds received one of three training types (active-same action, active-different action or observational) before participating in a habituation paradigm measuring cooperation understanding. Results suggest that 10-month-olds who received lab-based active cooperative experience later showed a boosted cooperative understanding as compared to infants who received observational training. Interestingly, home-based experience promoted cooperative understanding for those in the observational condition. Further, only active experience in a highly similar action context was effective at promoting 10-month-olds' cooperation understanding. Subsequent analyses will examine whether this boost in understanding is sustained over time and if other individual difference characteristics are associated with cooperative understanding.

3-H-112   Selectivity and strategy in infants helping behavior at 18 months

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Infants are highly prosocial: they help others, share toys, and comfort those in distress. However, a critical outstanding question concerns the degree to which infants are selective in their prosocial behavior. To test this question we investigated factors influencing infants' instrumental helping behavior. In Experiment 1, 24 infants were given the opportunity to choose to help either a wealthy experimenter (previously shown to possess many resources) or a poor experimenter (previously shown to possess few resources). Infants were more likely to help the wealthy over the poor experimenter (p = .007). However, in Experiment 2 (n = 24) when helping the rich experimenter required greater physical costs (i.e., a further walk) than helping the poor experimenter, infants showed a significant preference for helping the poor experimenter (p =.007; Expt. 1 vs. Expt. 2, Fischer's exact test, p = 0.0001). These findings demonstrate that infants vary their helping behavior according to the characteristics of the recipient that may signal or confer subsequent affiliative benefits to the infant and that infants may also be strategic in their helping in the sense that they weigh the costs and benefits of helping actions against each other to decide who to help.

3-H-113   Representation of Other's Uncertain Beliefs and Information-seeking Behaviors during Childhood

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The current study examined the development of children's ability to represent agents' uncertain beliefs and to link this uncertainty to subsequent information-seeking behaviors. We developed a "block-in-the-box" game, in which three blocks(two were of the same color) were hidden in three boxes respectively. After the first box was revealed, the player should decide whether to made a immediate guess or to look into the second box before guessing the third box. Four- and 5-year-old children (N=59) played the game

themselves, whereas 7- and 8-year-old children (N=122) observed another person playing the game and then either reasoned whether the player would open the second box or inferred the block hidden in the first box. The results showed that although 4-year-olds sought information more frequently when they felt uncertain, it was not until the age of seven did children start to explicitly consider others' uncertain beliefs when reasoning about their behaviors. Besides, compared to the task which required reasoning beliefs based on behaviors, children showed better performance when inferring behaviors according to beliefs.

3-H-114   Navigating a random world: Locus of control as a predictor of children's superstitious beliefs

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Children vary greatly in their beliefs about superstition and other supernatural concepts. However, little work has explored individual differences in children's credulity, an area that could be vital to understanding the nature and role of such beliefs. Among adults, a low sense of personal control is a reliable predictor of superstitious beliefs: for those who don't feel in control, superstition may offer a means of maintaining the comfortable belief that the world is controlled and non-random. Research suggests that even young children feel a need for control, and thus may behave similarly. The current study examines whether perceptions of control relate to superstitious beliefs in middle childhood. Six-, 8-, and 10-year-olds were read four vignettes about fictional children who engaged (or failed to engage) in a superstitious ritual and experienced a good or bad outcome (e.g., crossing one's fingers and then winning a coin toss). For each vignette, children were asked to indicate the degree to which the two events were related. A measure of locus of control was also administered. Results revealed that younger children were more superstitious than older children. Importantly, across ages, children with a lower sense of personal control endorsed superstitious relationships more strongly than those with a higher sense of personal control. A greater perception of the role of chance in determining life events also predicted superstitious belief.

3-H-115   The Effect of Register on Children's Social Inferences about Addressees

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Speakers deploy different registers, or styles of speech, based on who their interlocutor is. Registers are ripe with social information about an addressee and their relationship to a speaker. Although children make inferences about speakers based on speech they produce (e.g., Kinzler & DeJesus, 2013), whether children make inferences about addressees based on the speech their interlocutors produce has yet to be explored. We presented 5-8-year-old, monolingual children (N=30, data collection ongoing, goal of N=48) with three registers: Peer Talk (PT -speech directed to peers), Teacher Talk (TT -speech direct to teachers), and Foreigner Talk (FT -speech directed to non-native speakers). Based on register, children rated non-visible addressees on a 6-point scale (-3 to 3) to indicate how much they liked the addressee, how nice they were, how smart they were, how good of friends the addressee and speaker would be, and how in charge the addressee was in relation to the speaker. Preliminary data suggest addressees receiving Foreigner Talk were rated as less likeable (FT=0.13; PT=1.07; TT=1.47) and less smart (FT=0.47;

PT=1.57; TT=1.47) but not less nice (FT=1.20; PT=1.67; TT=1.67). Those receiving Teacher Talk may be seen as better friends with the speaker (TT=2.00; PT=1.30; FT=1.17) and as more in charge than addressees of different registers (TT=-0.27; PT=-1.27; FT=-1.20). Findings have implications for how children glean social information from speech as a third-party observer.

3-H-116   Ability Conceptions in Context: Self-efficacy and Social Comparison

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Studies suggest that with age, children shift from viewing ability as malleable to fixed (Heyman & Giles, 2004). However, individual differences in ability conceptions exist (Yeager & Dweck, 2012) and some studies document the opposite developmental trajectory (Gelman, Heyman, & Legare, 2007). We examined how self-relevant contexts, specifically self-efficacious beliefs and social comparison, affect children's ability conceptions. Five- to 6-year-olds and 9- to 10-year-olds reported their self-efficacious beliefs and completed an ability conception task in which they explained their own and others' general academic performance. Then, children were told that a high or low ability comparison peer outperformed them on a task. Children were asked to explain the cause of the peer's performance. On the ability conception task, fixed explanations were infrequent (M =.35, Range: 0-3), but older children provided more than younger children, β= .007, t(94) = 2.59, p<.01. Higher self-efficacy was related to fewer fixed explanations, but only when children reasoned about their own academic performance, β =-.357, Wald χ2 = 9.166, p< 01, not others', p>.05. Older children provided fewer fixed explanations than younger children when explaining the comparison peer's performance, X²(2, N =82) = 8.93, p=.01. The peer's ability level had no significant effect, ps >.05. The significance of self-relevance in the current findings suggests that ability conceptions are relatively context dependent.

3-H-117   Forming social evaluations using indirect information: Infants prefer characters who were treated nicely by similar others

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Infants prefer characters who are nice (e.g., Hamlin, Wynn, & Bloom 2007), who share their preferences (Mahajan & Wynn, 2012), and who speak their native language (Kinzler, Dupoux, & Spelke, 2007). However, for all of these evaluations infants have direct information about the character they are evaluating. In reality, people often have to rely on indirect information. For example, humans learn from testimony (e.g., Harris, 2002), and use gossip to form social evaluations (e.g., Dunbar, 2004). Here, we ask whether indirect information impacts 9- and 14-month-olds' social preferences. We find that infants can use indirect information: when they see someone who is similar (shares their food preference) treat one character prosocially and another antisocially, they choose the target of prosocial action (N=31 of 34, binomial p<.001; Study 2). However, forming these preferences requires strong indirect information: infants like characters who are treated well across two situations (e.g., the character has his stolen ball returned and is helped to get a toy from a box; Study 2), but not when the prosociality only occurs in one situation (Study 1). And, infants follow the social preferences of similar others, but not of dissimilar others (Studies 1 & 2) nor of people whose similarity vs. dissimilarity is unknown (Study 3). These studies

add to our knowledge of infant social cognition by providing the first evidence that indirect information can influence infants' social evaluations.

3-H-118   Gender stereotypes about leadership develop early in childhood

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Only 6% of CEOs of Fortune 500 companies are women, a statistic due in part to the stereotype among adults that men make better leaders than women. Although the consequences are clear, the developmental origins of this stereotype are less so. The present study examined the extent to which 3.5 - 6-year-old children (M age = 4.4±1.0 yrs; N = 69; 46% male) preferentially select males, over females, to hold a leadership (compared to a teamwork-focused) position. Children heard a story about a group attempting a task and were asked across three trials to select from an array of 6 children (3 male, 3 female) who should "be in charge" (Lead condition, n = 42) or who should "work on the team" (Team condition, n = 27). Although children displayed an own gender bias, being more likely to select their own gender overall, Wald X2(1) = 199.45, p < .001, the extent of this bias was moderated by condition and trial number, Wald X2(1) = 3.86, p = .050, such that both male and female participants showed a bias to choose males as leaders and females as team players (Fig. 1). These data suggest that the preference for male over female leaders develops early, with the potential to shape children's expectations and beliefs about their abilities and opportunities in a way that disadvantages females from early in life.

3-H-119   Do children learn from liars? Learning and friend preferences in lie-telling informants

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The current study examines whether children perceive prosocial lying behavior negatively or positively by measuring their willingness to learn novel information from different types of lie-telling informants. Children ages 4 to 11 years were assigned to either a prosocial lying condition, in which they watched a video of an informant telling a friend a "white lie", or a self-serving lying condition, in which the informant tells a friend a lie to get out of trouble, which is more negatively biased. All children also watched a second informant interacting with a friend in a neutral manner as a comparison. Following this familiarization phase, all participants engaged in six test trials in which each informant provided novel information about an object or its function. Children's verbal responses were recorded to determine from which informant they were willing to learn. Children were also asked which informant they would rather have as a friend. Eye-tracking data was also collected to examine whether children attended differentially to the lie-telling informants. While data collection is currently ongoing, preliminary data suggest a developmental trend towards trusting the information from the prosocial liar and avoiding endorsing the friendship of a self-serving liar (see Table 1). Eye-tracking data across ages suggest that children's first gaze varies between the lying and neutral informant depending on the intention of the lie-telling informant.

3-H-120   The Comparative Effects of Narrative and Factual Information on Children's Charitable Giving

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When presented with an anecdote about an individual in need, adults give significantly more to charitable causes than when presented with statistical facts, even when the facts document the plight of many in need (Västfjäll et al. 2014). Although developmental research has addressed children's sharing behavior, psychological research has yet to shed light on children's willingness to give to charitable causes. As has been demonstrated with adults, will a child's relative generosity increase when presented with an individual's narrative in place of factual information? We met one-on-one with 8-12 year olds in our lab. Each heard either a true story about an individual orphan in the Kumari Project safe house in Nepal, or general facts about the organization. Participants were then asked comprehension questions, and were compensated with seven one-dollar bills for their participation. Finally, participants were given the opportunity to donate privately any amount of their earnings to the Kumari Project. Findings show that children who heard a narrative donated more than children who heard factual information. One possible mechanism driving adult charitable giving is victim identifiability (Dickert et al., 2016), mediated by the capacity of a narrative to generate mental imagery in a reader, thereby increasing his or her sympathy for the victim. We are currently assessing whether these factors drive children's desire to give as well.

3-H-121   Do Babies See Faces in Face, Face-like, and Ambiguous Stimuli? Pareidolia in Infancy

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Faces are special to infants; infants prefer looking at faces over non-face stimuli and upright faces over inverted faces (e.g., Cashon & Holt, 2015; DeNicola et al., 2013; Libertus & Needham, 2014). The objective of this study was to investigate whether infants demonstrate signs of pareidolia, the phenomenon of seeing faces in ambiguous images, as adults have been shown to do (e.g., Ichikawa et al., 2011). We presented 47 full-term 7 to 9 month-old infants (M = 7.91) with eight upright and inverted versions of face, face-like, and ambiguous images side by side (see Fig. 1). The upright images were ranked by adults from most to least face-like. Given infants' reliable preference for upright faces, it was reasoned that if they perceived a face, they would show an upright preference. Mean upright preference scores were compared against chance (.50) for each stimulus using one-sample t-tests (two-tailed). Significantly higher preference scores were found for the realistic human face, schematic face, and Mooney face (ps < .05) (Fig. 1). These three images were ranked in the top four most face-like by adults. The findings suggest that infants around 7-9 months may perceive a face in some ambiguous images, such as Mooney faces, but may not experience pareidolia to the same extent as adults do.

3-H-122   Help! I need somebody: Locus of control explains school-aged children's help-seeking behavior

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Research on children's selective trust has focused mostly on potential informants' differences, but children's experiences also inform their help-seeking behavior. For example, experiencing success on a task changes preschoolers' help-seeking behavior, but not adults' (Palmquist, et. al., 2016). Our study will explore this developmental shift by asking 64 8-10-year-olds to play a searching game in which two informants take turns hiding objects. Some trials feature a helpful informant (who provides clues about objects' locations), and some trials feature an unhelpful informant (who does not). The game is rigged so that half of the children always locate the hidden objects, regardless of informant; the other half locates more objects with the helpful informant than with the unhelpful one. Later, on four test trials, children choose between the two informants for additional help. Children's magical/fantastical thinking, locus of control, and problem behavior are also assessed. Preliminary data suggests that always-successful (n = 20, M = 1.95, SD = 0.76) and differentially-successful (n = 22, M = 2.14, SD = 0.56) children do not differ in their preference for the helpful informant (t(40)= 0.911, p = 0.368). However, those always-successful children who do prefer the helpful informant also demonstrate greater internal locus of control (r = -0.499, p = 0.025, d = 0.06). Therefore, locus of control may explain the developmental shift in how success affects help-seeking behavior.

3-H-123   Children monitor changes in a social agent's reliability

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One way children learn about the world is by attending to social information, yet social agents may be capricious. Individuals who have been reliable in the past may be unreliable in the future, and vice versa. How do children process changes in social agents' behavior? Children (N=65, 6-9years) searched for coins hidden behind one of multiple locations, with rewards following a probabilistic pattern. Before participants made a choice, a confederate suggested a location; participants could choose the suggested location or another location. The confederate was either initially reliable (high accuracy in predicting reward location) or unreliable (low accuracy), but confederate reliability reversed halfway through the 200-trial task. We measured children's learning of the reward probability structure and how often children chose the suggested location. When the confederate switched from unreliable to reliable, children quickly updated behavior and followed the confederate's suggestions immediately after reversal(t(658)=3.72,p<.01). When the confederate switched from providing reliable to unreliable information, children were slower to stop following suggestions(F(4,1296)=42.99,p<.01). Overall, children relied more heavily on the confederate's suggestions than the probabilities. These data indicate that children have difficulty disengaging from social agents who have been helpful in the past, and also monitor unhelpful suggestions anticipating possible change in the future.

3-H-124   Creativity and reasoning development: Relations between creative contexts, mental-state reasoning, and possibility reasoning

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[1]University of Delaware, [2]Temple University, [3]University of California, Riverside

Creativity may promote reasoning ability development, as creativity involves perspective-taking and transfer (Flavell, 2004). The current study hypothesized greater participation in creative activities would predict greater mental-state and possibility reasoning. 179 3 to 5 year olds (52% female) read

storybooks about fantasy characters. Children's reasoning about whether impossible events could happen in real life (Richert & Schlesinger, 2016), characters' mental states (Barrett et al., 2003; Sabbagh et al., 2006), and creative activity participation (e.g., making up songs; Richert & Smith, 2011) was measured. Possibility reasoning was positively related to mental state reasoning, r=.22, p<.01, the greater children's reasoning that fantastical events are impossible, the more accurate their mental-state reasoning. In contrast, creativity was negatively related to possibility reasoning, r=-.316, p<.001, and was unrelated to mental state reasoning, r=-.06, p>.10. These finding suggest complex relations between creativity and possibility reasoning; such that more experience in creative or fantastical contexts may encourage openness to what is possible. Socially-contingent activities facilitate reasoning about mental-states, resulting in no relation between non-socially contingent creativity activities and mental state reasoning in this study. This poster will explore the complex relations between creativity and possibility reasoning abilities in young children.

3-H-125   How Social Status Influences Children's Understanding of Others' Mental States

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Being able to accurately identify others' mental states is a core aspect of social-cognitive development. The present study investigated how children's relative social status within a context influences their ability to identify others' mental states. Across two experiments, 3- to 7-year-old children (ns = 52, 51) were randomly assigned to hold either an advantaged or disadvantaged social status in a peer context, and were assessed on their ability to accurately identify others' mental states (via False-Belief and Belief-Emotion ToM assessments). When participants' statuses were manipulated by a structural factor (gender; Experiment 1), participants with disadvantaged status were more likely than participants with advantaged status to pass both the False-Belief (Wald χ^2 = 5.27, df = 1, p = .022; B = -2.54; 95% CI [-4.72, -.37]; Odds Ratio = 12.73) and the Belief-Emotion (Wald χ^2 = 4.40, df = 1, p = .036; B = -1.36; 95% CI [-2.63, -.09]; Odds Ratio = 3.88) assessments, controlling for age. When status was manipulated by an individual factor (performance on a task; Experiment 2), participants with disadvantaged status were more likely to pass the False-Belief (Wald χ^2 = 3.77, df = 1, p = .05; B = -1.40; 95% CI [-2.82, 0.01]; Odds Ratio = 4.06), but not Belief-Emotion (p > .5), assessment, controlling for age. Results provide the first empirical evidence that an individual's social status within a context can influence their ability to accurately identify others' mental states.

3-H-126   Working Memory Predicts Young Children's Ability to Resist Misinformation Regardless of Interviewer Rapport Building

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The present study sought to explore whether individual differences in cognitive abilities are related to children's ability to resist misinformation, and whether this relationship is moderated by interviewer rapport building. Three- to 5-year-olds (N = 44) were shown three different objects, each with an associated characteristic. After a play phase with either a supportive (who attempted to build rapport) or a neutral interviewer, children received misinformation from the interviewer about the objects, and then were asked to recall each object's identity and characteristic. They also completed measures on

their working memory and inhibitory control abilities. Results indicated that children with stronger working memory abilities were more resistant to the misinformation, regardless of whether they were questioned by the supportive or the neutral interviewer. These findings suggest that, in addition to interviewer behavior, individual differences in cognitive abilities may also influence children's ability to resist misinformation.

3-H-127   The Development of Chasing Detection: Do 4-year-olds show evidence of a pop-out effect for chasing stimuli?

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Humans attend selectively to animate stimuli. Both animacy perception and chasing detection develop early in life (Rochat, Striano & Morgan, 2004; Frankenhuis, House, Barrett & Johnson, 2013). Meyerhoff, Schwan & Huff (2014) reported evidence of a pop-out effect for chasing displays. The purpose of this study was to test whether attention to chasing, as evidenced by the pop-out effect, has developed by the age of 4. Method. We adapted Meyerhoff et al.'s (2014) procedure for use with 4-year-olds, by using a touch screen to display stimuli and record responses and adding a child-engaging cover story. The stimuli were black circles moving as the chaser, chasee and distracters. On each trial, the chasing pair was presented among a varying number of distracters (2,4,6,8,10). The chasee and distracters moved around the screen in a randomly determined pattern while the chaser pursued the chasee in a heat-seeking fashion. Participants were tasked with identifying the chaser by touching it on the screen. Results and Discussion. We hypothesized that we would find a pop-out effect for chasing stimuli among non-chasing distracters for both adults and 4-year-olds. Our independent variable was number of distracters and our dependent variable was reaction time. The number of distracters was not significantly predict reaction time for adults ($F(1, 136) = 0.026$, $p > .05$) or 4-year-olds ($F(1, 49) = 1.892$, $p > .05$), consistent with a pop-out effect for chase stimuli.

3-H-128   Accepting or discerning: Do preschoolers have preferences for certain types of explanations of biological causality?

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[1]The University of Texas at Dallas

By the preschool years, children know some facts about biology (e.g., cheetahs run really fast), but less is known regarding what children understand about the mechanisms that support those facts (e.g., how is it that cheetahs can run really fast). This study examined the kinds of explanations children accept in response to 'how' questions about animals. Four-, 5-, and 6-year-old children were asked 'how' questions about biological processes in animals and were provided with 4 responses to those questions: mechanistic explanations (i.e., refer to a mechanism), teleological explanations (i.e., refer to a specific purpose), circular explanations (i.e., repeat information from the question without adding anything new), and non-explanations (i.e., provide no answer). Children were asked to rate how well each answer really answered the question. Preliminary analyses (current n = 15, with plan of 60 by CDS) support that children distinguished between the explanations, $F(3,36) = 8.54$, $p < .001$, with mechanistic explanations rated as better at answering questions than teleological, circular, and non-explanations (see Figure). Ongoing data collection will provide evidence regarding whether there are age and individual

differences in explanatory preferences. Overall, this work will help inform us about how preschoolers make sense of and reason about scientific information.

3-H-129   Social-cognitive perceptions and learning: Young children's transfer from and beliefs about characters

Molly Schlesinger[1], Rebekah Richert[2]

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Young children's social-cognitive beliefs about characters impact transferring problem solutions from video to novel problems (Schlesinger et al., 2016). The current study explored how young children's beliefs about characters relate to using divergent or convergent problem solving methods (Lloyd & Howe, 2003). Sixty 3- to 6-year-old children from low-income preschools watched videos of characters creating and using levers to solve problems; following, participants attempted to construct levers themselves. Transfer was coded by whether participants created levers using objects analogous (convergent) or non-analogous (divergent) to video objects. Participants were interviewed about their self-efficacy, as well as how trustworthy the characters were and how similar the characters were to themselves. Participants who used divergent solutions had greater self-efficacy, $F(2, 57)=3.15$, $p=0.05$, and convergent participants had greater character trust, $F(2, 57)=4.85$, $p=0.010$, and similarity beliefs, $F(2, 57)=3.33$, $p=0.040$. This poster will further discuss the social-cognitive processes associated with divergent and convergent analogical transfer.

3-H-130   Are Accent Preferences Specific to Language? A Test Using Music as the Auditory Stimuli

Rachel Stevens[1], Douglas Behrend[1], Madison Myers[1]

[1]University of Arkansas

Multiple studies have shown that children display social preferences for others who speak with a native accent (e.g. Kinzler, Shutts, DeJesus, & Spelke, 2009) Music, like language, is regarded as being universal and differs culturally in its auditory properties (Brandt, Gebrian, & Slevc, 2012). To test for a "musical accent" effect, 33 five- and six-year-olds (M = 5.99 years; 15 male) were shown 8 pairings of children's faces linked with familiar-sounding, western music clips and unfamiliar, non-western music clips. Children did not choose the children linked to the Western music clips more often than chance (M = 4.39, chance = 4), $t(32) = 1.21$, $p= .24$. These results lend evidence to support the claim that language and accent are unique in their ability to guide social preferences for young children as compared to music, and that it is unlikely that simple auditory familiarity is responsible for language-based preferences.

3-H-131   A Friend in Need is a Friend Indeed: Children Use Social Obligations to Predict Social Category Membership

Jessica Switzer[1], Valerie San Juan[1], Susan Graham[1]

[1]University of Calgary

These studies examined whether: (1) Children infer social category membership based on helpful and harmful behaviour of a category member directed towards a new character; and (2) whether children use these social categories as a basis for inductive inferences. Children were shown two novel social categories (e.g., Blicks and Feps) that each possessed a distinct property (dancing or singing). During test trials, children first witnessed members from each social category perform different social actions (harmful, helpful, neutral) towards a series of novel test characters. They were then asked to categorize and generalize a property to each new character. Results of Study 1 (n = 129), indicate that 4- and 5-year-olds used harmful and helpful behaviour to predict social category membership, however they did not extend the category property to the new member. In Study 2 we examined whether children would generalize a property of a social category if it was framed as a social convention. Results (n = 73) replicated the categorization results of Study 1. Results further revealed that 4- and 5-year-old children generalized the social convention to the new category member. Our findings suggest that children use helpful and harmful behaviour to predict social category membership. Further, children view social conventions as critical to a social category and selectively extend these properties to new members of the same social category.

3-H-132 The rise and fall of children's social evaluations over time

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Humans evaluate others from the earliest years and even months of life, deciding who is good and who is not, whom they like and whom they dislike. Yet such initial evaluations represent only a portion of our social lives; our views about others are not necessarily constant over time and may change depending on the basis of the evaluation. We found that while five- and six-year-olds (N=144) were equally likely to prefer an individual who shares their toy preference (similar) and an individual who treats others well (nice) in the moment, they were more generous toward the similar character. However, after a one-week delay, children were more likely to prefer a nice character than a similar one, a difference that was also reflected in their giving and in what they remembered. These findings highlight the importance of comparing how various dimensions of social preference can be differentially expressed over time as a window into how social evaluations, enduring attitudes, and lasting relationships are formed.

3-H-133 Social categorisation on the Other-race Effect across a Single-race and a Multi-race population

Diana Tham[1], J. Gavin Bremner[1]

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The other-race effect (ORE) is a robust finding in face recognition with memory generally superior for same-race faces than other-race faces. Recent researchers theorised that the ORE arise from a combination of perceptual experience, social categorisation, and the motivation to individuate faces (Hugenberg et al., 2010, 2013). The present research aim to understand the interaction between perceptual expertise and social categorisation (personality group) on the ORE by comparing individuals from a single-race and a multi-race population. 235 children (between 5 and 14 years) and 69 adults from a single-race population (British: majority White exposure) and a multi-race population (Malaysians: Malay and Chinese exposure, and Western media exposure) were examined. A face race

and population interaction was found, F (3, 900) = 12.44, p < .001. British showed the typical ORE whereas Malaysians showed recognition advantages for Chinese, Malay, and White faces but ORE for Black faces. There was a personality group and population interaction, F (1, 300) = 4.551, p < .05. Malaysians were better in recognising faces categorised as members of their own personality group (including Black faces). Although it has been suggested that ingroup category labels can elicit the motive to individuate, the present findings suggest that these features may be more likely to elicit individuation in other-race (novel) faces when individuals have experience with more than one racial group.

3-H-134   Imitation in Chinese Children: How Pedagogical Cues and Prior Experience Influence Action Processing

Zhidan Wang[1], Yiting Chen[1], Andrew Meltzoff[2]

[1]Jiangsu Normal University, [2]University of Washington

Previous studies have documented that prior experience (Williamson, et al., 2008) and pedagogical cues (Kiraly, et al., 2013) influence Western children's imitation. For theoretical reasons, we were interested in testing this in Chinese children (N = 80). In 2 experimental groups, children saw an adult demonstrate actions either with pedagogical cues or not. In a third group, children were given pedagogical cues during the demonstration and also prior experience with the objects. A fourth group served as a baseline control. Relative to baseline scores (M=3.00), imitation was significantly greater in all 3 experimental groups, and children who saw the demonstration both with pedagogical cues (M=7.65) or without them (M=7.75) showed more imitation than did children who had prior experience (M = 5.10), F(3, 76)=17.88, p<.001. Imitation is a powerful source of learning about novel objects, but it is not fixed, automatic, and stereotyped. Cross-cultural differences and universals will be discussed.

3-H-135   The relationship between self-control abilities and children's beliefs about self-control

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[1]University of California Berkeley, [2]Cornell University

This study explores children's developing abilities to practice self-control, and how their self-control abilities relate to their corresponding beliefs about freely practicing self-control. Children (n=121) ages 4 and 5 were asked 4 questions to gauge their beliefs about self-control (e.g. 'Can you just choose to not eat a cookie?'). These same children were asked to complete two types of self-control tasks: a gift-wrap task (not look while the experimenter wrapped a gift) and a toy sort task (pick up toys rather than play with them). In one condition children completed the self-control tasks prior to answering the free will questions, while in another condition children answered the free will questions then completed the self-control tasks. Overall, older children held stronger beliefs about self-control than younger children, replicating previous results. Twenty children passed both self-control tasks (did not play with toys or peek at the gift), while 34 children failed both tasks. Results indicate that the experience of self-control altered children's corresponding beliefs about their own abilities. In particular, failure at both self-control tasks significantly reduced children's subsequent beliefs about being able to freely practice self-control.

3-H-136   Group Bias in Young Children's Vicarious Punishment

Xin Yang[1], Zhen Wu[1]

[1]Tsinghua University

We explored how children's group membership affects their third-party non-costly (i.e., "vicarious") punishment on behalf of a wronged ingroup member. Seventy-two 5- to 6-year-old Chinese preschoolers watched an ingroup puppet (marked by color preference) play 3 games with an ingroup, an outgroup, and a group-unaffiliated puppet. Each game consisted of two situations. In the immoral situation the ingroup member's possession was stolen by the other agent; in the unfair situation the experimenter distributed fewer resources to the ingroup member than to the other agent. Children could choose to help the ingroup member by returning its lost resource (restoring equality) or punish the other agent by removing all of its resources (thereby giving an advantage to the victim relative to the partner). We found that children preferred restoration over removal, highlighting the value of restorative justice in human cooperation. Unexpectedly, children with high ingroup bias (measured by behavioral attributions) punished outgroups less than ingroups and unaffiliated puppets in both situations. A possible interpretation is that children's punishment is motivated by social comparison, and this occurs less when engaging with outgroup members.

3-H-137   Understanding Transitive Preference in 10.5-Month-Old Infants

Julie Youngers[1], Yuyan Luo[1]

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Understanding transitivity of preference (if A is preferred over B hence A > B, B > C, then A > C) underlies our abilities to make rational decisions (Regenwetter, Dana, & Davis-Stober, 2010). Recent studies show that infants aged 10 to 16 months seem to reason transitively about an agent's preferences as well as agents' dominance relationships (Gazes, Hampton, & Lourenco, 2017; Mou, Province, & Luo, 2014). The present study seeks to examine if 10.5-month-olds can understand an agent's transitive preferences when she makes inconsistent choices. Infants were presented with two sets of familiarizations in which between item-A and B, the agent chose A four times and B once, and between B and C, she chose B four times and C once. Infants appeared to expect the agent to choose A over C, indicating that they understood that the agent preferred A over B and B over C even with her inconsistent choices within each pair. These and control results provide further support for the early emergence of our understanding of the transitivity of preferences.

Symposium 9 – Imitation as a Mechanism of Cultural Transmission: Exploring the Role of Biology, Context, and Culture

Genetic contributions to over-imitation in early childhood

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Over-imitation or the tendency to copy non-causal actions is a distinctive and potentially universal human capacity not seen in other apes (e.g. Horner & Whiten, 2005; Nielsen et al., 2014). It facilitates

human's acquisition of opaque cultural knowledge and makes cumulative culture - the improvement and transmission of knowledge over time - possible (Boyd & Richardson, 1985; Tomasello, 1999). Because the capacity is highly adaptive yet serves a function distinct from causal action imitation, we hypothesized that the capacity might have a distinct genetic basis. The present behavioral-genetic study investigated this possibility and the developmental trajectory of young children's engagement in non-causal versus causal imitation. We analyzed data from 314 same-sex twin pairs (145 MZ, 169 DZ) tested twice at ages 2 and 3 on a modified Birdhouse Task (Carpenter, Call, and Tomasello, 2002). We coded the proportion of causal actions (i.e., removing the pin and opening the door) and non-causal actions (i.e., vocal and gestural actions with the goal object) that children imitated at each age. The interaction between action type and age was significant, $z = 5.61$, $p < .001$ (mixed effect model with imitation scores nested within children within families). At both ages, children imitated causal actions more than non-causal actions. Across age, children's imitation increased with non-causal action imitation increasing more than causal action imitation. At age 2, genetic influences accounted for approximately 50% of the variance for children's imitation of non-causal actions and 30% of the variance for children's imitation of causal actions. The remaining variance was explained by non-shared environmental influences suggesting that at age 2 family-wide experiences and practices common to both twins (shared environmental effects) had no influence on childhood imitation. Importantly, consistent with our hypothesis as to the genetic distinctiveness of causal and non-causal imitation, almost 90% of the genetic effects on 2-year-old's imitation of non-causal actions were independent of genetic effects on the imitation of causal actions. At age 3, genetic influences accounted for approximately 30% of the variance for children's imitation of non-causal actions but no longer predicted variance for children's imitation of causal action. The remaining variance was explained by non-shared environmental influences. The finding that, by age 3, genetic effects only accounted for variability in children's non-causal imitation further supports the hypothesis that these two types of imitation are genetically distinct. Given the continued presence of genetic effects for non-causal imitation at 3, we investigated their source. Developmental continuity in children's non-causal imitation was due to genetic factors alone: 17% of variance represented continuity in the genetic effects present at age 2; the remaining 83% represent unique genetic effects at age 3. In sum, our analyses confirm that imitation is not a unitary construct and suggest that non-causal imitation--an adaptive heritable capacity at the root of human groups' cultural cohesion and diversity--may have a distinct evolutionary history.

The influence of communication and prior knowledge on overimitation

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Children and adults tend to imitate actions that are irrelevant to accomplishing a goal (e.g. Flynn & Smith, 2012; Horner & Whiten, 2005). Over & Carpenter (2012) argue that context may influence whether children form social goals or learning goals and therefore overimitate or not. We investigated in two experiments if contextual factors like the communicativeness of the model and children's prior knowledge of an efficient solution influences overimitation in five-year-old children. In each experiment children completed two trials. At the start of each trial, children observed one adult model retrieve a reward from a transparent puzzle-box. Prior to the first trial the model used causally irrelevant and relevant actions. Prior to the second trial a different model used only causally relevant actions. After each demonstration, children removed a reward themselves, with the number of causally irrelevant

actions providing a measure of overimitation. In the first experiment, we investigated whether communication of a model performing irrelevant actions is necessary to elicit overimitation in preschoolers and whether communication of another model performing an efficient action modulates the subsequent reduction of overimitation. The communicative model welcomed the child and acted naturally and communicative and sent ostensive signals during demonstration. The non-communicative model was unfamiliar to the child, ignored the child completely, did not talk, and avoided eye contact. 5-year-olds imitated irrelevant actions more often than children in a baseline condition who did not observe a model, both when they were modeled by a communicative experimenter and when they were modeled by a non-communicative experimenter (t(41) -4.40, ps < .001). However, children stopped using the previously learned irrelevant actions (i.e. performance of irrelevant actions at baseline levels) only when they were subsequently shown the more efficient way to achieve the goal by a communicative experimenter. It did not matter if they learned the inefficient strategy communicatively (t(41) = ?0.53, p = .601) or non-communicatively (t(41) = 1.92, p = .062) before. In the second experiment, we presented the efficient strategy before the inefficient strategy. Regardless of whether the efficient strategy was emphasized through communication (a) or not (b), most children did not adopt an inefficient strategy once they learned a more efficient solution (a: t(42) = 1.12, p = .27, b: t(41.99) = 0.83, p = .41). In sum, communication seems to affect the perseverance of overimitation rather than its elicitation and prior performance of an efficient solution seems to eliminate overimitation in most the children. These results show that context influences children's tendency to overimitate and indicate, that it matters which strategy children learn first. If they learn an inefficient strategy first an emphasized social context enhances children's social goals and therefore their motivation to overimitate. If they learn an efficient strategy first they focus on learning goals and their motivation to overimitate decreases. This indicates that children are not blind imitators copying everything they see, but are flexible learners who adopt different learning strategies depending on the situation.

Examining the role of conformity in children's flexible imitation: Children's imitation of instrumental and conventional tasks in the U.S. and Vanuatu

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Recent research with Western populations has demonstrated that children use imitation flexibly to learn both instrumental skills and the conventions of their social groups (Legare et al., 2015). This research indicates that children imitate behaviors with either high or low fidelity based on their interpretation of the purpose of a behavior as instrumental or conventional (Legare & Nielsen, 2015). Evidence for children's imitative flexibility in non-Western populations is limited, however, and the research that has examined children's imitation across cultures has only focused on instrumental tasks (Berl & Hewlett, 2015; Nielsen et al., 2014; Nielsen & Tomaselli, 2010). In this study, we examined the effect of an instrumental language cue (i.e., "I'm going to make a necklace.") versus a conventional language cue (i.e., "Everyone always does it this way.") on 6- to 8-year-olds children's imitative fidelity of a necklace-making activity in an industrialized, Western culture (U.S., N = 85) and a subsistence-based, non-Western culture (Vanuatu; N = 57). Consistent with previous research, U.S. and Ni-Vanuatu children engaged in higher imitative fidelity following the conventional cue (M = 3.46, SD = 1.42) than the instrumental cue (M = 2.43, SD = 1.27), F(1,141) = 20.86, p < .001. Ni-Vanuatu children, however,

engaged in higher imitative fidelity following the instrumental cue than U.S. children (M_Vanuatu = 2.79, SD_Vanuatu = 1.18; M_U.S. = 2.19, SD_U.S. =1.28), t(70) = 2.07, p < .05, a consequence of what we believed to be cultural variation in the value of conformity. We conducted a follow-up study with U.S. and Ni-Vanuatu adults (N = 128) to examine the role of conformity in children's socialization in each culture. In this study, participants were asked to endorse either a child that completed the necklace-making task with high imitative fidelity (e.g., displayed a high level of conformity) or a child that completed the task with low imitative fidelity (e.g., low level of conformity) as smart and, as a comparison trait, well-behaved. We found that U.S. adults were less likely to endorse high conformity children as intelligent and well-behaved than Ni-Vanuatu adults. This study provided experimental evidence of cross-cultural differences in the value of conformity in adults' evaluations of desirable traits in children, reflecting differences in the extent to which children in each society are socialized to conform. Although children's tendency to engage in instrumental imitation has been documented across cultures, little research has examined how children's imitation may differ based on social context, both in terms of the information provided about the goal of a task and cultural beliefs about the importance of conformity. Together, these studies demonstrate both cross-cultural continuity and variation in children's imitation, driven by both the framing of a task and cultural differences in the value of conformity.

