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Symposium 1: Is hurthing "them" okay? Children's perceptions of and reactions to outgroup harm

S1.1 Infants' expectations of ingroup help and outgroup harm during intergroup conflict

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Forming social allegiances can enhance one's survival, as individuals may unite to acquire resources and defend each other against rival groups (eg. Cheney & Seyfarth, 1986; Wilson & Wrangham, 2003). In addition, representations of social allegiances may constrain expectations about the social group's identity, roles and moral obligations (eg. Haidt & Craig, 2008; Hauser, 2006; Pietraszewski & Shaw, 2015; Pietraszewski, 2016; Rai & Fiske, 2011; Rhodes & Brickman, 2011; Rhodes, 2012). Across four studies, we investigated whether representations of social allegiances influences infants' expectations of third-party behavior towards ingroup and outgroup members during a conflict. Studies 1 and 2 investigated whether infants (17-20 mos, and 9-13 mos respectively) expect a member of a social group to indirectly help an ingroup member complete their goal of crossing a platform. Infants were introduced to two groups (equal in physical size and number) and one agent from each group faced a zero-sum conflict. Infants looked significantly longer when an ingroup member indirectly helped an outgroup member accomplish their goal (by colliding into their own group member until they fell off the platform) (Study 1, M = 15.97 s; Study 2, M= 13.21s), compared to when an ingroup member indirectly helped their own member accomplish their goal (by colliding into the outgroup member until they off the platform) (Study 1: M= 12.24 s; t(35) = 2.34 , p = .025); (Study 2: M = 10.84; t(59) = 2.11, p = 0.039). This suggests that infants a) expect a member of the ingroup to intervene during a conflict, and b) outgroup harm may be tolerated during a conflict. We then investigated whether infants (9-20 mos) expected an ingroup member to help an own group member directly achieve their goal (Study 3) and obtain a desired limited resource (Study 4) in a conflict scenario. Consistent with the results of Studies 1 and 2, Study 3 demonstrated that infants looked significantly longer when an ingroup member directly helped an outgroup member across the platform (M = 11.60 s), compared to when an ingroup member directly helped an own group member cross the platform (M = 9.18), t(87) = 3.92, p <.001. In Study 4, infants looked significantly longer when an ingroup member helped an outgroup member obtain a desired resource (M =15.47) compared to when an ingroup member directly helped an own group member obtain a desired resource (M = 11.08), t(46) = 2.90, p = 0.006. This demonstrates that infants' expectations of ingroup help extends across contexts. Together, these studies provide insight into infants' reasoning about social allegiances and corresponding obligations. More specifically, infants expect allies to intervene and exclusively help ingroup members accomplish their goals and acquire limited resources. At the same time, outgroup harm may be permissible during intergroup conflict. Collectively, these results suggest that ingroup loyalty may drive infants' expectations of social group behavior.

S1.2 Children's (surprising) perceptions of hate crimes

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Adults consider transgressions explicitly motivated by group membership (i.e., hate crimes) to be more serious than transgressions motivated by other reasons (e.g., dislike of the victim; Rayburn et al., 2003). This type of explicit, aggressive harm motivated solely by group membership has especially devastating

effects on both the victims themselves and the communities that share the victim's group membership (e.g., McDevitt et al., 2001). However, children generally evaluate outgroup harm as more acceptable than ingroup harm (Rhodes & Chalik, 2013; Mulvey, 2016), which raises the question of whether children may actually view "hate crimes" as relatively acceptable. Do children, like adults, see harm motivated simply by membership in an outgroup as more severe than other types of harm? In Study 1, 4- to 9-year-old children (N = 108) and adults (N = 115) heard about a mild transgression (e.g., taking someone's eraser) involving two members of novel groups of human-like creatures (e.g., "Circles" and "Squares"). In the key ("hate crimes") condition, a protagonist (e.g., a Circle) committed a transgression against an outgroup member (e.g., a Square) and stated the victim's group membership as the motive. Two other closely matched scenarios were compared: (1) a transgression against an outgroup member based on a personal reason ("Because I don't like you!"), and (2) a transgression against an ingroup member based on a personal reason. We examined participants' perceptions of these scenarios with a range of measures (e.g., how bad the action was, how punishable it was, how bad the transgressor was as a person). Overall, children rated the harm in the "hate crime" condition as least serious; adults showed the opposite pattern (Figure 1). In a follow-up Study 2, we replicated these results using more closely matched wording between the conditions. Building on these two studies, we asked whether the type of group mattered: Across federal and state laws in the US, only crimes motivated by membership in certain protected social categories (e.g., race/ethnicity, gender), and not other types of groups (e.g., sports teams), are considered hate crimes. Results from Study 3 showed that adults (N = 121) rated transgressions motivated by membership in a social category (vs. sports team) as more serious, whereas children (N = 120) did not distinguish between the two. Another characteristic feature of hate crimes is that the victim belongs to a historically marginalized group. Thus, in an ongoing study, we ask whether a status difference between the groups affects how children perceive outgroup transgressions motivated by group membership. Data collected so far from children (N = 159 out of planned 180) and adults (N = 110) suggests that status differences (i.e., the victim but not the transgressor belonging to a marginalized group) may in fact lead both children and adults to rate these transgressions as more serious relative to analogous transgressions when status differences are not present.

S1.3   Developmental differences in prosocial bystander responses to the social exclusion of immigrants: The effect of group norms

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Children and adolescents experience different forms of social exclusion, resulting in negative outcomes. Intergroup exclusion (i.e., being excluded based on the group membership), stems from discrimination and prejudice, and this bias-based form of bullying can be more harmful to children than other forms such as being excluded based on personal characteristics (e.g., being shy). As a consequence of ongoing migration, schools are becoming increasingly diverse and school-aged young immigrants are more likely to encounter bias-based bullying and discrimination in schools than their majority status counterparts. Group norms on who to include or exclude and who to help or not help shared by ingroup peers are important in such intergroup contexts. This experimental study explored how injunctive norms (what peers approve or disapprove of) and descriptive norms (what peers actually do) influence children's and adolescents' bystander responses to the social exclusion of immigrants. British children (aged 8-11, N = 226) and adolescents (aged 13-15, N = 237) were presented with a hypothetical scenario in which they were a part of a peer group of British friends who formed an after-school cooking club. Then they read that their group has a rule that they should help people if they are being left out (injunctive norm). Next,

the participants were told about a British or an immigrant newcomer who wants to join the club but was excluded from the club by a peer from the British group of friends. We manipulated the descriptive norm, so participants either read about their peer group helping the excluded newcomer or doing nothing to help. Participants then completed the measure that assessed their prosocial bystander reaction (help or do nothing). Participants also rated their likelihood of engaging in different forms of bystander reactions: direct (telling the excluder to include the new student and telling the new student you don't agree with the excluder) or indirect (getting help from a teacher or a friend) bystander challenging. Following the prosocial bystander measure (help or do nothing), participants provided their reasoning and justifications through answering a "why?" question. The results revealed that adolescents were less likely than children to show prosocial bystander responses. Participants were more likely to do nothing when they were told that the group did nothing to help the excluded child. Adolescents were also less likely to show direct and indirect bystander challenging compared to children. The reasoning findings also revealed developmental changes with age: Adolescents used more social-conventional reasons (i.e., group dynamics) to justify their responses compared to children. These findings show the power of the alignment between injunctive and descriptive norms in shaping prosocial behavior. Implications for the development of educational strategies to reduce the exclusion of immigrants in adolescence, and to promote inclusive bystander behaviours that challenge prejudice-based exclusion in globalised societies, will be discussed.

S1.4   The shadow of war: parental competitive victimhood and children's contact intentions in four post-conflict societies in Europe

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Previous research has demonstrated the intergenerational impact of mass trauma, such as the Holocaust (e.g., Barel et al., 2010), and political violence (O'Neill et al., 2015). More specifically, the extent to which parents perceive their group to have been victimised during the conflict (i.e., competitive victimhood) has implications for their children's intergroup relations (Stambuck et al., 2020). Comparative work across different cultures can shed light on the similarities and differences in these types of family processes across both majority and minority groups involved in a former conflict (Taylor et al., 2021). This paper explores the extent to which parental perceived competitive victimhood is related to children's intergroup contact intentions, and if group status (minority vs. majority) moderates this relationship. We collected data from 230 families with children aged 7 to 11 (M = 9.02, SD = 1.30) in four post-accord societies in Europe: Croatia, Kosovo, Northern Ireland, and Republic of North Macedonia. In each setting, children in this sample were born after the height of political violence, but are raised in relatively divided societies (i.e., separate school systems). Competitive victimhood was calculated by subtracting perceived victimization of one's outgroup from perceived victimization of one's ingroup. Higher scores equal a perception of relatively greater victimization of one's own group. Children were asked about how many sessions of 'shared education' (i.e., contact with the other group) they would like to participate in in a given week. Responses ranged from 0 to 10, with higher scores indicating a willingness to participate in more intergroup contact. A moderation analysis found that the main effect of minority/majority status on children's contact intentions was not significant (b = .18, SE = .23, p = .45), yet there was a main effect of competitive victimhood (b = -.02, SE = .01, p < .001). The more participants' parents thought their ingroup had been relatively victimized, the lower their child's contact intentions. There was also a significant status x competitive victimhood

interaction (b = .02, SE = .01, p = .007). Increased competitive victimhood was associated with decreased contact intentions for the minority only. In sum, for children born in a post-accord period, their parents' perceptions of how much their group suffered during the previous conflict has implications for children's willingness to participate in intergroup contact through shared education.

Symposium 2: Children's exposure to and use of socially meaningful variation in language

S2.1   Do bilingual infants experience each language in distinct interactional contexts

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In monolingual children, characteristics of the input vary as a function of the interactional context, including the type of speaker, speech register, and activity. For example speech from adults has been shown to be more supportive of infants' communicative attempts than speech from other children (Hoff-Ginsberg & Krueger, 1991). Child-directed speech has been characterized as having more pronounced pitch contours and being syntactically simpler than adult-directed speech, and to capture children's attention more effectively (Soderstrom, 2007). Characteristics of the input also vary by activity, which often correlates with time of day (Casillas et al., 2019; Soderstrom & Wittebolle, 2013). However, limited research has examined how dual language input to bilingual children is distributed across speech registers, speakers, and activities. This study asks: To what extent do bilingual infants experience each of their languages in distinct interactional contexts, and does this vary across communities? We examined the distribution of dual language input across speaker types (adults, children), speech registers (child-directed vs. adult-directed speech), and time of day (as a proxy for activity context) for infants in a Quechua-Spanish community in Bolivia and a Spanish-speaking immigrant community in the United States (US). We predicted that infants' exposure to each language (Quechua-Spanish and Spanish-English) would vary by: 1) speaker type; 2) speech register; and 3) time of day; and that patterns would vary by sociocultural community (indigenous community in Bolivia vs. immigrant community in the US). Families completed daylong audio recordings (8-16 hours). Each recording was split into 30-second clips. Clips were randomly selected and annotated from the daylong recording (M= 100 clips, 50 min) for language (Quechua, English, Spanish, Mixed), speaker (Adult, Other child), and addressee (Target child, Adult, Other child). We calculated the proportion of clips in each language in speech from adults and children, and in child-directed and adult-directed speech. Results revealed a significant 3-way interaction between speaker, speech register, and community. Among US families (n=10), infants heard a higher proportion of English in speech from children than in speech from adults (M children=0.32, M adults=0.03). They also heard a higher proportion of English in speech from children to other children than in speech rom children to adults. Among families in Bolivia (n=10), infants heard a higher proportion of Spanish in speech from children than in speech from adults (M children=0.77, M adults=0.27), and they heard a higher proportion of Spanish in speech from adults to children than from adults to adults. Across samples, infants heard each language in distinct interactional contexts, yet patterns differed by community. In the US, infants were exposed to the societal language primarily in conversations between children while they heard the minoritized language in adult-adult and adult-child conversations. In Bolivia, infants heard the societal language in adult-child and child-child conversations while they heard the minoritized language primarily in conversations between adults. Analyses of how dual language input varies by time of day will be conducted. Results will be discussed in the context of theories of dual language development and language maintenance and shift.

S2.3   Children's shift from CDS to ADS vocabulary across early childhood

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Child-directed speech (CDS) features words such as doggy, night-night, and tummy that are rarely used in adult-directed speech (ADS). Investigations of common characteristics of CDS forms, including reduplication and diminutivization, explain why they may be learned and produced earlier by children (Ota et al., 2018). However, much less attention has been paid to children's switch to using ADS equivalents--dog, goodnight, stomach--despite its relevance for vocabulary development and children's budding understanding of context-specific language use. Here, we asked (1) when children make the shift from CDS to ADS vocabulary, and (2) what linguistic information in their input may support this shift. Using 9,346 transcripts from the CHILDES database (MacWhinney, 2000), we examined 1,037 English-learning children's production of 15 common CDS/ADS word pairs (e.g., tummy/stomach) and their exposure to these words in everyday settings across the first 7 years of life. Children significantly increased their production of ADS forms across age ($\beta=0.02$, $p<0.001$; $p<0.05$ for 13 of 15 individual word pair trajectories), with the average CDS-to-ADS transition point at 2.5 years old across word pairs. Underlying this overall trend, we identified three distinct shift trajectory types, including early shifts to ADS (e.g., doggy/dog, night-night/goodnight by 2-3 years), later shifts to ADS (e.g., tummy/stomach, mommy/mom by 5-7 years), and cases where ADS forms appear to dominate from the start (e.g., blankie/blanket, birdie/bird). We next explored the linguistic features in children's input (i.e., other-produced speech) that may predict the CDS-to-ADS vocabulary shift. We asked whether factors that broadly distinguish CDS vs. ADS registers--utterance length, syntactic complexity, lexical diversity, speech rate, mean pitch, and pitch range (Narayan & McDermott, 2016; Soderstrom, 2007)--also distinguish the utterances containing CDS vs. ADS forms. We ran binomial mixed-effects logistic regression models predicting the appearance of CDS vs. ADS forms in a given utterance on the basis of 6 linguistic features, while controlling for main effects of and interactions with age and including by-pair and by-speaker random slopes and intercepts. We found significant or marginal effects for 4 of 6 input factors tested. Utterances with more words ($\beta=0.43$, $p<0.001$), greater syntactic complexity (i.e., more verbs: $\beta=0.21$, $p<0.001$), faster speech rates (i.e., more words produced per second: $\beta=0.18$, $p=0.005$), and narrower pitch ranges were more likely to contain ADS forms ($\beta=0.09$, $p=0.098$). Thus, many of the linguistic features that distinguish CDS vs. ADS registers similarly differentiated the local speech contexts surrounding CDS vs. ADS forms. Notably, these distinctions emerged even in transcripts that primarily included speech directed to the target child (i.e., speech from a single register). Additional analyses of the speech contexts surrounding children's productions yielded qualitatively similar results to those of adults' productions (e.g., children also used ADS forms in longer utterances), suggesting that child learners may be sensitive to these linguistic features in their input and may use this information to support their discovery of context-appropriate CDS/ADS pair use. Ongoing analyses examine whether the same linguistic features may additionally predict differences in shift trajectory type (e.g., earlier vs. later shift to ADS) across word pairs.

S2.4   Exploring children's communicative adjustments to learners with varying needs

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Being a good conversational partner requires sensitivity to the needs of the listener, regardless of whether those needs depend on short-lived situational factors (e.g. a listener's temporary skill level) or on enduring properties of the listener (e.g. a listener's native language or disability). The current study

used a teaching paradigm to probe children's ability to adjust their communicative practices for diverse types learners requiring different types of accommodations. To create a high stakes communication task, we used a teaching paradigm. Previous work suggests that 4-year-old children can adjust their speech to reflect their listener's general ability level; They use shorter sentences and more attentional prompts with a younger sibling than an adult (Shatz & Gelman, 1973); Provide less information when teaching about a novel toy to someone who is exceptionally smart (Gweon & Schulz, 2019); and provide more information when their learner's goal is to learn how a novel toy works (as opposed to just seeing what it does) (Gweon & Schulz, 2019). We asked children to teach 2 adults with different needs. One adult for every child was a "Control" adult: this person interacted pleasantly and showed no difficulties when following directions. The other adults varied across participants. The "Disability" adult was enacted by a college student with an actual developmental disability (either Williams Syndrome or ADHD); this adult explained what a disability was and then followed scripted difficulties when following the child's directions. The "Tired" adult explained that she was tired and distracted today, and followed the identical scripted difficulties as the Disability adult when following directions. The "Foreign-Language" adult spoke exclusively Spanish during the teaching episode and feigned confusion at instructions in English but was able to easily reproduce actions and follow pointing. Thus, the Disability and Foreign-Language adults possessed enduring properties that required special instruction while the Tired adult suffered from a temporary lack of skill. The 84 children (48 female; M=51.96 months) were tested in a museum lab. Each child was taught how to open two tricky boxes (requiring multiple, non-obvious steps to succeed). After mastering each box, the child was introduced to a new adult and was asked to teach that adult how to open the box for herself. Children's behaviors were coded in detail via videotape. Results showed that children modified their interactions for the novel adults (relative to the Control adult) and moreover, did so differently for each. For the Tired adult, children used more teaching talk & gestures (e.g. providing instructions, pointing at critical elements) in response to that adult's difficulties, but did not qualitatively change their rate of teaching (adjusted for time) or any social behaviors. For the Disability adult, children looked more to their parents and reduced the rate-adjusted frequency of teaching behaviors, but maintained the same level of social talk and gestures (e.g. greetings, nodding). For the Foreign-Language adult, children reduced all kinds of talking but looked significantly more at the adult learner. These differentiated patterns demonstrate sensitivity to the specific communicative needs and abilities of their interlocutor and show an early flexibility with communicative competence.