The role of personality on children's copying and innovation propensity: Conscientiousness, Agreeableness and Openness matter

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When faced with novel problems to solve, children can copy the actions of others, modify previously observed behaviours of others (innovation by modification/emulation), or attempt to generate solutions asocially by inventing new behaviours (innovation by invention) (Carr et al. 2016). Currently, little is known about what differentiates those that prefer to copy others from those who innovate. In this study, we examined whether, when faced with a novel problem, personality influences children's propensity to observe others or generate solutions individually. 282 7-11 year olds were presented with a novel, tool-use puzzlebox task - the multi-methods box (MMB: Figure 1) - offering multiple tools, entrances and exits to retrieve sticker rewards. All participants were asked by an experimenter "Would you like to have a go yourself, or would you like me to have a go first?" For those that elected for a demonstration, an experimenter performed the same technique four times. Then each child had ten attempts at retrieving rewards from the box. Personality ratings were obtained through parental and teacher ratings of the Big Five personality traits using Asendorpf and van Aiken's (2003) 23-item scale. This design allowed investigation of the proportions of children, who, a) prefer to observe others before undertaking a novel problem to solve, b) are willing to attempt to solve it individually, c) if they elect to observe a demonstration, whether they deviate from the methods observed, and whether these distinctions were related to personality. Overall, the majority of children (N = 173, 61.35%) elected for social demonstrations, but the tendency to do so decreased with age (Figure 2). Gender differences were also evident, with males (48.53%) more likely than females (29.45%) to elect for no demonstrations. Binary logistic regression revealed that conscientiousness predicted the propensity to elect for no demonstrations, odds ratio = 1.733, p = .042, while agreeableness predicted the propensity to elect for demonstrations, odds ratio = .569, p = .047. Further, of those that elected for

demonstrations, parental ratings of openness to experience predicted the number of deviations (entrances, exits and tools used to extract the reward) from the observed method, B = 1.207, t = 2.011, p = .046. Thus, these results show that personality predicts the propensity to elect to observe others or to 'go it alone', and indeed whether they deviate from observed behaviours. Specifically, agreeable children, characterised by being cooperative and prosocial, were those that tended to ask to observe a demonstrator first. In contrast, conscientious children, characterised by being organised and goal-directed were willing to tackle a novel puzzle on their own. Finally, of those that elected for demonstrations, those rated as creative and imaginative (openness to experience) were more likely to apply their own idiosyncratic methods to retrieve rewards and thus not to directly copy witnessed solutions. This is, to our knowledge, the first study to document individual differences in children's learning strategy use and thus sheds light on what may differentiate individual problem solvers from those that look to others.

Symposium 10 – Usable Knowledge for Improving Mathematics Learning: Bridging Research in Cognition and Development with Educational Practice in Diverse Contexts

Translating cognitive developmental theory to improve children's understanding of counting

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Children's ability to connect counting to cardinality is a foundational skill in the development of mathematical thinking. However, little is known about the specific learning materials that best promote this understanding. Lack of such knowledge is a problem because without it parents and educators are left to their own, sometimes erroneous intuitions about what works best. Our lab has been advancing and applying cognitive developmental theory to identify malleable factors in young children's counting input that improve children's understanding of cardinality. We identify potential factors based on the theory that counting practice will promote understanding of cardinality when it is structured to help children focus on the countable set rather than on the individual objects. In some experiments, we work individually with preschoolers in their school once a week for several weeks using a research-based, label-then-count counting script (Mix et al., 2012). In other experiments, we bring children into the lab and give their caregivers instructions for counting with them at home. In all experiments, we test the potential malleable factor by randomly assigning children to different counting conditions (or to a no-counting control condition). Before and after the intervention we assess children's counting skill and understanding of cardinality. Experiment 1 (N=39) showed that children's understanding of cardinality improves more after counting objects in picture books than after counting physical objects ($\eta2p$ = .13). Experiment 2 (N=77) showed that children's understanding of cardinality improves more when the counted objects are randomly scattered on the page than when they are placed in canonical patterns (like pips on a die) ($\eta2p$ = .11). Experiment 3 (N=74) showed no evidence that the sizes of the to-be-counted sets (e.g., small versus large sets) affects understanding of cardinality, but results suggested that larger sets (> 4) are better than smaller sets (1-3) for improving counting skill ($\eta2p$ = .12).

Experiment 4 (N=38) found that teaching children to perform finger montring gestures (e.g., holding all five fingers up at once) during counting practice improves counting skill more than teaching children to use finger counting (holding up one finger at a time) ($\eta2p$ = .28). However, there was no evidence that children's understanding of cardinality benefitted from being taught either type of representational gesture when compared to the standard tagging gesture. This may be because many participants struggled to produce the full set of representational gestures as instructed, or because several children across the conditions (including control) spontaneously performed a subset of the representational gestures without explicit instruction. Taken together, results lend some support to the theory that children's understanding of cardinality may benefit from input that focuses attention on the countable set as a whole, but they also offer some important complexities and caveats that will need to be investigated in future studies. More generally, the experiments provide an example of how to conduct translational research that advances both theory and practice, and they highlight that even relatively minor differences in the structure of children's input can affect understanding of foundational mathematical concepts and skills.

Using Cognitive Science to Inform the Design of Math Apps

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Using tablet computers for educational purposes is widespread in both schools and homes. Over 80,000 education-related apps are available for download (Apple, 2015). However, very few mathematics apps are theoretically motivated or empirically tested. One way to better understand the benefits of tablets for math learning is to use theory and research grounded in cognitive science to inform game designs. We will present two studies, one in the school context and one related to the home context, which both use the same tablet-based linear number board game. Linear number board games are physical representations of the mental number line, which is hypothesized to represent numbers horizontally from left to right (Hubbard et al., 2005). The cognitive alignment framework suggests that learning materials that align with this desired linear mental representation can better promote learning (Laski & Siegler, 2014). We created 0-100 numbered board game with rows linearly arranged in a 10 x 10 array for a tablet. The visual representation of the game displays the base-10 system (i.e., the rows represent the decades and the columns represent the units). While playing the game, talking with an adult about this representation, comparing the magnitudes of numbers, or identifying the numerals could further enhance children's attention to this numerical information. Educational apps that are actively engaging and socially interactive can enhance children's learning (Hirsh-Pasek et al., 2015). Study 1 examined whether playing the tablet-based linear number board game or a tablet game targeting domain-general working memory skills would improve kindergarteners' numerical knowledge (n=81). Both games involved playing for 10 sessions for 10 minutes each in school. Both games improved children's numerical magnitude knowledge. On a 0-100 number line estimation task, percent absolute error decreased from pretest to posttest for children who played the number game (M=24% to 18%, p<.001, d=1.50) and the working memory game, (M=25% to 22%, p<.001, d=.69), but there was no significant change for a no-contact control condition, (M=24% to 22%, ns, d=.30). Thus, the theoretically driven number-related and working memory tablet games can facilitate children's mathematical learning. Study 2 examined how parents and preschoolers (n=51 dyads) engaged in number-related talk while playing the tablet-based number game. Specifically, we examined whether extra instructions to focus on

numbers impact parent number talk beyond the number cues inherent in the game. All parents were given regular game instructions, but half of the parents were also asked to teach their children about numbers while playing the game. Preliminary analyses (n=19) of the videotaped interactions revealed parents who received the extra guidance used more number-related talk than the no guidance condition (parent number-related utterances M = 93 vs. 62, respectively, p=.02, d=1.24). Thus, minimal prompts to focus on numbers increased parents' math talk suggesting that mathematical tablet games can be socially interactive. Results will be discussed in terms of the potential for theory-driven tablet-based number games to promote the numerical knowledge of children.

Effects of Spatial Training on Elementary Mathematics

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Studies have reported significant positive effects of spatial training on mathematics (Cheng & Mix, 2014; Lowrie et al., 2017; Wolfgang et al., 2001). Though intriguing, these results bear close examination because they are based on relations that are either quite distal (e.g., block play in preschool related to mathematics scores in high school) or perhaps too proximal (e.g., mathematics outcome measures given immediately after spatial training). It is also unknown whether these effects are limited to certain age groups, certain mathematics tasks, or certain spatial trainings, as suggested by recent factor analyses (Mix et al., 2016; Mix et al., in press). In the present study, we provided 6? training sessions to 258 students in two grades (1st grade: n = 134, mean age = 7 years (SD =.64), 85 girls; 6th grade: n = 124 mean age = 12 years, SD =.59, 63 girls). The training was either mental rotation, figure copying, or language arts (control). All children were pre- and posttested with a range of mathematics problems, including word problems, calculation, numeracy, algebraic reasoning, and equation reading. Separate analyses of covariance (ANCOVA) were carried out at each grade level for each spatial training task (Mental Rotation vs. Figure Copying), with language arts control as a fixed factor, total mathematics posttest score as the dependent measure and total mathematics pretest score as the covariate. In first grade, there were significant gains in mathematics scores for mental rotation training versus language arts control (F (1, 87) = 6.17, p =.013, ?^2 = .07) but not for figure copying (F (1, 84) = 1.60, p =.21, ?^2 = .02). The effect for mental rotation training was driven by significant pre- versus posttest differences on place value (t (46) = 4. 32, p <.001, d = .30) and missing terms problems (t (46) = 3.87, p <.001, d = .26) in particular. In 6th grade, we found the same advantage for mental rotation training versus language arts control (F (1, 80) = 3.85, p =.053, ?^2 = .05), but not for figure copying (F (1, 80) = 2.74, p =.10, ?^2 = .03), and it was based on significant gains on word problems (t (40) = 2.72, p =.01, d = .31). The results provide evidence of spatial training effects on mathematics performance for children in two age groups (1st and 6th grade). These effects were apparent in gains for overall mathematics scores, but these gains were driven by improvement in specific skills that varied by grade. Interestingly, mental rotation training was the only effective spatial training in both grades. Practice in figure copying, though strongly associated with mathematics in 6th grade, did not lead to significant mathematics improvement when compared to a language arts training control.

Using principles from Cognition and Learning to Develop Fraction Knowledge in Struggling Middle Schoolers

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Fractions are foundational for learning algebra, thus representing a crucial component of mathematics education. Facility with fractions fosters the transition from elementary school arithmetic to the more complex concepts introduced in middle school. Students who leave 6th grade with weak fraction knowledge experience cascading math difficulties through the remainder of middle school when algebra becomes a primary topic (Siegler et al., 2012). In response to this serious educational issue, we developed and tested an intervention designed to build robust understanding of fraction magnitudes. Converging findings in cognitive science (e.g., Siegler et al., 2011) suggest that understanding fractions as magnitudes that can be represented on a number line provides a key underlying structure for learning a range of mathematical concepts. As such, our intervention revolves around the number line and aimed to build fundamental understandings of fraction magnitudes. To develop deep fraction knowledge and minimize cognitive load, foundational components were initially taught with a limited set of denominators. In addition, our approach uses gestures to guide students' attention and support connections among concepts (Alibali et al., 2011), comparisons of solution methods (Rittle-Johnson et al. 2009), instructional explicitness (Gersten et al., 2009), and clear visual models (Fuchs et al., 2009). The intervention was anchored by a meaningful story line (Bottge et al., 2014). We assessed the efficacy of this intervention for 6th graders (N = 51) who showed difficulties with fraction concepts on a validated screener. Students were randomly assigned at the student level to the experimental intervention (n = 28) or a business-as-usual control intervention (n = 23). The study used a pretest, posttest, and delayed (7 weeks later) posttest design. The intervention, carried out in small groups, occurred over 6 weeks (27 lessons). General fraction concepts, fraction number line estimation, fraction magnitude comparisons, and fraction arithmetic were assessed at the three time-points. Students' working memory, vocabulary, and classroom attention (teacher ratings) were also assessed as moderators. A series of RMANOVA showed that students in the experimental group performed significantly better than the control group on all fraction outcomes, both at posttest and delayed posttest. The one exception was fraction arithmetic, which was not emphasized in the intervention. Effect sizes were large (Hedges' g ranging from .82 to 1.09). Also of interest was whether effects of the intervention were moderated by student characteristics. Results revealed an interaction between attentive behavior and intervention condition on fraction concepts at post-test, controlling for pre-test. Simple effects demonstrated a buffering effect of the intervention on the normally negative impact of low attentive behavior on learning. In conclusion, the findings demonstrate the effectiveness of a research-based fractions intervention for students with math difficulties. A number-line centered approach to teaching fraction magnitudes, along with the implementation of targeted instructional strategies based on learning principles, helped struggling learners to make durable gains in fraction concepts. The approach was most beneficial for students with poor classroom attention.

Symposium 11 – Cue Use in Early Language Acquisition: Integrating Naturalistic and Lab-Based Methods

Developmental changes in the effects of referential context on label learning

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This research examined how referential context affects infants' ability to learn object labels that conflict with prior linguistic experience (i.e., nonlinguistic tones). We predicted that providing referential context for label learning would promote acquisition of the unusual labels. We also predicted developmental and experiential differences in openness to learning nonlinguistic labels. Specifically, older monolinguals' additional exposure to a single language may foster expectations about labels' properties that are more rigid than younger or bilingual infants' expectations. In Experiment 1, monolingual 14- and 19-month-olds participated in a Switch task measure of label learning. Infants viewed videos in which novel objects were labeled with nonlinguistic pure tones. At test, they failed to detect incorrect object-label pairings, suggesting that they did not learn the tones as labels. In Experiment 2, infants participated in the same task with added referential support. Prior to the label-learning task, infants saw familiar objects and heard their labels (e.g., dog). Monolingual 14-month-olds learned the nonlinguistic tone labels, but 19-month-olds did not. Thus, the labeling context helped younger infants, but not older infants, learn the novel labels. Older infants' expectations about the forms labels can take are not readily shifted. In Experiment 3, we tested bilingual 14-month-olds (learning non-tonal languages) in the task from Experiment 1. Bilinguals did not learn the nonlinguistic labels, despite showing flexibility in learning linguistic tone labels in prior research. This work explores two developmental patterns: 1. Accumulating experience with a language narrows infants' expectations about the forms that object labels take. 2. Broad linguistic experience may help bilingual infants rule out nonlinguistic forms as object labels while they remain open to a range of forms for linguistic labels.

Cue Use in Early Language Acquisition: Integrating Naturalistic and Lab-Based Methods

Elika Bergelson

By age two, children shift from modest noun comprehension to robust knowledge of many words. While in-lab studies often highlight properties that aid noun learning during in-lab manipulations, they leave open whether the prevalence of these properties predicts noun learning "in the wild." Here we analyze a new longitudinal corpus to examine whether properties thought to be "useful" for learning nouns predict 17-month-olds' productive noun vocabulary. We examine word frequency, talker variability, object-referent co-presence, and proportion of words in isolation/at edges. Participants (n=44) were part of a yearlong study, which consisted of monthly home recordings (daylong audio and hour-long video) from 6-17 months. RAs annotated object words said to or by the child, along with utterance-type, talker, and whether the object was present. The simplest model that explained significant variability in the 17-month noun vocabulary included just two predictors: month of talk-onset (earlier talkers had bigger vocabularies), and proportion of short-phrases (infants hearing fewer short phrases had bigger vocabularies). Combined, these variables accounted for 47% of the variance in productive noun vocabulary. These results suggest that when parents of pre-talkers use more complex sentences, their children say more words at 17 months. These results do not suggest that previously proposed measures are unimportant for word learning. Rather, this work highlights that receiving more 'bite-sized' input, and practice with a growing output may better (or at least more simply) account for individual noun vocabulary development than variables that aid learning in the lab.

Monolingual and Bilingual Toddlers' Use of Pragmatic and Object Cues in Word Learning

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Bilingual children have been shown to attend more to pragmatic cues (e.g., eye gaze) than monolinguals (Brojde et al., 2012; Yow & Markman, 2011), especially when pragmatic cues conflict with lower-level perceptual cues (e.g., proximity). Because attention to pragmatic cues is important for language learning (Brooks & Meltzoff, 2005), this study investigated differences in monolingual and bilingual two-year-olds' attention to pragmatic cues in an eye-tracking word learning paradigm. In this study, we introduced a conflict between eye gaze (a pragmatic cue) and object salience (a lower-level perceptual cue; e.g., Yurovsky & Frank, 2015). Participants saw videos in which a model looked to either a salient object (multicolored and covered in a distinct texture) or a nonsalient object (neutrally colored and no defining texture) and labeled it. Videos were presented in blocks such that the model labeled the same object (e.g., the nonsalient object) in each video of one block. After the 4 labeling videos in each block, participants viewed 3 test trials in which the two objects from the videos were shown side-by-side onscreen while an audio track played. Three different test trials were used to evaluate changes in children's looking depending on whether the label from the preceding videos (test trials 1 and 3) or a novel label (test trial 2) was used. Children viewed two blocks (labeling videos and test trials) in which the salient object was the target and two blocks in which the nonsalient object was the target. Children (Monolingual N=8, Bilingual N=5; M_age=24.6 months) were classified as monolingual or bilingual based on parent-reported language exposure. Preliminary analyses of looking behavior during the labeling videos showed a significant main effect of AOI (face, target object, distractor object) in the salient blocks, $F(2,20)=38.811$, $p<.001$, such that children looked significantly more to the model's face than the target object, $t(12)=6.307$, $p<.001$, and significantly more to the target object than the distractor object, $t(12)=4.412$, $p=.001$. Although there was also a significant main effect of AOI in the nonsalient blocks, $F(2,20)=22.293$, $p<.001$), such that children looked significantly more to the model's face than the target object, $t(12)=5.811$, $p<.001$, they did not differ in their looking to the target and distractor objects, $t(12)=.321$, $p=.753$. Preliminary analyses of test trials also show differences in children's looking patterns between salient and nonsalient blocks. An ANOVA revealed a significant interaction between language background (monolingual or bilingual) and test trial (1, 2, or 3) in salient blocks, $F(2,16)=7.090$, $p=.006$. However, no such interaction was found between language background and test trial in nonsalient blocks, $F(2,18)=.441$, $p=.650$. Follow-up t-tests to investigate the language background x test trial interaction in the salient blocks showed that bilinguals looked significantly more to the target object than monolinguals in the first test trial, $t(9)=2.955$, $p=.006$, and the third test trial, $t(9)=2.663$, $p=.032$ (i.e., the two test trials in which the target label was played). However, monolinguals and bilinguals showed no difference in looking to the target in the second test trial (i.e., when a novel label was played), $t(9)=.410$, $p=.693$. Taken together, these results suggest that both object salience and language background play a role in word learning at 24 months.

Children gesture when words are slow to come

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Conversations share a key, universal feature: we take turns, alternating between speaking and listening. Turn taking appears even in children's earliest games (e.g. peekaboo), and its acquisition may be critical for early language learning (Bruner, 1983). Since turns happen quickly, communication is highly time-sensitive, requiring rapid transmission of intended meaning. For infants still learning their native

language, recalling the words to convey their meaning may be a challenging task. Studies of infant language comprehension show that speed of processing for known words is a graded function of familiarity: rarer words are harder to process (Fernald et al., 1998). If rarer words are also harder to recall, they might be recalled too slowly to be produced before infants lose their conversational turn. Before they produce any words, infants already gesture to communicate with their social partners (Tomasello et al., 2007). We predict that gesture may also provide an alternative when word recall takes too long. If infants' language production--like their comprehension--is graded, infants should smoothly increase their use of gesture to refer to an object as the spoken word for that object becomes less familiar and thus slower to retrieve. We test this prediction in a corpus study of 10 infant-mother dyads recorded at home at 18- and 22-mo. of age (5 male, 5 female; 5 White, 3 Black, 2 Mixed-Race). Each ~90min recording was transcribed, and all referents produced in either speech or gesture were coded utterance-by-utterance. As it is difficult both to gesture about, and to code, gestures for abstract entities like "weekend," we analyzed only concrete nouns. Spoken references were counted only if the label for the referent was used (i.e., not pronouns). Gestural references were counted if they were deictic (e.g. pointing, showing). To estimate usage frequency, we computed total frequency for each referent across all dyads. The corpus contained 839 unique referents that varied in their usage frequency [M =16 (e.g., ant, brush); range=1 (wrench) - 886 (mom)]. If infants gesture to refer to an object when they cannot recall the spoken word for that object quickly enough, they should gesture particularly often for words that are infrequent, and particularly when they are younger. We fit a mixed-effects logistic regression to children's productions, asking whether children's use of speech vs. gesture for a particular referent was related to that referent's total log frequency in the corpus, the child's age, and the interaction between the two. Both main effects and the interaction were significant (age: β=.68, z=5.81, p<.001; freq: β=2.52, z=4.34, p<.001; age*freq: β=-.1, z=-3.64, p<.001), indicating that children are relatively more likely to use speech for frequent referents and gesture for infrequent referents, and that younger children are especially likely to gesture for infrequent referents. The frequency effect remained significant even when we subset the data to only referents produced in both modalities by individual children in individual sessions (β=.37; z=3.54, p<.001). Infants' word comprehension is not binary--it is a graded function of their knowledge. We show that infants' production is similarly graded, and that infants gesture when retrieval of an objects label is too slow. These results suggest infants are active participants in conversations, seeking not only to understand but also to communicate with caregivers.

Symposium 12 – Proto-political actors: The origins of legal and political thinking

The development of children's thinking about a social contract

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In political and moral philosophy, a social contract specifies an agreement by which individuals surrender some of their own individual rights and consent to a legitimate system of protection by the state. How do children's intuitions about the value and benefits of a social contract emerge and change over time? In an initial study, we presented 5-8-year-old children (N=80) with vignettes about a crime of theft that occurred in one of two cartoon worlds - one world in which wrongdoers are always punished

for theft, and another world in which wrongdoers are never punished for theft. In addition to evaluating the perpetrator, victim and bystander, children were asked in which world the crime was worse, and in which world they would rather live - the world with punishment or the world without. We found that punishment communicated something important about the nature of the crime - children across ages evaluated the theft crime in the world with punishment as worse than in the world without. Additionally, an understanding of the value of punishment to the social contract increased with age-- younger children reported that they would rather live in a world without punishment, whereas by 8 years of age, children preferred the world with punishment for themselves. In a second study, we tested a broader age range of 4-11-year-old children (N=72) with a related paradigm comparing two worlds, one in which bad things are punished in general and one in which punishment does not exist. Here again, younger children preferred the world without punishment, but as children aged they were more likely to prefer the world with punishment. We also queried children's intuitions of bad things happening more generally - older children also thought that the world with punishment would have fewer bad things happen. Study 3 compared 4-9-year-old children's (N=95) intuitions about the value of punishment in two different scenarios: one in which punishment was unequally applied across worlds (as in the first two studies), and one in which punishment was unequally applied within a world (i.e., one character is punished and one is not after committing the same crime). Across both scenarios, a preference for the punished individual or world emerged with age. Older, but not younger children, preferred the punished individual as a potential friend, and thought that this individual was less likely to commit a crime again in the future. A final study compered two different actions within the same world - one action that was punished and one that was not. Eight-to-11-year-old children (N=30), but not 3-7-year-old children (N=52), thought the punished action was less likely to occur in the future. Together, these studies suggest that an appreciation of the social contract emerges in middle childhood and reflects expectations of the role of punishment in deterrence, rehabilitation, and societal harmony. Open questions concern how children raised in different socio-cultural and political frameworks may arrive at different considerations of the value of punishment.

Children's and Adults' Perceptions of Incarceration

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The legal system touches the lives of millions of children in the United States. More than 2.5 million children have an incarcerated parent, and thousands of children are incarcerated themselves. Even individuals who do not have personal experience with incarceration are influenced by the legal system, as many children will grow up to work as judges or lawyers, to vote for politicians who shape criminal justice policy, and to educate their own children about criminal justice. Thus, children's perceptions of incarceration can inform their current and future outcomes, such as how they interact with formerly incarcerated individuals and how they decide which public policies to support. However, these perceptions are not currently well-understood. The current work investigated how children and adults - most of whom lacked personal experience with the legal system - perceived incarceration (Studies 1-2) and tested the consequences of these perceptions (Study 3). Future work can investigate perceptions among individuals who are more directly influenced by the legal system. In Studies 1-2, which included a majority White sample, we asked 6- to 8-year-olds and adults to define the word 'jail' or 'prison'. Participants then heard about an incarcerated individual and indicated how much they agreed with four

explanations for his incarceration. In both studies, children were more likely than adults to spontaneously highlight incarcerated individuals' bad essences by defining jails and prisons as places where 'bad people' go. However, children accepted explanations focusing on changeable behaviors rather than internal essences when such explanations were provided. Explanations for incarceration did not appear to depend on the incarcerated individuals' race, regardless of whether racial information was manipulated via stereotypically Black versus White names (Study 1) or images of Black versus White characters (Study 2). In Study 3, which included a racially diverse sample, 6- to 8-year-olds and adults exhibited more positive attitudes toward people whose incarceration was attributed to structural factors (e.g., poverty) rather than internal essences. Children also appeared to give White characters the benefit of the doubt by reporting that incarcerated White people were more likely to follow the rules in the future than incarcerated Black people. Reliable differences did not emerge between Black versus White participants. These findings contribute to work on essentialism by highlighting differences in spontaneous essentialist explanations across development and by demonstrating the negative effects of essentialist explanations for attitudes toward incarcerated individuals. These findings also contribute to the literature on explanations by showing that children and adults spontaneously offer explanations for incarceration even when not directly asked to do so, by indicating that children offer more spontaneous essentialist explanations than do adults, and by demonstrating that children accept non-essentialist explanations when these are provided. Finally, this project allows for the cross-fertilization of ideas between psychology, criminology, and public policy.

The essentialist origins of concepts of national identity

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What are the origins of sociopolitical attitudes? Here, we report evidence that early-emerging essentialist biases in how people make sense of the world shape the development of an important aspect of one's political identity: the concept of national identity. Children's thinking about natural kinds (e.g., dogs, lions) and social groups (e.g., women, African Americans) reflects a belief that such categories are determined by some deep, microstructural essence that is also responsible for causing category-typical properties and behaviors (e.g., Gelman, 2003). In this talk, we will present evidence that this early-emerging essentialist bias also shapes the development of children's concepts of national identity -- that is, how children understand what it means to be a member of a national group. While one's nationality is technically defined by circumstantial factors (e.g., birthplace, residence), young children's essentialist bias -- which is often stronger earlier in development (e.g., Taylor et al., 2009) -- may lead them to attribute nationality to inherent, biological traits instead. Over development, these essentialist attributions may wane. In Study 1, we administered a standard battery of essentialism questions to 70 children aged 5 to 8 (e.g., children were asked if they could tell which of two identical-looking people is an American just by looking at their blood). Five-year-olds gave inherent responses more often than expected by chance, and this tendency decreased significantly with age, as has been observed with other social categories (e.g., gender). In Study 2, we tested whether this essentialist construal is unique to children's reasoning about their own (American) national identity, or whether it applies to their understanding of national identity more broadly. To answer this question, we compared children's (5- to 8-year-olds; N = 70) reasoning about American vs. Canadian national identity, the latter being a familiar (yet distinct) identity to most Americans. There were no differences in children's

reasoning about American and Canadian identity. For both, 5-year-olds provided robustly essentialist responses, which decreased significantly with age. Thus, children's early concepts of national identity are similarly essentialist when considering their own vs. an outgroup's nationality. In Study 3 (5- to 8-year-olds; N = 72), we tested the consequences of children's essentialist views of national identity for another key proto-political attitude -- that toward intergroup inequalities. We hypothesized that children who essentialize their national identity will be more likely to endorse and justify advantageous intergroup inequalities. In addition to the essentialism battery from Study 1, children heard two stories in which Americans were portrayed as having an economic advantage over a novel non-American group and were asked (1) if these disparities were fair and (2) if Americans deserved their advantage. The results replicated the relationship observed in Studies 1 and 2 between essentialism of national identity and age. Importantly, the results of Study 3 also indicated that essentialism of national identity is indeed positively associated with justification of inequalities favoring one's ingroup. These studies provide insight into the development of proto-political attitudes toward national identity. Such insights may be crucial in an age when nationalism and xenophobia are seemingly on the rise.

Parental political ideologies relate to variation in the processes that drive costly punishment in early childhood

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A key function of the political systems that maintain large cooperative communities is to regulate the punishment of norm-violators. In adulthood, beliefs about punishment vary across the political spectrum. The present research examines the mechanisms that underlie norm-sanctioning behavior in early childhood and whether these processes vary by parental ideology, focusing on the strong case of when children are willing to pay a personal cost to sanction someone who has broken a norm but has not harmed them directly. This study thus provides a window into the development of a key proto-political behavior in early childhood, as well as insight into the transmission of political ideologies across generations. To assess costly punishment in very young children (ages 3-6, N = 190), participants were recruited from a museum playroom and given the opportunity to go down a special slide. They were then shown a video of a child (the "transgressor"), ostensibly visiting the museum the same day, crumpling up a third child's drawing. Next, they were told that the transgressor would be returning to the playroom later that day and wanted to go down the special slide. Participants were given the chance to close the slide as punishment to the transgressor -- an action rendered costly insofar as it would also deprive participants of the opportunity to go down the slide again. Across conditions, we varied the group membership of the transgressor in relation to the participant, as well as whether the participant was led to feel like they held a position of authority over social norms (by giving children a "sheriff's badge" and telling them they were in charge, or not). Overall, 48% of children engaged in costly punishment in this paradigm (whereas none did so in comparable conditions in which the actor held the drawing carefully and did not crumple it up). Punishment rates among each unitary age group (from ages 3 to 6) differed significantly from 0 (all Ps < .001), and the likelihood of punishment increased linearly with age. We considered punishment of out-group members more than in-group members to be evidence of more spiteful motivations, whereas punishment of in-group members more than out-group members to be motivated by a desire to enforce the social norms that maintain cooperative communities. Younger children (ages 3-4) punished in-group members more than out-group members

when they held authority within the group, indicating that the earliest forms of costly punishment are motivated by a desire to enforce cooperative norms. Older children were more egalitarian in their behavior (punishing in-group and out-group members equally often; the three-way interaction between age, group membership, and authority was reliable, B = .376, SE = .171, Wald χ2 = 4.84, P = .028). Further, the behavior of individual children related to the political ideology of their parents: Parental conservatism was associated with increased punishment of out-group members relative to in-group members (B = .836, SE = .36, Wald χ2 = 5.38, P = .021, OR = 2.30) across all ages. This relation was not explained by authoritarian parenting style or several other factors, but appeared more specific to parental ideology. Thus, the mechanisms underlying the early development of punishment appear to vary across children in relation to parental values. Implications for how ideologies might be passed on across generations will be discussed.

Oral Papers III – Concepts, Categories, and Causal Learning

O3.1   Preschooler's Causal Hypothesis Testing Reveals Developmental Shifts in the use of Temporal and Pedagogical Information

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A core component of cognitive development is the ability to reason causally. Past research finds that children as young as three can use patterns of covariation to infer causality (Gopnik, Sobel, Schulz, & Glymour, 2001), as well as information from base rates (Sobel, Tenenbaum, & Gopnik, 2014), mechanisms (Schulz, 1982), and prior beliefs (Schulz, Bonawitz, & Griffiths, 2007). However, there exist additional important sources of information in causal inference: temporal information and pedagogical context. We explore the developmental trajectory of causal reasoning by modeling the role of each of these sources of information and comparing the models to a new study of children's casual hypothesis testing. The models span 'simpler' information (e.g., mere imitation such as mimicking demonstrated actions without causal inference or simple covariation), to more complex (e.g., covariation with temporal, and with temporal and pedagogical information, which takes into account both prior events and a demonstrator's knowledge state). Outcomes of three experiments with 3- to 6-year-olds distinguish these models and reveal a developmental shift from simpler to more complex information in children's causal inferences. 135 preschoolers watched an experimenter try to activate a spinner on a machine over four attempts by placing a block onto it. The machine had an adjustable feature (F1 & F2, counterbalanced) on each side, each of which were intervened on at various points depending on condition. In Cond. 1, after two failed attempts, the experimenter adjusts F1, reveals a successful attempt, and then adjusts F2 with another success. If simply attending to covariation, then children should consider both F1 and F2 causally relevant. However, if they take temporal information into account, then F2's success can be explained away by F1. In Cond. 2, after one failure, the experimenter adjusts F1 with no following success, then adjusts F2 with two following successful attempts. Actions in Cond. 3 were identical to Cond. 2, but the experimenter claimed ignorance of how the machine worked. Thus, all children saw two interventions with two successful activations, but temporal information differed between Conds. 1 and 2 and pedagogy varied between Conds. 2 and 3. Following the

demonstration, the machine was briefly 'adjusted' out of view. The child was then given the block and encouraged to make the machine go. In all cases, the machine did not activate after children's attempt with the block. Our critical measure was which feature children first attempted to adjust, providing a measure of their inferences about the relevant causal properties of the machine. We compared responses of younger (M=48mos) to older children (M=67mos) in each condition (Cond.1 N=43; Cond.2 N=49; Cond.3 N=43) to the qualitative predictions of the models. This revealed a developmental shift from the simple covariation model to the more complex temporal and pedagogical model. For example, younger children did not use temporal information to screen off activations in Cond. 1 nor did they differ in their responses on Conds. 2 and 3 (in which pedagogy varies). In contrast, older children's responses reflected sensitivity to both temporal covariation and pedagogy, suggesting a developmental time course for when and how these factors are initially integrated into causal reasoning.

O3.2 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 (e.g., on the location of an object that was labeled; Kirkorian et al., 2016). The purpose here was to determine the extent to which attending to target information predicts subsequent learning from interactive and noninteractive video. Methods: Toddlers (24-35 months, N = 71) completed a search task in which they watched a bear hide behind an object and then searched for a bear sticker on a corresponding felt board. To watch the bear hide, toddlers touched the bear (relevant), touched a star (irrelevant), or watched without touching (noninteractive). Most children (72%, N = 51) were eye-tracked during each of four search trials. This abstract describes preliminary analyses based on the 44 children for whom fixation data have been coded to date. Of particular interest was the proportion of fixation time that was "on task" during hiding events (i.e., looks at the bear or target location) and the probability of an accurate search on each trial (i.e., finding the bear on the first try). Hypotheses: We predicted that, relative to the noninteractive condition, relevant interactivity would increase "on-task" fixation and search accuracy, whereas irrelevant interactivity would decrease on-task fixation and search accuracy. Results: The amount of on-task fixation did not differ by trial, age, or condition, all ps > .250. However, search accuracy did vary by trial, age, and condition. As in previous studies (e.g., Choi & Kirkorian, 2016; Schmitt & Anderson, 2002), search accuracy was relatively high on Trial 1, decreased on Trial 2, then increased on Trials 3 and 4, β_{10} = -1.36, SE = 0.45, p = .003 (linear term) and β_{20} = 0.36, SE = 0.12, p = .005 (quadratic term). The change in search accuracy across trials differed by condition, such that the increase across trials was particularly pronounced for children in the irrelevant (compared to noninteractive) condition, β_{12} = 0.74, SE = 0.28, p = .010. Toddlers' higher performance on subsequent trials in the irrelevant condition appears to be due to a decrease in the frequency of perseverative errors (i.e., searching in the previously correct but outdated location), $F_{(2,68)}$ = 3.67, p = .031. Additionally, search accuracy increased with age and with greater on-task attention, β_{03} = 0.23, SE = 0.05, p < .001, and β_{10} = 1.02, SE = 0.35, p = .003, respectively. Conclusion: While search accuracy did increase as a function of overall on-task attention, on-task attention did not differ by condition. Contrary to our

predictions, irrelevant interactivity resulted in the best overall search accuracy. Relevant interactivity did not increase attention to the target, and it did not increase performance relative to the noninteractive condition. These results suggest that the benefit of interactive media seen in prior studies cannot be explained by increased selective attention to target information (e.g., location of character during hiding events). Rather, enhanced learning in interactive conditions may be due to increased arousal and cognitive engagement. Future research should utilize other measures (e.g., heart rate, pupil diameter) to identify potential mechanisms.

O3.3 Using automated controlled rearing to explore the origins of object concepts

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One of the great unsolved mysteries in developmental science concerns the origins of the mind. What mechanisms underlie newborn perception and cognition? How do newborns transform sensory input into abstract knowledge? Despite widespread interest in these questions, two methodological barriers have hindered progress. First, it is not possible to conduct controlled-rearing studies on newborn humans, so researchers could not examine how specific types of experiences shape the newborn mind. Second, newborn humans cannot be tested for long periods of time, limiting our ability to study newborn cognitive development with high precision. To overcome these barriers, my lab developed an automated controlled-rearing method with a newborn animal model: the domestic chick. This method allows us to study newborn subjects continuously (24/7) within strictly controlled virtual environments. By recording each subject's behavior continuously, we can achieve low measurement error and obtain large, reproducible effects across experiments. With massive amounts of data from each subject, we can also examine whether each newborn succeeded or failed at an experimental task and study individual differences across newborn subjects. In this talk, I will focus on the development of object concepts in newborn brains. First, I will describe experiments demonstrating that newborn chicks rapidly develop high-level object concepts. For example, newborn chicks can solve the "visual binding problem," building integrated object representations with bound color-shape features. Newborn chicks can also solve the "invariance problem," building abstract object representations that generalize across novel viewpoints, backgrounds, sizes, and motion patterns. Together, these studies show that newborn brains can develop accurate object concepts rapidly, within the first few days of life. Second, I will describe experiments characterizing the role of visual experience in the development of object concepts. My lab has discovered four types of experiences that are necessary for the development of abstract object concepts that generalize across novel viewing situations. First, there is a "slowness constraint" on the development of object concepts. Newborns need visual experience with slowly moving objects to build abstract object representations. Second, there is a "smoothness constraint" on the development of object concepts. Newborns need visual experience with smoothly moving objects to build abstract object representations. Third, there is a "surfaces constraint" on the development of object concepts. Newborns need visual experience with the surface features of objects to build abstract object representations. Fourth, newborns need visual experience with objects moving on patterned (e.g., natural) backgrounds in order to recognize objects in novel scenes. These findings show that accurate object concepts do not emerge automatically in newborn brains. Rather, the development of these concepts requires experience with a natural visual environment, containing objects moving slowly and smoothly over time across patterned backgrounds. Without such natural visual experience, newborns

develop inaccurate object concepts. These results provide evidence for unsupervised temporal learning models from computational neuroscience, in which object representations are learned from the spatiotemporal statistics of the natural visual world.

O3.4   Categorization of negative facial expressions in late infancy

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Research has found that children initially categorize emotions in terms of two broad dimensions: valence (positive v. negative) and arousal (high v. low; Russell, 1994). These broad categories narrow into discrete (basic) emotions throughout development as children learn emotion labels and concepts (Widen & Russell, 2008). Consequently, it is thought that preverbal infants do not interpret facial expressions in terms of discrete emotions until they have acquired emotion labels (Lindquist & Gendron, 2013; Widen, 2013). Yet, to our knowledge, this theory remains untested. The current studies explore 1) whether preverbal infants perceive facial expressions in terms of the broad dimension of negative affect, and 2) how labels influence the formation of these categories. Across three studies, 14- and 18-month-olds were habituated to two negative facial expressions, either anger and sadness (ANGER-SAD condition) or disgust and sadness (DISGUST-SAD condition). After habituation, infants were shown four test trials: a familiar negative emotion (one of the habituation events), a novel negative face (a person not seen during habituation, expressing one of the habituation emotions), a novel negative emotion (a person seen during habituation expressing a novel, negative emotion), and a novel positive emotion (a person seen during habituation expressing a novel, positive emotion). If infants formed a broad category of negative affect, their looking time to the familiar negative emotion should not differ from their looking time to the two novel, negative emotion test trials (the novel negative face and the novel negative emotion). Their looking time to each of these three negative emotions should also be significantly lower than their looking time to the novel positive emotion. STUDY 1 (n=48 per age) tested whether infants would form a broad category of negative affect across multiple individuals. Infants were habituated to three people showing two negative emotions (ANGER-SAD or DISGUST-SAD). A Test Trial effect (p.<001) showed that infants did not form a broad category of negative affect. STUDY 2 (n=64 per age) tested whether infants would form a broad category of negative affect if the novel LABEL "toma" were added to each habituation event. A Test Trial x Condition effect (p<.001) showed that infants formed a negative emotion category in the DISGUST-SAD condition only. STUDY 3 (n=48 per age) explored whether cognitive load contributed to the condition differences in STUDY 2. Infants were habituated to one person showing two negative emotions, thereby reducing the habituation events from six to two. A Test Trial x Condition x Age interaction (p=.035) showed that infants in the ANGER-SAD condition still failed to form a broad category of negative affect. However, 14- but not 18-month olds in the DISGUST-SAD condition formed this broad category. Looking times and statistics are presented in Table 1. Overall, these results indicate that 1) preverbal infants do not spontaneously form broad categories of negative affect with anger, disgust, and sad expressions across multiple people, but 2) verbal labels can facilitate the formation of these categories. Secondary analyses on the relationship between infants' vocabulary development and emotion categorization will also be discussed.

O3.5   Developmental Precursors to Essentialism: Infants' Internal Property Bias

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The judgments of adults and older children are biased by a belief in unseen, internal properties-- sometimes described as an "essence"--that are responsible for causing the outward appearance and observable actions of living things. The proposed talk will present 3 lines of evidence arguing that infants' reasoning about animate agents (and not inanimate objects) is biased by an implicit belief in internal causal mechanisms, a possible precursor to later developing essentialist reasoning. Study 1: An agent's 'insides' are more important than its 'outsides' for determining its identity as the same persisting object over time. We tested 13-month-old infants in a reaching/memory task that involved showing them 2 small toys with either identical or different looking insides enter in and out of a box. The infants were then encouraged to reach into the box and retrieve the number of toys they believed were contained inside. We found that infants were more likely to represent two individuals inside the box after seeing instances of an object with two different insides but not after seeing objects with two different outsides. Furthermore, we find that this result holds only for agents and not inanimate objects. These findings suggest that infants possess an internal feature bias when representing the identity of individual agents. Study 2: Infants ignore external and superficial property changes when representing the socio-moral character of other agents. We tested whether infants believe that you can change what a person is like just by changing that person's appearance. Twelve-month-old infants watched animations showing a character trying to get up a hill. Sometimes another character (e.g., a green triangle) would help the ball reach its goal by pushing it from behind, while other times a 'mean' character (e.g., a red triangle) would push the ball the opposite way down the hill. We first found that infants can easily use the color of each character to remember who was 'mean' or 'nice.' Despite this fact, our second study demonstrated that infants believe that the 'mean' character's behavior would persist even if its appearance was changed to look identical to the 'nice' character or vice versa. This pattern suggests that infants might appreciate that you cannot change a book by changing its cover. Study 3: Infants associate an agent's sociomoral disposition with its internal properties. Sixteen 13-month-old infants witnessed an agent's goal being helped or hindered by two partially transparent characters that possessed contrasting internal and external features (e.g., one with a red 'hat' and red 'insides' vs. one with a yellow 'hat' and yellow 'insides'). When given a choice between two scrambled versions of the characters infants chose the one that possessed the same color as the helpful character's 'insides' and not its 'outsides' (see figure 1). A control condition indicates that when the inside properties were seen as non-causal, the infants do not match the character's internal feature with its social disposition. We end by proposing a theory for how an internal property bias might emerge from a combination of domain-general and domain-specific processes.

Symposium 13 – Words in the World: Novel Approaches to Improving Preschoolers' Vocabulary Development

Educational Media Supports for Low-Income Preschoolers' Vocabulary Development

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The aim of this research is to explore the mechanisms that facilitate vocabulary acquisition among low-income preschoolers through experiences with educational screen media. Using a mixed method design we present two studies with the primary goals of: identifying the malleable factors associated with screen-based pedagogical supports (SBPS); examining the interactive effects of SBPS on low-income preschoolers' viewing behaviors; and investigating the influence of SBPS on their vocabulary outcomes. This presentation reports on two studies designed to examine the landscape of literacy-related apps, and the features they may support vocabulary learning for low-income preschoolers. In Study 1, we report on a content analysis of 100 language- and literacy-focused educational apps, selecting two programs in each, to identify the prevalence of vocabulary opportunities, and the pedagogical supports-- techniques or features in these media that are designed to orient children to specific vocabulary words. In over the 2000 scenes coded, we identified two over-riding categories of supports: ostensive cues, designed to provide definitional information to children, and attention-directing cues, designed to signal children's attention to a target word. In Study 2, we use eye-tracking technology to examine which of these pedagogical supports might predict children's ability to identify program-specific vocabulary. Results indicated that although ostensive cues predicted overall attention to scenes, attention-directing cues were most effective in directing children attention to target words and their subsequent word identification. Children with higher language scores were more likely to use these cues to their advantage than their lower language peers. These results may have important implications for designing digital media to enhance children's opportunity to learn vocabulary. Findings from these studies begin to explore the critical features of educational media that support low-income preschoolers' vocabulary development. In so doing, our goal is to develop a better understanding of educational screen media's potential for promoting early literacy development and school readiness for children in need.

Story Talk: A Cognitive Research-based Vocabulary Intervention for Preschoolers

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Preschoolers need well-developed vocabularies to lay the foundation for success in learning to read and ultimately, for success in school. Story Talk is a book reading intervention for preschool teachers designed to promote significant increases in children's language and vocabulary resulting in a language-rich classroom. Story Talk includes a) reading guides, called Story Maps, that provide teachers and assistants with step-by-step guidance for explicit questions and comments that can promote children's language and vocabulary development throughout the reading. In addition, Story Talk provides b) classroom activities that support and extend the use of book-related vocabulary and concepts throughout numerous content areas in the classroom. Story Talk also offers c) a feasible professional development component with five workshops and bi-weekly coaching, including video exemplars to show authentic examples of best practices during targeted individualized coaching. Finally, the model features d) a fidelity of implementation measure for the teacher and the coach, as well as a child progress monitoring measure, to ensure that the desired language and vocabulary effects among children are achieved. Thirty preschool teachers were randomly assigned to either Story Talk or to the comparison group. A project-aligned fidelity measure showed that no teachers demonstrated fidelity at pre-test but preliminary end-of the year findings suggest that ten reached high fidelity (90-100%) and three reached acceptable fidelity (80-90%). Second, analyses showed that teachers whose practices were of higher quality in fall, as measured by the CLASS Instructional Support dimension, showed higher

quality and higher fidelity practices in spring. Progress monitoring data also suggests that children were learning the words that were targeted during book reading. Finally, hierarchical linear models showed that children in Story Talk made significant gains on the Peabody Picture Vocabulary Test-4 and the Expressive One-Word Picture Vocabulary Test. Consequently, the Story Talk intervention represents a resource-effective approach to improving quality in under-resourced early childhood settings.

The joy of vocabulary learning: A Preschool reading and play intervention

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Reading comprehension is critical for school success, yet many children have limited success because of insufficient vocabulary knowledge (Dickinson, Golinkoff, & Hirsh-Pasek, 2010). This paper reports results of a program of research aimed at teaching vocabulary in Head Start and state PreK classrooms. Prior findings show that vocabulary learning is supported when: 1) children are engaged and attentive; 2) words are heard multiple times in grammatically and semantically appropriate contexts; 3) easily understood information about word meanings is supplied; and 4) children have opportunities for language use. Combining book reading with play, we offered enjoyable, engaging opportunities for children to hear and use words. In Study 1, we examined effects of book reading combined with teacher-guided play. Teachers were provided lightly-scripted materials and in-class coaching to help them teach 16 words in each of four books. Ten classrooms were randomly assigned to a Read + Play condition; six to a Read Only condition. Each book was read four times across three weeks. Learning of taught words was assessed by comparing pre-post gains on taught words with those of untaught control words matched for form class and difficulty. Word knowledge was tested immediately before and after each book was read. Within-subject analyses showed large effects in both conditions. Children learned taught words at a rate significantly greater than control words for both receptive (Read + Play, d = 1.32; Read Only, d = 1.02) and productive knowledge (Read + Play, d = 1.12; Read Only, d = 0.94). A non-significant trend favoring the Read + Play condition emerged for both receptive (fall d = 0.18, spring d = 0.21) and productive knowledge (fall d = 0.11, spring d = 0.24). Our book reading methods contributed to vocabulary growth more than most studies. Play with replicas might well supplement that learning. In Study 2 (in progress), we created a variety of playful methods that teachers can sample to deepen the word knowledge taught during book reading. All children (N = 140) read four books and engaged in a playful activity once per week for four weeks. Ten classrooms were randomly assigned to different play activities (small-group games, large-group games, music, sociodramatic play, and a digital app), allowing us to compare effectiveness. Preliminary results indicate our intervention effectively taught vocabulary. For both expressive and receptive vocabulary, children showed larger pre- to post-test gains for target words compared to control words that were not taught (expressive d = 1.05; receptive d = 0.62). Additionally, there were differences by play type: Music led to the largest gains on both receptive (d = 1.20) and expressive (d = 1.15) vocabulary. Planned analyses will identify differences in learning among words taught during reading only, play only, or a combination of both. Analyses will also consider the effects of child and teacher level variables (e.g., general vocabulary, teacher education, implementation fidelity). Reading and play can be employed together to create an effective intervention to teach vocabulary to low-income preschoolers.

Pre-verbal Infants Perceive Emotional Facial Expressions Categorically

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Categorical perception (CP) occurs when equal-sized physical differences between stimuli are judged as smaller or larger depending on whether the stimuli fall into the same or different categories (Harnad, 1987). This phenomenon has long been established in the perception of speech sounds, colours, and emotional expressions: discrimination is faster and more accurate for stimuli from different categories (e.g., facial expression blends with two different predominant emotions) than from the same category (e.g., facial expression blends with the same predominant emotion). Some theories have argued that top-down processes underlie CP, with linguistic or conceptual categories reflected in perceptual judgments, but this explanation has been under question. If pre-verbal infants perceive emotional expressions categorically, this would argue against an explanation based on top-down processing from language or concepts. One limitation of previous work is that Studies on infants' CP of emotional expressions have not established the category boundaries based on adult judgements before using the stimuli to test CP in infants, unlike studies of infants' CP of colour and speech. We sought to test whether facial expressions of happiness and fear are perceived categorically by pre-verbal infants, using a new stimulus set that we first tested with adults. The category boundaries were established using a naming procedure in Experiment 1 (N = 62). CP with these stimuli was demonstrated in adults in Experiment 2 (N = 34), with both accuracy and reaction time in a delayed match-to-sample (i.e., X-AB discrimination) task. These stimuli were then used with 7-month-old infants (N = 34) in a habituation and visual preference paradigm (Experiment 3). Infants were first habituated to an expression of one emotion, then presented with the same expression paired with a novel expression either from the same emotion category or from a different emotion category. After habituation to fear, infants displayed a novelty preference for pairs of between-category expressions, but not within-category ones, showing categorical perception. However, infants showed no novelty preference when they were habituated to happiness. Our findings provide evidence for categorical perception of emotional expressions in pre-verbal infants. Our findings are consistent with accounts arguing that CP is not dependant on language modulating discrimination in a top-down manner. The asymmetrical effect challenges the notion of a bias towards negative information in this age group.

Infants and preschoolers discriminate and search for probable eliciting causes of diverse positive emotions

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Events in the world have a probabilistic, and relatively nuanced, relationship to our emotional responses (e.g., beautiful landscapes tend to elicit awe; fireworks tend to elicit excitement, etc.). This suggests that emotional expressions may provide rich information about their probable eliciting causes. Across five experiments, we tested whether infants and children can map diverse positive emotional vocalizations to their probable causes, and actively search when the observed candidate cause is unlikely given the

vocalization. In Experiment 1, five categories of eliciting causes (i.e., Funny, Exciting, Adorable, Sympathetic and Delicious) were selected, constrained by the criteria that they had to be recognizable to young children, and elicit distinct positive emotional reactions from adults. Two adults blind to the design made non-verbal vocalizations to those causes. In a forced-choice task, two to four-year-olds successfully mapped the vocalizations to their probable causes. Similar results obtained using a preferential-looking task in an initial sample of 12-23-month-olds (N=32), a replication with 18-23 month-olds (N=16), and a simplified task using a pre-registered design and analysis in younger infants (12-17-month-olds; N=32; Experiments 2 and 3). See Figure 1. Then we tested 12-17-month-olds with a manual search task in Experiments 4 (N=36) and 5 (N=66; both pre-registered) to provide converging results. An experimenter peeked through a peep hole in top of a box and made one of two vocalizations (Experiment 4: "Aww!" or "Mmm!"; Experiment 5: "Aww!" or "Whoa!"). Infants retrieved a toy from the box either congruent with the vocalization (e.g., a toy fruit in response to "Mmm!"), or incongruent (e.g., a toy car in response to "Aww!"). Infants searched longer in the incongruent than the congruent condition. See Figure 1. These suggest that even infants discriminate probable causes of diverse positive vocalizations, and selectively explore given improbable causes.

Preschoolers engage in emotional perspective taking during language processing

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In many communicative interactions, language alone does not allow a listener to infer a speaker's intended meaning with confidence. Consider the utterance "School starts tomorrow". Here, the intended meaning is markedly different if the sentence is spoken in a sad- versus happy-sounding voice. To recognize a speaker's communicative intent, skilled communicators rapidly draw upon multiple sources of information beyond the utterance itself. One such cue, as illustrated by the preceding example, is sensitivity to the emotions conveyed by intonation (emotional prosody). In this experiment, we used a novel emotional perspective-taking task to examine 4-year-olds' use of a speaker's emotional prosody to make inferences about the speaker's emotional state and, correspondingly, their communicative intent. Using an eye-tracking paradigm, we presented 4-year-olds (n = 97) with a competitive game in which a positive outcome for the child corresponded to a negative outcome for a speaker and vice versa. Critically, this allowed us to create a direct contrast between the relevant emotional response for the child and that for the speaker. On each trial, children were presented with a visual display containing two doors: the child's door and the speaker's door. They were told that there would be a sticker behind only one door and that the location of the sticker would determine which player would be awarded a sticker. Children were told that the speaker would receive advance knowledge of (but no control over) the sticker's location on each trial. Based on the speaker's ambiguous sentence about the sticker's location (e.g., "Look! There it is."), spoken with either happy or sad emotional prosody, children had to identify the location of the sticker before it was explicitly revealed to them. If children are sensitive to the emotional state of the speaker, they should assume that the sticker would be behind the speaker's door when the speaker sounds happy, and that the sticker would be behind their door when the speaker sounds sad. The opposite pattern of results would arise if children interpret the speaker's statements from a uniquely egocentric perspective. To examine potential individual differences, we measured children's vocabulary, working memory, delay inhibitory control, conflict inhibitory control, and offline measures of emotional and visual perspective-taking.

Analysis of children's eye gaze patterns suggests that they correctly inferred that the speaker was referring to the child's door in the happy-speech condition and to her own door in the sad-speech condition. These sensitivities, however, were less apparent in children's pointing decisions, suggesting preschoolers' ability to integrate emotional perspective cues is at an emergent state. Perspective-taking during on-line language processing was positively correlated with receptive vocabulary and an off-line measure of emotional perspective-taking, but not with visual perspective-taking, conflict or delay inhibitory control, or working memory. In summary, the results demonstrate that 4-year-olds will use perspective inferences about a speaker's emotional state to guide their understanding of communicative intent. This occurred despite the salient and emotionally significant conflict between the speaker's perspective (e.g., speaker's happiness about winning) and their own egocentric perspective (e.g., child's sadness about not winning).

A pleasant surprise: Children use probability to infer people's surprise and happiness

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Assessments of probability contribute to people's emotional reactions. We are surprised by improbable events, but not by probable ones. Similarly, positive outcomes are more pleasing if they are improbable ("What good luck!") rather than probable. Here we investigate whether young children consider probability when inferring surprise and happiness. Children might use probability in these inferences, as probability influences expectations from infancy (e.g., Denison, Reed, & Xu, 2013; Teglas et al., 2007; Xu & Garcia, 2008), and because preschoolers consider probability when making social inferences, like inferring others' preferences (Kushnir, Xu, & Wellman, 2010; Ma & Xu, 2011). By examining whether children use probability to infer emotions, we will expand our knowledge of probabilistic reasoning in the social domain and further understand how children attribute emotions. First, we examined whether children use probability to infer surprise. In preliminary work, we found that children use probability to infer surprise relatively late in development, where they do not robustly do so until the age of 7. In Experiment 1 (N = 60), we examined whether we could get 6-year-olds to use probability to infer surprise. Children were introduced to a character at a gumball machine that contained mostly one color of gumballs and few of another color. Children were prompted to either consider what color gumball the character had a better chance of getting (probability prompt), the color the character believed they would get (belief prompt), or the color the character saw more of (baseline prompt). The answer to these questions always prompted children to consider the majority colored gumball. Next, children saw the character receive a minority colored gumball. Children judged how the character felt about receiving a minority colored gumball by choosing between four emotions (i.e., surprised, neutral, happy, and sad). Children were significantly more likely to attribute surprise when prompted to consider the character's chances of getting a gumball than with the belief or baseline prompts, p = .011 (see Figure 1). This finding suggests that with appropriate prompting, children link probability and surprise. Experiment 2 examined whether 5 - 6-year-olds (N = 58) use probability to infer happiness. Children saw a scenario where a girl stood either before a gumball machine that contained mostly "yummy" red gumballs and few "yucky" black gumballs, or a machine that contained mostly black gumballs and few red ones. In both conditions, the machine dispensed 2 red gumballs and 2 black ones. Children were asked to rate how the girl felt about getting these gumballs using a 7-point scale ranging from extremely sad to extremely happy. Children rated the girl as happier when the gumballs came from the mostly-black

distribution than when they came from the mostly-red distribution, p = .019. This finding shows that children understand that happiness about an outcome depend on its likelihood of occurring and that having a lower chance of receiving something desirable makes people happier when they do receive it. Together, our findings show that young children use probability to infer surprise and happiness. These findings extend our knowledge of the social importance of probability, and also increase our understanding of the ways in which children attribute emotions.

Symposium 15 – Memory consolidation and learning across early childhood

Consolidation is key for bootstrapping segmentation

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We often measure learning in cognitive development immediately after a single laboratory exposure. However, immediate encoding, what can be studied in a single session, is only one step of the learning process. Learners, especially very young ones, may need to consolidate new knowledge in memory before they can use it to bootstrap future learning. We examine these steps in 7.5-month-olds using lexical segmentation. Infants tend to missegment novel words that go against the metrical pattern of their native language (Jusczyk, Houston, & Newsome, 1999). Known words such as Mommy allow them to overcome this bias and segment novel words correctly (Sandoval & Gómez, 2016). Known lexical information thus contributes to bootstrapping, enabling segmentation of adjacent words (Brent, 1999; Mattys, White, & Melhorn, 2005). We know little about how novel words become known words that can bootstrap segmentation, a topic we investigate here. In Experiment 1, we familiarized 31 7.5-month-olds with sentences containing a repeated novel name (Lola) followed by novel iambic target words (e.g., ...Lola's beret...). Immediately after familiarization, we tested infants on iambic targets and iambic control words not heard during familiarization. We measured listening times using the Head-Turn-Preference Procedure. Infants failed to discriminate between the iambic targets and the iambic control words, t(30) = 0.20, p = .84, M target = 9.24s, M control = 9.16s. Given that known names, enable segmentation of iambic targets (Sandoval & Gómez, 2016), we designed Experiment 2 to facilitate infants' learning of the novel name. Infants listened to an audio-story containing the novel name (Lola) every day for 14 days. Audio-recordings of the story varied across four talkers across the 14 days. Parents played the story before nap-time or bedtime, on average 54 minutes before their infant fell asleep. On the 15th day, the infants underwent the same familiarization and test procedure as in Experiment 1. Unlike Experiment 1, infants in Experiment 2 showed longer listening times to the iambic target words that followed Lola in the familiarization sentences than to the iambic control words they had not heard during familiarization, t(11) = 2.24, p = .046, M target = 8.97s, M control = 7.91s. Age did not differ across experiments, t(41) = 1.30, p = .20, M Exp 1 = 7.66 months, M Exp 2 = 7.85 months. These results suggest that novel names can gain enough strength in memory after just 14 days of exposure to enable segmentation of iambic words. Although new words do not immediately bootstrap the segmentation of adjacent words in 7.5-month-olds, they can be a powerful aid in bootstrapping if infants consolidate them through repeated exposure.

Children's forgetting of words mapped via mutual exclusivity

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Researchers have focused on identifying the processes underlying children's ability to map words to objects in order to understand the mechanisms that drive language development. According to the constraints-principles account, children use constraints (i.e., rules) to map new words to objects. For instance, the mutual exclusivity bias (MEB) describes children's tendency to assume that an object can have only one label (Markman, 1989). To date, most assessments of MEB have been conducted at an immediate test. As a result, we lack an understanding of how MEB affects long-term language learning. To address this gap in the extant literature, we examined children's use of MEB in relation to their long-term memory for word mappings. In Experiment 1, children (N = 39; M age = 46.62 months) were presented with a classic MEB task in which they were asked to map two novel labels to a single novel object. Children's retention was assessed at a 5-minute delayed test. We examined whether children retained words mapped via MEB (first learned label for an object) and words not mapped via MEB (second learned label for an object). Because MEB supports children's ability to select a referent at an immediate test, we hypothesized that MEB supports children's ability to retain and retrieve word mappings from long-term memory. Results revealed that children mapped the initial labels, and not the second labels, to the objects via MEB (i.e., the difference in mapping behavior was significant, p<.01). In fact, children's forgetting, as measured by difference scores, for words mapped via MEB was faster than for words mapped without using the constraint (i.e., second label). In Experiment 2, we examined whether interference from the second label was the mechanism underlying children's forgetting of words mapped via MEB. This experiment replicated Experiment 1 and revealed that children's (N = 85; M age = 47.78 months) mapping behavior was consistent even when the learning of two novel labels was spaced apart in time or there was no second label. Thus, even when children experienced no interference from a second label, they still rapidly forgot words mapped via MEB. Taken together, these results suggest that MEB supports initial mappings of words to objects, but this linguistic constraint may not support long-term language learning. These findings challenge our current assumptions about the benefits of word learning constraints. Historically, language development theories have assumed that constraints, such as MEB, are beneficial for children's retention and retrieval of learned words. However, this research suggests that existing language development theories need to revisit how constraints affect children's word learning beyond the moment of word mapping.

Two-year-olds consolidate verb meanings during a nap

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Children can learn word meanings even from a single encounter (e.g., Carey & Bartlett, 1978). This immediate encoding, however, is only the first step in building up a lexical representation. Learners must also store and consolidate the encoded information, and retrieve and fine-tune it on future encounters. Sleep is an integral part of memory consolidation and later recall (e.g., Diekelmann, Wilhelm & Born, 2009; Gómez & Edgin, 2015; Wilhelm, Prehn-Kristensen, & Born, 2012). Language learning, too, shows a facilitative role of sleep, even during daytime naps (e.g., Gómez et al., 2006; Hupbach et al.,

2009), which are an important routine in early childhood. Here, we examine the role of sleep, asking whether the syntactic properties of a newly-learned verb are consolidated after sleep. According to a prominent verb-learning theory, children exploit the syntactic context in which a verb occurs to infer its meaning (Gleitman, 1990). For example, hearing a novel verb in transitive sentences (e.g., 'The boy blicked the girl') leads to an inference that the verb labels a causative event (e.g., boy pushes girl) as opposed to a non-causative one (e.g., boy and girl wave). But can this new encoding be retained over a delay; if so, does it require consolidation during sleep? Twenty-two 2-year-olds (range: 24.4-29.9 months, mean: 27.0 months) visited the lab twice in one day. During Visit 1, children participated in a well-established verb-learning task (e.g., Arunachalam & Waxman, 2010; Yuan & Fisher, 2009). During Familiarization, they heard a novel verb intransitive sentences; at Test their eye gaze was recorded as they were asked to find the verb's referent given two simultaneously presented events -- one (the target) depicting a causative event, the other (the distractor) depicting a non-causative event. Children returned home for a few hours, during which half napped (Sleep Condition) and half remained awake (Wake Condition). At Visit 2, children viewed the same Test phase as in Visit 1, but without the Familiarization. This required children to rely on the representations they had previously formed for novel verbs at Visit 1. Eye gaze data were entered into a mixed-effects logistic regression model, with looking at the causative event as the dependent variable. We found a significant interaction between Visit (1 vs. 2) and Condition (sleep vs. wake) ($\chi 2(1) = 23.45$, $p < 0.001$): on Visit 1, there was no difference between conditions; on Visit 2, children who slept looked at the causative event more than those who had stayed awake. This result suggests that newly-encoded syntactic information about a novel verb is consolidated during naps. This converges well with evidence that sleep facilitates early language acquisition, especially word learning (Sandoval, Leclerc, & Gómez, 2017). Importantly, children often encounter verbs in sentences in the absence of the events they describe (e.g., Gleitman & Gleitman, 1992); therefore, being able to consolidate syntactic information about a new verb is critical to learning. Our results indicate children can do this, but that sleep-dependent memory consolidation plays a critical role.

Declarative memory consolidation over naps in early childhood

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Sleep is beneficial to learning in young adults. Whether naps are an asset to preschool education is unknown. We found that performance on a visuospatial learning task is improved following a nap compared to an equivalent interval awake in young children (Kurdziel, Duclos, & Spencer, 2013). We hypothesize that the benefit of a nap on the visuospatial task reflects nap-dependent consolidation that is generalizable to other declarative, hippocampal-dependent memory tasks. However, the visuospatial task is unique from typical declarative learning tasks: the spatial aspect may make the task uniquely amenable to hippocampal neural replay during sleep. Consistent with our hypothesis, Williams and Horst (2014) reported that children acquired novel word meaning from storybooks better when storybook exposure was followed by a nap compared to when they stayed awake following the nap. Limiting the interpretation of this result, however, is that comparisons were made across-subjects; children who slept were habitual nappers while those who stayed awake were non-habitual nappers. Thus, the apparent benefit of the nap may reflect group differences in temperament or behaviors known to differ across habitually and non-habitually napping children(Spencer et al., 2016; Tribble et al.,

2015). We used a story-based memory task consisting of 4 10-page storybooks describing an activity or event (e.g., making cookies). The first page of each storybook consisted of a goal sentence with a corresponding picture, and the subsequent 9 pages had a short sentence describing an action in the sequence of the event or activity with a corresponding picture. Children participated in two conditions, a sleep condition and a wake condition. Both conditions began with an encoding phase in which the experimenter read 2 of the stories to the child. During immediate recall, children were given cards depicting scenes from the story and placed the cards in the correct order without receiving feedback. Subsequently, in the sleep condition, children took a nap; in the wake condition, children stayed awake for an equivalent amount of time. During delayed recall, which followed the nap/wake interval, children were presented with the cards again and asked once more to put the cards in the correct sequence. Recall was probed again 24-hrs after encoding. In 18 children (33-68 months), delayed recall after nap-promotion was greater than recall following wake-promotion (p=.01). Moreover, this tendency to benefit from the nap persisted the next day (p=.04). In addition, there was no difference in experimenter-recorded sleepiness scale or child reported sleepiness across conditions for the sample. As such, differences in alertness following nap- and wake-promotion are not likely to account for the results. Moreover, across studies, a separate group of participants was recruited and sleep physiology was recorded. Relations between behavior and sleep physiology provide further support for an active role of sleep in declarative memory consolidation in children. As such, naps may be an asset to early education.

Symposium 16 – Environmental influences on children's intergroup cognition

The influence of a diverse environment on children's social generalization

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Generalizations about social groups (prejudices, stereotypes) are based on limited sets of data. But not all data are equal: rationally, we should generalize more readily from diverse evidence than from narrow evidence. In 2 studies, we asked whether children and adults employ this rationale when generalizing about an unknown group - students from "the Jiffy school." Participants were told that a diverse group of Jiffy children liked X while a narrow group liked Y. The question is whether participants extended X-- the preference of the diverse group--to the rest (majority) of the group. In Study 1, 5-year-olds (N = 15) and adults (N = 20) were shown two objects hidden in bags (so the look of the objects should not influence the decision), one liked by the diverse group, the other liked by the narrow group. We used race and gender to create diverse/narrow groups. In race trials, the diverse group consisted of one white and one black child; the narrow pair consisted of two white children (Figure 1a). In gender trials, the diverse pair consisted of one boy and one girl; the narrow pairs were two boys or two girls (Figure 1b). Participants had to decide which object was preferred by the majority of the children in the school. Adults generalized more from the diverse evidence (most students will like what children of different races/genders liked) but 5-year-olds generalized predominantly from the narrow set. In both race and gender trials, 5-year-olds chose to generalize from their own ingroup, rather than using inductive reasoning. Are 5-year-olds incapable of using inductive rationale for generalization and chose ingroup by default? We hypothesized that this was not the case. Instead, children may have chosen their own race group because their representation of "the Jiffy school" reflected their typical environment: majority

white children. To test this hypothesis, in Study 2, a new group of 5-year-olds (N = 15) were first primed with a picture of mixed race and gender children from the Jiffy school (Figure 2). After this, children were tested in an identical manner as in Study 1. Now we found that children favored the diverse group's preference in race trials significantly more than they did in Study 1. The same trend was found in gender trials although not yet significant. Overall, these results show that 5-year-olds are able to use inductive reasoning for generalization, choosing diverse over narrow evidence. Importantly, this reasoning depends on baseline representation: our children participants living in majority white environment presumed that an unknown population matches their environment. But with minimal intervention (mixed race picture), 5-year-olds could change this narrow representation and used diversity reasoning instead.

The effects of diversity and segregation on children's inferences about others' racial attitudes

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Despite the increasing diversity of the United States, many local contexts (i.e., schools and neighborhoods) remain racially homogeneous. In three experiments we investigate how low diversity and segregated environments shape perceptions of others' racial attitudes. Imagine seeing a White child in a predominantly White class befriend another White child. Because friendships with White children are likely given the environment, you may be reluctant to make an inference that the child prefers White peers to Black peers. Now, in the same predominantly White class, imagine seeing a Black child befriend another Black child. If people chose friends randomly, friendships involving Black children should be quite rare and thus may serve as a strong indicator of individuals' racial attitudes. In two experiments we tested this possibility. Participants (7- to 10-years-old) saw a Protagonist (Experiment 1: a White child; Experiment 2: a Black child) choose to play with either White or Black children from a predominantly White or predominantly Black classroom. Given the demographics of the class, the race of the selected playmates was either likely (e.g., White children chosen from a predominantly White class) or unlikely (i.e., "violated" random sampling assumptions; e.g., Black children chosen from a predominantly White class). Participants then made inferences about the Protagonist's racial attitudes. When judging a White Protagonist (N=208), children inferred the Protagonist liked peers of the same race as their prior playmates when the race of playmates was unlikely, but not when the race of playmates was likely, $F(1, 204) = 6.83$, $p = .010$, $\eta2p = .032$. Similarly, when judging a Black Protagonist (N = 198) engage in same-race friendships, participants inferred a racial preference when the race of playmates was unlikely, but not when they were likely, $F(1, 193) = 11.03$, $p < .001$, $\eta2p = .054$. However, children's inferences did not differ when judging the Black Protagonist engage in cross-race friendships, $F(1, 193) = 1.78$, $p = .184$, $\eta2p = .009$. These experiments demonstrate that low diversity can set the stage for inaccurate perceptions of others' racial attitudes. That is, the same behaviors (i.e., engaging in same-race or cross-race friendships) have different consequences depending on the context in which they occurred--friendships with minority group members, but not majority group members, serve as a strong indication of individuals' racial attitudes. Although these results highlight the importance of increasing diversity, that may not be enough, as even diverse contexts can be segregated. In Experiment 3, children (5- to 8-years-old; N = 79) either saw a segregated neighborhood (i.e., Black children lived on one half and White children lived on the other) or an integrated neighborhood. Participants exposed to a racially segregated neighborhood inferred that children in the neighborhood preferred same-race

peers to cross-race peers, $F(1, 77) = 5.33$, $p = .024$, $\eta2p = .065$. However, this was not the case for those exposed to an integrated neighborhood, $F(1, 77) = .89$, $p = .349$, $\eta2p = .011$. Because inferences about others' racial attitudes predict engagement in cross-race interactions (Shelton & Richeson, 2005), these results indicate that we need to be especially cognizant about the ways in which the structure of society works to inhibit positive intergroup relations.

Effects of Diversity on Children's Learning and Trust

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Intergroup bias emerges in early childhood. There are varying accounts of when children develop race-based biases (Hailey & Olson, 2013), but cross-race relationships and being in a more integrated environment help reduce children's race-based biases. However, it remains unclear how race and social environment influences how young children learn from and trust others, especially in a school/educational environment. Children appear more trusting of information conveyed by in-group over out-group members and are also more likely to delay gratification for a trustworthy adult over an untrustworthy adult, suggesting racial differences might influence children's learning and propensity to trust others as early as the preschool years. The present study investigated 3- to 6-year-old Black and White children's learning and trust in people of a different race. Children were recruited from racially homogeneous preschools where the majority of children and teachers matched the race of the child (Black or White). The first three tasks were each conducted twice: once with a White experimenter and once with a Black experimenter. Each task consisted of four trials and began with pictures of two adults: one White and one Black. In the learning task, each adult provided a different label or function for a novel object and children were then asked what they thought it was named or called. In the preference task, children were asked which of the two adults they wanted as their teacher. In the accuracy task, children heard each adult correctly or incorrectly provide labels or functions of familiar objects and were asked which of the two adults they wanted as their teacher. Lastly, in the delayed gratification task, children were given a marshmallow and instructed to wait and not eat it by a new White or Black experimenter they had never met. Children's responses to the first three tasks did not differ by experimenter's race, child's race, or school demographics. There was no effect of age except in the accuracy task: children were more likely to prefer the accurate teacher with age ($r =.567$, $p < .001$). Overall, children did not prefer to learn from Black or White adults (Mwhite=4.03(.281); t(38)=.091, p=.928). However, children showed a significant preference to have a White adult compared to a Black adult as their teacher (Mwhite=4.82(.324); t(38)=2.531, p=.016). Children preferred an accurate over an inaccurate teacher regardless of teacher race (Maccurate=6.36(.295); t(38)=7.996, p<.001). Black children's wait time did not differ according to experimenter's race (Mwhite=420.10s(112.527); Mblack=407.85s(105.193); t(21)=-.079, p=.938). However, White children waited significantly longer for a White experimenter (Mwhite=833.13s(46.165) compared to a Black experimenter (Mblack=499.56s(89.724); t(15)=-3.180, p=.006). In sum, both White and Black children preferred White teachers over Black teachers. However, children's learning was not affected by the teacher's race. Strikingly, whereas Black children's waiting times did not differ based on the experimenter's race, White children waited significantly longer for a White experimenter than a Black experimenter. Data from children in racially diverse preschools is currently underway, which will allow us to compare the effects of integrated preschools on children's learning and trust.

Predictors of Children's Willingness to Engage in Cross-Race Friendships

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Cross-race friendships have positive effects on individuals, including lowered feelings of vulnerability in the school context, reduced feelings of being misunderstood, and more positive racial attitudes (Davies, Tropp, Aron, Pettigrew, & Wright, 2011; Graham, Munniksma, & Juvonen, 2014; Shelton, Douglass, Garcia, Yip, & Trail, 2014). Unfortunately, research also indicates that cross-race friendships are less common than same-race friendships in childhood and become less common as children age (Aboud, Mendelson, & Purdy, 2003; Graham et al., 2014). Given the positive benefits of such relationships, more research is needed to explore the factors that promote or discourage the development of cross-race friendships, particularly in early childhood when they may be most effective in shaping positive racial attitudes. Past work indicates that social milieus in which children are embedded affect their opportunities for and the quality of their cross-race contacts and interactions; children simultaneously engage in processes that mediate and moderate the effects of these milieus. A recent integration of the extant literature proposed a conceptual model, General Intergroup Friendship Theory (GIFT), of the pathway from intergroup contact to positive intergroup attitudes in children (Bigler, Rohrbach, & Sanchez, 2016). The model outlines factors hypothesized to shape the reciprocally-related processes of intergroup contact, interaction, friendship, and attitudes. We review the model and report the results of empirical tests of the roles that environmental and social network diversity, among other factors, play in shaping children's engagement in cross-race friendships. Our work with a predominantly White sample of 44 mothers and their 4- to 6-year-old children revealed that parental racial attitudes did not predict their children's racial attitudes or behaviors. However, the percentage of Black individuals in mothers' social networks predicted children's willingness to be in close proximity to Black people ($R2 = .10$, $\beta s = .05$, $p < .05$); this in turn predicted their positive behavior around a Black confederate ($R2 = .13$, $\beta = -.37$, $p < .05$). The current study builds on these findings by exploring the extent to which a number of factors, including parent and child social network diversity, predict children's willingness to engage in cross-race friendships when given the opportunity. More specifically, Latino, White, and Black children ages 5 to 11 were told they would participate in a pen pal program and were asked to choose the four individuals whom they would most want to befriend. Children's racial attitudes were then assessed through interviews regarding their endorsement of racial stereotypes, levels of racial centrality, diversity of their social networks, and beliefs about the benefits and challenges of same- and cross-race friendships. Additionally, parents completed a survey examining their racial socialization practices, both their own and their child's social network diversity, and the extent to which they endorse a colorblind ideology. The results will be discussed in an effort to elucidate the race-related attitudes, beliefs, and experiences that predict children's willingness to pursue cross-race friendships.