Symposium 3: Exploring children's early engagement and motivation in science: Implications for cognitive development

S3.1   Teaching science as an activity rather than an identity benefits prekindergarten girls' science self-efficacy and engagement over time

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Language that describes science as an identity (e.g., "Let's be scientists! Scientists discover new things") suggests that success in science depends not on what one does, but rather on who one is (Knobe et al., 2013; Rattan et al., 2012). Such a categorical representation of scientists lays the foundation for social stereotypes (e.g., that the kind of person who is a scientist includes those who are White and male) and may be especially detrimental to the science engagement of children whose identities are inconsistent

with these stereotypes (e.g., for girls). Building on prior work that has found these immediate effects of replacing such language with action-focused language (e.g., "Let's do science! Doing science means discovering new things") on gender differences in science engagement (e.g., Rhodes et al., 2019; Lei et al., 2019), the present research tested how these subtle linguistic cues shape girls' early science engagement over developmental time. To do so, we administered an interactive online science program to prekindergarten-aged children (N = 485; Mage = 5 years; 58.3% White, 14.0% Asian, 18.7% Biracial/Mixed, 3.5% African-American, 0.2% Native American; 11.9% of the sample, of any race, identified as Hispanic/Latinx). The curriculum included four virtual science lessons that taught children concepts of friction, gravity, buoyancy, and transparency. By random assignment, the curriculum was taught with either action-focused or identity-focused language across the four lessons. One lesson was made available to children at a time, at least one week after each preceding research session. Children's science self-efficacy, science engagement, and science gender stereotypes were assessed one week after the first lesson, one week after the final lesson, and again several months later. Compared to girls in the identity-focused language condition, girls in the action-focused condition had higher science self-efficacy, t(466) = -2.16, p = .031, greater science engagement, t(492) = -2.29, p = .022, and fewer gendered stereotypes about science, t(501) = 2.22, p = .027 (see Figure 1). These effects were consistent across time, suggesting that the effects of language did not diminish even several weeks and months after children participated in the curriculum. Boys' responses did not vary across language conditions for any of these measures (ps > .10). Further, girls' science gender stereotypes mediated the effects of their assigned language condition on their science self-efficacy (indirect effect: .03, 95%CI[0.0004, 0.07], p = .046) and science engagement (indirect effect: .02, 95%CI[0.001, 0.03], p = .034), suggesting that identity-based linguistic cues contribute to girls' early disengagement from science by eliciting stereotyped representations of the category scientists. Overall, these data suggest that action-focused descriptions of science benefit girls' science self-efficacy and engagement, and that repeated exposure to action-focused language (in this case, across four science lessons) leads to benefits that extend across time (at least over several months). Furthermore, the effect of linguistic input on girls' science engagement was mediated by their early-developing gender stereotypes about science. This work sheds light on a novel mechanism through which stereotypic representations of science are transmitted to young girls and has broad and important implications for combatting girls' disengagement from science early on.

S3.2   Children's selective trust of achievement-oriented versus effort-oriented scientists

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Children's early motivation in science is impacted by language cues about a scientists' brilliance (e.g. Bian et al., 2017). Recent work with 4- and 5-year-old children showed that children who read about a hardworking scientist persisted longer on a task than children who read about a brilliant scientist (Haber, Kumar, et al., 2021). The current study explores how four- to seven-year-old children perceive scientists described as hardworking compared to scientists described as brilliant. We collected data on Zoom from 55 4- to 7-year-old children (Mage = 71 months; SDage = 15 months, 25 female). Utilizing the selective trust paradigm, we first introduced children to two scientists, an Achievement Informant described in terms of her ability (e.g. "she is really smart") and an Effort Informant described in terms of her efforts (e.g. "she is really hardworking"). Order of introduction was counterbalanced. We then asked children three sets of four selective trust questions: a set of Object Label Endorsements (e.g. "This scientist calls the object a dax and this scientist calls the object a nez. Do you think the object is called a

dax or a nez?"); a set of Science Question Endorsements (e.g. "Imagine you want to ask the question 'Why is the sky blue?' Would you rather ask this scientist or this scientist to answer your question?"). Next, we asked children to respond to a question evaluating their beliefs about intelligence (following Bempechat et al., 1991). Finally, we reintroduced either the Achievement Informant or the Effort Informant and invited children to do a science persistence task. Analyses show that for the Object Label Endorsement trials, children were equally likely to endorse the Achievement Informant as they were to endorse the Effort Informant (t(54) =0.06, p = 0.65). For the Science Question Endorsement trials, children selectively endorsed the Achievement Informant over the Effort Informant (t(54) =3.42, p < 0.01). These findings suggest that children's decisions about whether to trust the Achievement Informant or the Effort Informant depend on context. When learning about novel object labels, children appear to trust either scientist, but when considering who to ask a science question, children selectively trust the scientist described as "smart." We found some variability in children's mindset, with 78% of children endorsing an incremental theory of intelligence and 19% endorsing an entity theory of intelligence. Additionally, survival analysis indicates that, holding age and gender constant, there was no difference in children's persistence by informant exposure (β = -0.22, p > 0.05). Future work should continue to explore the effect of ability-focused versus effort-focused language on children's social preferences.

S3.3   Different opportunities to participate in science and their relationship to elementary student engagement

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Engagement is critical for students' science learning and achievement, but unfortunately, tends to drop as students begin middle school. Thus, it is critical that we better understand ways to foster student engagement during the formative elementary years. Declines in students' engagement can be partially explained by opportunity gaps to participate in science, particularly along socioeconomic lines (Authors, 2018). Previous research has found that middle school students' opportunities to participate (OtP) in science learning significantly predicted their engagement (Authors, 2020). OtP in science learning include 1) acquiring foundational knowledge (e.g., learning scientific vocabulary), 2) planning an investigation (e.g., generating research questions), 3) conducting an investigation (e.g., collecting primary data), and 4) using evidence and communicating scientific ideas (e.g., presenting evidence to support claims; Authors, 2018). Thus, in the present study we draw on the opportunity-propensity framework (Byrnes & Wasik, 2009) to examine the relationship between the OtP factors in science and elementary student engagement, accounting for school socioeconomic status (SES). Students in grades 3-5 from 41 different classrooms participated in this study (N=1005). Students responded to items assessing their perceptions of opportunities to participate in classroom-based science activities (e.g., "Come up with and do my own scientific investigation") and their perceived science engagement (e.g., "I stay focused in class"). Students' perceived science engagement consisted of items assessing behavioral, cognitive, emotional, and social engagement (Wang et al., 2016). School SES data (percentage of students eligible for free or reduced lunch) were obtained from state records. Using multilevel structural equation modeling to account for students nested within different schools, we examined the relationship between the four OtP factors in science and students' science engagement while controlling for school SES. We found that OtP in science were differentially related to the engagement dimensions (r = .015 to .302, p< .01). General patterns showed that OtP in science factors were moderately correlated to cognitive engagement (r = .170 to .302, p < .01), whereas the relationships to behavioral

and emotional engagement were consistently weak (r = .015 (ns) to .147, p < .01). A path analysis showed that only planning an investigation and communicating ideas predicted engagement. Planning an investigation predicted cognitive (β = .166, p < .01) and emotional engagement (β = .111, p = .026), whereas communicating ideas predicted cognitive (β = .236, p < .01) and social engagement (β = .160, p = .01). The final multilevel SEM model estimated OtP and engagement in science as latent variables, and had satisfactory model fit ($\chi 2$ = 56.589, p < .01, CFI = .926, RMSEA = .034, SRMR = .049). School-level SES was not predictive of OtP (β = -.097, p = .364), but OtP was positively predictive of students' science engagement (β = .442, p = .021). Overall, we found that OtP in science learning is important for elementary student engagement. However, opportunities that involved students in critical thinking and meaning construction (i.e., generating research questions) were more important for fostering engagement than traditional teaching practices (i.e., filling out science worksheets). This is a key finding for understanding best practices in science education.