Oral Papers IV – Number, Space and Memory

O4.1   Interactions of Space and Arithmetic: Operational Momentum in Preschool Children

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Background: When adults add two sets of objects together, they tend to overestimate the outcome to this operation; when subtracting, they tend to underestimate the outcome. Adults exhibit rightward spatial shifts of attention for addition, and leftward shifts for subtraction. These results form the behavioral basis of operational momentum, wherein space and number interact as we dynamically move attention along the number line to solve arithmetic problems. Using a spatial scaffold to represent number is an important part of enriching mathematical cognition, and has implications for the etiology of dyscalculia and typically developing children's developmental trajectories in formal math. To date, the evidence for operational momentum in childhood is mixed, and has been examined exclusively when adding and subtracting. In the current study, we studied whether children who have not yet entered into formal schooling exhibit operational momentum when performing the simpler operation of ordering amounts from the least to most (sometimes called a proto-operation). Method: 50 preschoolers (mean age of 3.9 years) and a comparison group of 49 college-age adults saw two blocks of trials. In the Order block, participants viewed a set of objects that increased in magnitude across three slides (4 dots, 8 dots, 16 dots), and were instructed to choose the next set in that order (e.g., 32 dots). In the No Order block, participants viewed a single magnitude, presented three times (32 dots, thrice). After viewing these slides, participants were provided with two alternatives to choose from, one on the right side of the screen and one on the left. The correct answer was presented alongside an underestimated amount (6 trials), or an overestimated amount (6 trials). There were also trials in which the correct answer was not present; instead, an overestimate was presented alongside an underestimate (6 trials). These trial types allow us to probe for outcome estimation biases, with the overestimate options serving as more-tempting foils in the Order block if operational momentum is present. On some trials, we presented two identical values alongside each other (8 "tie" trials). This trial allows us to probe for spatial shifts of attention, with preferential right-side responding predicted for the Order block due to rightward shifts of attention. Results: In the presence of a correct answer, neither adults or children exhibited spatial shifts or overestimation as a function of operation. However, these biases appear in trials with no correct answer presented (e.g., conditions of uncertainty, which heighten the use of heuristics). When choosing between an overestimate and underestimate, adults were more likely to choose the overestimate in the Order block than the No Order block (45% vs. 26%, p < .001). In the tie trials, they chose the right-side response more in the Order block compared to the No Order block (56% vs. 49%, p = .049). Preschoolers solely exhibited spatial biases; in the tie trials, they chose the right side 64% in the Order block and 49% in the No Order block (p = .04). Conclusions: Taken together, these results suggest that spatial biases during simple arithmetic operations are present before formal schooling with the mental number line or symbolic math. The data also support the theory that the development of the operational momentum bias starts with an initial spatial component, which leads to the mis-estimation component in late

O4.2   Is it Who You Know, or Where you Live? Examining the First Memories of European American and Chinese American Adults Born in the United States

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Introduction. Chinese and American university students differentially report on their first memories (Wang, 2001), likely as a result of micro- (maternal reminiscing style) and macro- (the broader cultural context) level influences. The present study was conducted to determine whether similar effects would be observed when examining the first memory reports of European American (EAA) and Chinese American adults (CAA) born in the United States. Mothers of participants were either born in the United States (EAA) or China (CAA). Hypotheses. We predicted that the first memories reported by EAAs would occur at an earlier age relative to the first memories reported by CAAs. We also expected that the first memories reported by EAAs would be more elaborative (i.e., include more words), would be more self-focused, and would be more individual-focused in content relative to memories reported by CAAs. Finally, we expected that EAAs would report talking and thinking more about their first memory as well as report greater confidence that their memory was their own relative to CAAs. Method. The final sample included 64 EAAs and 27 CAAs recruited from the undergraduate participant pool at a large public university. Participants completed online questionnaires in which they reported on demographic information, the first memory they remembered independent of pictures or conversations with others, and their age in years and months when the event occurred. Participants rated how freque

O4.3　　　　　The effect of perceived threat to freedom of choice on children's preference for scarcity

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The scarcity effect is the tendency to prefer commodities that are rare. This effect has been studied at length in adults (see Lynn, 1991 for a review), but scarcity's impact on children's judgments and decision-making has received limited research attention. A recent study has suggested that at 8 years of age, children begin to show a strong preference for scarce objects (author name, in prep.). The present study aims to investigate an underlying cognitive mechanism for this observation - psychological reactance. With scarcity representing a threat to one's ability to possess an object, it was hypothesized that perceived threat to freedom of choice would induce a preference for scarcity in children who would not otherwise demonstrate the effect (i.e., children under 8 years of age). In Experiment 1, the threat to freedom of choice was manipulated by increasing the extremity of scarcity. Children aged 5 to 7 years (N = 93) were introduced to a fictional agent and a virtual toy shop via a PowerPoint presentation. It was explained that the agent had some money to spend at the shop. On each of 4 trials, two types of novel toys were presented in a ratio of 30:1 in the Experimental condition, and 30:5 in the Control condition. On each trial, children were asked which toy they thought was more fun (judgment tasks) and which they thought the agent should buy (decision tasks). For each child, the proportion of scarce toys judged as more desirable and the proportion of scarce toys chosen to be purchased were calculated. The results showed that a preference for scarcity increased with age on both task types (judgment: r = .44, p = .002; decision: r = .33, p = .024). Compared to chance responding, in the Control condition none of the age groups showed a preference for either type of toy, replicating previous findings (author name, in prep.). However, in the Experimental condition, 7-year-olds showed a significant preference for scarce toys on the judgment tasks, t(15) = 2.21, p = .043. In Experiment 2, the threat to freedom of choice was manipulated by introducing competition for scarce resources. Using the same virtual shop paradigm as in Experiment 1, 5- to 7-year-olds (N = 92) were shown two types of novel toys in a ratio of 30:2 in both Experimental and Control conditions. In the Experimental condition, two peers were depicted alongside

the agent, serving as competition. No such competition was involved in the Control condition. A one-way ANOVA revealed a significant main effect of age on preference for scarcity, $F(2, 86) = 10.359$, $p < .001$. In the Experimental condition, compared to chance responding, 5-year-olds showed a significant preference for the abundant toys on both the judgment and decision tasks, $t(14) = 3.17$, $p = .007$ and $t(14) = 2.98$, $p = .010$. In contrast, 6- and 7-year-olds in the Experimental condition judged the scarce toys as more desirable significantly more often than chance, $t(14) = 2.69$, $p = .017$, and $t(15) = 4.07$, $p = .001$, respectively. Moreover, 7-year-olds in the Control condition showed a significant preference for the scarce toys on both judgment and decision tasks, $t(13) = 2.28$, $p = .040$ and $t(13) = 2.60$, $p = .022$. The present data suggest that a preference for scarcity can be induced in young children through manipulation of threat to freedom of choice. This provides support for psychological reactance serving as one of the mechanisms underlying the development of the preference for scarcity observed in adults.

O4.4 Expectations about color categories inform preschooler's recall

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Young children learn and remember much about the world, despite limited cognitive resources (Cowen, 1997). No learner could be expected to recall past events with perfect fidelity, so how might young minds deal with uncertainty from their own recalled experiences? Past work has shown how children's expectations can influence learning, with prior beliefs integrating with new evidence (Schulz, Bonawitz, & Griffiths, 2007). Here we explore the possibility that expectations born from children's prior experience also interact with memory. One possibility is that children simply remember with arbitrary noise, such that details of a recalled item could be more or less randomly erroneous. However, we predict that when children recall imperfect memories, they fill in possible 'error' by relying on prior expectations. Thus, recalled items move towards a prototypical category member. This is consistent with a Bayesian model of memory (Persaud & Hemmer), but has not been explored with children. Such a model is particularly interesting to explore with children because it can afford a new method to investigate changes in both expectations over categories and accuracy of working memory in early childhood. This present study explores this role of prior knowledge in preschooler's memory in the domain of color. We chose color because it is a domain in which children have extensive experience (Bornstein, 1985), it holds a degree of universal categorical agreement (Berlin & Kay, 1969), and because it is a fundamental feature of how we define and differentiate many categories, including object kinds or race. We developed a task that asked children to learn an arbitrary mapping between a shape and a color, and then looked at children's recall of the exact color hue (by pointing to options along a color wheel) when prompted with the uncolored shape. To test our prediction, we selected our target colors to be 1.5 standard deviations on both sides of the mean hues for orange, purple and blue categories. Category means were derived from past work with adults, suggesting universal category distributions for 11 categories, including our three test categories (Persaud & Hemmer, 2014). 34 preschoolers (M= 60mos, Range = 41-71mos) participated in local daycares. Five additional children were dropped due to experimental error (3) or failure to pass a check question (2). To assess the predicted error towards the mean, we subtracted the original target hue value from the recalled hue. Thus, if category expectations influence children's memory, stimuli in the lower hue range of the category should be remembered as higher towards the mean and thus have a positive difference value, while targets in the higher range of the category should be remembered lower towards the mean with a negative value. We assessed this

difference in high and low targets by comparing these error values for each of the three color categories tested. For all three color categories, the error of high and low targets significantly differed in the predicted direction (See Fig. Orange:t=2.8, p=.01; Blue:t=4.4, p<.0001; Purple:t=3.2, p<.01). Overall these findings suggest that children rely on their expectations to fill in noise in memory. These results are also consistent with our computational model of color inference, and are an important step towards characterizing how children's learning and memory is influenced by cognitive representations. ⌷⌷⌷⌷

O4.5   Thinking inside the box: Children view number, diversity, and connections of parts as internal complexity cues

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What do children know about the "insides" of objects? One might think they know little; children rarely see insides firsthand and lack a detailed understanding of internal mechanisms (Keil, 2003). Beyond such considerations, many researchers from Piaget onward have argued that children struggle to represent that which is not visible (see Springer, 2001). Despite such challenges, even preschoolers (Gelman & Wellman, 1991) know that insides are crucial to objects' identities and functions. Additionally, preschoolers know that internal complexity affords functional complexity. Ahl & Keil (2016) and Erb, Buchanan, & Sobel (2013) found that young children preferentially matched complex insides with novel machines producing numerous and diverse functions. In these studies, internal complexity was conveyed using the combined cues of number, diversity, and connectedness of parts. However, which internal cues are necessary and sufficient to convey "complexity" remain unclear. Moreover, how might children represent the internal complexity of real-world (rather than novel) objects? This paper explores *which specific internal features convey causal complexity to children and adults.* By addressing such questions, we explore the richness and detail of children's mental representations of insides. Study 1 examined 5-, 6-7, 8-9-year-olds' (n = 234) and adults' (n = 78) abilities to make verbally- and visually-based complexity judgments. Participants judged 5 pairs of artifacts differing in mechanistic complexity (e.g., a smartphone vs. a flashlight), depicted via simplified drawings equated in their visual complexity and size, in two counter-balanced blocks. In the "Learn" block, participants identified which object is "hardest to learn about" in terms of how it works. In the "Insides" block (Fig. 1), participants saw two schematized pictures representing objects' insides and matched each picture with the object whose insides they thought were most similar to it. We varied the paired visual contrasts depicted in the "Insides" block in three different conditions, separately testing the cues of 1) number 2) diversity and 3) connections between parts. For instance, do participants preferentially match complex objects with more-diverse insides? Participants received a score of 0 (incorrect) or 1 (correct) for each item. We compared total scores (0-5) to the at-chance score of 2.5. All age groups were above chance (p < .001) in the "Learn" block. In the "Insides" block (Fig. 1), 5-year-olds were above chance in the number of parts condition, t(25) = 3.59, p = .001, matching more internal parts with more complex objects (e.g., smartphones), but at-chance in the other two conditions (ps ≥ .124). However, the three older age groups were above chance in all three conditions (p < .001), indicating that each cue independently conveys complexity at these ages. Study 2 (n = 78) found that 6-7, 8-9-year-olds, and adults (ps ≤ .025) view number of parts as a complexity cue even when controlling for surface area. We have shown that even 5-year-olds have abstract, verbally-based expectations regarding the complexity of real-world objects; they also expect complex objects to have more parts inside. Older children and adults also view

the subtler features of diversity and connections of internal parts as complexity cues. Years before receiving formal science education, children have detailed expectations for how complexity is instantiated inside objects.

Poster Session 4

A - Cognition in Applied Contexts

4-A-1   **Complexity Science and Math Learning: A Case for Informal Math Practice**

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There is a curious discrepancy between reading pedagogy and math pedagogy. Reading practice is encouraged from a young age, with many opportunities available. There are far fewer recommendations for math, and practice is largely confined to school assignments and prescribed homework [1]. Could it be that math requires less practice than reading? In the current paper, we present findings from a math practice program, and continue to explore this question using insights from complexity science. Specifically, we seek to determine the relative role of math practice, vis-à-vis top-down explanations, illustrations, and clarifications, using theoretical considerations about the emergence of knowledge. An informal math practice (IMP) program was implemented in a 7-week summer day camp at two sites: one day/week in Site A, and three days/week in Site B. IMP utilized a math practice app on tablets. Children largely chose their own problems and worked independently. Adult facilitators were present to encourage and motivate them to engage in independent practice. Data was analyzed to determine differences between the two sites in a change in score from pre-test to post-test on a standardized measure of math fluency. Children at Site A engaged in an average of 4.10 (SD = 1.52) IMP sessions, and Site B an average of 15.58 (SD = 3.05). Site B had a greater improvement in their math fluency scores (M = 2.16, SD = 9.56) than Site A (M = -1.54, SD = 10.06), which was marginally significant, $t(1) = 1.79$, $p = .08$, with a medium effect size, Cohen's d = .38. We will now look into why IMP shows promising potential, by considering the mental challenges math presents the mind and how complexity science can inform pedagogy. At the elementary level, math problems include the number system, simple operations, and the number line, content that can be challenging for children. These challenges include attention to detail, precision, abstractness, fluency, and relational reasoning, and the cumulative nature of math is not helping. We provide a model of the mind to help explain this, inspired by complexity science and network theory, by arguing that knowledge is stored as mental networks of coordinated impressions that adapt continuously towards increased network cohesion. This conceptualization of knowledge and its emergence has high ecological validity, and is in line with numerous findings in cognitive science (e.g., 3, 4). More importantly, the mental-network model provides clear recommendations about what an ideal learning context needs to contain: it must afford children with experiences that lead (1) to appropriate impressions and (2) an appropriate coordination among impressions. Building upon this, we derive the ideal math pedagogy that informs IMP. Both characteristic of an ideal learning context for arithmetic are missing from an every-day surrounding. This state of affair should make it obvious that the likelihood for spontaneous discovery of arithmetic is minimal (cf., 3), which might be the reason traditional math pedagogy focuses on top-down explanations, illustrations, and clarifications. Indeed, much research concentrates on finding effective

math curricula and teaching strategies [5]. However, these efforts are based on the mistaken assumption that the mind can be talked into doing something different than it naturally does. We conclude that an increased emphasis on practice is necessary, rather than curriculum development and teaching strategies

4-A-2   Is Everything on the Internet Real?: Children Judge Information from Books and the Internet Similarly

Michelle Jackson¹, Judith Danovitch¹

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Previous research has examined children's fantasy-reality judgments (e.g. Woolley & Cox, 2007) and children's ability to learn from books (e.g. Ganea, Ma, & DeLoache, 2011). However, although children are exposed to the Internet as an information source, few studies have addressed children's fantasy-reality judgments and recall of information from the Internet. In two experiments, 111 children ages 6-7 and 9-10 heard information about novel animals from a book or a website containing the same information and images about each animal. Children were equally likely to judge the animals as real from both sources, but some evidence indicated that younger children were more likely to believe the animals were real. There was also evidence that children who learned from the website recalled more information than children who learned from the book. These findings suggest that children may treat sources differently when initially learning information but similarly when making fantasy-reality judgments. Implications for use of the Internet in educational settings will be discussed.

4-A-3   Staying Connected: How America's Young Children Use Video Chat

Megan Norris¹, Robyn Kondrad¹

¹Appalachian State University

Video chat has revolutionized how geographically distant people interact. With the rapidly spreading accessibility of this technology, the American Academy of Pediatrics (2016) released new recommendations about how adults should engage in video chat with young children. This qualitative study provides the first nationally representative sample specifically exploring how families with children between 6 months and 5 years of age currently use video chat. A Qualtrics survey through Amazon's Mechanical Turk was completed by an economically (family income <$35k:32%, $35-100k:60%, >$100k:8%) and racially (74% White, 11% Black, 14% Asian) diverse sample. 81% of parents with an income below $100,000 reported using video chat with their child at least once a week compared to 56% of high income families. 67% of video chat recipients lived more than 30 miles away and most were family: grandparents (80%), parents (42%), other relatives (41%). Blacks chat with grandparents about as often as parents. Whites and Asians, in contrast, are twice as likely to chat with grandparents as parents. 46% of parents reported that their child "is engaged most of the time"; calls ranged from 2 to 60 minutes (M=19.87). The most frequently reported activities were talking about the day (76%), demonstrating toys (51%), and playing music (42%). A clearer picture of the current video chatting landscape will be helpful in developing guidelines for using this technology with young children.

4-A-4   The Relationship Between Dual Representation of Written Numerals and Place Value Knowledge in the First and Second Grades

Helena Osana[1], Aryann Blondin[1]

[1]Concordia University

Mastering the symbol system in mathematics is a central component of mathematical proficiency. Young children in school must learn place value, the notion that the position of a digit in a multi-digit numeral represents its value. Children who understand that the 5 in 52 represents five groups of 10, for instance, can be said to have "dual representation" (Uttal et al., 2009) -- they understand that the digit represents not only its "face value," but also a quantity that is determined by its position. In contrast, children who see both the 5 and the 2 as representing 5 ones and 2 ones, respectively, with no regard for the meaning of the digits' positions, have been said to hold the "concatenated digits" view, which can hinder students' mathematical reasoning (Verschaffel et al., 2007). As such, we argue that children's place value understanding is dependent on their dual representation of multi-digit numerals. Our objective was to investigate (a) differences in first- and second-grade children's dual representation of written numerals, and (b) the relationship between dual representation and performance on a standard task typically used by teachers to assess students' place value knowledge. Method. The sample consisted of 123 first graders and 82 second graders. The Picture Place Value Task (PicPVT) measured dual representation of written numerals and the Conventions of Place Value Task (CPV) assessed children's place value knowledge. For the PicPVT, children were presented with a numeral that had a specific digit underlined, and were asked whether a display of hexagons (the correct number of groups with either one, 10, or 100 hexagons in each group) "matched" the underlined digit. A score of 9/20 was possible simply by counting the groups (face value responses). Correct responses on the remaining 11 items required looking beyond the face value of the digit. For the CPV task, the researcher circled a specific digit in a written numeral and asked, "what does this mean?". Results. Four dual representation (DR) groups emerged: (a) DR; (b) Guessing; (c) Developing DR; (d) No DR. The Guessing group showed no discernable pattern of responses on the PicPVT items. The proportion of children in each DR group varied by grade, with a higher proportion of children in the first grade without dual representation and a higher proportion in the second grade with dual representation. Children with dual representation outperformed those in all other groups on the CPV task, regardless of grade. Differences between DR groups on CPV performance varied by grade (Fig. 1). In the first grade, children with dual representation outperformed those in all other DR groups. In the second grade, those with dual representation only outperformed those with no dual representation. There were no differences in CPV scores between those in the DR category and those in the Guessing and Developing DR categories. Conclusions. The primary contribution of the present study is the finding that the benefits of dual representation extend to students' learning of school mathematics. As we had predicted, children's dual representation of written numerals is predictive of performance on standard classroom place value tasks. The role of dual representation differs by grade, however. It is possible that second graders can marshal partially developed symbolic understanding to support their place value knowledge, but younger children need more mature symbolic awareness to do so.

4-A-5   Increasing Children's Persuasion Knowledge through Argumentation

Susie Stanley[1], Chris Lawson[1]

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To what extent can a short lesson on argumentation influence children's persuasion knowledge? Children in third and fourth grades (N=44) participated in one 25-minute intervention that was designed to teach them about the key components of an argument (i.e., i.e., claim, reasons, counterargument, and rebuttal). Pre- and posttest measures assessed children's construction of persuasive arguments, and their awareness of persuasive tactics used in a novel domain (i.e., advertising). Results indicate that this intervention led to significant posttest gains in children's ability to generate persuasive arguments. Moreover, children exhibited posttest gains in their understanding of persuasive tactics and the intentions of advertising. The results from this data have implications for future research that support the implementation of argumentation curriculum in grade school and advancing critical thinking skills associated with persuasion knowledge.

4-A-6   **Parental Math Homework-helping Strategies as a Prelude to Productive Struggle**

Salvador Vazquez[1], Jennie Grammer[1]

[1]UCLA

Productive struggle, expending effort to make sense of something that is beyond one´s current level of understanding, has been shown to improve memory retention, conceptual understanding, transfer of knowledge to novel problems, and increase the use of metacognitive strategies among children and adolescents in math classrooms. Considering how beneficial productive struggle may be for math learning, little is known of the contextual factors that influence whether productive struggle is being used by parents when helping with math homework. Building on a previous investigation about the association between parent attitudes towards productive struggle and math homework-help frequency, this study assesses what parents know about productive struggle and if any teaching strategies they are using allows for their children to struggle productively. Using a comparative case study design, interview and observation data on parent/child homework interactions from multiple families representing a range of socioeconomic backgrounds will be presented.

B - Cognitive Foundations: Memory, EF, Attention, Action

4-B-7   **The development and validation of classroom-based executive function assessments in school-aged children.**

Sammy Ahmed[1], Sarah Remer[1], Nathan Sheppard[1], Frederick Morrison[1]

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Researchers rely on multiple techniques when studying executive function (EF). However, it remains unclear how various EF measures relate to child behavior in school. Here, we employ newly-developed tasks that have been designed to resemble self-regulatory behaviors in classroom settings. We tested associations between classroom-based and both laboratory-based and teacher reported measures of child EF in 195 kindergarteners. Results reveal that classroom-based working memory is related to teacher reports (r=.29, p=.003) more strongly than laboratory-based working memory (r=.22, p=.006). Classroom-based inhibition is related to teacher reports (r=.27, p=.000) and laboratory-based inhibition at similar magnitudes (r=-.25, p=.043). Finally, classroom-based attention is related to teacher reports (r=.33, p=.002), but not laboratory-based measures of attention (r=.16, p=ns.). These findings suggest

that classroom-based measures are associated with well-validated measures of EF, and might be more strongly related to self-regulatory behaviors in classroom contexts, which has implications for the ecological relevance of laboratory EF measures.

4-B-8   The effect of stimulus features on infants' apparent visual short-term memory capacity

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We examined whether infants' limited visual short-term memory (VSTM) for multiple-item arrays reflects an inability to individuate the items. In studies using the simultaneous stream procedure, 6-month-old infants fail to detect changes in multiple-item arrays. We recently observed that 6-month-old infants detected changes in multiple-item arrays if changes involved two features (e.g., a green square paired with a red triangle changed to a blue circle paired with a red triangle), perhaps reflecting enhanced encoding of the individual items due to increased within-array variability. To test this possibility, we presented 6-month-old infants (N = 29) streams with varied items, but changes in only one dimension (e.g., a red circle paired with a green square changed to a yellow circle paired with a green square). If increasing item variability facilitates infants' VSTM for multiple item arrays, they should prefer these changing streams. In contrast, if infants require a larger change (i.e., in two dimensions) to detect changes in multiple item arrays, they should not prefer these changing streams. Infants preferred the changing stream significantly more than chance at both set size 1, $t(28) = 4.58$, $p < .0001$, and set size 2, $t(28) = 2.82$, $p < .01$, suggesting that increasing within-array variability allowed infants to detect the change and individuate items in VSTM.

4-B-9   Exploration dominates choice behavior in young children

Nathaniel Blanco[1], Vladimir Sloutsky[1]

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Exploration is a critical activity that supports learning throughout the lifespan. Exploration is most valuable when there is more uncertainty about the environment, and so it should be especially crucial in childhood when relatively little is known about the world. Despite a rich body of research on the neurobiological and computational bases of exploration in adults and non-human animals, less is known about exploratory behavior in children. In our study adults and 4-year-olds completed a decision-making task where they chose one of four options on each trial and received a reward. In this simplified 4-armed bandit task, options were invariant across trials and highly separable. Adults quickly optimized their choices, choosing the best option on a large majority of trials, while most children chose all options with approximately equal proportions. But, children's choices were far from random: their tendency to switch between options was well above chance. Most children were also best characterized by a model that explicitly switches rather than by a reinforcement learning or a random model. These results suggest that even young children systematically explore and that the relative strength of this exploratory tendency, compared to seeking immediate rewards, is much higher in young children than adults. We suggest that choices in early childhood may be largely driven by exploration and that broadly gathering information has particularly high value during this period of life.

4-B-10   **Investigation of attention to emotional faces in young typically and atypically children.**

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Emotional information automatically captures attention and can have major impacts on further stages of information processing and global cognitive development. The current study investigates attention to emotion in young children (ages nine months to six years) across three different populations (Autism Spectrum Disorder (N=28), fragile X syndrome (N=47) and typical development (N=110)) using an eye tracking, affective dot probe task with happy and threatening trials. Both the TD and FXS groups, but not the ASD group, show attentional biases towards threat. The TD group also shows an attentional bias on happy trials, while the FXS group does not. Interestingly, the ASD group shows a unique pattern of attentional avoidance on happy trials. Investigating the differences in attentional behavior between these groups provides insight into how differential attentional patterns to emotion can predict disparate patterns of social development and may inform intervention strategies for children at risk for social disorders.

4-B-11   **Brain signal complexity differences between monolingual and bilingual children**

Ashley Chung-Fat-Yim[1], John Grundy[1], Ryan Barker[1], John A Anderson[1], Ellen Bialystok[1]

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Brain signal complexity develops over time and greater complexity is associated with better cognitive outcomes. Recent evidence from the adult literature has shown that bilinguals have more complex brain signals than monolinguals, but the developmental course of this complexity for the two language groups is unknown. In the present study, 21 bilingual and 38 monolingual children perform a Go/No-Go task while EEG was recorded in order to compare brain signal complexity between the groups. Overall brain signal complexity was equivalent for the two groups; however, complexity had a different relationship to performance in each group. Brain-behavior correlations revealed that greater complexity was associated with greater accuracy for both groups. Greater complexity was also associated with faster RTs for bilinguals, but not monolinguals, moving bilinguals along a developmental trajectory that is not yet apparent in monolinguals. The results are discussed in terms of how switching between languages that compete for selection leads to domain-general developments in brain signal complexity.

4-B-12   **The Effects of an Interactive Digital Storybook on Children's Comprehension and the Role of Individual Differences in Attention**

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With the rapid growth of technology, children now access stories through computers, apps, and tablets (Vaala, Ly, & Levine, 2015). Well-controlled studies are needed to test the effectiveness of electronic books (e-books) on preschoolers' learning outcomes, and to investigate whether interactive features are useful or distracting for children's comprehension. This study investigated the effects of an interactive digital book on children's vocalizations and comprehension, and whether an interactive book might be

especially useful for children with less developed attentional control. The study used a within-subject design with 60 children (33 boys, 27 girls) ages 4 to 5-years-old (4.81 ± 7 months). Each testing session was recorded as children were read commercially available children's books written and illustrated by Thatcher Hurd: Cat's Pajamas or Zoom City (with the author's permission). Children were presented with an interactive version and a control condition of either a static version (n=30) or board version (n=30) of the books. Order and story were randomized and counterbalanced. The features of the interactive book were content-related animations that activated contingent on the child's vocalizations (e.g., child vocalizes "car" and an illustration of a car animates). After each story, children were administered a comprehension test. Condition-blind research assistants coded vocalizations (Cohen's K = 0.94) and comprehension (Cohen's K = 0.89). Children participated in an attention task from the NEPSY Tests (Korkman, Kirk & Kemp, 1998) in which children were asked to click on target stimulus among distractors as quickly as possible in 180 seconds. There were no significant differences in vocalizations between using the interactive book compared to the control conditions. There were significant differences in comprehension, with the use of the interactive book exhibiting higher comprehension across all participants (MInteractive = 70.24%, SD =12.4%) compared to the static book (MStatic = 37.53%, SD =9.7%), t(29) = 13.557 p < .001 and compared to the board book (MInteractive = 65.47%, SD =16.2%; MBoardbook = 45.83%, SD =14.1%), t(29) = 8.515 p < .001. Importantly, the degree to which children improved in their comprehension was related to their attentional control. For each child, a change score was computed (control comprehension test score subtracted from interactive comprehension test score), and was compared to the child's performance on the attention task (a composite of search time and incorrect responses, where higher scores indicate worse attentional control). There was a significant correlation between improvement in comprehension and attention score, r = 0.68, n = 60, p < .001. This relation was still significant after controlling for age, sex, and verbal intelligence. As children's attention score increased, they showed more benefit in comprehension from the interactive version of the story: the interactive features of the book were especially helpful for children with less developed attentional control. The use of the interactive book exhibited increased comprehension compared to the use of a board book and static book, regardless of the quantity of words a child said aloud. Digital books with well-deployed features have the potential to improve children's learning, and may be especially useful for children who have less developed executive function skills such as attentional control.

4-B-13   Age Differences in the Memorial Consequences of Multiple-choice Testing

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We examined the effects of multiple-choice tests on children's learning. Past research with adults and 2nd graders has shown both positive and negative effects of multiple-choice testing. Participants who have been previously tested on the material answer more questions correctly on a final test, but they are also more likely to incorrectly answer with multiple-choice lures. In Experiment 1, both younger (6 - 7.5 years) and older (8 - 9.5 years) children answered multiple-choice questions (e.g., "What is a group of lions called: a flock, a pride or a tribe?"). They then took a short answer test that included new questions as well as previously tested questions (e.g., "What country did the Pilgrims come from?" and "What is a group of lions called?"). Both age groups showed similarly-sized, large benefits from multiple-choice testing, but the older children were more susceptible to the negative effects of testing. In Experiment 2, we examined why the older children demonstrated a larger negative testing effect. Younger and older children completed the same multiple-choice testing paradigm, along with various

measures of their memory abilities and knowledge. We again found that both age groups benefited similarly from taking the multiple-choice test, but the older children showed a larger negative testing effect. Importantly, the size of the negative testing effect was related to children's general knowledge, but not to their item memory, source memory or working memory.

4-B-14   Effect of Proximity of Illustrations to Text on Beginning Readers Fluency and Comprehension

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Reading is a critical skill as it provides a gateway for other learning. Many children struggle to acquire this essential skill due to neurodevelopmental disorders (e.g., Dyslexia, ADHD), poor pre-reading skills, and vulnerabilities in general cognitive functioning (e.g., working memory, processing speed, etc.). The difficulty of learning to read may also be compounded by the suboptimal design of books for beginning readers. The typical layout of children's books places text and illustrations in close proximity, often embedding text within illustrations. There are a number of reasons to include illustrations in books for beginning readers: they may help provide additional information, contribute to text coherence, or even serve to motivate the reader (Carney & Levin, 2002; Fang, 1996). However, the close proximity of text and illustrations may also inadvertently create competition for attentional resources, which could be problematic for beginning readers. The goals of this study were two-fold: (1) to examine how beginning readers allocate attention to text and illustrations while reading, and (2) to explore whether increasing the spatial separation between text and illustrations can reduce the hypothesized attentional competition thereby improving children's reading fluency and comprehension. Participants (N=28, Mage=7.41, SD =.54) read aloud a commercially available book designed for beginning readers. The book was presented on a laptop computer and a RED250 SMI eye tracker was used to assess children's attention allocation. Half of the book was presented in the standard layout condition (i.e., text was embedded within illustrations; this condition presented children with the book layout designed by the publisher); the other half of the book was presented in the partially separated layout condition (i.e., text was adjacent to but spatially separated from illustrations; this condition presented children with a layout that was digitally manipulated for the purpose of this research). Condition order was counterbalanced across participants. Reading fluency was assessed via a Running Record, in which the experimenter recorded the child's decoding accuracy for each word in the story. Reading Comprehension was assessed by performance on a post-test, which measured children's ability to recount key events in the story (Retelling) and answer detailed questions about the story (Story Questions). Children's pattern of attention allocation was indexed by the number of gaze shifts from the text to the illustrations. Consistent with the hypothesis that close proximity between text and illustrations induces attentional competition, children shifted their gaze from text to illustrations more frequently in the standard layout condition (M=5.71) than in the partially separated condition (M=3.92), p<.001. There was no effect of condition on reading fluency and gaze shifts were not correlated with fluency (all ps>.05). However, reading comprehension was higher in the partially separated condition (Retelling p=.08; Story Questions p<.0001). These findings suggest close proximity of text to illustrations in books for beginning readers may induce competition for attentional resources and negatively impact children's reading comprehension. We will discuss how this research can help uncover low-cost and easy to scale basic principles for more optimal design of reading materials for beginning readers to improve children's literacy skills.

4-B-15   **Self-Control and Food Attitudes in Children**

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Self-control is important for achieving long term health-related goals. Food choices are largely determined by taste and healthiness. We examined whether self-control would influence food attitudes in youth. Thirty-five children aged 8-13 years completed the self-control scale (Tangney et al., 2004). Computerized tasks measured healthiness, taste, and preference ratings on foods (Fig. 1). Estimated regression coefficients of taste and healthiness on food preference represented the relative contribution of taste and healthiness attributes on food choices. Children with low self-control perceived that unhealthy foods were more tasty and likable than healthy foods (ps = .001), but children with high self-control did not (Fig. 2). Food preferences were predicted by only taste attributes in both groups (ps < .0001) (Fig. 3). However, a negative correlation between healthiness and taste attributes was only significant in children with low self-control (p = .001). Findings suggest that children reporting lower self-control have a strong preference for calorically-dense, unhealthy foods, and a negative association between healthiness and taste.

4-B-16   **Foraging in the playroom: Random walk behavior in human infants**

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Dozens of studies report a random movement pattern called "Levy walk behavior" (or "Levy Flights") in a diverse set of organisms including microbes, insects, sharks, birds, and mammals. This movement pattern reflects how organisms experience and interact with the world across a wide range of ecological contexts. The Levy walk hypothesis suggests that the optimal strategy for searching in an unknown environment is to make successive movements in uniformly random directions where the length of each movement is drawn from a probability distribution that is "heavy-tailed." The probability Pr(d) that the walker performs a bout of length d is given by: where 1<γ<3. Here, we examined whether human infants' exploratory patterns can be explained in terms of Levy walk behavior. We observed 14-month-old infants' (N=40) locomotion in a laboratory playroom for 20 minutes and tracked their locomotor bouts. We fit a set of candidate distributions to the observed bout distances by calculating maximum likelihood. We found that paths were best fit by a heavy-tailed Levy distribution. This is the first study reporting the use of Levy walk behavior as a tool for characterizing infants' spontaneous locomotor exploration. Our findings indicate that infants' exploration strategies during free play are similar to those used by optimally foraging animals.

4-B-17   **Using fNIRS to Investigate the Neural Basis of Intersensory Processing in Early Childhood**

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Intersensory redundancy (temporally synchronous input from multiple senses) can guide attention to multimodal events, and is thought to be important for language, cognitive, and social development (Bahrick & Lickliter, 2012). Recently, the Intersensory Processing Efficiency Protocol (IPEP) has been used to assess individual differences in the development of intersensory processing (detecting a sound-synchronous target amid distractors). This task presents 6 simultaneous dynamic events in two conditions (social: talking faces; non-social: objects being lifted and dropped on a table) with a soundtrack that matches one of the events. The neural basis of audiovisual integration and the underlying source of individual differences in this ability are not well understood. Based on fMRI studies with adults (Stevenson & James, 2009), we expect lateral frontal and superior temporal areas to be engaged during performance of the IPEP. In this project, the IPEP was administered to children ages 3-5 on a touchscreen while neural data were collected using fNIRS. Behaviorally, children performed worse on the social trials. The fNIRS data revealed that both groups of children engaged lateral frontal cortex when successfully performing both social and non-social trials. However, activation in temporal cortex was stronger on social trials compared to non-social trials. These results suggest that both common and distinct neural processes are associated with sensory integration across domains.

4-B-18   Experimentally induced spontaneous memories in young children: A shortcut to episodic memories?

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When asked to recall past events, young children typically have difficulties retrieving and talking about such events (e.g., Dahl, Kingo & Krøjgaard, 2015; Simcock & Hayne, 2002). In accordance with such findings Tulving (2005) has claimed that children below the age of four are unable to travel mentally back in time to re-experience past events. We here present evidence challenging Tulving's claim. In order to respond to questions concerning the past, deliberate, strategic recall involving the use of prefrontal cortex is required. However, strategic recall is not the only way in which memories come to our minds. Diary studies have documented that young children at times recall memories of past events spontaneously (that is, without being asked or prompted; e.g., Todd & Perlmutter, 1980). Because spontaneous retrieval is based on associative mechanisms and hence less dependent on executive functions, which develops late in the ontogenesis, spontaneous retrieval may be less cognitively demanding than strategic retrieval (Berntsen, 2012). In the past, spontaneous memories in children had only been documented in diary studies. However, recently Krøjgaard, Kingo, Dahl, and Berntsen (2014) succeeded inducing spontaneous memories in 46-month-old children experimentally. In the present study we used a modified version of the experimental paradigm from Krøjgaard et al. (2014) in an attempt to induce spontaneous memories in 35-, and 46-month-old month-olds. The children visited the lab twice. The parents had been instructed not to tell the children that the study was about memory. At the first visit, the children were shown one, and only one, out of two distinct events: either a Teddy Event involving mechanical teddies that could sing and wiggle their ears; or a Game Event involving two games. When not being demonstrated, the props for the events resided in two opaque boxes. The children were not at any point given the impression that they had to remember anything. One week later the children returned to the lab, and while waiting (2 min) in front of the locked boxes for the experimenter to return, the children's possible spontaneous utterances were recorded. Two measures were used: a Word List and a Coding Scheme (assessing hits on seven dimensions, e.g. 'relieving'). Coders were blind with respects to Condition (Game vs. Teddy) and interrater agreement was 98.3%. The results from the Word List measure showed that the children spontaneously produced words only

from the word list referring to the event they had seen, but not to the event they had not seen. Similarly, the results from the Coding Scheme revealed that hits were obtained only in relation to the event they had seen. Importantly, the scores on the phenomenological dimensions (incl. 'relieving') were significant, indicating that - contrary to Tulving's (2005) claim - even the 35-month-old children at times were capable of mentally travelling back in time. These results support the recent claim that spontaneous retrieval may be a basic mode of remembering present early in the ontogenesis (Berntsen, 2009, 2012).

4-B-19   Inhibitory control predicts improvement in elementary school students' measurement strategies

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Understanding units of measurement is important in mathematics success (Lehrer et al, 2003). Children's lack of conceptual knowledge of linear measurement is revealed when an object is misaligned with the starting point of the ruler; many children incorrectly read the number at the end of the object (an immature "read-off" strategy) (Solomon et al, 2015). More mature strategies involve counting hash marks that flank the object or correctly counting linear units. We predicted that inhibitory control (IC) would help children inhibit the perceptually-salient read-off strategy, leading to improvements in strategy use over time. Children (K-3rd-graders at Time 1; N=156; 88 girls) completed an IC task (Hearts & Flowers switch trial accuracy; Wright & Diamond, 2014) at Time 1 and a shifted ruler task at Times 1 and 2 (12 months later). We noted children's most frequent strategy on the shifted ruler task. At Time 1, the majority used a read-off strategy (71%; hash-mark: 23%; correct: 6%). From Time 1 to 2, 17.3% moved to a more mature strategy. Time 1 IC predicted whether children improved in measurement strategy from Time 1 to 2 (B=3.08, SE=1.42, p=.03), controlling for grade and gender. Results held controlling for working memory. Further, results were specific to IC: performance on Hearts & Flowers non-switch blocks did not predict measurement. Results suggest that IC plays an important role in the shift from perceptually-salient to conceptually-mature measurement strategies.

4-B-20   Save the best for last? No evidence for a positive peak-end rule across the lifespan

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When people reminisce about an emotional experience, they tend to base their evaluation not on the overall pleasure or pain experienced, but on the best/worst moment (the "peak") and the final moment of the experience (the "end")--the peak-end rule. The peak-end rule has been demonstrated for negative experiences such as pain (Kahneman, Fredrickson, Schreiber, & Redelmeier, 1993). However, less is known about the peak-end rule for positive experiences. We attempted to replicate findings of a peak-end rule for candy gifts (Do, Rupert, & Wolford, 2008), and extend these findings to a lifespan sample. We gave children age 3-17 (n = 152), adults age 18-55 (n = 126), and older adults age 55+ (n = 63) either a great candy (chocolate bar) or a great candy followed by an average candy (lollipop), and asked them to rate the gift. If the peak-end rule holds, people who received both candies (high peak + low end) should be less satisfied than those that received the great candy alone (high peak & end). Though children were more satisfied with the candy than were adults, we found no evidence of the

peak-end rule in any age group. We discuss potential implications and boundary conditions for the positive peak-end rule.

4-B-21   Theta oscillations in 4-year-olds are sensitive to task engagement and task demands

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Top-down control processes are essential for guiding attention and working memory towards task-relevant information. Recently, it was suggested that frontomedial theta oscillations play a critical role in these cognitive processes. While first findings in infants hint at the involvement of theta oscillations in top-down control early in life, little is known about the involvement of these oscillations in different tasks and their specific cognitive demands. To solve the progressively complex tasks children are confronted with when approaching school age, top-down control becomes increasingly relevant for young children. Simultaneously, during early childhood, brain regions thought to generate frontomedial theta oscillations (i.e. medial frontal and anterior cingulated cortices) undergo major maturational changes. It is thus an open question whether already in preschoolers the involvement of theta oscillations in top-down control can be detected in task engagement and dependent on the specific task demands. In this EEG study, we investigated whether theta power in 4-year-old children is sensitive to being engaged in a task and to the different cognitive demands of a language- and a motor-related task. In a within-subjects design, we provided children with three different task instructions before they watched short movie clips: they were asked to either subsequently name the color of the object in the scene (Color-naming Task), to imitate the action they saw (Imitation Task) or to watch without a task (No Task). We then analyzed the children's theta-band power (3-6Hz) with cluster-based permutation tests in two contrasts: 1) Task vs. No Task and 2) Color-naming vs. Imitation Task. Additionally, we analyzed whether children's theta power increased with prolonged task engagement. The findings revealed more frontomedial theta power when the children were engaged in a task than when they had no task. The results further showed stronger theta power over left fronto-temporal sites for the Color-naming compared to the Imitation Task. This topography is consistent with adult findings on theta oscillations during language-related processing. Additionally, 4-year-olds' theta power increased with the duration of cognitive engagement. These findings support recent theoretical work highlighting the role of theta oscillations for top-down control and extend this work to neurocognitive processing in young children. Implications for adult research on the neural generators of frontal theta and for research on early childhood development are discussed.

4-B-22   Associations Between Executive Functions and Math Achievement: The Moderating Effect of Emotion Regulation

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Research has indicated close links between executive functions and mathematical skills, with each core component of executive functions (inhibition, switching, working memory) predicting unique variance in children's mathematical skills. However, little is known about how individual differences in children's emotion regulation skills affect these relations. With the current sample of 5- to 7-year-olds (N = 386) of an ongoing cross-sectional study (Grob & Hagmann-von Arx, in prep.), we investigated whether

children's emotion regulation affected the relations between different core factors of executive functions (EF) and mathematical skills. Emotion regulation, inhibition, switching, working memory, and math skills were assessed using the Intelligence and Development Scales - 2. Separate moderation analyses revealed that inhibition, switching, and working memory predicted math achievement (all ps < .01), even after controlling for age, sex, maternal education, and verbal reasoning; however, emotion regulation did not (all ps > .34). Importantly, the interaction terms of EF x emotion regulation were significant for each core component (all ps < .05), indicating that the link between different EFs and math varied as a function of emotion regulation. Simple slope patterns indicated an amplifier effect of emotion regulation in that children who scored high on either inhibition, switching, or working memory could boost their math skills when having high emotion regulation skills.

4-B-23 Exploring links among subjective social status, prefrontal cortex structure and cognitive skills in children

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Subjective social status (SSS) is an index of an individual's perception of his or her social standing, as opposed to more objective socioeconomic factors, such as income and education. Although SSS has well-established links with health outcomes in adults, less is known about the ways in which parental SSS may relate to prefrontal cortex (PFC) structure and cognitive skills in children. Thus, in this ongoing study, we examined associations between parental SSS and PFC structure and cognitive skills in 5- to 9-year-old children (N = 77 cognitive assessments, 33 MRI scans). Preliminary analyses revealed that higher parental SSS was significantly correlated with reduced surface area of the right rostral middle frontal gyrus (r=-.403, p<.05), a region known to play a significant role in cognitive control. While objective measures of family socioeconomic status were associated with children's cognitive skills, SSS was not. Future work in larger samples will explore the relative contributions of objective and subjective factors to cognitive and neural outcomes.

4-B-24 Transfer of Metacognitive Strategy Learning in Young Children

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With training, young children can learn a strategy to optimize their performance in a task -- something that they fail to do without training (O'Leary & Sloutsky, 2016; O'Leary & Sloutsky, submitted). For example, 5-year-olds can be trained to select the easier of two games (e.g., the red or the blue game) to achieve optimal performance. However, the nature of the strategy that young children form has yet to be investigated. It is possible that young children form a strategy that is specific to the current task at hand (e.g., to select the blue game). Alternatively, they may form a strategy that is more abstract (e.g., to select the easy game), and can more easily transfer to a novel task (Siegler & Jenkins, 1989). To investigate the nature of the strategies children form, a pre-/post-test design was used to assess whether successful strategy training in one task (i.e., to select the easier of two numerical discrimination games) transfers to a novel task. Five-year-old children were assigned to an experimental condition or a control condition. In the experimental condition, children were trained (between the pre- and post-test

phases) to select the easier game by being explicitly instructed to do so and by receiving performance feedback. In the control condition, no scaffolding was provided. Children were further divided into a near or far transfer condition. In the near transfer condition, young children completed a line length discrimination task during pre- and post-test. Greater effects of training in the experimental condition than the control condition would suggest that young children formed a strategy (i.e., to select the easier game) that was sufficiently abstract to generalize to a similar task with novel stimuli. In the far transfer condition, children completed a working memory task during pre- and post-test. Greater transfer in the experimental condition here would indicate that children formed an abstract strategy, and that they could apply this strategy across dissimilar tasks. In the near transfer condition, young children who learned to apply a strategy rule showed more gains from pre- to post-test. This suggests that the strategy formed was not dependent on the feedback and frequent strategy reminders used in training, as children continued to apply the strategy even when this scaffolding was removed. In addition, the findings suggest that the strategy formed was not tied to the specific stimuli in the task in which they learned. On the contrary, young children formed a strategy that was sufficiently abstract to identify and select the easier game in a task with unique stimuli. In the far transfer condition, some (but not all) children showed clear evidence of transfer. Together, these findings suggest that strategy transfer may be stimulus-independent, but somewhat task-dependent, in young children. The implications of these findings for training young children's metacognition will be discussed.

4-B-25 Executive function facilitates learning from math instruction

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Early math is a robust predictor of success in later academic years, and extensive evidence has suggested executive function (EF)--skills engaged in the achievement of goal-directed behaviors--is strongly related to early math. Further, EF has been shown to be associated with learning-related behaviors. In the present study, we investigate whether EF moderates math learning in a diverse sample of 1st grade children. Data come from a prospective longitudinal sample of 1,292 children from non-urban, low-income counties in PA and NC. Math ability was assessed using the Applied Problems subtest of the Woodcock Johnson in K and 1st grade; EF was measured with 3 widely-used tasks. First-grade teachers reported frequency of math activities and explicit math instruction. Both scales demonstrated good internal consistency. Over and above stability in math from K to 1st grade, EF and Instruction--but not Activities-- were associated with math at 1st grade. Further, the interaction between EF and Instruction predicted math in 1st grade. Analysis of simple slopes revealed that for children with mean levels of EF, Instruction was moderately associated with 1st grade math; for children with EF 1SD above the mean, amount of Instruction was not associated; and for children with EF 1SD below the mean, Instruction was strongly associated. Findings suggest amount of math instruction matters more for those with low EF than for those with average or high EF. Implications will be discussed.

4-B-26 Executive Function Skills Predict Event Processing and Recall in Preschoolers

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Often there is little need to attend carefully as events unfold across time; at times, however, goals or situational demands make it important to attend carefully in order to remember event content. An as yet unanswered question is precisely what changes in processing when an effort is made to attend. As well, it seems plausible that people may differ in their ability to recruit attention voluntarily; perhaps executive function (EF) skills influence observers' ability to flexibly engage attention when desired. Eighty-four children (N = 43 female) between the ages of 36 and 48 months (M = 41.8) were randomly assigned to one of two conditions. In the Neutral condition, children were simply asked to advance at their own pace through a series of slides depicting an actor packing a number of items into a suitcase. In the Attention condition, children were explicitly asked to pay attention in order to remember what they saw later, and then advanced through the self-paced slideshow. Looking times to each slide served as a measure of attention modulation throughout the event. Participants then answered a series of verbal memory questions regarding the event and completed a battery of EF tasks. Using this innovative new "dwell-time" method of measuring how children modulate their attention to an unfolding event, results replicated previous findings that overall, participants tended to look longer to slides depicting gist-level details of the event than to slides depicting fine-grained details, $t(83) = 3.60$, $p<.001$, (Hard, Recchia & Tversky, 2011; Meyer, Baldwin, & Sage, 2011). To address our primary research questions, first a repeated measures ANOVA with EF (High vs. Low) included as a between-subjects factor showed that children with strong EF skills tended to show adult-like attention modulation patterns across the slide show, whereas children with poorer EF skills did not, suggesting that EF skills may play an important role in effective event processing $F(2,164) = 6.859$, $p = .001$. Second, an independent samples t-test showed that children with strong EF skills scored significantly higher on event memory than those with poorer EF skills $t(82) = -2.381$, $p = .02$. Third, a significant interaction between condition (Neutral vs. Attention prompt) and EF group suggested that prompts to pay attention affected memory outcomes differently for children with strong versus weak EF skills, $F(1,80) = 5.009$, $p = .028$. Simple effects analyses revealed that this effect was driven by differences in the Attention condition. When explicitly told to pay attention, children with strong EF skills showed significantly better memory performance than those with poorer EF skills, $p = .001$. Finally, exploratory analyses suggested children prompted to pay attention showed marginally more efficient attention modulation patterns across the event, $F(1,80) = 3.544$, $p = .063$. This is the first evidence to date, to our knowledge, linking children's emerging EF skill with processing of events, on the one hand, and memory for events, on the other. These findings help to showcase the way in which EF deficits can seriously undercut children's ability to flexibly alter their processing, which in turn undercuts their learning across domains.

4-B-27   Impossibly Special: Impossible but not Improbable Events Boost Children's Learning

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Infants and children learn better following physically impossible, surprising events than closely matched events that are physically possible and therefore unsurprising (Stahl & Feigenson, 2015; 2017). Here we asked whether events that are surprising because they are merely improbable (not impossible) also boost learning. We showed 2- to 3-year-olds a gumball machine containing 20 novel toys that children could easily see. We taught them that inserting a coin made one toy "randomly" emerge from this distribution. In the Expected condition (n=32), the retrieved toy had a 50% chance of being drawn; in the Impossible condition (n=31), it had a 0% chance of being drawn (because no toys of that type were in the observed distribution). After the toy emerged we taught children that it was called a 'blick', and at test asked them to identify the 'blick' among two distractors. Children who saw the Expected outcome

failed to learn, whereas children who saw the Impossible outcome learned the novel word. Critically, three additional groups of children saw an Improbable outcome, in which the retrieved toy had either a 10% (n=26), 5% (n=32), or 2.5% (n=35) chance of being randomly drawn. These children all failed to learn the novel word for the toy, despite its retrieval being surprising because it was quite unlikely. Thus, the ability to even conceive of an outcome´s possibility, even if highly unlikely, appears to diminish the effect of surprise on learning.

4-B-28   The Real Thing: Preschoolers Prefer Actual Activities to Pretend Ones

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Pretend play is a quintessential activity of early childhood, and adults supply children with many toys to encourage it. Yet in traditional societies, children pretend much less, and instead do more real work, engaging in practical life tasks with functional tools. Do young children actually prefer to pretend, or do they do it because they are unable to engage in some activities for real? Here we examined, for nine different activities, American middle-class preschoolers' preferences for pretend and real activities. 100 children were tested (M = 58.5 months, range 36 to 82 months). Children chose real activities 65% of the time. The preference increased from age 3, when pretend choices were made 53% of the time; from age 4 on, real choices were made over 70% of the time. Children provided cogent justifications for their preferences. They preferred real activities because they are functional, useful, and provide novel experiences. When they preferred pretend activities, the typical reasons were being afraid of the real, lack of ability, and lack of permission. Two control studies showed the results were not due to real pictures appearing more fun, or to another aspect of the pictures. For the latter study, two identical line drawings were described as pretend and as real, and children still preferred the real activity. Additional studies are exploring whether these preferences are reflected in children's actual behavior, and whether children might prefer pretend for items that involve identity (namely, role enactment) rather than action. The results are discussed with reference to children's developing sense of self-efficacy and the content of preschool curricula.

4-B-29   Does Executive Function and Language Underlie the Development of Moral Disgust?

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The current study examined the influence of executive function (i.e., EF, or conscious control) and language on the emergence of moral disgust. Thirty-seven 3-year-olds, twenty-eight 4-year-olds, and fourteen 5-year-olds completed a battery of EF (i.e., delay of gratification, dimensional change card sort, and backward digit span), language (i.e., Peabody Picture Vocabulary Test), and disgust understanding tasks (i.e., disgust rated on a 5-point likert scale in response to different actions, Danovitch & Blooms, 2009). A difference score (i.e., disgust ratings for moral compared to negative events) was calculated to determine whether children understood that moral events (e.g., stealing) should be considered more "disgusting" than negative events (e.g., an accident). Results demonstrate that only 4- and 5-year-olds rated moral actions as more disgusting than negative actions, suggesting moral disgust understanding may emerge earlier than the previously examined kindergarten age. Only language predicted better moral understanding when accounting for age and EF, possibly because a better vocabulary may relate

to better representation of mental states (e.g., children may be more likely to use words to describe emotions). This study expands work examining children's moral disgust understanding to a younger age, while also revealing the underlying cognitive abilities that contribute to moral disgust appreciation.

4-B-30   Examining The Effect of Target-Distractor Similarity on Single-Feature Target Search Performance in Children and Adolescents

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Whereas simple single-feature target searches such as pop-out can be performed as early as in infancy (i.e., Adler & Orprecio, 2006), more difficult searches such as conjunction searches requiring the binding of 2 unique features, are still difficult to perform well into childhood (i.e., Donnelly et al., 2007). It remains unclear, however, how visual search performance improves from childhood to adulthood in cases where the target is defined by a single unique feature but search is difficult. To examine this, 9- to 10-years-olds, 14- to 15-year-olds and young adults (19+ years), were tested on a single-feature search task, in which the level of target-distractor similarity, and thus difficulty, was manipulated. Results revealed that 9- to- 10-year-olds were significantly slower to detect the target at all levels of target-distractor similarity. Age group differences in the slopes of the RT - set size function were also found. How these differences can inform about the development of attention will be discussed.

4-B-31   Do Not Forget Your Lunch: Executive functions in everyday tasks

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Executive function (EF) refers to a set of neurocognitive processes involving goal-directed behavior necessary to execute everyday tasks, such as getting ready for school. To date, cognitive research has relied on lab-based tasks to examine different components of EF, and parent report measures of their child's EF in the real-world. To better understand the everyday importance of EF, we designed a lab-based task that mimics the demands of the real world. Six- to ten-year-old children followed a plan to get ready for school, including making a lunch and packing it in their backpack. Children wore a mobile eye-tracker during the task so we could gain a first-person perspective of decision-making. Preliminary results show that with age, children more accurately executed the plan. We will present additional analyses examining relations between standard lab-based EF tasks, parent reported EF measures, and the child's accuracy and efficiency in completing this real-world task.

4-B-32   Longitudinal Associations Between Maternal Behaviors During Problem-Solving and Children's Cognitive Flexibility in Early Childhood

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Cognitive flexibility - the ability to switch responses flexibly across tasks, rules or operations - predicts better math and reading performance (Yeniad et al., 2013) and greater social understanding (Bock,

Gallaway, & Hund, 2015). Given that early childhood is a period of rapid transformation in cognitive flexibility, it is important to understand which caregiver behaviors may lead to improvements in this aspect of executive functioning during this period. The goal of this study is to examine the differential roles of mothers' emotional support and cognitive support during problem-solving activities in the development of cognitive flexibility and to test whether child cognitive flexibility leads to changes in caregiving behaviors over time. In particular, emotional support may contribute to child cognitive flexibility by motivating children to exert control and helping children regulate distress and engage in activities that may improve cognitive flexibility (Carlson, 2009). Cognitive support may allow children to understand the task at hand and use cognitive skills (e.g., counting) that may improve cognitive flexibility. Children with greater cognitive flexibility may evoke greater emotional and cognitive support from their caregivers. Two hundred seventy-eight children (55% female, 59% European American) and their mothers participated in laboratory visits when children were in preschool, kindergarten, and first grade. At each visit, cognitive flexibility was measured via a computerized version of the Dimensional Change Card Sort (DCCS) task. Children's percent score on post-switch (30 trials) and borders (12 trials) blocks were averaged to create a cognitive flexibility score. At each visit, mothers' behaviors were observed during a semi-structured problem-solving task. Emotional support was operationalized as higher levels of emotional responsiveness, and lower levels of negativity and intrusiveness, and cognitive support was operationalized as the extent to which mothers' provide appropriate information about the task, use demonstrations, and link the task to daily life. Structural equation modeling analyses were conducted in Mplus 7.4. The measurement model including emotional support as a latent variable at each time point had excellent model fit [CFI=1.00, RMSEA=.00 (.000-.034), SRMR=.023]. The cross-lagged model including child age and minority status, and maternal education as covariates fit the data well [CFI=.930, RMSEA=.056 (.044-.068), SRMR=.065]. Cognitive flexibility, emotional support, and cognitive support showed stability over time. Greater maternal emotional support predicted greater child cognitive flexibility from preschool to kindergarten (B=5.61, SE=2.76, p=.042), and from kindergarten to first grade (B=4.79, SE=2.27, p=.034). However, mothers' cognitive support did not predict child cognitive flexibility and child cognitive flexibility did not predict mother behaviors over time. This study suggests that mothers' emotional support, but not cognitive support, during problem-solving activities may be a driving force in the development of children's cognitive flexibility in early childhood. This finding suggests that improving mothers' emotional support may be a viable strategy for improving children's cognitive flexibility and adaptive functioning. Contrary to findings from previous research (e.g., Blair, Raver, & Berry, 2014), child cognitive flexibility did not predict changes in parenting over time.

C - Concepts, Categorization, Casual Learning

4-C-33   The Last Straw: Can Thought Experiments Advance Children's Understanding of Weight

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Note: This study was submitted/accepted at SRCD, but it was NOT presented at SRCD We asked if a thought experiment (TE) can help young children to advance their understanding of matter, and if yes, then how. Like Aristotle, young children believe weight to be a property that some physical entities lack. Would children revise this belief if provided with counter evidence in a real and in a TE? To answer this

question, we tested 122 6- and 7-year-olds in a pre-training/ training/ post-training study. The pre- and post-training interviews consisted of questions about the weight of different pieces of matter and questions about other inter-related concepts. In the real experiment condition, children received evidence that a single grain of rice can topple a card placed on a fulcrum. In the TE condition, children simulated in their head what would happen if one keeps adding grains of rice on one side of the card or if the fulcrum gets thinner. The results showed that children could correctly simulate in the TE. In addition, both the real and the TE had large effects on the posttest judgments about the weight of a grain of rice and there was significant transfer to other pieces of matter in both conditions.

4-C-34   Examining Parent-Child Conversations while Reading Fantasy/Reality Storybooks

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Preschoolers' fantasy-reality distinctions vary by the emotional content of the information, such that preschoolers report that happy and sad fantastic or real events can occur more often than frightening events (Carrick & Ramirez, 2012). The present study examined the role parents play in children's fantasy-reality distinctions, given that children rely on parents' testimony when evaluating information and use parents to understand and regulate emotions. 59 parents and their children (3- to 5-years-old) read happy, frightening, and sad stories that contained either fantastic or real events. Their conversations were coded and analyzed for patterns across story conditions. Findings revealed that parents encouraged belief in happy and sad events by engaging children with the events (e.g., relating events to child's life, helping characters), and discouraged belief in frightening events by distancing children from events (e.g., ameliorating situation, saying events are not real). Findings are discussed in terms of how parent-child conversations shape children's emerging understanding of fantasy and reality.

4-C-35   Children expect physically versus mentally similar individuals to share different types of properties

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Children believe that individuals who share physical traits or category membership also share properties (e.g. Gelman & Markman, 1987). We asked whether children expect that individuals who share mental states will share properties, and whether physically versus mentally similar individuals will share different properties. We showed 4-6-year-olds (n=22) and 7-10-year-olds (n=25) drawings of a girl, Nina, and two other girls: one who "looks like Nina" (Physical match), and one who "thinks like Nina" (Mental match). We asked children which of the girls shared with Nina mental, physical, or hybrid mental/physical Traits (e.g. "Can count to a million" (Mental); "Grows fast" (Physical); "Speaks with a loud voice" (Hybrid)) or Essences (e.g. "Has a mind like Nina" (Mental), "Has a brain like Nina" (Physical); "Is more like Nina" (Hybrid)). For Traits, children chose the Physical match for Physical traits ($p<0.001$) and chose at chance for Hybrid traits ($p=n.s.$). For Mental traits, older children chose the Mental match ($p<0.01$) while younger children chose at chance ($p=n.s.$; 4-6 vs. 7-10 $p<0.001$). For Essences, older children chose the Mental Match ($p<0.0001$, older vs. younger $p<0.001$), while younger children chose at chance (all $ps=n.s.$). These results suggest that children expect physically similar individuals to share

physical properties, but their expectations about who should share mental properties changes over development, from an uncertain conception to a mental conception.

4-C-36   Preschoolers rationally use evidence to select causally relevant variables

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Can preschoolers learn from evidence to determine which variables will be relevant for intervention on a novel causal system? N=42 preschoolers (21 three-year-olds and 21 four-year-olds, mean age = 48.1 months) saw three animated sequences in which a seed grew into a cactus when it was planted in a pot and watered with a watering can. Pots had distinctive patterns and watering cans had distinctive colors. Cactuses could turn out either spiky (bad outcome, for a turtle who wanted to eat them) or smooth (good outcome). In the first two sequences, children saw that replacing one of the causes (e.g., a yellow watering can for a blue one) did not make a difference to the outcome: cactuses were smooth each time. In the third sequence, children saw that changing the other variable (e.g., changing a polka dotted pot to a striped pot) did produce a difference: the outcome was a spiky cactus. At test, children saw a novel watering can and a novel pot produce a spiky cactus. They were asked, "Which do you think we should change to make a smooth cactus, the pot or the watering can?" Children chose the correct (i.e., difference-making) variable 78.57% of the time, p<0.0001, with no difference between pot-relevant and watering can-relevant conditions. Ongoing studies investigate whether children show transfer for the relevance of analogous elements of similarly structured causal systems: e.g., mapping the causal relevance of "B" in the causal chain A»B»C to intervene on "Y" in X»Y»Z.

4-C-37   Children's Understanding of Learning and Its Relation to Their Learning

Jeein Jeog[1], Douglas Frye[1]

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This study examines young children's understanding of learning based on the learner's knowledge state, and how that understanding is related to the child's own learning. Eighty-five children aged 3 to 5 years were presented with novel (e.g., how to 'juna') as well as familiar knowledge (e.g., how to clap), and asked whether they knew it, whether they need/want to learn it, and if really learned it from the researcher. How much novel knowledge they acquired in the situation was also measured. The results showed that with age, children come to understand that if they are ignorant, they need and want to learn, but if already knowledgeable about something, they do not need to learn it again. Moreover, children's understanding of learning was related to their actual learning and behaviors in the learning situation, even with age and language ability controlled.

4-C-38   Proposal for an open database of psychological stimuli

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As a field, we have a wealth of stimuli (pictures, speech recordings, animated and live videos, etc.) that are central to our experiments and theories. As individual researchers, however, developing or finding these stimuli is often a significant bottleneck. If you know of existing stimuli, the authors will often be willing to share, but these materials are scattered across paper appendices, laboratory websites, and online file systems- it can be very hard to discover stimuli you're not already aware of. If you do find them, we have not agreed as a research community how to share information about them - have they been normed for familiarity with a certain population? Are they appropriate for 2 year olds but not 4 year olds? How should they be cited? There is an alternative. The CHILDES database (MacWhinney, 2000) revolutionized language acquisition research by bringing corpora together in a central repository, using a standardized format, and adding new information about the corpora (e.g., part-of-speech tagging) over time. We can do the same for our stimuli, by creating metadata standards and an online sharing platform. I will present a prototype of such a system, focusing on a survey of what stimuli we have, which are already shared openly, and what common information will help us use and reuse stimuli to support theory building. This will facilitate not only sharing and discovery, but also new kinds of research and a more cumulative and robust science of the human mind.

4-C-39   Children use labels, but not discrete boundaries or stability over time, as cues to essentialize a novel category

Rebecca Lange[1], Paul Muentener[1]

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Previous research has shown that children treat natural and social categories as 'essential' - they expect category membership to be stable over time, that categories will have discrete boundaries, and that categories will map onto labels. The current study examined whether children can use these characteristics as cues to determine whether a category should be essentialized. In this study four- to six-year-old children (n=140) were introduced to novel characters who varied in color, shape, and texture. Children were provided with a single cue (Stability, Discreteness, or Labels) to form categories on the basis of texture. The cue varied by condition: texture was stable as creatures grew older, but color and shape changed (Stability condition); texture came in discrete categories, but color and shape varied along a gradient (Discreteness condition); or creatures were labeled differently according to texture, but not according to color or shape (Label condition). We found that children in the Label condition, but not the Stability or Discreteness conditions, used texture to make inferences about which characters shared kind-like properties (p<.05), as shown in Figure 1. Findings suggest that while children expect essentialized categories to be stable and discrete, they do not spontaneously use this information to determine whether a category is essential.

4-C-40   How Children and Adults Reason About the Persistence of Characters in Fairy Tales

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It is commonly assumed that both children and adults reason about the transformations that occur in fairy tales as involving individuals that persist through dramatic appearance changes. Yet this assumption has not been examined experimentally. We investigated the role of language in guiding attributions of individual persistence to a transformed character in a fairy tale. Adults, 3-year-olds, and

5-year-olds (n = 64 per age group) were presented with a storybook adaption of The Frog Prince, in which a frog is transformed into a prince. We labeled the frog with a proper name (i.e., Charlie) and queried participants about the character's persistence following the transformation (i.e., "Is this Charlie?"). Between conditions, the transformation was described using either continuous (i.e., "the frog turned into a prince") or discontinuous (i.e., "the frog vanished and a prince appeared") language. Adults always judged the post-transformation character to be the same individual and were more likely to do so than either 3- or 5-year-olds. Furthermore, 3-year-olds were more likely to judge the character to be the same individual when the transformation involved continuous language. Adults thus may be more likely than young children to infer that fairy-tale transformations involve persisting individuals; and the use of language that implies continuity through change may enhance these inferences in preschoolers.

4-C-41   Stepwise versus globally-optimal information search in children and adults

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How do children search for information when myopic strategies that only consider the immediate next time step fail to identify the globally most efficient query? Previous studies investigated children´s information search using variants of the 20-questions game, where the goal of the searcher is to identify an unknown target item by asking as few yes-no questions as possible. These studies quantified the informativeness of children´s questions in terms of stepwise information gain, that is, the expected reduction of entropy on the next time step. In some cases, choosing questions according to such a myopic strategies is the most efficient approach to identify the true item as quickly as possible. However, this is not true in general, because stepwise-optimal methods are not guaranteed to identify the most efficient sequence of questions. Are children or adults able to identify the best questions in scenarios that require planning ahead by considering which questions will be available on the next time step? We used computer simulations to identify an environment (set of items and feature distributions) in which stepwise-optimal methods like entropy reduction in the next time step and simple strategies like the split-half heuristic fail to identify the best first question. We compared children's (n = 43, mean age = 10.4) and adults' (n = 48, mean age = 43.9) search behavior in an environment where stepwise-optimal methods fail to identify the best first question. Subjects were given the choice between four initial questions: they could choose among three constraint-seeking questions, which differentiated between subsets of multiple items, and several hypothesis-testing questions, which targeted individual items. Importantly, the two constraint-seeking questions with the highest information gain were not equally efficient: while both questions entailed an identical reduction of uncertainty in the next time step, one of them was uniquely optimal in terms of reducing the expected number of questions needed to identify the unknown target. After the first question, subjects could choose among the remaining questions; subsequently they could generate arbitrary questions. To incentivize efficient search, subjects had to pay 0.5 euro for each question, from an initial endowment of 5 euro. The findings indicate that both children and adults tend to rely on boundedly rational strategies, focusing primarily on questions´ implications for the immediate next time step. Children´s search was as globally efficient as adults´ search when selecting from a set of candidate questions. When generating questions from scratch, however, adults tended to generate higher information value questions.

4-C-42   The emerging causal understanding of institutional objects?

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Psychological research has largely neglected institutional objects, a unique set of human-made objects including money, membership passes, and borders. Their trademark is that their functions stem from the ongoing intentions of the community that uses them, rather than their physical structure. For example, money's value is not inherent to its physical form; rather, money's value is assigned to it by a community via their mutual intentions. In contrast, the primary functions of objects like hammers are afforded directly by their physical structure - independent of the community's current intentions. In this paper we take a developmental approach, exploring whether children distinguish between these two broad classes of objects: institutional objects like money and standard artifacts like hammers. To do so we adapt a transformation paradigm to examine whether children believe that changes in a community's intentions about an object cause an object to change category membership and possible function. Previous research suggests that children and adults tend to believe that the way artifacts are grouped together or categorized might be culturally contingent (and thus based in mutual intentions). Where these two types of objects come apart is their possible functions. Hammers physically afford certain actions (e.g., forceful blows) because of their physical structure, whereas money affords certain actions (e.g., buying bread) because of cultural conventions. Thus, after a community changes its intentions about an object, only standard artifacts retain their same affordances. We interviewed 90 children divided equally across three age ranges: 4-5, 6-7, and 8-9-year olds. All conditions are within-subject, including question type (categorization vs. possible function) and object type (standard artifact vs. institutional object). Children are presented with a faraway island inhabited by a single social collective, the Vawns. Children learn about novel sets of objects (e.g., gadas) and their conventional functions (e.g., cracking open nuts). The Vawns decide that a subset of the objects is no longer a member of the category. Children are asked (in randomized order) whether the objects are still members of the category (are these gadas still or not gadas anymore?), and more importantly, whether they still afford the same possible function (can a Vawn still use one of these to crack nuts?). Critically, we fully cross the physical appearance of objects, such that whether any given object stimulus is a standard artifact or institutional object is randomized. Young children (4-5 years old) believe that all objects, including institutional objects like money, retain their possible function. The recognition that mutual intentions play a causally determinative role in the possible function of institutional objects emerges during the early elementary years, becoming robust by 8-9 years. This is the first empirical research in any population to document that mutual intentions underlie the possible functions of institutional objects. Indeed, there has been little acknowledgement that institutional objects are conceptually distinct from other types of human-made objects. Thus we believe our manuscript fills an important gap in previous research, while simultaneously documenting striking changes in children's intuitive theories about human-made objects during the early elementary years.

4-C-43   Assessing Event Representation with Objects in Children with Autism Spectrum Disorders

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Insistence on sameness is a characteristic unique to autism in which children establish rigid routines and have difficulties adapting to change in everyday life. Thirty-four pre-school children (n=10 ASD; n=10 typically developing; n=14 cognitive and linguistic delays) were assessed using the generalized imitation

paradigm. After observing causal, arbitrary, and familiar sequences of actions modeled by the experimenter with one set of objects, children were then given a functionally similar set of objects that they could use to generalize the events. Comparative data revealed that all groups were able to generalize and imitate actions and sequences compared to their baseline assessments. Although all three groups generalized fewer causal actions, ASD children performed as well as TD children. However, children with cognitive and language delays showed more differences, generalizing substantially fewer causal actions than the other groups. Furthermore, verbal IQ data was also related to generalization ability: CLD children with higher verbal IQ generalized better on these tasks than those with lower IQ. Although some participants found generalizing actions to be problematic, their sequential understanding of events remained intact. Findings suggest that in the face of change, children with autism, especially those with higher verbal abilities, can spontaneously generalize novel and familiar events as well as their typically developing counterparts under some circumstances.

4-C-44 Developmental shifts in a preference to learn about social categories versus individuals belonging to those categories

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The ability to represent information about social categories (e.g., females, African Americans) is essential for navigating the social world, particularly as category representations enable people to infer the most appropriate way to interact with each person they encounter. people ubiquitosly categorize individuals and generalize newly learned information about individuals to their category; therefore, they do not need to learn anew every time they meet someone. For instance, after learning that a member of a group celebrates a particular holiday, one might infer that other members of the group generally celebrate this holiday as well. The tendency to quickly and easily generalize new noncategory information may partly stem from a more basic drive to acquire information about categories more readily than information about individuals. As an initial step to test such a drive, we asked participants to choose between learning facts about novel social categories (e.g., "Norbins") and facts about individual members of the category (e.g., "This Norbin"). Adults chose to learn about the category more often than the individual, $t(44) = 4.72$, $p < .001$, $d = 1.42$. We replicated this result with a larger, online sample ($N = 146$) to assure that the effect of category-level facts is robust. Importantly, this preference was not explained by a preference to learn about many individuals over one, as participants showed no preference to learn an existential fact (e.g., (e.g., about "Some Norbins") over an individual fact (e.g., about "This Norbin"), $t(45) = 1.59$, $p = .12$, $d = 0.47$. Children showed a different pattern of responses, however, with preliminary data suggesting that they may not show the same preference to learn about social categories over individuals. Instead, 5-8 year-old children showed no learning preference at all, $t(65) = 0.51$, $p = .62$, $d = 0.13$. These results contrast with previous evidence that children prefer to learn about animal categories than about individual animals belonging to those categories (Cimpian & Park, 2014). The current work therefore makes headway towards better understanding preferences to learn about categories across development, and across domains. It also improves understanding of the underpinnings of social category reasoning - people may be particularly driven to learn about social categories, but this preference may be learned over time as the categories become more relevant to one's social engagements.

4-C-45 Of blickets and butterflies: The effect of contextualization on diagnostic reasoning

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Although studies of causal reasoning suggest that preschoolers can successfully diagnose the causal structure of novel systems (e.g., Gopnik, Sobel, Schulz, & Glymour, 2001), tests of scientific thinking show that children struggle with analogous tasks until late in elementary school (Kuhn, Pease, & Wirkala, 2009). One way to reconcile these conflicting results is to note that causal reasoning tasks tend to use decontextualized systems (e.g., blicket detectors), while scientific thinking tasks tend to use contextualized tasks that involve prior knowledge. We investigated the effects of contextualization on children's diagnostic reasoning capacities asking children (N=215, mean age = 85.7 months, range = 48.3 - 130.7) to either figure out pair of colored blocks would make a machine light up (Decontextualized) or to figure out which pair of colored flowers would attract green butterflies (Contextualized). Aside from their surface features, the tasks presented identical additive causal models. Children were no more likely to succeed in the Decontextualized task (40.2% correct) than the Contextualized task (42.2% correct; $X2(1, N=215) = 0.09$, ns), suggesting that prior knowledge does not interfere with children's reasoning abilities. This conclusion was confirmed in a within-subjects study (N=97, mean age = 81 months, range = 46.2 - 132.9), in which performance on the two tasks was uncorrelated, $\rho(97) = .09$, ns.

4-C-46   Does Training Facilitate 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 (Vukatana et al., 2015) demonstrated that 11-month-olds learnt and generalized novel animal-sound associations when familiarized with multiple exemplars, but not a single exemplar. 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 category exemplar. 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 =33). 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 = .48) trials, indicating that they did not acquire the original animal-sound pairings nor extend the sound to new members of the same categories. Our findings suggest that at 11-months of age, the demands of learning two novel animal-sound associations outweigh the benefits that categorization training may provide.