Symposium 4: Beyond deficit models of children's cognitive development: Advances in research considering culture, context, and knowledge in how children develop cognitive skills

S4.1   Perceiving minds in autistic children

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Autism is a lifelong, neurodevelopmental condition, affecting 1 in 54 children. It is most commonly associated with social differences. Indeed, one of the oldest, most widely held beliefs about autistic people is that they are not interested in social interaction. In the earliest scientific account of autism, for example, autistic children were described as "happiest when left alone" (Kanner, 1943). Even today, an NIH online fact sheet suggests that autistic children may be "indifferent to social engagement." This belief--based primarily on inferences non-autistic people make about the meaning of autistic people's unusual behaviors--has had a tremendous (and often negative) influence on how autistic people are studied and treated (Jaswal & Akhtar, 2019). The most common intervention in autism focuses on changing autistic children's social behavior to look more like non-autistic children's social behavior. The underlying assumption is that autistic children's social behavior (or apparent lack thereof) is caused by a socially deficient mind (or no mind at all), rather than a socially different mind that is attempting to adapt to the world it finds itself in. In this talk, I report findings from a qualitative study that challenges the deficit model of the autistic child's mind. I provide evidence that mothers of non-speaking autistic children perceive their children as having social minds and respond to them accordingly. Critically, acting as if a child's behavior is indicative of a particular competence can create the conditions for the child to develop that competence (e.g., Gros-Louis et al., 2017). The study involved phenomenological interviews with 13 mothers to understand how they experienced connection with their 5- to 14-year-old nonspeaking autistic children. These mothers had all publicly discussed the strong connection they felt to their children; the goal of the study was to understand how they came to perceive their children as interested in connecting with them. Put another way, how did they come to see their children's behavior as reflecting a socially oriented mind? Thematic analysis was conducted and content relevant to the mothers' experience of social connection was coded, discussed, and grouped into candidate themes and sub-themes. Three themes emerged: 1) a range of child behaviors elicited feelings of connection; 2) mothers (re)framed child behaviors that could undermine connection as caused by

factors unrelated to the relationship; and 3) mothers held several convictions that may help create and sustain connection in the face of uncertainty about the meaning of their children's behavior. Even though their autistic children may not consistently act in conventional socially oriented ways, these mothers reported perceiving their children's behavior as embedded within an emotionally reciprocal relationship. Our findings suggest these mothers shared beliefs that enabled them to expand the behavioral boundaries of what "counts" as an indication of a social mind: the attribution of a personality to their children, a presumption of competence in them, and an acceptance of their children's differences. Mothers engaged in rich interpretations of their children's behavior, much like mothers of non-autistic infants and children do, potentially fostering their children's cognitive development.

S4.2   Young children use social knowledge to regulate exploration

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Exploration and control are often viewed as opposing developmental processes, with exploration dominating early learning and becoming tempered by later-developing executive control processes (Gopnik, 2020). Consistent with view, young children have frequently been compared to neuropsychology patients with frontal lobe deficits, who struggle with using knowledge to guide action, resisting impulses, and inhibiting exploratory behavior (Diamond & Taylor, 1996). However, unlike patients, children's apparent control deficits have been viewed as developmentally adaptive, fostering carefree exploration (Gopnik, 2020). But is children's exploration really so devoid of control? In this talk I present research investigating an alternative view: that young children can use control in a variety of ways, and as their knowledge expands they become increasingly flexible in regulating their exploratory behavior. Social knowledge may be particularly important for learning to regulate exploration (Vygotsky, 1967). We tested this possibility in an online study examining 3- to 5-year-old children's use of social information to regulate exploratory choices, adapting a paradigm developed by Botto & Rochat (2018). Fifty-nine middle class, U.S.-based children (75% White, M age=4.56 years) completed an exploratory choice task in which an experimenter demonstrated two sets of actions involving play materials or a toy (e.g., stacking Duplo blocks vertically or horizontally) and then positively or negatively evaluated the outcomes (e.g., "Wow, isn't that great?" or "Ugh, I don't like that."). Children were then told it was their turn and that they could point to one or more of the evaluated options and/or a novel option to try. On some trials, the experimenter said she would watch the child make their selection (and remained on screen) whereas on others she said she would be right back (and left the screen). Children were motivated to explore, frequently pointing to positively evaluated (M=53%) and novel options (M=56%). Yet they tended to inhibit selections that were negatively evaluated by an experimenter (M=34%), especially on trials where they believed they were being watched (not-watched M=39%, watched M=27%), β=0.99, SE=0.33, z=3.02, p<.01. Children did not, however, decrease selection of novel options when watched, p>.25. Thus, the observed patterns suggest children were balancing conflicting desires of exploring options versus resisting those that could evoke a negative response. With age and regardless of whether they were watched or not, children increasingly avoided negatively evaluated options, β=0.14, SE=0.05, z=2.77, p< 0.01, or exclusively selected positive options, β=0.09, SE=0.04, z=2.39, p=0.02. These patterns are consistent with children increasingly regulating their exploratory choices in light of others' preferences, perhaps inferring that others' preferences may be informative about how one should explore. Overall, the findings are consistent with exploration and control coexisting early in development, and children showing increasing flexibly in how they explore in light of different kinds of

social information. These findings call for more research on the interplay of exploration, control, and knowledge in development.

S4.3   Examining relations between performance on non-verbal executive function and verbal self-regulation tasks in demographically-diverse populations

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Self-regulation is a widely studied construct, assumed to be cognitively supported by executive functions (EFs). There is a lack of clarity and consensus over the roles of components of EFs in self-regulation across research disciplines. This leaves a gap in our understanding of the cognitive mechanisms that help to account for variation in self-regulatory skills. Our objective is to fill the gap between studies of self-regulation, which focus on associations with academic success, and studies of EF in cognitive science that focus on parsing out its components based on discrete tasks. Although there is evidence that the early development of EF is correlated with academic scores, the relationship between the two may be bidirectional, with formal education also influencing the development of EF skills. Here, we tested whether EF skills pertaining to updating relevant information, more specifically visuospatial working and short-term memory, were associated with self-regulation in eight to 13-year-old children across diverse populations that vary in amount of formal schooling. There are two challenges to understanding how these updating skills operate in relation to self-regulation. The first is an incongruence in ages typically studied in self-regulation literature versus ages when executive function components are distinguishable. The second is the publication bias towards samples from the U.S. and other wealthy, English-speaking, countries, which have universal and compulsory access to formal education and high rates of literacy, thus confounding potential other factors associated with cognitive development. The current study examines the relations between performance on a) a self-regulation task (Heads, Toes, Knees Shoulders Task) and b) two EF tasks (Knox Cube and Beads Tasks) that measure different components of updating: working memory and short-term memory, respectively. We compared 107 8-to 13-year-old children (64 females) across demographically diverse populations in 4 low and middle-income countries, including Tanna, Vanuatu; Keningau, Malaysia; Saltpond, Ghana; and Natal, Brazil. The communities varied in market integration/urbanicity and level of access, structure, and quality of schooling. We found that performance on the visuospatial working memory task (Knox Cube) and the visuospatial short-term memory (Beads) task are each separately associated with performance on the self-regulation task, even when controlling for schooling and location effects. These effects were robust across demographically-diverse populations of children in low-and middle-income countries. We conclude that in these populations of children, the development of visuospatial short-term memory, visuospatial working memory, and self-regulation is associated, despite differences in verbal processing demand between these tasks. This study is among the first to examine the relationship between EF skills and the HTKS self-regulation task in middle childhood with demographically-diverse populations. Our results identify relationships between updating EFs and self-regulation, independent of schooling and location effects. We found evidence that working and short-term memory represent distinct processes, though both are associated with higher performance on a self-regulation task. Our study highlights the

need to examine and define associations between EFs and self-regulation, and to investigate samples from other than Western, wealthy, and highly educated ones.

Symposium 5: Investigating how children relate knowledge and social affiliation

S5.1   Wearing your knowledge on your sleeve: Young children's reasoning about clothing as a marker of social group

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We employed a vignette style design where we introduced children to individuals who either wore the same or different style of clothing. Then, we asked children to make inferences about whether or not these individuals also shared specific knowledge. Shared knowledge in this case was knowing how to prepare and eat a novel fruit and was highlighted by referencing group-specific knowledge (e.g., "there is a very special way that people who eat this fruit have to eat it"). In Experiment 1 (N = 120), 3-and 4-year-olds and 6-and-7-year-olds inferred that those wearing identical clothing (i.e., same style, color, and pattern) were likely to share the same knowledge, while those who wore different clothing were not. In Experiment 2 (N = 120), we introduce variation into the clothing (i.e., same style but different colors and patterns) to make it more difficult for children to use a similarity heuristic. In this case, 6-and-7-year-olds but not 3- and 4-year-olds, used clothing style to make inferences about shared knowledge. Using the same varied clothing styles, Experiment 3 (N = 120) demonstrates that 3-and 4-year-olds use clothing style to make other social inferences (i.e., about friendship choices), demonstrating that younger children are capable of making some social inferences based on shared clothing style. Finally, Experiment 4 (N = 30) tested the mechanism underlying 6-and-7-year-old children's judgments. Namely, we manipulated the ownership status of the garment and found that when the same clothing style was worn by an owner, but not a borrower, older children inferred shared knowledge. These results together suggest that younger children are sensitive to clothing style and understand that it has some inferential power. However, age-related differences suggest that an understanding of the properties predicted by shared clothing is developing during early childhood. Older children understand that the visual similarity of clothing itself does not alone mark group-specific knowledge, but rather it is the non-obvious history the clothing indexes that links the wearer to the clothing that thus denotes its social significance (i.e., how/why the object was acquired and/or the ways it was previously used).