D - Cultural Learning

4-D-47   Listening in: Teachers' role in supporting preschoolers' science learning on playscapes

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Playscapes are playgrounds that resemble a natural environment. Rather than man-made playground equipment, they feature native plants, rolling hills, trees, logs, etc. The explicit intent of their designs is to expose children to nature in a safe and playful manner. And indeed, there are several benefits attributed to the use of playscapes, including motor development (e.g., increased gross motor skills), cognitive development (e.g., increased attention span), and social development (e.g., decrease bullying, increased social skills). In the current paper, we focus on yet another potential benefit: learning about science. Science is an amorphous domain defined by facts (science content) and processes (scientific method) for the area of life science, physical science, and earth/space science. While preschoolers can easily learn some science concepts via spontaneous exploration, other concepts are rather challenging, even prone to misconceptions. For the latter concepts, teachers are crucially important, namely to highlight science-relevant aspects of the surrounding and allow children to ignore irrelevant aspects. For playscapes, both types of science concepts are present: those that can be learned spontaneously, via explorations (e.g., the difference between caterpillars and butterflies), and those that require guidance (e.g., the life cycle of a butterfly). To what extent do preschool teachers support children's science learning on the playscape? To answer this question, we carried out a case study with 10 teachers interacting with preschoolers on the playscape. No specific training was provided, and teachers were told to interact as they naturally would. To get at the effect of context, two types of playscapes were used: one located in a rural area of a nature preserve, and one located in an urban setting. To get at whether teacher interaction change over time, teachers completed up to five visits (to one or both playscapes). Their interactions with children were audio-taped. Teacher audio was transcribed and divided into chunks of utterances. Depending on the content, chunks could vary in length from a few words to whole sentences. The relevant aspect was for a chunk to convey only one concrete idea. Chunks were then categorized by two different raters (interrater reliability: 82%; disagreements were decided upon with the help of a third rater). The categories were: (1) science-relevant utterance (e.g., "those are geese"), (2) science-diverting utterance (e.g., "there is magic in the grass"), (3) supervisory utterances (e.g., "do not throw rocks"), and (4) other utterances (e.g., "I can take your picture."). For each teacher and visit we calculated the relative percent of science-relevant, science-diverting, and supervisory utterances. The most striking finding was the difference between teachers. While science-relevant utterances were prominent for some teachers (n = 3), supervisory utterances were prominent for other teachers (n = 5). This finding was not modulated by the number of visits: Even after three visits, the relative amount of each type of utterance stayed within less than 3% of change. However, the type of playscape affected teacher interaction: The relative proportion of supervisory utterances increased by at least 10% for all but one teacher in the rural playscape. These findings point to the need to increase teacher training to ensure science learning in nature.

4-D-48   Preschoolers do not test counter-intuitive claims: Evidence from Turkey

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We presented Turkish preschoolers (M=4.42 years, SD=.70; N= 86) with five different-sized Russian dolls for visual inspection and asked them to say which doll was the heaviest. All children stated that the biggest doll was the heaviest. We then provided half of the children with counter-intuitive testimony, telling them that the smallest doll was the heaviest and that the biggest was the lightest, a claim that was false. The other half of the children received testimony confirming their intuitions (i.e., that

biggest=heaviest). When subsequently questioned, almost all children who received counterintuitive testimony endorsed the claim that smallest=heaviest. Next, the experimenter left the room, giving children an opportunity to seek empirical evidence by picking up the dolls. Children rarely explored, no matter what testimony they had received. Upon the experimenter's return, children were told that they would get to keep a bag of candy if the doll they placed on a scale was heavier than the bag of candy. Almost all children who had endorsed the experimenter's claim that the smallest doll was the heaviest selected the smallest doll, only switching to the biggest doll on a second trial after seeing that the smallest doll was not heavy enough. Thus, preschool children endorse a counter-intuitive claim and do not spontaneously seek evidence to test it despite being able to learn from such evidence when prompted to gather it.

4-D-49 Children's Intention Understanding and the Development of Religious Concepts

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The development of children's religious concepts is influenced by socio-cultural factors, such as the beliefs, doctrines, and rituals of their religion. A mechanism by which socio-cultural factors influence concept development is through internalization of cultural concepts. Children's ability to understand intention allows internalization to happen. The present study interviewed sixty-six children between the ages of 4- and 7-years-old to assess their understanding of intention in the context of the ritual of baptism as well as their concepts of God and supernatural causality. Children judged the efficacy of four variations of a prototypic baptism, which varied in the practitioner's intention and performance. Children's efficacy judgments held together along two dimensions: intentional and accidental acts. Children's efficacy judgments of intentionally performed religious behavior were related to their concept of God's knowledge. Children's efficacy judgments of accidentally performed religious behavior were related to their concept of God's properties and natural explanations of baptism.

4-D-50 The Examination of Turkish Preschoolers' Possibility Judgments and Explanations about Extraordinary Events

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Young children learn about the world not only through experimentation and observation but also through communication with others. Knowledge acquired through communication is particularly important when it comes to unobservable or unobserved extraordinary events. Research with Western samples has shown that children (<10 years of age), unlike adults, tend to judge both improbable (e.g. having lion as a pet) and impossible (e.g. walking on water) events as impossible. In their justifications, children provide either non-informative or hypothetical explanations, while adults provide more factual explanations. We examined the development of possibility judgments and explanations with 3-, 4- and 5-year-old Turkish preschoolers from middle-class and low-income families. We presented 71 children (36 middle-class) with booklets consisting 4 improbable, 4 impossible, and 4 ordinary events. Results confirmed earlier findings that Turkish preschoolers judged both improbable and impossible events as impossible. Children from low-income families judged extraordinary events as possible more frequently than those from middle-class families ($p<.001$). Children from low-income families provided more non-

informative explanations for their judgments than children from middle-class families. The differences between socioeconomic groups are discussed in terms of children's conceptual knowledge states, and higher preservation of traditional values and deferential stance among low-income families.

E - Language Development

4-E-51 Learning new words from familiar ones: Can two-year-olds use linguistic context to learn from accented speech?

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During the second year of life, word learning and speech processing improve dramatically. By 19 months, infants are able to use syntax and the meanings of familiar words to learn novel words (Ferguson et al., 2014); e.g., infants know that the subject of the verb eat must be animate and so they guess that a vep is animate after hearing The vep is eating. The time it takes infants to make these referent-animacy decisions decreases to under 500ms by 24 months (Ferguson et al., under review). By 24 months infants' lexical representations are also becoming more flexible, and infants at this age recognize accented productions of both familiar (e.g., Best et al., 2009) and novel (e.g., White & Aslin, 2011) words. In the present study, we asked whether 24-month-olds can use their increasingly flexible speech processing system to learn novel nouns from context, when hearing Spanish-accented speech. Infants (n=24; testing ongoing) heard novel nouns in dialogues providing linguistic context (The vep is eating) or no context (The vep is right here) regarding a noun's animacy. At test, infants saw animate and inanimate objects and were asked to find the vep. Results indicate that infants hearing accented speech look equally to both objects and so fail to use the information provided by the familiar verb. While 24-month-olds may be able to recognize words in an unfamiliar accent, integrating familiar word meanings to learn new words is considerably more taxing in non-native speech.

4-E-52 Do Re Metaphor: Spatial metaphor provides an advantage for learning pitch words

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Across languages, spatial words are commonly used to describe more abstract dimensions, like pitch, but the reverse is relatively rare. Here, we explore whether this asymmetry can be explained by the demands of language learning: Is it easier for children to learn a new word in the context of space then extend it to pitch, compared to the reverse? We assessed 3- to 6-year-olds' ability to learn and extend a novel word from space-to-pitch and pitch-to-space. Participants were taught that "daxy" meant either high or low in one domain (i.e., spatial location or auditory pitch), tested on their ability to use the word in the trained domain, and then tested on their ability to extend "daxy" to the other domain. Older children learned "daxy" both when it was taught in the spatial domain and in the pitch domain, but younger children were better able to learn "daxy" in the spatial domain. Regardless of age, however, children who were able to learn the original meaning of "daxy" were also readily able to extend it to its untrained meaning. These findings indicate that it may be easier for young children to learn a word for

space and extend it to pitch compared to the reverse, potentially helping explain why asymmetries in metaphorical language exist.

4-E-53   Time to go on a space adventure! Using digital games to support early vocabulary learning

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Despite the prevalence of educational apps for children, few report benchmarks of educational quality, including research testing or educational expertise (Vaala, Ly, & Levine, 2015). We tested a narrative-based digital game that teaches ten words and encourages engagement by having children use knowledge of word meanings to move the game forward. In Study 1, middle-SES 4-year-olds played the game in the lab, followed by a stringent test of word learning where children were asked to choose the correct picture representing the meaning of each word from four related choices that required generalization beyond the game. Preliminary data (N = 18) show that children who played the game answered more questions correctly than children who did not, d = 2.2, p <.001. In Study 2, low-SES 3- and 4-year-olds (N = 33) played the game four times as part of a larger classroom intervention. Although no gain emerged on the receptive test, children's expressive knowledge showed gains from pre- to post-test, d = .65, p = .01. The difference between pre- and post-test scores was significantly larger for target words than for five non-exposure control words, d = .65, p = .01. Results show that both middle-SES children in the lab and low-SES children in the classroom learned new vocabulary from an interactive tablet game, suggesting that developmentally-appropriate digital games show promise for vocabulary learning during early childhood, especially when parents and teachers are not available.

4-E-54   The Goldilocks Effect in Preschooler Attention to Spoken Language

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We extend the idea from the infant literature that children preferentially attend to stimuli at a manageable level of complexity to a rich, naturalistic domain: spoken language. 21 preschoolers (3.05-5.87, M=4.39) watched two video-presented speakers alternate narrating pages of a textless picture book displayed in the center of the screen. They then selected the speaker they would "want to hear tell the end of the story." The speakers' utterances were matched for syllable count, speech rate, and sentence length, and each introduced a target rare English word in an equally supportive sentential context. They differed, however, in the proportion of words that are likely to be familiar to the child. While all the words used by the simple speaker appear on the M-CDI, the complex speaker used more later-acquired words. We assess participants' learning of the target words, as well as their vocabularies (via the PPVT), with the prediction that children with higher vocabularies will be more likely to select and learn from the more complex speaker. Data collection is ongoing, but preliminary analyses are promising. Children are more likely to learn the rare words introduced by the simple speaker (p<.001), validating our complexity assessment, and they are more likely to select the more complex speaker as

they get older (25% of 3-year-olds compared to 66% of 5-year-olds). For an online measure of attention, we are recording children's eye movements throughout the storybook exposure.

4-E-55   Metacognitive Disambiguation: Predicting the 'Right' Choice

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Young children tend to select an unfamiliar object over a familiar object as the likely referent of a novel name. Several explanations for this "disambiguation effect" have been proposed, but none addresses whether the child represents the object contrast in an abstract way. For example, a child who picks a garlic press over a balloon as a "kerm" and a tea infuser over a key as a "blicket" may not represent these decisions as being similar. The child might not think of both as choices of an unfamiliar or as-yet-unnameable object over a familiar or already-nameable object. To address this question, three- and four-year-old children received several different disambiguation test trials with feedback. Children then received prediction trials consisting of new unfamiliar-familiar object pairs and had to predict which choice would be correct. These trials were the same as the disambiguation test trials except that before the novel name was presented, the child was asked to predict which object was going to be right. Children's predictions should favor the unfamiliar object if they represent the choice abstractly. All children showed a strong disambiguation effect on the disambiguation test trials. However, only the four-year-old children's predictions consistently favored the unfamiliar object on the prediction trials. Thus, only in this age group was there evidence that they represented their choices on disambiguation test trials as being similar to one another.

4-E-56   Who is doing what to whom? Investigating the dynamics of infant attention in two-participant causal events.

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Successful language acquisition relies in part on infants establishing mappings between concrete event components (e.g. thematic roles such as agent and patient) and the linguistic means of expressing them. Eventually, infants must abstract over specific events and their participants to form broader event representations. Thus, infants must first learn to encode the identities and roles of both agent and patient, and the causal relations between them. In the current work we presented 30 English-learning 13-month-old infants with silent animations of simple causal interactions between two participants. Across three experiments we systematically varied different components of the events to assess infants' sensitivity to changes in i) the action performed by the agent, ii) the identity of agents and patients, and iii) the animacy of agents and patients, as well as reversals of the thematic roles of agent and patient in each case. Time-series analysis of eye tracking data was used to examine dynamic, event-related, changes in infants' distribution of attention to agents and patients as events unfolded, and also to compare differences in patterns of attention across our manipulations of the different event components. Results are discussed in the context of infants' developing sensitivity to linguistically relevant event cues.

4-E-57   Sentences, Centers, and Sets: Set Selection and the Meanings of More and Most

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Given some blue and yellow dots, (1) and (2) are true in all the same situations. 1) Most of the dots are blue 2) More of the dots are blue Nonetheless, they differ in meaning: (1) is proportional, so the number of yellow dots is only indirectly relevant; (2) is comparative, so the number of yellow dots is vital. We show that from a young age, these different meanings have distinct consequences for encoding and storing visual information. Participants (n=137; ages=3;11-8;3) were shown a blue/yellow dot display on an iPad and asked whether e.g. "the blue team painted more/most of the dots". Upon responding, the dots disappeared and they were asked to "touch where the middle of the blue/yellow dots was". If participants attended to a particular set during evaluation, they should provide a better estimate of its center (despite it being incidental to the task). We expect participants to know the center of the focused set (blue) following both more- and most- judgments, but to know the center of the non-focused set (yellow) only after evaluating a more-statement. As predicted, we observed a main effect of quantifier ($F(1,130)=6.9$, $p<.01$) and an interaction between quantifier and set ($F(1,130)=6.0$, $p<.02$), with participants being more accurate to touch the center of the non-focused set following more-statements than following most-statements. These results suggest that from an early age the meanings of more and most highlight different sets, even for identical displays.

4-E-58   Using context-dependency through redundant correlated contextual cues in word learning

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The context you learn in influences how you recall information. For example, acquiring information in only one context often leads to context-dependent learning (Smith et al., 1978). When there are multiple competing sources of information to be recalled, context dependency may help activate information that is hard to retrieve through correlated cues (Sloutsky & Robinson, 2013). If each system of knowledge is correlated with a contextual cue, then each cue will shift a person's attention to recall the appropriate information. Because context dependency helps the recall of competing information, this study examines its effects on learning shape and texture categories signaled by redundant correlated contextual cues. Three-year-olds learned shape and texture in two conditions: a contextual separation condition and a contextual overlap condition. Children in the contextual separation condition attended to shape in one context and attended to texture in the second context. Children in the contextual overlap condition attended to both shape and texture on both contexts. After training, children were asked to find a texture match in both contexts to test if they could shift their attention away from shape. Results from this study will inform our understanding of the cognitive and attentional mechanisms behind word learning when generalizing to a feature that is difficult to attend to at this developmental time point.

4-E-59   Parent Input During a Brief Face-to-Face Interaction Predicts Number of Vocalizations and Vocabulary Size in Toddlers

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Children who hear more child-directed speech have more rapid vocabulary growth (Hart & Risley, 1992). The present study assessed the role of child vocalizations in the relationship between parent language input and child vocabulary size. We assessed whether individual differences in amount of parent speech would predict both the rate of child vocalizations and vocabulary size. Thirty-nine 18-month-olds (M=17.9 months, SD=.38) participated in an 8-min unstructured play session. Parents were provided toys and instructed to interact with their child normally as they would at home. Rates of adult words and child vocalizations per minute were obtained using the Language Environment Analysis System (LENA). Vocabulary size was measured using the MacArthur-Bates Communicative Developmental Inventory (MB-CDI). Percentage-bend correlations (pb; robust to non-normality and outliers) indicated more adult words were associated with more child vocalizations, pb=.48, p=.001. In turn, more child vocalizations (but not adult words; p=.11) predicted greater MB-CDI expressive vocabulary size, pb=.41,p=.01, suggesting the relationship between adult input and vocabulary size is mediated by child vocalizations. Findings demonstrate that a brief, dyadic interaction provides an appropriate context for assessing language and highlight the central role of child vocalization in language development.

4-E-60   "You Guys" Versus "Y'all": Presence of Dialect Vocabulary Enhances Children's Ability to Categorize Speakers

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Young children can categorize speakers based on accent differences (Wagner, et al., 2013). The present study investigated if children could categorize speakers of different dialects differing in both accent and vocabulary items. Participants (37 three-to six-year-olds) watched a video of a puppet show, in which puppets spoke in either a South Midland or Mid-Atlantic American dialect. Two puppets spoke sentences that differed either in accent only, regional dialect words only, or in accent plus words. A third puppet spoke in a dialect that matched one of the first two puppets. Participants were asked to match the third puppet with the puppet "it belonged with." There were six accent trials, six word trials, and six accent plus word trials, presented in random order. Participants performed better than chance on the words (p<.001) and accent plus words (p<.001) trials, but not on the accent only trials (p=.16). Performance did not differ between accent plus words and words only trials (p=.18). A median split on participants at five years, four months showed no difference between younger and older age groups (p=.19). These results suggest children's ability to categorize speakers improves with inclusion of dialect-specific vocabulary. A second study will explore children's ability to infer whether a speaker will use vocabulary specific to a certain dialect to describe a novel object based on the speaker's previous use of dialect-specific vocabulary.

4-E-61   Neural correlates of linking communicative signals and cognition in infants

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To acquire language, infants must first distinguish the sounds of their native language and then ascertain how these sounds are linked to the objects and events they encounter. At 3 and 4 months, listening to both human (speech) and nonhuman primate vocalizations (Madagascar, blue-eyed lemur: Eulemur macaco flavifrons) support infants' object categorization, a core cognitive capacity (Ferry, Hespos, & Waxman, 2010; 2013). By 6 months, only human speech confers this advantageous effect. Moreover, backward human speech--a sound equally complex to forward human speech--does not have this effect at any age. Here we use EEG to reveal the neural correlates of listening to these three types of sounds. Our results indicate that for 6-month-olds, both lemur vocalizations and backward speech elicit robust P300s in right parietal regions, suggesting that these unfamiliar sounds draw more of infants' attention relative to forward speech. In addition, lemur vocalizations elicit enhanced gamma activation (40-60Hz) in right frontal regions relative to forward or backward speech, suggesting that these sounds are affectively arousing (Muller, Keil, Gruber, & Elbert, 1999). These results, which suggest that there may be multiple routes by which a signal can support infant cognition, converge with neuroanatomical evidence that indicate dual-pathways for the evolutionary origins of human language (Ackermann, Hage, & Ziegler, 2014).

4-E-62   The Complex Relationship between Socioeconomic Status and Word Learning in Grade School

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Background. Children from low socioeconomic status (SES) have significantly smaller vocabularies than their high SES peers, a difference that increases throughout grade school. Factors that could explain SES related vocabulary differences in grade school are school academic environment, maternal education, and children's vocabulary scores. In the current study, we sought to understand how these factors affect word learning and thus vocabulary growth. Method. Forty-four children ages 8-15 completed a word learning from context task and the Peabody Picture Vocabulary Test. Child's school and maternal education were provided by parental report. School academic environment was determined by measuring the schools' average score on state reading assessments. Results. Mediation analyses revealed that word learning was best predicted by a path including all of the three factors (ab: .0012 [.0001, .0044]). Specifically, the most predictive path followed this pattern: maternal education> ⯑ school environment> ⯑ vocabulary scores> ⯑ word learning. Conclusion. Our findings highlight that the increase in the vocabulary gap between low and higher income children in grade school may be related to word learning, however that difference is driven by a complex relationship between school academic environment, maternal education, and children's vocabulary scores.

4-E-63   Parental use of referential cues and infant vocabulary development

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Parental linguistic input is essential to early language development; however, non-verbal input also plays a key role (e.g., Baldwin 1996). Parents' use of referential gestures, such as pointing, during interaction with their infants facilitates joint attention (Pecheux, Findji & Ruel, 1992) which in turn is related to enhanced word learning (Carpenter, Nagell & Tomasello, 1998). The present longitudinal

study is focused on parents' use of referential gestures during natural play time interactions with their infants at 9 months and infants' vocabulary development at 13 months. Analyses reveal a significant, positive relationship between parents' frequency of pointing and infants' scores on the MacArthur Communicative Development Inventory (t(15) = 2.373; p = .03). These findings, from naturalistic interactions, are consistent with prior evidence of the importance of non-verbal cues for word learning, and may have implications for the optimal use of non-verbal communication to support and enhance early language development.

4-E-64   **Non-native exposure promotes monolingual children's endorsement of multiple labels**

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Recognizing that objects can have different labels across languages is an important metalinguistic skill, particularly for acquiring a second language. Much past research on this topic has compared bilingual and monolingual children, treating the groups as dichotomous. This fails to consider the variability in experience with non-native languages of children categorized as monolingual: Although most children in the US are fluent only in one language, many are exposed to a multilingual environment. We assessed the influence of non-native language experience on children's acceptance of labels in two languages. A continuous measure of language exposure was obtained by asking parents to report the number of hours their children heard non-English languages. English-speaking 5-year-olds (N = 73) were presented with novel labels, in English and Spanish, for unfamiliar objects and were asked to endorse either or both labels. Children with greater exposure to non-English languages were more likely than less-exposed children to endorse both the English and Spanish labels. In contrast, a binary measure of fluency in a second language--commonly used to categorize bilinguals--was not significant. These findings show that monolingual children can display metalinguistic skills historically documented for bilingual children, and that language experience should be considered separately from language fluency. A follow-up study in which non-native exposure is manipulated also will be introduced

4-E-65   **Learning color names: How input shapes word boundaries**

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How do children discover the boundaries of word meaning? One way to investigate this question is through color names, an excellent example of how learners divide continuous space into discreet word categories. Where does navy blue end and black begin? Previous research demonstrated that Japanese children delineate more nuanced color boundaries with increased language exposure in their native language. As such, adults have many more color names than do 5-year-olds (Saji et al., 2015). Because SES predicts differences in the amount of language input (Hart and Risley, 1995; Fernald et al., 2013), this project attempts to replicate and extend the Japanese study by asking how SES might impact learning for children from low- and middle-income American families. Middle-SES 3-year-olds (n=20), middle-SES 5-year-olds (n=4), and low-SES 5-year-olds (n=20) named 93 color chips developed by the Japan Color Research Institute. Current results replicate that age is a determining factor: 5-year-olds (91.79%) outscored 3-year-olds (79.64%) on applying basic color words to their referents (t = 2.22, p = .04). Further, age appears to affect the acquisition of the color lexicon more strongly than does SES,

though the data here are preliminary. Multi-Dimensional Scaling will be used to further explore the nuanced learning of color boundaries and to discuss how the learning of color names informs the learning of word boundaries more generally.

4-E-66   Spatial language promotes cross-magnitude associations in early childhood

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Across languages and cultures, spatial language is frequently coopted to describe other domains. In English, for example, we describe temporal durations as long or short, numbers as big or small, and auditory pitch as high or low. However, there is also variety in the exact spatial relations evoked. Although English describes temporal durations in terms of two-dimensional length, Greek and Spanish use three-dimensional spatial terms. Likewise, though English describes pitch in terms of height, Turkish and Farsi use terms related to thickness. Here, we explore how children's experience with spatial metaphors influences their cross-magnitude matching ability. To test this, we probed whether English-learning children are better able to match magnitudes in ways that reflect familiar spatial metaphors compared to unfamiliar ones (e.g., height-pitch as opposed to thickness-pitch). Second, we explored whether children are better at matching magnitudes when spatial metaphors are provided via a verbal label - even when the metaphors are unfamiliar - compared to when the task is purely perceptual. Children aged 3-6 years (N=112) performed perceptual and linguistic cross-magnitude matching tasks across space and time, and across space and auditory pitch. In the perceptual matching task, children matched pictures of varying spatial extents to sounds that varied in duration or pitch (e.g., children see a picture of a long snake and match it to a long or short auditory tone). In the linguistic matching task, children received linguistic cues: they heard a word that described the temporal duration, auditory pitch, or spatial extent of an object and matched this to one of two objects in the other dimension (e.g., children hear two tones and are asked which tone "a long snake" makes). To assess the role of linguistic experience, children were assessed with familiar relations that map onto English-language spatial metaphors (time: long/short, pitch: high/low) and novel relations that are not expressed in English (time: big/small, pitch: thick/thin). Interestingly, we did not find an effect of metaphor familiarity on matching performance: children were equally proficient at matching time and pitch onto familiar and novel spatial relations, and performed above chance for all matches (correct performance indicates matching in the direction reflected by spatial metaphors). Performance improved with age (F = 5.35, p < .005), and performance was better in the linguistic task compared to the perceptual task (F = 17.14, p < .001)(Figure 1). The advantage for linguistic matching was especially pronounced for the younger children, suggesting that linguistic cues help children align these magnitudes in the absence of clear perceptual similarities. Taken together, these results suggest that spatial language promotes cross-domain associations in early childhood. Critically, this process appears to be equally accessible for spatial metaphors that are both familiar and novel, suggesting that experience with specific metaphors is not necessary for forming these associations. Instead, spatial language may promote the perceptual organization of other domains by providing a reference frame for aligning these domains, as well as by highlighting relevant spatial attributes. These results therefore provide insight into how linguistic and perceptual experience interact over development to shape our representation of other concepts.

4-E-67   Different context, same learning: 2-year-olds' robust word learning across contexts

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Context dependencies in memory have been widely studied, with the general consensus being that matching contexts between learning and test results in the best performance. Matching learning and test contexts has been shown to improve memory for object labels in toddlers (Goldenberg & Sandhofer, 2012; Vlach & Sandhofer, 2011). We investigated the effects of matching contexts on retention of labels after a delay. 2.5-year-olds (n=24) were presented with novel labels in matching or mismatching contexts. Across four trials, children revealed above chance and equivalent learning in matching and mismatching contexts immediately and after a 10 minute delay (see Figure). Two-year-olds' ability to link labels with referent objects may be more robust than previous work has indicated as they generalized across contexts and retained the mappings across a delay. Our task included half as many trials as previous work. One possibility is that children become more sensitive to context dependencies as task demands increase.

4-E-68 The development of the neural systems supporting handwriting and letter perception from kindergarten to adulthood

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Introduction: Handwriting experience increases the neural response in ventral-temporal, parietal, and frontal motor regions during letter perception in pre-literate children. This neural system supports both handwriting and letter perception in literate adults. Though we do not know how the brain supports handwriting in pre-literate children, some have proposed that the neural system used during handwriting in pre-literate children develops into the neural system that supports literate letter perception. In this study, we investigated the degree to which neural activation overlapped during handwriting and letter perception across development. Methods: We first determined the neural systems that supported handwriting in pre-literate (n = 5, ages 4.5 - 6.0 years old), early-literate children (n = 10, ages 6.0 - 8.5 years old), and literate adults (n = 11, ages 18.0 - 22.0 years old). We then assessed the degree to which handwriting and letter perception recruited similar brain systems in each group by comparing brain activation during handwriting letters and during letter perception. Finally, we collected Beery Visual-Motor Integration (VMI), Visual Perception, and Motor Coordination scores as measures of handwriting ability and the respective perceptual and motor skills. Results: We found that pre-literate children recruited left precentral and postcentral gyri and right intraparietal sulcus during handwriting. Early-literate children recruited these same regions and, in addition, right ventral-temporal cortex. Literate adults, as expected, recruited bilateral ventral-temporal and parietal cortices as well as left frontal motor regions. In pre-literate children, we found no evidence of overlap between the neural systems supporting handwriting and letter perception. Overlap in right ventral-temporal cortex increased significantly from pre-literacy to early-literacy and again from early-literacy to adulthood. In literate adults, the neural systems supporting handwriting and letter perception overlapped in bilateral ventral-temporal cortex, right parietal cortex, and left premotor cortex. We found, further, that activation during letter perception in bilateral ventral-temporal and parietal cortices correlated with Beery VMI and Visual Perception scores independently of age. Only activation in the left intraparietal sulcus correlated with Beery Motor Coordination scores. Discussion: Our results indicate that the early stages of handwriting are supported by a parietal-frontal neural system that begins to incorporate ventral-temporal cortex with experience. The incorporation of ventral-temporal cortex into the pre-

literate frontal-parietal handwriting system corresponds to the onset of ventral-temporal response during letter perception. The incorporation of ventral-temporal cortex into the parietal-frontal system may be largely driven by the perceptual experiences created by handwriting, given that measures of visual-motor integration and visual perceptual skills correlated with the neural changes observed in ventral-temporal and parietal cortices. These results indicate that the neural systems supporting handwriting and letter perception become increasingly intertwined with experience.

4-E-69   Understanding of "Yesterday" and "Tomorrow" in English- and Mandarin-Speaking Children

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This study investigated the cognitive and linguistic processes involved in understanding time, specifically, the understanding of temporal adverbs and temporal reasoning in preschool children. We addressed three questions: First, how do 3- to 5-year-olds understand the temporal adverbs, "yesterday" and "tomorrow"? Second, are there differences in temporal adverb understanding between children who speak a language in which the past and future is marked by verb tense and temporal adverbs (English) and children who speak a language in which the past and future is marked only by temporal adverb (Mandarin)? Third, how does children's temporal reasoning interact with their understanding of "yesterday" and "tomorrow" in making temporal judgments, across languages? Three- to five-year-old native English- and native Mandarin-speakers participated in this study. A sentence-picture matching paradigm was used in which children are presented with a pair of pictures showing a beginning state and an outcome state of an action, and are asked to point to one picture to answer a question. Two tasks were created using this paradigm. In the Now task children heard a sentence describing either a past action, e.g., "I carved the pumpkin yesterday", or a future action, e.g., "I'm gonna pack the suitcase tomorrow", and were asked "What does it look like now?" In the Yesterday and Tomorrow task, children heard a sentence describing either a past action or a future action occurring today, e.g., "I carved the pumpkin today" or "I'm gonna pack the suitcase today", and were asked "What will it look like tomorrow?" or "What did it look like yesterday?" Participants were assigned to either the Now task or the Yesterday and Tomorrow task. Sentences were translated into Mandarin for Mandarin-speaking participants. Children's response accuracy by task and language are shown in Figure 1. For the Now task, both English- and Mandarin-speaking children performed significantly better when responding to now questions about actions from yesterday (83.62% correct) than when responding to the same questions about actions occurring tomorrow (28.60% correct). In this task, understanding of "yesterday" was tested within a forward reasoning process and understanding of "tomorrow" was tested within a backward reasoning process (see Table 1). In contrast, in the Yesterday and Tomorrow task, "tomorrow" is embedded in forward reasoning and "yesterday" is embedded in backward reasoning. No significant differences were found between responses to tomorrow questions and responses to yesterday questions for both English- and Mandarin-speaking children. Although answering questions about tomorrow requires forward temporal reasoning, which should be easier than backward reasoning, children did not display any advantage for this type of question. This indicates that understanding "tomorrow" is harder than understanding "yesterday" in both English and Mandarin. In both tasks, Mandarin-speaking children performed better than English-speaking children, except when being asked about now given tomorrow actions. Both groups performed significantly below chance on this condition. These findings suggest that 3- to 5-year-olds understand "yesterday" better than

"tomorrow" regardless of the forward or backward reasoning task that it is embedded in. This tendency is evident in both English-speaking and Mandarin-speaking children.

F - Moral Development

4-F-70   **Thinking about you: Focusing attention on others reduces in-group bias in preschool children**

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The current study investigated 5- to 6-year-old children's' in-group bias in resource-allocation decisions can be reduced when they are led to pay more attention to the recipient. In Experiment 1, participants were asked to allocate 2 stickers between themselves and a friend (an in-group member) or a stranger (an out-group member). Participants could choose to take all the stickers or to give one sticker to the other person. Children allocated significantly more stickers to friends than to strangers, suggesting that they made distributive decisions in favor of their in-group members. The procedures of Experiments 2 and 3 were identical to that of Experiment 1 except that participants were asked a question about the partner's emotions or thoughts. The results indicated that children distributed stickers equally between themselves and the other regardless of the group membership of the recipients. In experiment 4, even asking a question about the partner's physical characteristic (e.g., clothes color) could reduce children's in-group bias when make a choice for sticker distribution. These results suggest that children's fair distribution can be promoted when they are encouraged to think more about others.

4-F-71   **Children's Sensitivity to the Ulterior Motives behind Apologies**

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Do children recognize that some apologies are more sincere than others? In this study, 6- and 10-year-olds (N = 48) heard stories about characters who accidentally harmed a peer and then either apologized privately (consistent with prosocial motives) or apologized because a group of peers was watching (consistent with self-presentational motives). While ten-year-olds preferred private apologizers, evaluating them as nicer and selecting them more often as someone with whom they would want to play, six-year-olds showed no preference between the two types of apologizers. By age 10, children recognize that apologies given when others are present are motivated by an ulterior motive to maintain one's reputation. Six-year-olds, in contrast, are still learning how impression management influences behavior and infer that both private and public apologies are equally sincere.

4-F-72   **The intersection of emotion and executive function: The effects of guilt on preschoolers' inhibition and flexibility performance**

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Emotions affect executive function (EF) skills. For example, "hot" EF tasks, which involve emotional responses, are more challenging than "cool" EF tasks (Carlson, Davis, & Leach, 2005). Less is known about the effects of task-unrelated emotions on "cool" EF performance (Rader & Hughes, 2005). We examined how a complex social emotion, namely guilt, affected preschoolers "cool" EF. We also assessed how language and temperament moderated the effects of guilt on EF. Three- to 5-year-olds underwent a guilt or neutral mood manipulation and completed inhibition and flexibility tasks. In the guilt condition, spontaneous verbalizations were coded for guilt relevant language. Mothers reported on children's temperament. A significant interaction between age and condition on inhibition performance, $F(2, 142)=6.75$, $p<.05$, $\eta\rho^2 =.04$, indicated that younger children performed worse in the guilt condition than the neutral condition, $t(79) = -2.72$, $p<.01$; however, older children's performance did not vary significantly by condition $p>.10$. Younger, but not older, children's use of guilt relevant language was related to impaired inhibition performance, $\beta =.707$, $t(29)=2.37$, $p=.03$. Guilt had no significant effect on children's flexibility performance, which was unrelated to guilt relevant language, $ps>.05$. There were no effects of temperament, $ps>.05$. These findings elucidate the relations between emotion and EF across development and provide insight for future emotion-cognition research.

4-F-73   Does Group Membership Affect Children's Judgments of Social Transgressions?

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Children judge moral transgressions like hitting to be more serious and more punish-worthy than conventional transgressions like cutting in line (Slomkowski & Killen, 1992; Smetana, 1981). Children also judge the actions of in-group members more favorably than those of out-group members (Aboud, 2003; Zak & Knack, 2001). The current study asked if children judge moral and conventional transgressions committed by an in-group member differently when compared to those same acts committed by an out-group member and if children judge the transgressors themselves differently based on their group status. Using paper dolls, 3-, 4-, and 5-year-olds (N=74) were introduced to an in-group member (with a matching shirt) and an out-group member (with a contrasting shirt). These group members then committed moral and conventional transgressions. Children were first asked to judge the seriousness and punish-worthiness of the transgressions and then to judge the "badness" of the transgressors. Results show that children judge transgressions committed by out-group members to be more serious (M=1.8/2) and more punish-worthy (M=1.7/2) than those committed by in-group members (M=1.6/2 and 1.4/2, resp.), ps<.01. Likewise, out-group transgressors (M=1.62/2) were judged as "worse" people than in-group transgressors (M=1.37/2), p<.01. Overall, results suggest that in-group membership positively affects how children view members, leading to more lenient judgments of both the member and their actions.

G - Number, Spatial Cognition, Relational Reasoning

4-G-74   What Do Children's Gestures Tell Us About Their Emerging Understanding of Space Science?

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The present work examined how children's nonverbal behaviors reflect their emerging mental representations of space science. We analyzed pre- and post-test video interviews of 3rd-grade students (N=85, M age=8.6) before and after a multi-session learning phase about the day-night cycle (Anggoro & Jee, 2017). Children were asked to explain what causes the change from daytime to nighttime, sunrise, and sunset. Participants' gestures were coded for type, including iconic rotation (representing the rotating motion of the Earth), and iconic movement (indicating movement of the Sun). Children were found to gesture less frequently overall after instruction (pre: M=6.46, SD=7.85, post: M=3.94, SD=6.46, t(83)=3.77, p<.05), largely due to the decrease in movement gestures from pre- (M=2.32, SD=2.52) to post-test (M=1.24, SD=1.91; t(84)=4.30, p<.01). Rotation gestures remained stable (pre: M=1.65, SD=2.71, post: M=1.44, SD=2.29, t(84)=0.75, ns), and were the most common gesture at post-test (36% of all gestures). Children were more likely to verbalize causal understanding if they produced the rotation gesture, X2(1,N=84)=7.63, p<.01. These results support the idea that gestures express knowledge that may be absent in verbal explanations (Goldin-Meadow, 2003, 2015). Rotation gestures may reinforce emerging causal understanding of the solar system (Plummer, 2016). Future work will explore whether gesture-enhanced instruction aids children's learning of spatially rich science topics.

4-G-75   Digits vs. Magnitudes in Symbolic Numerical Estimation

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It is often assumed that mental representations of numerical magnitude are the primary drivers of performance on numerical tasks such as number line estimation (NLE). Here, we test this assumption for symbolic NLE. If the magnitudes of presented numerals are the primary influence on estimates, then numerals with similar magnitudes but different digits should be placed in similar locations. But if specific presented digits matter, these placements will differ. In three studies (N = 309) children aged 7-11 and adults completed NLE tasks using targets with similar magnitudes but different leftmost digits (e.g. 798 vs. 801, or 59 vs. 62), and placements for different magnitudes but similar leftmost digits (e.g. 701 vs. 798, or 51 vs. 59). Study 1 used an atypical speeded NLE task, while Studies 2 and 3 used a standard non-speeded NLE task presented on paper or on an iPad. Under both conditions in all age groups (except the youngest age group in the speeded task), leftmost hundreds or tens digits influenced estimates. Individual differences emerged in the degree to which estimates are influenced by leftmost digits vs. numerical magnitudes. Also, for the 0-1000 range, children first made placements based only on hundreds digits, and later incorporated target numerals' magnitudes beyond their hundreds digits. Ongoing work is exploring such a developmental progression in the 0-100 range. These findings show that magnitudes of target numerals do not determine numerical estimates.