S5.2   Investigating the Types of Secrets That Promote Friendship Evaluations in Children

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Starting from a young age and continuing into adulthood, secrets play a prominent role in social interactions. Prior research shows that children see secret-sharing as a reliable cue to friendship, more so than sharing an object, fact, or group membership (Liberman & Shaw, 2018). Children also expect that sharing a friend's secret will harm that particular friendship (Liberman, 2020). However, it is unclear which aspects of a secret underlie this association with friendship, especially when compared to other types of information sharing. Specifically, given the adult literature on the benefits of gossip for establishing friendship and trust, do children similarly see sharing someone else's secret as a cue to friendship? Or must the secret consist of personal information? Furthermore, because a secret is meant to be concealed from others, does sharing the secret more broadly reduce its efficacy in promoting

friendship? Or is the content that comprises a secret enough to suggest friendship, regardless of how many other people know it? Across two studies, we begin to investigate these questions. In Study 1 (N=163, 4-11 years old), we asked about children's friendship expectations between a person who revealed her own secret versus someone else's secret. That is, participants listened to a story in which a confidee learned about a secret either directly from the secret-holder (a personal secret) or from a third-party classmate (a second-hand secret) and then rated the friendship between the secret-sharer and the confidee. With age, children became more likely to differentiate their expectations of friendship based on whether the secret was personal versus second-hand: ratings of closeness between the confidee and secret-sharer became stronger for personal secrets but not for second-hand secrets. These findings replicate previous research showing that sharing a personal secret leads to friendship. However, children did not evaluate the friendship between the recipient and third-party any differently when the third-party shared a second-hand secret compared to a non-secret personal fact. Thus, children seem to evaluate personal and second-hand secrets differently, with the sharing of personal secrets being the primary cue to friendship. In Study 2 (ongoing, 4-11 years old), we investigate whether audience size impacts children's inferences about friendship. In particular, children rate the friendship between a main character and a classmate after the main character decides to keep her secret from everyone, tell only that classmate, or share the information with everyone. Preliminary data from an adult sample suggests that the main character and classmate are rated as closest friends when the secret is shared exclusively with that classmate, followed by shared broadly with everyone, and as least close friends when the secret is kept from everyone. Taken together, these results suggest that secret-sharing is the strongest cue to friendship when the information is a personal secret (rather than about someone else) and is shared exclusively with the recipient (rather than more broadly with multiple people). Furthermore, these inferences seem to increase with age as children become more attuned to the social complexities of keeping and sharing secrets.

S5.3 Children Use Mutual Relationships to Infer Affiliation

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From a young age, children infer relationships between others based on numerous cues. For example, they infer that people are related if they are close in proximity, spend time together, or share preferences and make similar choices (Afshordi & Liberman, 2021, Roberts et al., 2017). However, another cue that can be used to infer relationships is numerical information about how many people are known in common. For instance, suppose that Alice and Bob know two people in common, but Alice and Carl know thirty people in common. Based on the number of mutual acquaintances alone, we may infer that Alice is more likely to know Carl than Bob. Previous work suggests that adults infer missing relationships in incomplete triads (e.g., Freeman, 1992), however, it is unknown if these inferences are influenced by the number of mutual acquaintances, and when these judgments emerge. In three preregistered experiments, we examined whether children and adults judge that two people are affiliated based on the number of people they both know. In Experiment 1, we examined if adults (N=176) judge others to be affiliated based on their mutual acquaintances. They were shown two target people and the friends of each target within a larger group. Across six trials, we manipulated 1) whether the two targets had one, three, or five mutual friends; and 2) whether there were few or many people in the group. Participants judged how likely it was that the targets were friends, from -3 (extremely unlikely) to 3 (extremely likely). Adults rated the likelihood was higher when there were more mutual friends, $p<.001$, and when there were fewer people in the group, $p=.008$. In Experiment 2, we examined

if 5-7-year-olds make similar inferences about mutual relationships and affiliation. Children (N=60) saw similar trials as Experiment 1, but with the overall number of people held constant across trials. Children judged whether the two targets knew each other (yes/no), and rated how confident they were, e.g., "maybe [yes/no] or for sure [yes/no]?". Children judged the targets were more likely to know each other with more mutual acquaintances in common, p<.001. This judgement did not differ by age, and there was no age-by-condition interaction. Based on this finding, children infer that individuals are more likely to know each other if they have more mutual acquaintances. In Experiment 3 (ongoing), we are further probing whether 5-7-year-olds are sensitive to the number or proportion of mutual acquaintances. In two trials, only a few of the total acquaintances were mutual (low-proportion; 3:9 and 4:10), while in the other two trials, many of the total acquaintances were mutual (high-proportion; 3:4 and 4:5). Children made the same judgments as in Experiment 2. We might conclude that children are sensitive to proportion if their affiliation judgments are greater in the high than low-proportion trials. However, if judgments are equal across trials this might suggest that they are only sensitive to number. Our preliminary data suggests that 7-year-olds use proportion, while younger children use number. Together, our work shows that from a young age we can infer whether two people are affiliated based on their mutual acquaintances. This contributes to our knowledge about how children infer relationships, by showing they use numerical information about acquaintances to infer affiliation.

Symposium 6: Misunderstanding and misalignment in children and machines

S6.1   Loopholes, a window into value alignment and the learning of meaning

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Our own goals often don't align perfectly with others' but refusing to cooperate can be costly: Between compliance and refusal there exists a vast gray area where people can feign confusion, obey the letter of the law but not the spirit, do what was asked but not what was wanted: in everyday requests, loopholes can often be found and exploited. The ability to understand and help others emerges early (Bohn & Frank, 2019; Warneken & Tomasello, 2006), but a deeper comprehension of goals, ambiguity, and utility trade-offs that enables one to leverage the under-specification of social interaction for one's own gain may emerge later in childhood. Here, we explore (1) the emergence of loophole behavior in parent-child interactions and (2) children's and adults' intuitions about the function of loopholes in these interactions. In Study 1, we surveyed 260 parents about their children's tendency to exploit loopholes (N=425, 3 to 18 yrs). Responses indicate that loophole behavior (1) is prevalent and frequent in parent-child interactions: 60% of children were reported as engaging in loophole behavior currently (45%) or previously (15%); (2) emerges around 5.6 years of age, peaks around 7.4 years, and tapers off around 9.3 years; (3) is a general cognitive phenomenon and not specific to particular linguistic constructions or conceptual domains: Parents shared anecdotes of how children found loopholes with scalars, timing, reference, knowledge, and more. In Study 2, we empirically tested whether adults and children estimate that loopholes decrease the likely degree of punishment, and increase likely amusement compared to non-compliance. Participants were presented with scenarios (based on the anecdotes in Study 1) in which a parent made a request of a child, and the child either complied, did not comply, or found a loophole (e.g., Parent says ``No more Xbox,'' and child switches to PlayStation). Adults (N=140) read nine scenarios (3 compliance, 3 non-compliance, 3 loophole) in an online survey and evaluated the child's response according to (1) how much trouble the child would get into and (2) how funny the parent

would find the behavior. Children (N=20, 4 to 10yrs) saw three scenarios (one of each type), presented as stories over Zoom, and evaluated the behavior in terms of trouble; we also coded whether children smiled and/or laughed. Adults and children thought loophole behavior would result in more trouble than compliance but less trouble than non-compliance. Adults also thought parents would find loophole behavior funnier than compliance or non-compliance, and children smiled/laughed more for loopholes. These findings parallel the developmental trajectory of loophole behavior in Study 1, suggesting that children's ability to identify others' loophole behavior may correlate with the degree to which they exploit loopholes themselves, as well as advancements in other related domains (e.g., Theory-of-Mind and pragmatic reasoning, Barner et al., 2011; Tomasello, 2018). This work is a first step in a more detailed empirical and formal study of the development of loophole behavior. We are currently investigating when children predict others will exploit loopholes, and the loopholes children spontaneously generate when given a request. We will discuss a novel computational framework of goal communication that supports loophole behavior, as well as the implications of this research for improved insight into human communication and human-AI interaction.

S6.2   Children's evaluations of the hypocritical moral inconsistency in principled rule use

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Adults recognize that several different decision rules can be used to resolve disagreements. For example, one can share resources equally or use a merit principle in which the harder worker gets more (Hook & Cook, 1979). Either rule could be considered fair, but what seems less fair is inconsistently using these rules depending on what will advantage you--dividing by merit when one does better, equality when one does worse. Here, we explore children's evaluations of such moral inconsistency when individuals use ostensibly principled procedures in order to benefit themselves. In Experiment 1, we explore how children (N = 139, 4- to 9-years old) evaluate an allocator who gives themself more because he or she did a better job. What we vary between conditions is whether he or she has used this merit rule in the past (i.e., was morally consistent) or used an equality rule (i.e., was morally inconsistent). Specifically, children were told a story in which two characters clean up a room. One of these characters is asked to allocate resources between the two characters. On Day 1, the one who was asked to allocate the resources did a less good job than the other character. In the morally consistent condition, the allocator uses a merit principle on both days, giving more to the other child on Day 1 and more to themselves on Day 2. In the morally inconsistent condition, the allocator used an equality principle on Day 1 (where they did worse) and then changes principles on Day 2 (where they did better) to merit, giving more to themselves on Day 2. As predicted, children thought the exact same distribution on Day 2 was less fair in the morally inconsistent condition as compared to the morally consistent condition. Importantly, we found no such differences on Day 1 evaluations, suggesting that children were responding to the moral inconsistency of the rule use itself. We found no age effects. In a second pre-registered experiment (N = 120, 4- to 9-years old), we investigate if children specifically dislike inconsistency generally or if they specifically dislike hypocritical moral inconsistency. Here, allocators across two conditions are inconsistent in decision rules they use across two days. However, one character endorses an inconsistent rule in a self-serving way (endorsing equality when she did worse) that may seem hypocritical and the other in a self-sacrificing way (endorsing equality when she did better). Our results suggest children dislike moral inconsistency rather than just general inconsistency. That is, children negatively evaluate inconsistency that is self-serving but positively evaluate inconsistency that is self-sacrificing. We further find that children are more likely to negatively evaluate self-serving inconsistency

as they grow older. An ongoing third pre-registered experiment (n = 100, 4- to 9-year olds) attempts to replicate Study 2 and further investigate whether children predict future dishonest behavior based on one's self-serving vs self-sacrificing inconsistent use of rules. We discuss how these results inform theories about the development of fairness, rule use, and hypocrisy.

S6.3   Human-AI (mis)communication: challenges and tools for successfully communicating what we want to computers

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While we don't always use words, communicating what we want to an AI is a conversation--with ourselves as well as with it, a recurring loop with optional steps depending on the complexity of the situation and our request. Any given conversation of this type may include: (a) the human forming an intent, (b) the human expressing that intent as a command or utterance, (c) the AI performing one or more rounds of inference on that command to resolve ambiguities and/or requesting clarifications from the human, (d) the AI showing the inferred meaning of the command and/or its execution on current and future situations or data, (e) the human hopefully correctly recognizing whether the AI's interpretation actually aligns with their intent. In the process, they may (f) update their model of the AI's capabilities and characteristics, (g) update their model of the situations in which the AI is executing its interpretation of their intent, (h) confirm or refine their intent, and (i) revise their expression of their intent to the AI, where the loop repeats until the human is satisfied. With these critical cognitive and computational steps within this back-and-forth laid out as a novel framework, it is easier to anticipate where communication can fail, and design algorithms and interfaces that ameliorate those failure points. To illustrate the value of each step in this new framework, I will present design choices and interface affordances as well as study results from several previously published systems where humans communicate goals to an AI. Take, for example, the scenario of a human asking the AI to perform string filtering on their behalf, based on whether each string matches the human's intended pattern or not. In a typical system of this type, the human expresses their desired pattern by composing examples, but the inherent ambiguity in these user-provided examples leads to misunderstandings that can be hard to correct, especially if the inductive bias of the system requires far too many examples are necessary for the AI to infer the human's intent correctly. The first system I will present uses an interaction model to (1) disambiguate the human's intent by allowing them to annotate their examples with markings about how general--or literal--the AI should treat components of each example and (2) reduce the human's cognitive load associated with understanding and validating the correctness of the AI's intent interpretation by strategically generating additional examples that are near and far from the human-provided examples. These system-generated examples help the human confirm or refine their intent and clarify its expression---by choosing better examples for the AI. The second system I will present builds upon the first by (1) giving the human a window into the internal process of the AI, allowing them to better model the AI's capabilities and characteristics, as well as (2) providing interface affordances for the human to tweak the AI's priority over different possible partial intent interpretations as the AI searches for the best complete intent interpretation it can find. As a result, humans were able to communicate their intent to the AI more quickly and correctly, for more complicated goals, as measured by two within-subjects user studies (N=12, N=18) with controls. I will close with remaining open human-AI challenges made more explicit by this new framework that algorithm and interface designers can address in future work.

Symposium 7: How and for whom: The relations between self-regulation and academic success for children living in poverty

S7.1   The role of EF skills in mathematics skills for children living in poverty

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Students who begin school with higher levels of mathematic skills tend to continue to outperform peers who enter school with lower levels (Duncan et al., 2007). This makes some intuitive sense: Children must master basic skills to build more advanced understanding (Clements & Sarama, 2014). This rank-order stability paints a grim picture for students who enter school behind their peers in mathematics, though there is some evidence that certain domain-general skills such as executive function (EF) might disrupt some of this stability by enabling children to integrate new information more efficiently and effectively (e.g., Blair et al., 2016; Ribner et al., 2017; Ribner, 2020). However, mathematical skill development does not look the same for every child nor does it occur in isolation: Children exist within a set of systems (e.g., educational, cultural, familial, economic) that influence their learning (e.g., Bronfenbrenner, 1986). Notably, children living in poverty demonstrate poorer EF than their peers in higher socioeconomic status homes (e.g., Raver et al., 2013), partially explaining lower performance in mathematics (Nesbitt et al., 2013; Fitzpatrick et al., 2014). Here, we seek to explore the relative role of EF--and growth therein-- in the development of children's mathematical skills throughout elementary school. To do this, we leverage data from the Early Childhood Longitudinal Study-Kindergarten Cohort 2010-11, a nationally-representative dataset containing repeated measures data for over 18,000 participants with direct assessment of mathematical skills and EF at the beginning and end of each academic year. Growth curves were estimated for each mathematical skill and EF (here, indexed by a single measure of working memory, the Numbers Reversed task) from kindergarten through fifth grade. Growth curves were then combined into a single parallel process model in which the intercept of each skill was allowed to correlate; growth parameters were allowed to correlate, and growth parameters were regressed on the alternate skill's intercept. That is, we estimated the extent to which the starting points of each skill (e.g., EF) predicted the rate of growth in the other skill (e.g., math) over and above correlations among each starting points and rate of growth in the two skills. Across the sample, starting point in EF predicted growth in math (β=.42, p<.001). Curiously, starting point in math was negatively associated with growth in EF (β=-.44. p<.001. We then estimated a multi-group model wherein the same parallel process model was simultaneously estimated for children in poverty (whose households report incomes under 200% of the poverty line for a household of that size) and children from higher income homes. We find that the starting point of EF is nearly twice as predictive of rate of growth in math for children whose households are in poverty than it is for those whose are not (β=.47 versus β=.28, Wald test of parameter constraints p<.001), suggesting EF might be particularly important for the disruption of rank-order stability in math for children living in poverty. Implications for practice and policy will be discussed.