4-G-76   Associative Knowledge in Rational Arithmetic

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Learning statistical regularities from the environment plays a critical role in early development, for example in infants' and young children's language development. Braithwaite, Pyke, and Siegler (in press)

hypothesized that learning statistical regularities also plays an important role in a domain that is governed by formal rules rather than statistical relations, mathematics. The present study tested this proposal in the areas of fraction and decimal arithmetic. Sixth and eighth graders in the United States and China were asked to select an operation that they thought likely to accompany specified operands and to generate operands that they thought likely to accompany a specified arithmetic operation. As hypothesized, children in both countries disproportionately selected addition or subtraction as the operation when presented fraction operands with equal denominators, and they disproportionately generated such operands when presented addition or subtraction as the operation. Also as hypothesized, children in both countries disproportionately selected multiplication or division as the operation when presented operand pairs that included one whole number and one fraction, and they disproportionately generated such operands when presented multiplication or division as the operation. These associations were consistent with statistical relations observed between the aforementioned problem features in both US and Chinese commercial textbook series. Similar consistency between children's associations and textbook problem distributions was also found in decimal arithmetic. The findings indicate that the statistical structure of instructional materials, such as the problems in textbooks, affects learning of mathematics.

4-G-77   Children rely on hand configuration rather than number when labeling number gestures

Jacob Butts[1], Dominic Gibson[1], Talia Berkowitz[1], Susan Goldin-Meadow[1], Susan Levine[1]

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Recent research shows children can accurately use number gestures to label sets of items, suggesting number gestures (e.g. three extended fingers to indicate "three") may be an important stepping stone between non-symbolic and symbolic representations of number (Gunderson, et. al, 2015). The present study investigated the extent to which children think of number gestures as symbols by asking four-year-olds to identify the numerosity of one-handed number gestures that were flashed on a computer. In key trials, the number of fingers in the gesture was inconsistent with the iconic configuration of the gesture (e.g. one finger was digitally removed to give a hand four total fingers but all those fingers and thumb extended into a canonical five-gesture configuration). Analyses revealed that young children's responses in these trials reflected each gesture's configuration instead of the actual number of fingers displayed, indicating that children form configuration-number mappings akin to symbolic representations of number.

4-G-78   The Dimensionality between Visuo-Spatial Working Memory and Calculation Ability

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The association between visuo-spatial working memory (VSWM) and mathematics has been found to vary in different studies. This may be due to the different levels of cognitive domains undertaken (e.g., Männamaa et al, 2012). Recent findings about the multidimensionality of VSWM (Mammarella et al, 2008; Pickering, 2001; Vecchi et al. 1995) and the multidimensionality of mathematics (Ashcraft, 1982; Dehaene et al., 2003; Mix & Cheng, 2011; Wu & Adams, 2006) imply the possibility that the association between VSWM and mathematics may occur only on certain dimensions. The present study was to

identify these dimensions. A static form of a VSWM task and a calculation ability test were examined, using multidimensional item response theory (MIRT, Reckase, 2009) procedures. A sample consisting of 537 third-graders (with 238 boys) was used for the study. The mean age was 9.05 years (SD = .36). The first step of the analysis was to examine the number of dimensions needed to model the data. An exploratory approach was taken, following the steps in MIRT analysis taken by of Reckase et al. (2015). Tests for uni-dimensionality with DIMTEST 2.0 (Stout et al., 1992) were carried out separately for VSWM and calculation. It was found that both tasks were multidimensional (VSWM: t = 3.5471, p = .0002 and Calculation: t = 3.1479, p = .0002). Both tasks were then combined into one dataset for a further dimensionality analysis: parallel analysis (Horn, 1965) to identify the numbers of the dimensions. The results of parallel analysis showed that three dimensions (eigenvalues: 5.60, 2.28, 2.00) were involved in these items. Several hypothesized models were then proposed following an expert review and a review of the neural imaging literature. Within these models, it was established that the best model (AIC: 16565.99, BIC: 16891.73) recommended that the subitizing processes (the item had from one to four pictures) in VSWM and the multiplication and division of Calculation should assess the same dimension. Furthermore, the error patterns of the responses enabled the VSWM item responses to be separated into two different types, revealing either the dimensions of Number (whether the correct number of objects is indicated) or those of Location (whether the correct location of objects is indicated). When these error patterns were analyzed separately, it was found that only the Number aspect of VSWM and the subtraction and division of Calculation assess the same dimension. These results suggest that certain dimensions of VSWM and calculation are related. For example, it may be that the process of subitizing is employed when difficult types of calculation are called for, such as multiplication and division. Subitizing may help to estimate or keep track of the multiple elements (symbols, numbers, and their relations) that belong to difficult types of calculation. Furthermore, the finding that only the Number dimension of VSWM is related to subtraction and division also indicated that VSWM may be used mostly in the process of tracking the number of multiple objects in calculation, rather than in tracking their locations. Overall, the current study provides probable clues for future training in VSWM to improve math skills; for example, asking children to subitize the number of objects is perhaps more effective than marking the location of objects. However, to verify this finding requires further research.

4-G-79 Making Concrete Connections in Math

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Researchers have long supported the use of concrete manipulatives (e.g., blocks, counters) to aid learning; yet, the mere use of manipulatives does not guarantee success (McNeil & Jarvin, 2007). To avoid ambiguity while learning from manipulatives, researchers recommend drawing explicit connections between concrete materials and the abstract symbols they represent (Brown, McNeil, & Glenberg, 2009; Moyer 2001). In this study, we begin to explore which connections best support children's learning about place value. Fifty-two first-graders participated in a one-on-one session in one of four conditions: (1) Concrete Only, (2) Concrete-then-Abstract, (3) Comparison, or (4) Concreteness Fading. For children with low prior knowledge at pretest (n=31), preliminary results show gain scores on a 12-item posttest were highest with Concreteness Fading (M=4.5), followed by Concrete-then-Abstract (M=3.0), Concrete (M=2.5), and Comparison (M=1.1). Although data collection is ongoing, these findings suggest that concreteness fading may help connect concrete materials to abstract mathematical symbols.

4-G-80   Emerging Stereopsis and its Relation to Infants' 3D Object Recognition and Mental Rotation

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The aim of this longitudinal study was to investigate the relation between stereo vision and the ability to recognize or mentally rotate three-dimensional objects. Infants (N=34) were tested at 4 and 7 months of age. Stereopsis was assessed using the Lang Stereo Test® in a preferential looking paradigm. At each test time, object recognition and mental rotation were tested in a violation-of-expectation paradigm. An object rotated 180° in the picture plane and was occluded by a short blackout. It reappeared either as the original object or as its mirror version in one of three orientations: the final rotation position (baseline), rotated 60° further in the same plane (extrapolated), or rotated 60° in an orthogonal plane. An analysis of variance of infants' looking times at the objects after reappearance yielded a significant interaction between stereopsis, sex, object version, and test time. Detailed analyses showed that at 4 months of age only infants with stereopsis, and mainly girls, looked longer at the mirrored than the original object in the baseline orientation, indicating object recognition. At 7 months, infants differentiated mirrored and original objects regardless of orientation and sex, suggesting successful object recognition and mental rotation. The present findings indicate that recognition of 3D objects is present at 4 months of age, but qualified by the development of binocular depth perception. In contrast, mental rotation emerges between 4 and 7 months.

4-G-81   More to the story: Students' performance on equations and story problems involving algebraic proportions

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When solving story problems in mathematics classes, students must comprehend the question, create an appropriate representation, and solve the resulting math problem. Prior work has shown that students' relative abilities to solve story problems as compared to equations depend on the degree of difficulty of the mathematics in the problem. Students show a verbal advantage for simple linear equations, but perform better on numeric equations when the equations are more complex (Koedinger, Alibali, & Nathan, 2008). However, this work has not yet considered how these results may extend to other types of equations. An outlying question is whether proportions are relatively easy for students, as in the case of simple linear equations, because they are mathematically similar. In contrast, because they involve multiple relations, proportions may be more difficult and similar to multi-step complex equations. In the current research, we compare the relative difficulty of story and equation problems involving algebraic proportions using problem-solving data from 7th-9th grade students enrolled in Algebra I. First, we found that students performed better on proportions than complex linear equations ($F(1, 305) = 53.79$, $p < .001$). Students' scores on proportions problems were not significantly different than their scores on simple linear equations ($F(1, 305) = 1.66$, $p = .20$). However, unlike the previous results from simple linear equations, we found that students performed equally well on story problems and equations ($t = 0.73$, $p = .47$). Given that proportions are equally difficult as simple linear equations, it was surprising that our story problem findings did not match Koedinger & Nathan (2004). By examining students' strategies for story problems, we found that students used symbol manipulation (cross-

multiplying) on 79% of the problems, using informal strategies (guess and check or unwinding) less than 10% of the time. This is a sharp contrast to previous work (Koedinger & Nathan, 2004), which found that students used symbol manipulation on only 5% of story problems involving simple linear equations. Separately, we measured students' skills with subcomponents of story-problem solving: 1) setting up proportions from number sentences, 2) translating story problems into proportions, and 3) solving proportions equations. Using linear regression, we investigated which component skills affect story-problem solving. Results indicate that translating from words (B = 0.12) and solving number problems (B = 0.62) contribute to success at solving story problems. However, writing number sentences as proportions was not a significant predictor (B = 0.09). Taken together, these results suggest that proportions are a distinct type of algebraic equation. Despite research evidence that proportional reasoning and conceptual understanding of ratio concepts may be instrumental in algebraic problem solving, it seems that students rely on rote procedures in practice. Regardless of presentation format (story problem vs. equation), students in our sample were very likely to use cross-multiplication algorithms when solving proportions, which are dissimilar to other equations that do not have a readily available procedure. Future research could investigate ways of supporting proportional reasoning during students' algebraic proportion problem solving and design scaffolds to help students make use of information provided in story problems.

4-G-82   The Role of Encoding in Children's Understanding of Mathematical Equivalence Depends on Problem Format

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Mathematical equivalence is a fundamental concept. Unfortunately, most children (ages 7-11) have difficulties solving mathematical equivalence problems, which have operations on both sides of the equal sign (e.g., 3 + 4 = __ + 5). One prevailing explanation for children's difficulties is that children encode, or internally represent, the problems inaccurately. Previous research has found that encoding accuracy depends on format, with accuracy encoding right-blank problems (e.g., 3 + 4 = 5 + __) being much lower than accuracy encoding left-blank problems (e.g., 3 + 4 = __ + 5). Following the prevailing account, right-blank problems should be harder to solve correctly than left-blank problems. Alternatively, it may be that the role of encoding in solving differs by problem format. An integrative data analysis was conducted with data from 14 studies assessing children's performance solving both problem types, considering children who solved at least one but not all problems correctly (N = 196). Contrary to the hypothesis that encoding drives accuracy, accuracy on right-blank problems (60%) was significantly higher than accuracy on left-blank problems (27%), $p < .001$, $\eta^2 = .22$. Additionally, children's encoding accuracy was positively correlated with solving accuracy on right-blank ($r = .27$, $p = .002$), but not left-blank ($r = .09$, $p = .30$) problems. Results indicate that the role of encoding in children's solving of mathematical equivalence problems depends on problem format.

4-G-83   Spatial Alignment of Handled and Non-handled Objects During Fitting

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Handles are a common feature of many human tools, but handles pose potential challenges for the tool user. Actors must treat handles as extensions of objects and gear their actions to the tool's functional end. To address how preschool children begin to plan action with handled-objects, 65 toddlers between 17-36 months of age were presented a fitting task in which they either reached for a rod or a handled-rod and transported it to a slot located at the midpoint of the table. A 3-D motion capture system (Qualisys) was used to measure the angle between the rod and slot. The results indicate children prospectively align non-handled objects before handled-objects. Additionally, prospective alignment increases with age for both types of objects. More generally, these results suggest that in the preschool years, children become more proficient in planning actions that are tied to the spatial structure of objects.

4-G-84   Making Relations More Relevant Through Size and Number Comparison

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Relational Match to Sample involves matching one of two choice cards to a sample card. Each card contains two geometric shapes, which are either the same as each other or different. The correct choice card is the one that instantiates the same relation ('same' or 'different') as the sample card. Children below the age of five fail RMTS. Previous work has suggested that failure on relational matching tasks is indicative of a lack of the appropriate relational representations or insufficient executive function. An alternative hypothesis is that children assume that matching games involve matching individual objects and simply do not consider the cards as a whole, and consequently do not find the relations holding within the cards relevant. By pre-training kids on a matching game where the basis of matching was not object identity but rather the either the number of objects on the card (1 v 3) or the relative size of the objects (big v small), we tested whether drawing their attention to non-object-focused bases of matching would shift their assumptions and make relations more relevant. Results show that both pre-training conditions improve performance above chance. A second study replicated the relation-boosting effect of number and size matching in adults. These results are consistent with the idea that, in additional to relational representations and executive function, relational relevance is an important factor to consider both in experimental and real-life contexts.

4-G-85   Better Close than Far: How Young Children Code Relative Proximity to a Landmark

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Remembering and communicating about location often involves comparisons of relative proximity. Such comparisons can involve determining which of two landmarks is closer to an object (e.g., a purse is located closer to the couch than to the chair), or which of two objects is closer to a landmark (e.g., one glass is closer to the sink than another glass). However, most previous work has focused on how young children code the proximity of a single object to a single landmark. Here we examined how memory for relative proximity develops over the second year of life. Sixteen 24-month-olds and sixteen 30-month-olds watched an experimenter hide two different toys in two identical containers placed 2 and 12 inches from a landmark. After a 10-second delay during which parents carried children outside of a curtain to the opposite side of the room, children were asked to search for the target toy. There were four trial

types that varied the position of the target and non-target containers relative to the landmark. We found that both 24- and 30-month-olds searched correctly at levels significantly greater than chance when the target was relatively close to the landmark, but only 30-month-olds did so on one of the trial types when the target was relatively far from the landmark (Figure 1). These results are consistent with the proximal-to-distal shift observed in early development and demonstrate developmental change in the ability to code spatial relations involving relative proximity.

4-G-86   An Interactive Assessment of Dimensional Adjective Comprehension

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This abstract introduces a new measure of children's comprehension of dimensional adjectives. While the development of dimensional adjectives has been of interest for many years (e.g. Lindholm, 1979), most measures have relied on showing children construction paper cut outs of shapes in various sizes. With modern technology, it is simple to design an interactive game using a tablet, where children can rapidly complete many trials. The new measure evaluates children's comprehension of 10 terms describing the relative dimensions of objects (big, little, fat, skinny, large, small, long, short, tall, short). Each word was included in four trials, where children saw two toys, which were the same but altered along the dimension of interest (e.g. a long train and a short train), and were asked, "Touch the [target] toy". All children saw all 40 trials. Ninety children participated in the pilot testing of the measure, ranging in age from 37-76 months (M=58.06, SD=8.62). Children also participated in the Peabody Picture Vocabulary test. Initial analyses show that both PPVT (r(88) = .25, p =.02) and age (r(87) = .43, p <.001) are correlated with the number of words comprehended on the dimensional adjective measure. This measure will allow dimensional knowledge to be quickly assessed, as a quick determinant of certain types of spatial and language knowledge.

4-G-87   How does parents' use of large number words develop over time and relate to children's number knowledge?

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Children's math knowledge varies widely at school entry and predicts their elementary school achievement (Duncan et al., 2007). Research has found that parents' use of small number words (<11) with toddlers and preschoolers is positively related to children's number knowledge (Levine et al., 2010; Ramani et al., 2015). Additionally, a recent study found that parents' use of number words greater than ten during play with 5- to 6-year-olds was predictive of children's concurrent math knowledge (Elliott et al., 2017). However, little is known about parents' use of large number words with children prior to school entry and how early large number input contributes to children's later math knowledge. Of particular interest is whether early large number word input accounts for additional variance in math knowledge beyond small number word input. To address this question, we videotaped a diverse sample of 64 children during 12 sessions between the ages of 14 and 62 months and examined their parents' use of large number words. Preliminary results show a substantial variation in parents' large number talk (ranging from 0 to 139 words). Additionally, parents' use of large number words related to children's use of large number words (r = 51, p < 0.001). We will also examine how parents' use of large number words

changes as children develop, and how large number input relates to children's early and later math knowledge over and above small number talk and other talk.

4-G-88   Perceptually rich instantiations hinder children's learning of novel fraction concepts: A real-world classroom intervention

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Although an understanding of fractions is a critical precursor for other math concepts, school-age children in the U.S. lack age-appropriate math skills. Thus, understanding the context in which children best learn novel math concepts is critical for the development of instructional materials. The aim of the present study was to examine whether instructional format affected children s learning and transfer of fraction concepts. Six- to 8-year-old children participated in a longitudinal, pre/post test design in which they received a fraction-training intervention. Half of the children were taught using impoverished, black-and-white stimuli and half of the children were taught using perceptually rich stimuli. We also manipulated the extent to which instruction was grounded in visual vs. symbolic representations. We find that 1st and 2nd graders are able to learn fraction concepts following both interventions, despite having no formal fraction education. Children in the perceptually rich intervention showed lower pre- to post-test gains than children in the impoverished intervention. While children in the impoverished Experiment faired best after receiving symbols+pictures training (rather than pictures-only or symbols-only), children in the perceptually rich intervention faired worst following training using symbols+pictures. Children s performance was also impacted both by prior math knowledge and their working memory. This work has implications for instructional design.

4-G-89   The Differential Impact of Shape and Color on Children's Memory for a Pattern

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While shape helps us categorize objects in our environment, color helps us discriminate among them. Here we examined the influence of each on children's memory for a pattern. Forty-seven children (Mean age=7.14 , SD=0.69) built a design pattern (see figure) and then took two surprise memory tests. In a recall test, children reconstructed the pattern from memory. In a recognition test, children completed eight trials that assessed memory for the shapes and colors of the pattern. Children made significantly more color than shape errors during recall, $t(46)=-7.94$, $p<.001$. However, they did significantly better on color than shape trials during recognition, $t(46)=4.65$, $p<.001$. Children's shape vocabulary was correlated with shape, $r(47)=.56$, $p<.001$, and color recognition, $r(47)=.33$, $p=.03$. Color recognition memory was correlated with color recall errors, $r(47)=-.32$, $p=.03$. We discuss how the asymmetry in shape and color as object properties leads to differential influences on children's pattern memory.

4-G-90   A Play-Based Mathematics Intervention for Head Start Families

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Children from low-income backgrounds lag behind their peers on basic mathematical skills as early as preschool. Engaging in informal math activities with trained researchers, such as playing numerical card games, has led to significant improvements in children's math skills (Scalise et al., in press). The present study examined the effectiveness of providing low-income parents with a numerical card game to play at home with their child for six weeks. Head Start preschoolers (n=42) were randomly assigned to play either a numerical magnitude comparison game or a shape and color matching game. Families also audio-recorded their game playing sessions. Preliminary analyses suggest that children who played the shape and color matching game saw greater improvements in their shape naming and matching, whereas children in the magnitude comparison condition improved their basic numerical skills (counting and cardinality). Unlike previous studies, children who played the magnitude comparison game with their parents did not significantly improve their symbolic magnitude comparison skills. However, their symbolic magnitude difference scores were correlated with the amount of time they spent playing the card game. Parents' mathematical talk from the audio recordings will be used to shed light on the patterns of children's improvement. The results suggest that playing card games may be a beneficial tool for parents seeking to support their children's mathematical development.

4-G-91 What Influences Variability in Parents' Number Talk in the Lab and at Home?

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Prior studies demonstrate that children's understanding of cardinality is predicted by parents' use of number words during everyday interactions (i.e., number talk). However, number talk has been studied in various settings (e.g., structured vs. naturalistic observations) without examining the differences between settings or the parent characteristics that predict umber talk. As part of a larger study, 74 three- to four-year-old children and their parents were observed for 10 minutes each in the lab and at home. In the lab, dyads were given a standard set of toys, whereas at home, they played with toys of their choice. We then explored whether parents' number estimation skills, math anxiety, and formal math ability related to their number talk in either setting. Parents' math ability was the only parent characteristic correlated with number talk and only when observed in the lab. These findings suggest that parents' own cognitive abilities influence the opportunities they provide for their children to learn math, but also stress the importance of considering the context in which parents and children are observed and how parent characteristics influence their behavior differently in these contexts.

4-G-93 The trade-offs of gesture on analogical reasoning and memory for relations

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Analogical reasoning is essential for learning new materials. However, previous literature suggests a developmental trajectory in which younger children often fail to notice the key relationships in analogies. We describe a study testing the potential for gesture, an under-studied tool for drawing children's attention to relationships, to improve their analogical reasoning performance. In the current study, 5 and 6 year old children (N=72) were assigned to either the experimental or the control groups depending on whether they received linking gestures, which are hand motions that physically embody a

link between objects. They completed the Scene Analogy Task (Richland, Morrison, & Holyoak, 2006) and were then tested on their memory of the scene materials with either relational or featural changes. The results indicate that children who receive linking gestures significantly outperform the controls in analogical accuracy, especially in the presence of featural distractors. However, this group is less able to identify featural changes in the memory test than the controls. Together, this study shows that linking gestures are able to direct children's attention to key relational structures, but improve analogical reasoning at the expense of broader encoding of featural specificity. These findings have potential implications for psychologists and educators interested in improving classroom learning.

4-G-94   Preschoolers' Acquisition of the Words 'Same' and 'Different'

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Psychologists have proposed that abstract, relational concepts like 'same' and 'different' may differentiate human and animal minds (Penn et al., 2008). In three studies, we explore when these relational concepts arise in language by testing preschoolers' knowledge of the words 'same' and 'different'. In Study 1, we tested English- and French-speaking preschoolers on a 'same' and 'different' vocabulary task with 2-item cards: children either succeeded on both words or neither, suggesting that 'different' may be represented as 'not same'. English-speaking 2-year-olds failed the task, while half of the 3-year-olds and almost all of the 4-year-olds succeeded. In Study 2, we tested English-speaking 2- and 3-year-olds with 16-item cards, and found the same pattern of success as with 2-item cards: 2-year-olds failed while some 3-year-olds succeeded. Finally, in Study 3, we asked if 4-year-olds could combine the words 'same' and 'different' with the quantifier 'all' in a new 16-item card-sorting paradigm; results showed that 4-year-olds adopted the rule 'all same/not all same', regardless of whether they were explicitly told to sort by the rule 'all same/not all same' or 'all different/not all different'. Overall, these results show that the words 'same' and 'different' simultaneously emerge in children's vocabulary around 3 years in a format that permits combination with 'all' and 'not', and suggest that 'different' means 'not same'.

H - Social Cognition

4-H-95   Does the Speech Act Matter? An Examination of How Promises and Tellings Influence Preschoolers' Epistemic and Practical Decisions

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Recent work has called into question evidential models of testimonial learning (Koenig & McMyler, 2017), arguing for a distinction between interpersonal reasons to trust versus evidential reasons to believe - both of which may feature in children's epistemic decisions (e.g. to learn) and practical decisions (e.g. to wait and share). One way to parse out these distinct reasons to trust is to assess how different speech acts, such as promises or acts of telling, bear differentially on epistemic and practical decisions. In Study 1, 3- and 4-year-olds (N = 75) were familiarized to an agent who either refused or

tried but failed to keep promises. Children's practical decisions to delay gratification and share were reduced by failed promises and negative intent, but acceptance of new information was not reduced. Study 2 presented 3- and 4-year-olds (N = 45) with an agent who withheld or failed to tell them accurate information (e.g. "That's a cup"). Neither practical, nor epistemic decisions differed as a function of condition. Explicit judgments revealed that children credited knowledge to tellers with negative intentions, but judged her as less likable, compared to the other two conditions. These findings suggest that children may perceive promises as carrying more interpersonal weight than acts of telling, but that neither failed speech act reduces children's decisions to learn. Thus, such findings call into question purely evidential models of trust.

4-H-96   Investigating the development of true belief representation in rhesus monkey infants

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Though converging evidence indicates that nonhuman primates share many perspective-taking abilities with humans, it is still unclear whether the mechanism by which nonhuman primates are able to reason about another agent's beliefs, desires, and goals is the same as the mechanism in humans. One way to demonstrate a parallel mechanism in two species is by comparing the developmental trajectory in both. As such, we tested a population of 240 infant and juvenile rhesus macaques (Macaca mulatta) on a true belief task using the looking-time method. Preliminary data analysis indicated that similar to human infants, infant rhesus macaques (younger than one year of age) seemed surprised when an agent acted inconsistently, but not consistently, with her knowledge regarding the location of a hidden object. Further analyses will pinpoint the age at which this ability comes online, and will seek to further illustrate the developmental trajectory across the entire juvenile period (under five years of age). Our findings suggest that despite divergent socioecology, rhesus macaques show some human-like parallels in their development of true belief representation.

4-H-97   Didn't know, or didn't show? Preschoolers consider knowledge state and degree of omission when evaluating teachers

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Pedagogy is a powerful, efficient way to learn about the world. However, it also comes with an inherent risk: being misinformed. How do young children detect and evaluate unhelpful teachers to ensure accurate learning? Prior work suggests preschool-aged children expect teachers to be accurate and fully informative, and avoid informants who violate these expectations (e.g., Jaswal & Neely, 2006; Koenig, Clement, & Harris, 2004; Gweon et al., 2014). This raises important questions about the cognitive mechanisms and representations that support such evaluations. While adults make graded judgments of teachers' quality based on how much information was taught given what the teacher knew (Bass et al., 2015), it is possible that children's evaluations simply reflect coarse-grained judgments (e.g., good/bad) based only on observable behaviors. Here we show that preschool-aged children make sophisticated, graded teacher evaluations in ways that are consistent with computational accounts of pedagogical reasoning (e.g., Shafto, Goodman, & Griffiths, 2014). Specifically, we asked whether children 1) exonerate under-informative pedagogy when the teacher had limited knowledge, and 2) distinguish

between under-informative teachers who provide different amounts of information. Twenty-four preschoolers (M(age)=60 months, range=49-72 months) were familiarized with a novel toy with four functions. Children then watched a series of videos of different informants discovering the toy's functions and then teaching learners about how the toy worked. Children rated each informant's teaching on a 0-20 point scale. The teaching videos varied based on the functions that the teacher discovered (and thus knew) and taught, including: Discover 4/Teach 4; Discover 4/Teach 2; Discover 4/Teach 1; and Discover 1/Teach 1. The Discover 4/Teach 4 video was always shown first as an example of excellent teaching. The order of the other videos was counterbalanced across participants. First, we compared ratings in the Discover 4/Teach 1 condition to the Discover 1/Teach 1 condition. Children rated the teacher who knew only one function (M=11.5, SD=5.7) significantly higher than the teacher who knew all four functions (M=7.8, SD=5.4; t(23)=2.58, p=.017), pardoning incomplete teaching when it was explained by limited knowledge. Second, we compared the Discover 4/Teach 2 condition to the Discover 4/Teach 1 condition. Even though both teachers provided incomplete information, children gave higher ratings when the teacher demonstrated two functions (M=11.9, SD=6.4) than when she demonstrated just one (M=7.8, SD=5.4; t(23)=2.54, p=.019). These results suggest that children draw graded inferences about teacher quality based on 1) the teachers' epistemic states and 2) how much information they demonstrated. These findings were also observed in a replication with adults (N=24). In sum, we find support for the claim that children are able to go beyond the observable aspects of teachers' behaviors to make nuanced inferences about the informativeness of others: They evaluate teachers based on how they selected information given their knowledge states. This suggests that even before the onset of formal schooling, preschoolers have highly sophisticated cognitive models of what it means to be a good teacher. Ongoing studies are investigating other factors that modulate children's evaluations of teachers (e.g., teachers' inability to discover a toy's functions).

4-H-98 Building blocks of cooperation: Preschoolers use task difficulty to decide whom to help.

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The ability to estimate the difficulty of novel tasks is crucial for making optimal decisions to explore, learn and interact with others. While previous work suggests that an adult-like concept of difficulty develops late (Nicholls & Miller, 1983), recent work suggests children can infer the relative difficulty of simple, novel tasks in a concrete, physical domain (building block structures). Here we ask whether such inferences support children's decisions to act efficiently and cooperate effectively. Children (n=200, age:3.0-5.9) were either introduced to an agent who had to build one of two towers, an "easy" 6 block tower or a "hard" 15 block tower, to obtain a reward (Self Condition), or an agent who had to help one of two friends, each of whom were building the towers (Other Condition). Only children who could tell which tower was more difficult were included in analyses (n=168). Children preferentially chose the easy tower in the Self condition (66.7%, p=.004), and the hard tower in the Other condition (67.8%, p<.001), showing significant difference between conditions (p<.001). Age did not predict performance in either condition (Self: p=.07; Other: p=.78). These results suggest that children use their understanding of objects and agents to reason about the difficulty of simple, concrete tasks in the absence of direct experience. While this ability continues to develop, it is already powerful enough to support sophisticated social decisions.

4-H-99   Preschoolers Selectively Trust and Selectively Share Based on the Mental States of Others

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Discerning the pro- or antisocial traits of social partners is a complex, yet essential skill. When choosing social partners, children must understand people may have laudable qualities in one domain but lack them in another. For example, a friend may have the best intentions for helping us with a task, but lack the necessary knowledge to assist. Research suggests children trust accurate and honest sources over corresponding inaccurate and deceptive sources (Mills, 2013), and share more resources with prosocial rather than antisocial individuals (Kenward & Dahl, 2011). However, it is unclear whether children reason about both factors--reliability and prosociality--within the same social partners. This study investigated children's selective trust and selective sharing in response to sources that differed in valence of two mental states (accuracy and prosociality) simultaneously. Three-to-five-year-old children (N=168) received advice from a partner about where to look for hidden prizes in a search task. Between subjects, partners were established (via training trials) as intentionally-helpful, intentionally-harmful, accidentally-harmful, or accidentally-helpful. Across three trials, we measured children's trust in the advice provided by the source in the search task, then, children were given an opportunity to share their earned prizes from the game with the source who offered them advice. Results indicated only a main effect of sources' accuracy on children's trust (p < .001). (See Table 1.) Thus, children relied primarily on the accuracy of sources' advice when deciding whether to trust, regardless of sources' intentions to help or harm. Interestingly, children chose to share more with sources who displayed at least one positive quality--either prosocial intentions or accurate advice. Children shared more (and equally) with intentionally-helpful, accidentally-harmful, and accidentally-helpful sources than they did with intentionally-harmful sources. (See Table 1.) There was a main effect of sources' prosociality (p < .001), and a marginal main effect of sources' accuracy (p = .06), on children's sharing. Why did children share equally with these three sources? Perhaps children require strong cues about others' negative qualities before they are willing to punish, or forego social norms (such as those dictating sharing). Additionally, children were asked if sources "wanted to help" and were "nice or mean." In general, children correctly inferred the characteristics of three of the sources (intentionally-helpful, intentionally-harmful, and accidentally-harmful), but not the accidentally-helpful source (who actually sought to harm). (See Table 2.) Children misattributed this source's unintentional help as inherently prosocial. Children may have particular difficulty interpreting the actions of unintentionally helpful sources because they are rarely encountered, or because children interpret their traits in terms of what they do, rather than what they want to do. In closing, results indicate children trust sources whose advice leads to positive outcomes, but share with sources who demonstrate prosocial intentions or provide good advice. Overall, this suggests preschool-age children have some understanding that individuals may be valuable social partners in some, but not all contexts, depending on their individual characteristics, and use available social information differently when making various decisions regarding the same individual.

4-H-100   Neural Correlates of Preschool Children's Spontaneous False-Belief Reasoning

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What are the mechanisms supporting the developmental transition to an accurate, explicit understanding of false-beliefs? We explore neural and behavioral data from 3- to 5-year-olds to address this question. EEG was recorded while children (N = 56) passively viewed false-belief (FB) location-change scenarios modeled after infant spontaneous FB looking-time tasks. Children's concurrent FB understanding was also assessed via standard explicit, elicited-response tasks. We examined (a) the neural activity associated with passively viewing a FB event, (b) whether and how that neural activity was associated with children's FB reasoning assessed behaviorally, and (c) whether and how neural activity might differ for children who pass versus fail standard behavioral FB tasks. EEG alpha (6-9 Hz) activity was suppressed in all children as they passively viewed the FB events, with significant suppression concentrated in the right temporoparietal scalp (RTP). The magnitude of RTP alpha suppression uniquely predicted children's behavioral FB performance, beyond influence of domain-general cognitive covariates (i.e., executive functioning, verbal and non-verbal intelligence). However, explicit FB "passers" and "failers" demonstrated RTP alpha suppression at crucially different points in the FB scenario, illuminating possible mechanisms supporting the transition to accurate, explicit FB understanding. Implications for dual systems theory and infant theory-of-mind research are also discussed.

4-H-101   Young Children Trust Accurate Robot Informants with Agency

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Children acquire substantial knowledge about their world by communicating with others, referred to under the headings of "trust in testimony" or "natural pedagogy." In the past several years, children have started receiving information from not only people but also technological devices, and specifically social robots. Two studies assessed whether children appropriately trust robot informants. In Study 1, 67 3-year-olds were introduced to both an accurate and an inaccurate robot. We found that children appropriately sought out and accepted information from an accurate robot over an inaccurate one. Moreover, children were more likely to seek out information from the accurate robot if they attributed more qualities of psychological agency to the two robots. In Study 2, 26 3-year-olds received information from an accurate and inaccurate inanimate machine lacking any features of psychological agency. Children in Study 2 did not appropriately seek out information from an accurate technological informant: unlike for human or humanoid robot informants, children did not use the contrasting accuracy of the two machines to determine which technological informant to trust when those informants lacked features of psychological agency. These findings suggest that children are capable of learning from technological devices like social robots, but improve when those devices display features of psychological agency.

4-H-102   Tool Learning and Use: Different Patterns of Strengths for Children With and Without Autism

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When children encounter a novel tool, they tend to use others' social cues rather than features of the object itself to quickly and permanently affix a purpose or function to it. Yet despite being relatively less

sensitive to social cues, children diagnosed with autism spectrum disorders (ASD) tend to be excellent tool users. In this study, we explored patterns of artifact learning and use in both typically developing (TD) children (n=24) and those with a high-functioning ASD diagnosis (n=24). We found that compared to ASD children, TD children used novel tools more consistently like an adult model, showing rapid and efficient tool learning across test trials, but were somewhat less flexible in using known objects to solve an insight task, demonstrating functional fixedness that impaired their problem solving. Results provide unique perspective on relative strengths and weaknesses present in these two groups' tool learning strategies and, more broadly, shed light on the role of intentional reasoning in the development of human tool use.

4-H-103   Improving equality: Training children to count promotes equal sharing behavior

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By the preschool age, children understand, recognize, and explicitly discuss principles of fairness. Yet, in many contexts, young children do not share their own resources fairly until middle childhood and the cognitive mechanisms that explain equal sharing behavior are poorly understood. The present studies explored (1) three potential cognitive correlates of equal sharing behavior (cognitive control, working memory, and numerical cognition) and (2) whether children's numerical cognition causally explains equal sharing behavior. Preschoolers (N = 98) were assigned to either a counting training in which they were trained to individuate and count the items or a control group. Children completed sharing tasks both before and after training to assess their propensity to share resources equally. Finally, all children also completed a working memory, cognitive control, and numerical cognition assessment. Children's numerical cognition (counting fluency) uniquely predicted their equal sharing behavior at pre-test, above and beyond any effects of age, cognitive control, or working memory. Training children to count improved equal sharing behavior, but only during trials in which children stated they had intended to be fair. A second study (data collection ongoing), investigates whether we can further improve sharing behavior by increasing structural similarities between counting training and sharing tasks.

4-H-104   Preschoolers use others' effort as a cue to attention and selective imitation

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Young children discriminately learn from informants based on informant traits, known as selective trust (Harris, 2012; Harris & Koenig, 2006); however, research has not examined how children's attention relates to informant trust. We examined whether children were more likely to imitate informants who exerted either high or low effort to solve problems. Participants' (3-to 6-years-old; N=71) attention (e.g., eye tracking) was recorded while watching videos of two informants solving problems. Each informant consistently displayed high or low effort to solve problems (familiarization trials); in the final problem, informants exerted the same amount of effort and used unique solutions for the same problem. After watching the videos, participants attempted to solve the final problem by themselves; participants could selectively imitate the high or low effort informant by choosing the solution either informant used in the video. Younger children (3-4 years) were more likely to use the high effort informant's solution, whereas older children (5-6 years) were more likely to use the low effort informant's solution, $\chi^2(1) = 5.01$, p =

.025. A multilevel analysis revealed an interaction between age and informant trait such that younger children looked longer to the high effort informant; this pattern was reversed in older children (β = -0.24, p = .004). The findings suggest that preschoolers perceive other's effort as a meaningful social cue to guide their attention and imitation.

4-H-105   Math Anxiety and Academic Stereotypes in 5th Grade Students

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Math anxiety in early adolescence is relatively understudied, despite the fact that this is when gender differences in math-liking first emerge (e.g. Wigfield et al., 1991). Here we explore correlates of self-reported math anxiety in a diverse population of 146, 5th grade students (N=70 males). Overall, girls reported higher math anxiety than boys (p<.05) and had lower math performance as measured by a timed 3-minute math fluency task (p<.001). For girls but not boys, there was a negative relationship between reported anxiety and math performance (p<.05), such that highly anxious students were the lowest performers. This relationship was driven primarily by a subset of the females who were from low socio-economic status backgrounds and had notably higher math anxiety and lower math performance (N=21, p<.05). We also looked at children's endorsement of the academic stereotype that "Boys are good at math and girls are good at reading". There were no gender differences in endorsement rates (p=0.22), but there was a three-way interaction between endorsement, gender, and anxiety (p<.05) showing that male endorsers had a strongly positive relation between test scores and math anxiety, whereas all other students showed a neutral or negative relation between test scores and math anxiety. Results suggest that by 5th grade, math anxiety is well-integrated with students' perception of their own math performance as well as their awareness of broader societal gender stereotypes.