S7.2   Examining latent profiles of early life stress and executive functions at age 5

Sarah Vogel[1], Seulki Ku[2], Meriah DeJoseph[3], Annie Brandes-Aitken[1], Daniel Berry[3], Clancy Blair[2]

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Introduction: Research in recent years has shifted towards understanding the differential effects of dimensions of early SES-related stressors on development, specifically dimensions of sociocognitive resources, threat, material deprivation, and instability. Work in this area has generally found that

sociocognitive resources are positively associated with the development of executive functions (EF). The roles of threat, material deprivation, and instability in the development of EF are less clear, with research in this area being a bit mixed. Some work has found positive associations between threat and EF, while some has found negative or no associations. Likewise, emerging work has found that experiences of caregiving instability may promote the development of attention shifting, but inhibit the development of inhibitory control. Altogether, the mixed research in this area combined with the high co-occurrence of these experiences suggests that more work is needed examining how these experiences together influence the development of EFs. Methods: Data come from the Family Life Project (FLP; n=1,292), a longitudinal sample of mostly low-income families. Data were collected in the home at child ages 6, 15, 24, 35, and 58 months. Sociocognitive stimulation was measured at each time point using the learning materials and parental responsiveness subscales of the HOME inventory. Threat was assessed using the physical and verbal aggression subscales from the Conflict Tactics Scales. Instability was measured via the total number of changes in primary caregiver, secondary caregiver, residential moves, and changes in number of people living in the child's home from 6-58 months. Material deprivation was measured via the Economic Strain Questionnaire. EF was measured at 58 months using the EF touch battery of tasks assessing inhibitory control, attention shifting, and working memory. We performed a latent profile analysis to examine how the four dimensions of early experience co-occur within the FLP sample and test for differences in EF between groups. Results: We identified 6 latent profiles within the sample. Group 1 was characterized by high levels of all stress measures and low sociocognitive resources. Group 2 was characterized by low/moderate stress and low sociocognitive resources. Group 3 was characterized by high instability and moderate levels of all other measures. Group 4 was characterized by low instability, moderate threat and material deprivation, and moderate/high sociocognitive resources. Group 5 was low stress, high resources. Group 6 was very high instability, moderate threat and material deprivation, and low sociocognitive resources. Attention shifting. Group 1 had the lowest attention shifting scores, while group 5 had the highest. Working memory. Group 5 had the highest average working memory scores. Group 6 had significantly lower average working memory scores than every other group. Inhibitory control. Group 5 had the highest average inhibitory control scores. There were no differences in inhibitory control between groups 1 and 6 (the two high instability groups). More detailed results will be discussed. Discussion: These findings point to the need to nuanced measurement of early stress and enrichment and highlight unique environmental phenotypes with influences on the development of EFs. Implications will be discussed.

S7.3   The Longitudinal Associations Between and Within Poverty-Related Risks and Executive Function

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Children growing up in poverty are more likely to experience hardships across multiple domains including resource scarcity, housing insecurity, and domestic violence, putting them at risk of socioemotional and cognitive difficulties. Although much research has examined associations between poverty and children's outcomes across one or two time points, fewer studies have explored these associations using repeated measures over time and across different periods of development. Moreover, recent research has emphasized the importance of moving beyond measures of income poverty or cumulative risk models to conceptualize poverty-related risk (PRR) and towards a multidimensional model of PRRs that capture the heterogeneity in how different risk factors influence

child outcomes. Identification of the timing and PRR domain(s) that impact child outcomes is key to the development of appropriate interventions and programs to mitigate the long-term consequences of growing up in poverty. In this study, we examine the bidirectional relations of PRR factors with executive function (EF) using four timepoints over 12 years in a sample of about 500 Chicago-area children raised in low-income households. We will first conduct descriptive and correlational analyses of all observed variables across all timepoints to understand basic relations between these phenomena before fitting a more complex structural equation model. These longitudinal associations will be examined using a random intercept cross-lagged panel model (RI-CLPM; Hamaker et al., 2015), which allows us to disaggregate between-child and within-child variation in PRR factors and EF. By controlling for within-child variation in PRR factors and EF, this model may produce less biased estimates of how changes in PRR factors contribute to EF. We expect to observe significant cross-lagged paths for PRR factors predicting EF skills across development. Results will be interpreted with implications for intervention design and public policy.

Symposium 8: How children think about power, social status, and inequality

S8.1   Children's sensitivity to gender- and race-based inequality

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Social hierarchies are often characterized by systematic inequality that empowers some and disempowers others. Children tend to favor equality and dislike inequality between individuals (Shaw & Olson, 2012; 2013) and previous studies show that children are aware of gender and racial biases (Bigler et al., 2008). However, it is unknown whether children are sensitive to the group-level inequality sometimes present in social groups, or if they are be motivated to ameliorate group-level inequality when they detect it. In three studies, we investigated whether 4-9-year-olds (N = 206) recognized gender and racial inequality in social hierarchies and if they would act to make social groups more equal. In Study 1, we presented children with two-tiered hierarchies dominated by "bosses" who were White men. The other positions in the hierarchies were occupied by either White Women or Black men. Children were allowed to "promote" individuals in these hierarchies, with the option to make each hierarchy more equitable or to perpetuate preexisting inequalities. We found that 7-9-year-olds promoted more underrepresented individuals than 4-6-year-olds, F(1,78)=4.89, p=.030. Additionally, younger children addressed gender inequality more than racial inequality (p=.018). However, the differences in children's responses to gender and racial hierarchies appeared to be influenced by participant gender, F(2,156)=10.96, p<.001. Girls promoted more women to be bosses than boys did (p<.001) and girls promoted more women to be bosses than they promoted Black men (ps<.002). In Study 2, we attempted to replicate our initial finding with a more complex 3-tiered hierarchy, allowing children to make "promotions" using cards on a physical pegboard. Children could promote people to either be the "Big Boss," "Little Boss," or "Workers." We found that children promoted White and Black men to positions of power at similar rates. Interestingly, children often promoted women to "Little Boss," but they promoted men to the position of "Big Boss" significantly more often than women (ps<.046). In Studies 1 and 2, it was possible that children only noticed inequality because they were being asked to move people in social hierarchies. To determine whether children are generally sensitive to inequality in social hierarchies, we presented them with hierarchies that varied in equality in Study 3. Data collection is ongoing, but preliminary data show that children judge under-represented hierarchies

to be fair; however, 7-9-year-olds were better able to distinguish between the varying levels of fairness than 4-6-year-olds, $F_{(1,42)}=6.07$, $p=.018$. Young children do not necessarily categorize hierarchies as unfair, but they act to make hierarchies more equal when given the chance. Older children appear to be more sensitive to gender- and race-based inequality, and they do more to address inequality than younger children. At the same time, girls appeared to be more responsive to gender inequality than boys, and they were also more attuned to gender inequality than race-based inequality. Also, children appeared to exhibit a gender-based "glass ceiling" effect. By assessing how children respond to gender and racial inequality, we can improve our understanding of how biases develop and provide new insights into how adults recognize and respond to systemic inequality.

S8.2   Navigating an unequal world: Children's understanding of social inequalities across cultures

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Economic inequality is on the rise, reaching high levels across the globe. Critically, children learn to navigate the social world against the backdrop of these striking inequities. How do children from different cultures conceptualize wealthy and poor people and the disparities between them? Study 1 documented the developmental trajectory of children's understanding of wealth, poverty, and social inequalities across cultures. We tested 4-12-yr-olds and adults from the US, Turkey, and China (pre-registered; current N = 342, planned N = 412). Current results show largely similar developmental trajectories in both US and Turkish children (data collection in China and in adults is ongoing), demonstrating 1) a large age-related decrease in pro-rich bias in attitudes; 2) domain-specific effects on inferences about generosity (e.g., expecting that the wealthy as compared to the poor are more generous with resources but not with time); and 3) an age-related increase in the understanding of inequality and the links between wealth and social power. Hence, with a broad battery of experimental measures, we demonstrated a striking developmental shift in pro-rich biases, as well as an increasing conceptual depth in children's reasoning about social inequalities across cultures. Despite children's shift towards thinking that economic inequality is unfair, the social world is imbued with inequalities and with people who justify and perpetuate them. How do children become supporters or opponents of social justice and equality? Would their own positions in the social ladder play a role in coloring their early understandings of social inequalities? To answer these questions, we conducted a pre-registered Study 2 of 180 US children aged 5-9. Children were randomly assigned to a rich or poor novel group or a control condition (no group assignment) and were asked about 1) their attitudes; 2) how they wanted to allocate new resources to the two groups; and 3) their justifications about inequality (7 forced-choice questions). These justifications questions were on whether they think inequality is due to internal or external factors, fairness judgments, social mobility beliefs, meritocratic beliefs, general just-world beliefs, opinion on maintaining vs. changing the status quo, and opinions on deservingness and redistribution. Results show that merely assigning children to a rich vs. poor novel group in a short experiment is sufficient to motivate children to favor the rich and even justify existing wealth disparities. The patterns are especially pronounced in younger children (5-6-yr-olds) compared to older children (8-9-yr-olds). These findings suggest that the human tendency to justify and perpetuate inequalities that advantage their own social groups is potentially early emerging. Together, these studies experimentally investigate how children navigate an unequal social world and provide new insight into the development of more complex understandings of wealth, poverty, and social inequalities across ages and cultures.