4-H-106   Children's Belief in Testimony Based on Hearsay, Book, or Internet Sources

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After hearing speakers' claims about the occurrence of improbable and impossible events, children report greater belief in the improbable events (Lane, Ronfard, & El-Sherif, in press). However, such beliefs also depend on how the speaker gained her knowledge--whether from first-hand observation or from another person (i.e., hearsay). We compare children's belief in impossible and improbable events following informants' claims based on oral testimony (hearsay), printed sources, or electronic sources. Children ages 4-10 years (n=229) watched 8 videos, each featuring a speaker who claimed that an impossible or improbable event occurred, attributing their knowledge to hearsay (i.e., "Someone told me that..."), a book (i.e., "I read in a book that...") or the Internet (i.e., "I read on the Internet that..."). After each video, children indicated whether the event could happen. The youngest children (4-5) held similar (low) levels of belief in impossible and improbable events. With increasing age, belief in impossible events decreased, regardless of the informant's source. Belief in improbable events was similar across the age range when children received hearsay or book-based testimony, but increased with age when children received Internet-based testimony. Indeed, the oldest children (8-10) who heard Internet-based claims held stronger beliefs in improbable events in contrast to peers who heard hearsay. Implications for educating children about the Internet will be discussed.

4-H-107   Robbing from the Rich Because You are Poor: Children Attend to Resource Availability When Judging the Permissibility of Behaviors

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Robin Hood stole from the rich and gave to the poor, and was praised for it. We tested whether children (ages 4 to 13) and adults (N = 277) integrate concepts of resource availability and group membership when judging resource consumption (e.g., is it permissible for the poor to eat from the rich?). Participants judged individuals who consumed ingroup resources (e.g., a Hibble eating a Hibble berry) or outgroup resources (e.g., a Hibble eating a Glerk berry). We varied the scarcity of each group's resources. Participants believed it was bad to consume outgroup resources, especially when the outgroup was scarcely resourced, and that it was bad to consume ingroup resources when the ingroup was scarcely resourced. Importantly, older children and adults (not younger children) believed it was more acceptable for individuals from scarcely resourced groups to consume from an abundantly resourced outgroup. Developmental, theoretical, and societal implications will be discussed.

4-H-108   Fostering Creativity Through Guided Play

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Can guided play spark creativity? Direct instruction, in which adults dispense information to children may limit imagination and discovery (Bonawitz et al., 2011). Free play, on the other hand, is so unconstrained that it too fails to heighten creativity (Cutting et al. 2011). Guided play, a child-led and adult supported activity rests between these two extremes (Weisberg et al., 2015) providing children with more freedom than direct instruction and more support than free play. We predicted that guided play would foster creativity. Eighty children ages 4 to 6 played with Legos in either guided play, free play, or direct instruction conditions. They then completed a creative problem solving task in which they were asked to remove a ball from a jar using everyday objects. A subset (n=12) also completed the standard alternative uses task (Wallach & Kogan, 1965). Preliminary results suggest no differences in conditions in respect to whether children solved the ball task. Yet of the children that completed the alternative uses task, those in the guided play condition scored higher on originality (M=2.60) than those in direct instruction (M=0.67) and free play (M=0.75), which suggests that guided play may facilitate more novel ideas. We will continue to examine this effect as data is collected. Future analyses will code the ball task for exploratory and adaptive behaviors. We hypothesize that children in the guided play condition with outscore their peers on each of these measures.

4-H-109   Rules behind ruling: Children's understanding of elections and voting

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Political theorists and philosophers have long debated what are the fairest and best ways to govern. In many western countries, adults consider voting as a fair way to elect leaders and to make decisions. The present work considers if children hold beliefs about how leaders should be selected, and if they view voting as a fair decision making tool. In Experiment 1, five- and six-year-olds (n=21) rated elected leaders and leaders appointed by another authority figure as much more acceptable than leaders who took power for themselves. Further, Experiments 2 and 3 investigated when children think that voting should be used to make decisions and when it should not be. In both experiments, five- and six-year-olds were told about a group of boys who needed to make a decision, and then were asked whether the group should go with the majority's choice, or the minority's choice. In Experiment 2, children (n=21) selected the majority choice in cases that affected the entire group, but not cases that only affected the minority. In Experiment 3, children (n=25) opted not to go with the majority in cases when the minority's choice was objectively correct (i.e., they understand that people voting does not change facts). As early as kindergarten, children in the U.S. not only hold beliefs about the ways leaders come into power, but also have intuitions about when to use voting as a tool for making decisions.

4-H-110 Validating the Children's Social Understanding Scale: Maternal and Paternal Reports, and Links to Executive Function

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The Children's Social Understanding Scale (CSUS; Tahiroglu et al., 2014) is a parent-report measure of children's theory of mind (ToM). It has strong psychometric properties, predicting children's ToM over age and other cognitive abilities. This study tested whether (a) paternal as well as maternal CSUS predicts children's ToM, (b) the robust association between ToM and executive function (EF; Carlson & Moses, 2001) is present for parent reports as well as children's task performance, and (c) the relation between CSUS and children's ToM remains significant with age and EF controlled. 118 families with 3- to 5-year-olds participated. Parents completed the CSUS and the Behavioral Rating Index of Executive Function (BRIEF; Gioia et al., 2005) while children were given ToM and EF tasks. CSUS reliability was high for both mothers and fathers (as = .91 and .89). Maternal and paternal CSUS were highly correlated (r= .52) and both predicted children's ToM (rs = .33 and .26). Consistent with the literature, children's ToM and EF were significantly related (Table 1). Importantly, the same was true for parent-reported ToM (CSUS) and EF (BRIEF). The composite CSUS (averaged across mothers and fathers) significantly predicted children's ToM over both age and children's EF. Our findings suggest that, for both mothers and fathers, the CSUS is a valid measure of children's ToM that taps specific mental state understanding as opposed to general age-related development or cognitive competence.

4-H-111 Executive Function and Theory of Mind as Predictors of Reading Expressiveness

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Both accuracy and automaticity, two components of reading fluency, are related to executive function (EF; Cutting, Materek, Cole, Levine, & Mahone, 2009), but reading expressiveness has received limited attention. Connections between fluent reading and EF make sense; reading involves managing multiple aspects of text, and EF enables individuals to manage such complex, goal-directed tasks (Goldstein &

Naglieri, 2014). We hypothesized a similar relation between reading expressiveness and theory of mind (ToM) (which is related to children's and adults' reading comprehension; Author, 2016; Kidd & Castano, 2013) because an understanding of authors'/characters' intentions and emotions is needed to convey them orally. Fifty-one undergraduates completed reading-specific cognitive flexibility (RCF), working memory, planning, inhibition, ToM, and expressiveness measures. Expressiveness was related to RCF, working memory, inhibition, and ToM. EF contributed 15.5% of variance, with RCF and inhibition contributing uniquely, and ToM contributed 12.1% additional, unique variance to expressiveness. Implications for educational practice will be discussed.

4-H-112   Infant gaze following depends on ostensive context: an eye-tracking study of 5- to 7-month-olds in Vanuatu

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Caregivers and infants in Western cultures are competent producers and receivers of communicative gaze-signals. However, given reports of cultural variations in provision of face-to-face contact by caregivers, it is not clear whether infants' competencies in receiving adults' gaze-signals are universal across cultures. We used an eye-tracking paradigm to assess gaze-following responses of 5- to 7-months-old infants in an indigenous Melanesian small-scale society of Tanna island in Vanuatu, where face-to-face parent-infant triadic interactions are reportedly less prevalent than in Western populations (Little, Carver & Legare, 2016). We found that - just like Western 6-month-olds in an earlier study (Senju & Csibra, 2008) - Ni-Vanuatu infants followed gaze of an actress on a computer screen (specifically, they looked longer and more frequently at the gaze-at object rather than the distractor) and did so only if her gaze-shifts were preceded by infant-directed speech, but not when they were preceded by adult-directed speech. These results are consistent with the notion that gaze-following is tied to infants' early emerging communicative competencies and rooted in universal mechanisms rather than dependent on cultural specificities of early socialization.

4-H-113   The psychological calculus of children's welfare tradeoffs

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Will I share my sandwich with you? While this may seem like a simple question, the answer depends on multiple features of our relationship (e.g., are we kin, are you formidable, will we interact again?) and of the situation (e.g., am I hungry? are you? how good is this sandwich, anyway?). These variables coalesce into a single decision - do I share my sandwich or not? This seemingly simple output masks a complex internal calculus that must incorporate how much I value your welfare relative to my own. This comparative valuation has been termed a welfare tradeoff ratio (WTR), and can be calculated by looking for a consistent "switch-point" in a series of forced-choice tradeoffs that ask how much of a resource I am willing to forgo to give you a specified benefit (Hartig, 2011). Across cultures, adults display remarkable consistency when making WTR decisions for an individual and easily differentiate between types of targets (i.e., kin, friends, strangers, and enemies) (Delton & Robertson, 2016). But when does this capacity for consistent differential social valuation emerge in development? In two studies, we asked (1) Are children consistent when making welfare tradeoff allocations, i.e.do they express a stable

"switch-point"? (2) Do children show different WTRs based on the target? We predicted that, like adults, children would exhibit stable switch-points and would express higher WTRs towards friends than enemies or strangers. In Study 1, 4 to 11-year-olds (N = 167) made resource allocation decisions first toward a friend and then stranger in a paper-based welfare-tradeoff task using stickers. Children reliably allocated resources consistent with a single switch-point and were just as consistent at age 4 as they were at 11. However, contrary to our prediction, children did not express higher WTRs toward friends than strangers. In Study 2, 4 to 10-year-olds (N = 210) made resource allocation decisions toward a friend, stranger, and enemy. Children played on a tablet that randomized target order and selected their preferred resource: stickers, erasers, or temporary tattoos. Replicating Study 1's results, regardless of age, children expressed consistent WTRs toward all targets. In support of our second prediction, that children would have different WTRs depending on the recipient of the resources, children exhibited significantly higher WTRs toward friends than enemies. However, as in Study 1, children did not differentiate between friends and strangers. Although the "stranger" was described as someone the child would never meet, children might still think of them as potential friends whereas adults have a more robust concept of an anonymous other. We conclude that despite children's limited experience with complex social networks and resource allocation, they are able to reference a stable welfare tradeoff rule when deciding whether to benefit themselves or benefit another and that this rule changes depending on the child's cooperative relationship (or perceived potential relationship) with the target. These findings support the evolutionary hypothesis that the emergence of sophisticated forms of social valuation are part of a deep cognitive foundation and are not due merely to learned behavior.

4-H-114 Theory of Mind in Fetal Alcohol Spectrum Disorders (FASD)

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Theory of Mind (ToM) is the ability to reason about what oneself or another person knows, believes, feels, and desires. Little is known about ToM in Fetal Alcohol Spectrum Disorders (FASD), a cluster of conditions characterized by impaired cognitive, social, and behavioral functioning. The literature on ToM in FASD is limited. The present study examined cognitive and affective ToM in children with FASD. Seventy-eight children (52 typically-developing [TD], 26 FASD), ages 3-17, completed a battery of cognitive and affective ToM tasks, working memory and inhibitory control tasks, and language tasks. Children with FASD performed more poorly than TD children on a measure of affective ToM (but not cognitive ToM), language ability, and working memory. Moreover, while prior research has shown that older children with FASD demonstrate poorer ToM than younger children with FASD, our results show that older children with FASD (1) actually demonstrate better cognitive ToM than their younger peers, and (2) perform similarly to their younger peers on an affective ToM task. Taken together, these findings suggest that while children with FASD have more difficulty understanding emotions than TD children, older children with FASD fare no worse than their younger peers at understanding other people's minds or emotions.

4-H-115 Factors Promoting Children's Generalization of Counterstereotypic Information

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Two studies tested whether lab interventions can reduce children's gender stereotypes about toy preferences. In Study 1, participants (N = 49, M = 5.8 years) rated how much girls liked trucks and boys liked dolls. Next, intervention participants were exposed to counterstereotypic information about children's toy preferences (e.g., "Boys like dolls"); control participants learned stereotype-irrelevant information. At post-test, participants rated how much new children liked counterstereotypic toys. Only intervention participants' endorsement of counterstereotypic toy preferences increased from pre- to post-test (p = .03); participants in the intervention condition endorsed more counterstereotypic toy preferences at post-test than participants in the control condition (p < .001). Study 2 (N = 144, M = 5.8 years) manipulated the presence/absence of generic language (e.g., "Boys like dolls" vs. "These boys like dolls") and gender labels (e.g., "Boys like dolls" vs. "Kids like dolls") across 4 conditions in order to assess the influence of these language properties on stereotype reduction. Contrary to hypotheses, neither presence of generic language nor use of gender labels was necessary: Even children who heard phrases such as "These kids like dolls" (while viewing images of boys) increased counterstereotypic responding from pre- to post-test (ps < .001). Ongoing research is testing the longevity and breadth of these effects.

4-H-116   Fighting unfairness: are girls or boys more likely to intervene against a gender gap in pay?

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Despite a robust preference for fairness, people are routinely unfair. A clear example of this is the gender gap in pay: women tend to be paid less than men for doing the same work. One account for this pay gap is that individuals are more tolerant of pay inequalities that benefit males and are thus less likely to rectify them. Here we test this possibility and additionally ask whether the origins of the gender gap in pay can be traced into childhood. In an ongoing study, 4 to 7-year-olds (N = 69) were presented with scenarios in which a boy and a girl performed the same work and were paid equally or unequally, with unequal payment benefiting either the male or female worker. Children then had a chance to pay to intervene to redistribute the characters' earnings. Preliminary results suggest that boys were less likely than girls to intervene against unfairness (GLMM, gender x pay distribution, $X^2_2 = 6.529$, p = 0.0382). Additionally, older children showed a greater tendency towards intervention (GLMM, age x pay distribution, $X^2_2 = 22.492$, p < 0.001), though there was no interaction between gender and age (p = 0.1). In our ongoing work, we are exploring these questions with older children (8- and 9-year-olds) and additionally examining how children redistribute earnings when they intervene against unfairness. Our data thus far point to the promise of using a developmental approach to better understand the origins of systematic gender-based injustice in our society.

4-H-117   Ethnicity moderates children's implicit gender stereotypes about cognitive skills and scholastic aptitude

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Gender and ethnic stereotypes regarding cognitive abilities emerge during childhood (e.g., Bian, Leslie, & Cimpian, 2017; Cvencek, Meltzoff, & Greenwald, 2011; Cvencek et al., 2015), but it is unclear how gender and ethnicity interact to bias children's evaluations of others' skills. The current research

examined the role of ethnicity in implicit gender stereotypes about cognitive and scholastic aptitude in an ethnically diverse sample of 120 children aged 7 to 12 years. Children were presented with vignettes describing an individual who excelled in a female-stereotyped (e.g., reading, verbal fluency) or male-stereotyped (e.g., science, spatial reasoning) domain along with photos of an adult female and male of the same ethnicity (i.e., African-American, Caucasian, Latinx). When asked to identify the individual described in the vignette, children were more likely to attribute female-typed abilities to Caucasian females than to Caucasian males and were more likely to attribute male-typed abilities to Caucasian males than to Caucasian females. However, children did not exhibit these gender biases when evaluating the abilities of African-American or Latinx adults. These effects did not vary by age. Our findings demonstrate that gender and ethnicity interact to bias children's evaluations of others' cognitive abilities, highlighting the importance of considering intersectionality when examining gender stereotypes and the need for further developmental research on their origins.

4-H-118   Children's sensitivity to the cost of action selection

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From infancy through adulthood, we assume that others act to maximize reward while minimizing physical effort (Baker et al., 2003; Liu et al., 2017; Gergely & Csibra, 2003; Jara-Ettinger et al., 2016), and past research on action understanding focuses exclusively on these variables (c.f. Gershman et al., 2016). But physical effort is not the only cost of action--the mental effort required to select an action carries cost as well (Shenhav et al., 2017; Kool et al., 2010). To ask whether children are sensitive to this aspect of cost in their intuitive psychology, we designed 2 experiments where participants (pre-registered Exp 1 N=32 4-5-year-olds; pilot Exp 2 n=11, planned N=24) were asked to help an agent reach a goal by selecting an environment for it to travel through. In Exp 1, these environments differed in decision structure as well as several other features (e.g. total path length available for travel, presence of dead ends) and in Exp 2, they differed only in decision structure. See Fig 1. We predicted that if children are sensitive to the agent's cost of mental effort, then they will select less complex environments for it to travel. We found that children tended to choose easier environments, both in Exp 1 (B=7.220, p<.001, OR=1366.489), and in pilot Exp 2 (B=2.222, p=.017, OR=9.221). These findings suggest that our intuitive understanding of effort goes beyond the physical constraints and actions of agents and appreciates their unobservable mental activities.

4-H-119   Is "same as me" always better?: Children's evaluations of novel cultural information provided by in-group and out-group informants

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The current study examined whether children accepted information about a Samoan cultural practice from a member of the relevant cultural group (i.e., Samoan informant) over information provided by an in-group member (i.e., same-race informant). Thirty 3-year-olds and 35 7- to 8-year-olds heard conflicting testimony from each informant and then indicated which informant they thought was correct (i.e., correctness question) and which informant they would prefer to learn from in the future (i.e., future learning preference question). Older children endorsed the Samoan informant for future learning

significantly more than younger children, t(63)= 2.95, p = .004, and significantly above chance, M = 0.71, SD = 0.46, t(34) = 2.77, p = 0.01. Younger children did not perform significantly different from chance, M = 0.37, SD = 0.49, t(29) = 1.49, p = 0.15. Neither older children, M = 0.54, SD = 0.51, t(34) = 0.50, p > .01, nor younger children, M = 0.43, SD = 0.50, t(29)= 0.72, p > .01, endorsed either informant systematically for the correctness question. These question differences may suggest that the future learning preference question prompts older children to reflect about advantages the Samoan informant has in this context, while younger children struggle with the idea of affiliating with an out-group member. Implications for social learning models and the measures used to assess informant preferences will be discussed.

4-H-120   Co-Viewers Support Children's Understanding of Video Chat, but Live Experiences are Still Richer

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Children under 3-years-old learn better from people than screen-based experiences, but adult co-viewers may be able to diminish this "video deficit" effect. We evaluated whether 24- to 36-month-old children (n=61) were more responsive and more accurate from live interactions compared to video chat interactions. For both, an adult co-viewer provided a supportive context and additional explanations. Even with supportive co-viewing and rich social contingency from a partner, the video deficit was evident. Children were more responsive to and more accurate in their responses to a live partner than a video chat partner (p=.035). Furthermore, in the video chat condition, 29-36 month-olds were more attentive than younger 23-28 month-olds (p=.003), but there was no significant difference in the live condition, consistent with the lessening of the video deficit by 3-years-old. Results show that live social interactions are the richest context for young children's learning, even with a supportive co-viewer.

4-H-121   Children's understanding of the communicative intentions of storytelling

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Stories can serve a number of communicative purposes, but are often told to entertain and inform. Adults frequently use stories as a way to convey information and teach social lessons to children. However, previous work suggests that children are not able to identify and explain the morals of written stories until they are as old as 10 (Narvaez et al., 1999). Recent evidence shows that stories have an effect on children's behaviour (Larsen et al., under review; Lee et al., 2014), suggesting that children understand story morals on at least an implicit level. The current study seeks to examine whether by placing storytelling in a meaningful context with a clear storyteller, 5- to 8-year-olds (N = 75) show earlier success than when asked to identify morals in decontextualized stories. Children in an experimental condition heard a base story wherein a protagonist has a problem, and a secondary character tells the protagonist a story in which a similar problem is solved (embedded story). Children were then asked why the storyteller told the story, what she wants the target character to do, and to make a prediction about what the character will do. Children in two control conditions heard either the base or embedded story on its own. Children as young as 6 years old were able to correctly identify a

story's moral when framed as a question about a storyteller's intention in stories both about familiar (sharing) and unfamiliar morals (group entry).

4-H-122   **Investigating how children evaluate sources of information from a majority group**

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Following a majority can be useful, but it is also important to evaluate the source of the majority's information. When members of a majority share a single piece of evidence, they present lower quality information than members of a majority who collect evidence independently. In previous work we found that, unlike adults, 4- and 5-year old children failed to distinguish shared and independent sources of information. When given both majority and minority testimony, children endorsed the majority regardless of their source of information, but also privileged their own conflicting evidence over a majority. Here, we presented children with a simplified experiment and equated the salience of the child's personal evidence and the majority's information to see if reduced cognitive demands improved performance. Similar to our previous findings, children failed to distinguish between independent and shared sources (Fisher's exact test, Experiment 1, p=0.36; Experiment 2, p=0.68), endorsing the majority over a conflicting minority (two-tailed binomial test, p<0.001), but were at chance when given their own conflicting evidence (two-tailed binomial test, p=0.36). In our third experiment, children still failed to distinguish shared and independent sources even in the absence of conflicting information. These findings suggest that children have difficulty in evaluating an informant's source of evidence given only testimony and rely on group size or their own evidence instead.

4-H-123   **The role of context and cognitive ability in children's skepticism of deceptive information**

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How do knowledge and cognitive skills interact to influence children's trust? Across 8 trials, 3- and 4-year-olds (n = 33) watch an experimenter, who they know is deceptive, drop a ball down one of two criss-crossing tubes. Those in the knowledge condition see the ball travel down the tube; those in the no-knowledge condition do not. The deceptive experimenter tells children the wrong location for the ball, and then invites them to search. Children also complete theory of mind (TOM) and inhibitory control (IC) tasks. Across conditions, 4-year-olds search correctly more often than 3-year-olds t(31) = -3.51, p = 0.001, d = -1.26. Although knowledge condition 4-year-olds search correctly above chance in both the first and last four trials, ts > 4.25, ps < 0.005, better TOM predicts their correct searches on the first four, r(8) = 0.697, p = 0.055. Knowledge condition 3-year-olds search correctly less often than 4-year-olds on the first four trials, t(15) = -4.39, p = 0.001, d = -2.27, but not the last four, t(15) = -1.91, p = 0.076; TOM and IC do not predict their correct searches. TOM helps 4-year-olds quickly ignore deceptive information, whereas repeated experience with visual access helps 3-year-olds. On-going research (n = 27) suggests that even when children first see another adult get tricked by the deceptive experimenter, they are no more likely to ignore her deception.

4-H-124   Investigating the nature of infants' preference for imitators using neural and behavioral measures

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Past research demonstrated that, after observing an individual imitate a social partner, infants preferentially attend to the imitator over a non-imitator. The current research investigated whether this attentional bias is driven by a social preference for the imitator or by other motivators of attention, such as information seeking, by asking (1) if infants prefer to approach imitators, and (2) if observation of imitation elicits activation in the infant medial prefrontal cortex (MPFC), a region associated with computing social value. Both investigations tested two sets of displays, one featuring animated characters and the other featuring videotaped actors. Hemodynamic responses in MPFC (and control regions not hypothesized to respond to imitation) were measured using functional near-infrared spectroscopy (fNIRS). The animated displays elicited both preferential reaching (22/32 12.5-month-old infants, P<0.05) and higher HbO2 responses in MPFC to imitation vs. non-imitation (7.0-10.0 months; t(16) = 4.20, P<0.001). In contrast, video displays elicited neither preferential approach (9.5-10.5 months; z(12)=0.10, P>0.4) nor a stronger MPFC response to imitation (7.0-10.0 months; t(16)=0.45, P>0.4). These results suggest that some but not all attentional preferences for imitators are socially motivated, and that behavioral approach and neural signatures of social value provide convergent evidence for a social interpretation of infants' preferential attention.

4-H-125   Relationships between Solitary Creative Activities and Fantastical Reasoning in Development

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Creative activities provide opportunities for inductive reasoning, fantastical thinking, and executive functioning; however, minimal research has examine the influence of engagement with solitary (as opposed to social) creative activities on children's distinctions between fantasy and reality. This poster will examine data from 7 studies of 3- to 6-year-old children (N=839) who were interviewed about their engagement in solitary creative activities (i.e., talking to themselves before falling asleep at night) and their belief about the reality status of fantastical characters and fantastical events. Three studies (n=391) revealed engagement in solitary creative activities was positively related to the belief that fantastical characters are real, r=0.46, p<0.001. In contrast, four studies (n=448) found engagement in solitary creative activities was positively related to understanding of possibility and impossibility, r=0.28, p<0.05. Collectively, these patterns suggest engaging in non-social creative activities (e.g., solitary play) promotes children's understanding that impossible events cannot happen in the real world, but do not appear to support their developing understanding that fictional beings do not exist in the real world.

4-H-126   In Sickness and In Filth: Children's Emerging Biases Toward Unhealthy and Unclean Others

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Cleanliness is universally valued, and a dislike of dirtiness is often leveraged to facilitate negative attitudes toward outgroup members (Speltini & Passini, 2014). Unhealthy people are also universally avoided, which can be observed by age 6 (Blacker & LoBue, 2016). To examine children's attitudes toward unclean and unhealthy individuals, we presented 5-9 year-olds (N=32, data collection ongoing) with photos of two "twin" children, who were either described as being dirty (spilled soup on shirt) and clean, or described as being sick (vomit covering shirt) and healthy. We administered a battery of tasks measuring attitudinal biases. Preliminary data show that participants were considerably more likely to trust the testimony of the healthy child over the sick child, p<.001. Selective trust was less marked between the clean and dirty twins, p=.055. Participants preferred to distribute desirable resources to clean people, p=.007, and preferred to distribute undesirable resources to dirty people, p=.006, but did not differentiate between healthy and sick recipients, ps>.8. Participants explicitly ascribed positive traits to clean and healthy individuals and ascribed negative traits to dirty and sick individuals, ps<.05. Children's age did not significantly impact the results across tasks. Overall, these findings show that children strongly favor both clean and healthy individuals, but these biases are distinct and come online in different but overlapping situations.

4-H-127   Children's Attitudes Toward Gossipers

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The current study explored children's attitudes toward peers who gossip. Four- to 8-year-old children (N = 116) were read three e-books. In each book, one child character (i.e., the gossiper) gossiped with a peer about a non-present character. The gossip had either positive, negative, or neutral valence. Following each book, children were interviewed on their attitudes toward the gossiper relative to a non-gossiper. Overall, children had favorable views of the gossipers when the gossip valence was positive or neutral. They favored the gossipers over the non-gossipers in selective social learning, social preference, and perceived trustworthiness. When the gossip valence was negative, children chose randomly between the gossipers and the non-gossipers across all three domains. This effect of gossip valence was more pronounced for 6- to 8-year-olds than for the younger children. These findings have practical implications for educators and parents looking for ways to foster positive social interactions in children.

4-H-128   The Negotiating Mind: should we split the orange in half, or do something else?

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Negotiation is critical for interpersonal interactions, yet adults often fail to find optimal solutions and little is known about how successful negotiation skills develop in childhood. Here we tested the development of conceptual abilities that support successful negotiation. We presented ninety-six 3-10 year-old children with two novel tasks to measure children's: 1) understanding that people can value the same resources differentially; and 2) understanding that underlying interests motivate stated positions. In the first task, children distributed two different resources (candies) to two people who stated either

absolute preferences (liking A but disliking B) or relative preferences (liking both, but liking A more than B). By age 5, children differentiated relative from absolute preferences. In the second task children viewed two people who wanted a single limited resource (an orange), but their interests differed - one wanted the pulp to make juice and one wanted the peel to make cake. While younger children proposed splitting the orange in half, with age, children increasingly proposed the value-maximizing solution of splitting the peel from the pulp. In current research we are extending this study to cross-cultural populations.

4-H-129   Costs of Helping Only Influence Children's Ethnic Out-Group Helping Intentions

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Studies show that children are often inclined to help less when costs of helping increase. However, these studies do not take into account who children are helping. Yet, developmental intergroup research has shown that the intergroup context influences children's reasoning about helping and behavior. Two experimental vignette studies are presented that examine the influence of the costs of helping on children's (8-13 years) intention to help in an ethnic and gender intergroup context. Study 1 (n = 320) shows that the costs of helping reduce children's willingness to help ethnic out-group peers but do not influence children's intention to help ethnic in-group peers. Study 2 (n = 166) replicates the ethnic group context results of Study 1 for a different ethnic out-group peer. Moreover, children's reduced willingness to help ethnic out-group peers when costs increase was not contingent on their ethnic in-group or out-group evaluation or their age. Additionally, the role of costs in children's gender group helping intentions and show a somewhat inconsistent pattern across the two studies that needs further attention. Taken together, this research for the first time shows that the costs of helping reduce children's willingness to help ethnic out-group peers but not ethnic in-group peers.

4-H-130   Children and Adults Associate Intellectual Giftedness With Men Over Women

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Considerable research has investigated gender stereotypes about specific intellectual skills such as math and science (e.g., Ambady et al., 2001; Cvencek et al., 2011; Nosek et al., 2009). However, little attention has been paid to what is potentially a more general stereotype: Our society also tends to associate intellectual giftedness with men rather than women. For example, a recent analysis in the New York Times found that American parents are 2 to 3 times more likely to search Google for whether their boys are brilliant and geniuses than to make similar searches about their daughters (Stephens-Davidowitz, 2014; see also Storage et al., 2016). However, there are very few peer-reviewed studies that have investigated this "brilliance = males" stereotype (Bennett, 1996, 1997; Kirkcaldy et al., 2007; Tiedemann, 2000). Moreover, the studies published so far unfortunately have several limitations. First, they use explicit measures, which may be problematic if some participants are unwilling to admit to this negative stereotype. Second, these studies often elicit participants' estimates of their own intelligence, which is problematic because women may under-report their intelligence (due to modesty norms; Rudman, 1998). Finally, these studies only examine adult populations and therefore provide no information about the developmental course of this stereotype. In the present studies, we measured adults' and children's

implicit "brilliance = males" stereotypes using the Implicit Association Test (IAT; Greenwald et al., 1998). Across four studies (total N = 1,043), children and adults completed an IAT in which they sorted pictures of male and female faces, as well as words from a "genius" category and a positively-valenced control category ("creative" [Studies 1, 3, and 4], "happy" [Study 2]). In the first three studies, we recruited participants from Amazon's Mechanical Turk (Studies 1 and 2), from a large public university in the Midwestern US (Studies 1 and 2), and from outside the US (also via Mechanical Turk; Study 3). Consistently across these studies, participants of both genders implicitly associated men rather than women with brilliance and genius. Effect sizes ranged from 0.15 to 0.46 (all statistically significant). In addition, IAT scores correlated significantly (but modestly) with explicit measures of prejudice against women (e.g., scales of old-fashioned and modern sexism; Swim et al., 1995). In the final study, we used the same IAT as in Studies 1 and 3 ("brilliant" vs. "creative") to investigate whether the "brilliance = males" stereotype is present in childhood as well. We recruited 9- to 10-year-olds, which were the youngest ages at which children could comfortably read and understand the words presented as part of the IAT. These children also associated brilliance with males rather than females (effect sizes were significant in each samples). These studies are the first to investigate the stereotype against women's intellectual abilities. Our results suggest that, at an implicit level, this stereotype is present in a wide range of participant populations, including children. These data provide an important impetus for future work examining the consequences of this stereotype for women's educational and career outcomes.

4-H-132   Children's Evaluation of Verified and Unverified Claims

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We rely heavily on what others tell us in order to develop an understanding of the world beyond our personal experience (Gelman, 2009; Harris & Koenig, 2006). But in learning from testimony, children must learn to selectively trust informants whose claims are likely to be reliable. Children are vigilant against clearly false information (Harris, 2012). But little research has explored children's understanding that claims that may be correct, but have not been verified, should not be automatically trusted. Experiment 1 examines whether 6- to 7-year-olds (N=24, Mean age=86.5 months, 12 boys) understand that claims that are sufficiently verified are preferable to claims that are not. Children saw puppets encountering sets of four boxes with unknown contents. Across six trials, two per trial type, children saw puppets either look in all boxes (full verification), in one box (insufficient verification), or in none (no verification) and then make claims about the contents. Children rated the puppets' statements on full verification trials (M=4.81, SD=1.11) significantly higher than insufficient verification trials (M=3.52, SD=1.18, t(23)=3.84, p<.001, d=.784) and no verification trials (M=3.29, SD=1.58, t(23)=3.86, p<.001 d=.788). Experiment 2 replicated this study with 4- to 5-year-olds (N=24, Mean age=57.2 months, 12 boys). The findings were nearly identical, suggesting that even preschoolers have some understanding of the importance of verification in evaluating others' claims.

4-H-133   Children Expect Leaders to be Protectors, Not Bullies

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Hierarchical relationships are ubiquitous across human society. In these relationships, high-ranking people are deferred to, have better access to resources, and more influence. However, scholars have characterized high-ranking individuals in contrasting ways: either as bullies or as authorities. Bullies maintain their position by intimidating or acting aggressively toward subordinates, and authorities maintain their position by providing benefits, such as protection. Here we tested whether children expect leaders to act like bullies or authorities. Four- to-7-year-old children were told four stories about groups of novel creatures. In the pictures that accompanied the stories, one of the creatures in each group, the leader, sat in a throne and wore a crown. In two of the stories one of the creatures, bullies another, and at the end of each story, children were asked who they thought did the bullying. In the other two stories one of the creatures protects another and children were asked who they thought did the protecting. We found that children guessed that the non-leaders did the bullying (87/104 chose the non-leader in one bully story p<.001; 79/104 chose the non-leader in the other bully story p<.001) and guessed that the leaders did the protecting (79/104 chose the leader in one protecting story p<.001; 80/104 chose the leader in the other story p<.001).

4-H-134   Individual differences in children's mind-mindedness: Effects of relationship type, age, and social cognitive ability

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Mind-mindedness (MM)--or treating others as individuals with thoughts and feelings--is typically studied in parent-child dyads, in which high parental MM predicts positive child outcomes, including greater theory of mind. Given MM's importance, researchers have begun examining MM in other relationships. By adulthood, MM is not trait-like (e.g., one's MM about a friend is unrelated to MM about a famous person; Meins et al., 2014). Earlier in development, however, greater variability in mental state awareness may result in consistent, trait-like MM differences across children. To investigate this hypothesis, 38 children (20 males) aged 7-12 described both their best friend (Meins et al., 2006) and a classmate they did not know well. For each description, we calculated an MM score (proportion of statements relating to mental attributes). Consistent with adult findings, children's MM scores for their best friend and classmate were uncorrelated (e.g., children with high MM for a best friend were not more likely to show high MM for a classmate). MM scores for both the best friend and classmate increased with age and did not show sex differences. Children also completed a theory of mind battery and measures of social anxiety, empathy, and friendship quality. Controlling for age, there were no relations between MM scores and any of these measures. These findings suggest that, by middle childhood, MM is not trait-like and may be separable from other social cognitive abilities.

4-H-135   The best but not the boss? Children's assumptions concerning the social status of ingroups and outgroups

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Ingroup bias is pervasive, but not invariant, and social status is one feature that modulates how people perceive their groups. Children and adults in low status social groups often display attenuated ingroup preference or even preference for higher status outgroups (Newheiser & Olson, 2012). However,

children from high status groups do not show such sensitivity to social status. Instead, their attitudes seemingly do not disambiguate between high and low status outgroups, only incorporating such information with age (Dunham, Baron & Banaji, 2006). The current study explores a possible explanation of this phenomenon: that children tacitly assume that their ingroups occupy high status positions unless exposed to countervailing evidence. Children were assigned to a minimal group, presented with vignettes featuring interpersonal or intergroup status disparities (Gulgoz & Gelman, 2016) and were asked to decide the group membership of the characters. Experiment 1 found a marginally significant tendency to associate the ingroup with high status and this tendency was marginally associated with stronger ingroup preference. Large item effects complicated these results, motivating Experiment 2 (ongoing, Figure 1), in which we varied the status of the agents (high vs. low) as well as the valence of the actions (malevolent vs. benevolent). Preliminary results suggest children associated benevolent, but not malevolent, status with the ingroup, not in support of our primary hypothesis.

4-H-136   Iranian children favor social status over ethnic similarity

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By 3 yrs old, children categorize people into ingroups and outgroups and generally prefer to associate with ingroup members. Here, we examined if social status could eliminate ingroup preferences, particularly on children's desire to associate with, trust and be loyal to members of different social groups. We tested if Iranian children would regard a high status outgroup similarly to their ingroup and favor status over ethnic similarity. We had 7- to 12-yr-old Iranian children (N=71) rank 4 social groups, Iranian children from their school, Iranian children from a different school (control group), Arab children (ethnically similar outgroup) and American children (high status outgroup), on perceived social status and desire to associate with from 1 (lowest ranking)-10. Children also rated how much they wanted to befriend, trust and be loyal to members of different groups from 1(definitely no) to 4(definitely yes). As predicted, children ranked American children highest on social status (Mdn =10) and Arab children lowest (Mdn=4), F(15, 269)=8.73, p<.001. They also ranked Americans highest on desired association and preferred to befriend, trust and be loyal to American children over Arab children F(90,1627)=10.81, p<.001, and even the Iranian control group F(90,1627)=5.67, p<.001. Our findings show that Iranian children want to associate with members of a high-status outgroup as much as their ingroup, and favor status over ethnic similarity when gaging loyalty and trust

4-H-137   Isolating Communicative Effectiveness: Disentangling the Effects of Head Turns, Eye Gaze, and Pointing Gestures on Infants' Cue-Following Abilities

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In all cultures, infants learn to follow cues from caregivers. In western cultures, infants follow adults' pointing gestures that are accompanied by head turns and eye gaze in the same direction. Here, we test which cue or combination of cues is most effective in directing infants' attention. In an ongoing experiment, we tested 12- and 18-month-olds' (n =16) ability to follow an experimenter's social cues directed towards novel objects. Six combinations of social cues were used (Figure 1). Each test trial had 3 iterations of a communicative cue, either on its own (e.g., point) or combined with another (e.g., point

and eyes). Control trials with all 3 cues combined were also included. Across ages, infants followed eye gaze and pointing more often than head turn alone (p = .002), eye gaze alone (p = .007), and head turn with eye gaze (p = .048). Thus, gaze and pointing are most effective at directing infants' attention. Once data collection is complete, we will determine whether cue-following behavior and cue-following latency differ between 12- and 18-month-olds. These findings will contribute to our understanding of joint attention by exploring how pointing gestures influence infants' cue-following at different developmental time points. Moreover, this study will be the first to compare the effectiveness of each of these social cues, either on their own or combined with others, and therefore pinpoint the unique contribution of each to infants' gaze-following capabilities.

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