S8.3   Children's inferences about and explanations for occupation-based wealth

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Young children often rely on quantitative (e.g., number of items, Li et al., 2014) and qualitative (e.g., quality of items, Olson, et al., 2012) cues to make inferences about others' wealth. However, less research has examined whether children use occupational role markers (e.g., attire) to infer wealth or status, despite ample research in adults finding that adults reliably use occupational attire to make status-based inferences and evaluate others (Kraus et al., 2017). The current study investigated whether 5 - 9-year-old children use attire to predict the quality (i.e., having a new or old car) or quantity (e.g., having a lot or little money) of individuals' resources (R1) and whether children's occupation-based inferences about wealth vary for men and women targets (R2). Additionally, we examined whether children's endorsement of internal and external explanations for wealth vary by the inferred wealth or poverty of the target (R3) or by target gender (R4). In an ongoing study (N = 69), children see a photo of an adult who varies in gender (man; woman) and occupation-typical attire (janitorial overalls; business suit). To assess inferences about target wealth, children complete 4 forced-choice questions about the quality (e.g., has a new or old phone; car) and quantity (e.g., has a lot or a little money; big or small house) of the target's resources. Children are then given four possible explanations for target's wealth (if child said target had a lot of money) or poverty (if child said target had little money) and are asked whether each explanation is true, or not true. Two explanations reference internal factors (effort, intelligence) and two reference external factors (parent wealth, luck). In preliminary analyses using generalized linear mixed effect models, children reliably use occupational attire to infer wealth (R1), expressing that targets in business suits had more or better resources than those in janitorial clothes, b = -0.68, SE = 0.16, p < .001; this pattern did not vary based on target gender (R2, all ps > .10). Children were more likely to explain wealth (than poverty) with internal explanations, b = 2.67, SE = 1.05, p = .011, but were equally likely to endorse external explanations for both wealth and poverty (R3), all ps > 0.10. Finally, there were no effects of target gender on children's endorsement of internal explanations, p > .10, but children were marginally more likely to endorse external explanations when the target was a woman, b = 1.34, SE = 0.80, p = .095 (R4). In particular, children were more likely to endorse an external explanation for wealthy women (65%) than for wealthy men (29%). Taken together, 5- to 9-year-old children use occupational cues to predict other markers of wealth for both men and women. Children's tendency to explain women's (more than men's) high occupational status in terms of luck or parental wealth could indicate an early-emerging tendency to discount women's internal qualities when explaining success, with potentially gendered implications for young girls' beliefs about their potential for upward social mobility.

S8.4   Who is admired and who should help?: Children's evaluations of knowledge, prestige, and wealth

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The developmental literature defines social status in terms of prestige (Enright et al., 2020), wealth (Shutts et al., 2016), and a multitude of other ways. However, it is unclear whether children associate knowledge with status. Although knowledge does not necessarily equate to status, there might be a conceptual overlap given the value that children place on both (Marble & Boseovski, 2020; Mistry et al., 2021).   This talk will focus on the extent to which children distinguish status from knowledge. We investigated age-related differences in the status-related attributes that children prescribe to high-

status versus knowledgeable people (Study 1) and children's expectations regarding the problem-solving capabilities of wealthy versus knowledgeable people (Study 2).   In Study 1, 55 5- to 10-year-olds were presented with a high-status character and a knowledgeable character. The high-status character was described as prestigious. The knowledgeable character was described as knowing everything about the context presented. Children answered three status-related questions: which of the characters was the most admired, most appreciated, and which had the biggest job.   Eight- to 10-year-olds systematically endorsed the high-status character across all measures (admiration: M = .69, SD = .89, $\chi2(2)$ = 7.18, p = .03; appreciation: M = .22, SD = .48, $\chi2(2)$ = 37.17, p < .001; job: M = .64, SD = .87, $\chi2(2)$ = 13.17, p = .001). Younger children were unsystematic (admiration: M = .94, SD = 1.00, $\chi2(2)$ = 5.38, p =. 07; appreciation: M = .89, SD = .94, $\chi2(2)$ = 2.95, p = .23; job: M = .79, SD = .85, $\chi2(2)$ = 1.68, p = .43). These findings suggest that with age, children are more likely to distinguish between possessing status versus knowledge. Given that young children overgeneralize positive attributes (Boseovski, 2010), perhaps they thought that the knowledgeable character was also admired and appreciated.   In Study 2, 64 5- to 8-year-olds were presented with a high-status character and a knowledgeable character. The high-status character was described as wealthy. The knowledgeable character was described as knowing about a lot of topics. Children were asked which character should assist someone who experienced a negative event (civil liberties violation, physical injury), which character should be "in charge" of problem-solving the event, and how much each character was obligated to help.   Overall, children systematically endorsed the knowledgeable character as the individual who should assist for both events; civil liberties M = .77, SD = .43, t(63) = 4.98, p < .001, d = .43; physical injury M = .66, SD = .48, t(63) = 2.61, p = .005, d = .48. Children also endorsed the knowledgeable character as the person who should be "in charge"; civil liberties M = .70, SD = .46, t(63) = 3.52, p < .001, d =.46; physical injury M = .67, SD = .47, t(63) = 2.91, p =.005, d =.47.   A mixed logistic regression revealed that children viewed the knowledgeable character (M = 1.86, SD = .43) to be more obligated to assist than the wealthy character (M = 1.39, SD = .75), b=1.78, Wald $\chi2$=8.58, p = .003. These findings suggest that children prioritize knowledge even in situations that do not involve a learning-related goal.   Our discussion will integrate these findings to consider why some dimensions of status (i.e., prestige) overlap with children's understanding of knowledge whereas others do not (i.e., wealth).

Symposium 9: Cognitive development and the law

S9.1   Prominence, property, and the legal principle of accession

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The legal principle of accession suggests that ownership of an item can extend to related objects, resources, and benefits (Merrill, 2009). For example, David Hume (1739) illustrated this principle by pointing out that people might typically assume that whoever owns or controls a large land mass is also likely to rule over surrounding islands. This legal principle was raised in Roman law, discussed in early Western legal writing, and some non-Western legal traditions include policies that may also reflect this principle. We report a series of experiments on children aged four to seven (total n=406) and on adults (total n=823) that explore the psychological basis of this principle. We suggest the principle of accession expresses aspects of psychology that shapes inferences about ownership and possibly inductive inferences about other relations too. Specifically, people may be more willing to draw certain inductive inferences from exemplars that are physically prominent (e.g., the large land mass) than from exemplars

that are not (e.g., the individual islands). This account is broadly consistent with historical examples that illustrate the principle of accession, with Hume's own explanation for the psychological basis of the principle of accession, and with findings suggesting that prominent items serve as reference points when people express relations and comparisons (Gleitman et al., 1996; Talmy, 1983; Tversky, 1997). In our first experiment, children and adults were informed that a character owned one exemplar item, and then judged whether this character also owned surrounding target items. For three of four item sets, four- to seven-year-olds and adults were more likely to judge the agent owned the target items if the agent was initially described as owning a related prominent item than as owning a regular item. Our second experiment then examined whether this effect of prominence would also arise for relations besides ownership. To this end, participants were instead informed that the agent liked the target item, and then inferred whether the agent likewise liked the surrounding exemplars. We again, found stronger inductive inferences for three of four item sets when the exemplar was physically prominent rather than regular. Our final experiment examined adults only and directly compared inductive inferences about ownership and preferences, and yielded similar findings, while also discovering that prominence more strongly affects ownership than liking for two item sets. Together, these findings suggest that the legal principle of accession may express intuitions that are present from early in the lifespan, and which stem from the effect of physical prominence on inductive inference. The observed effects of prominence we observed are unlikely to fully depend on some factors known to impact induction, such as the monotonicity, diversity, and typicality of premise items. At the same time, the item effects we observed suggest the effect of prominence does depend on background conceptual knowledge. We will outline two explanations for why prominent items are strong bases for induction and also consider implications for the psychology of ownership.

S9.2   Moral Cognition Among and About Children of Incarcerated Parents

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One out of every 28 children in the United States has an incarcerated parent (Pew Charitable Trusts, 2010), but research on cognitive development has not focused on these children's experiences or asked how parental incarceration might shape cognition. In particular, because individuals ostensibly face incarceration on the basis of moral transgressions, parental incarceration might shape moral judgment. Past work (Dunlea & Heiphetz, 2020) showed that children - including children of incarcerated parents and their peers whose parents were not incarcerated - attributed contact with the legal system to internal immorality, such as a bad essence or wicked desires. However, this work asked only about incarcerated people in general, not people with whom participants have a close relationship. Extending this research, Study 1 interviewed 6- to 12-year-olds with (n=24) and without (n=58) incarcerated parents about their relationships with significant others. Regardless of parental incarceration status, children described their parents in overwhelmingly more positive than negative terms. Additionally, children with and without incarcerated parents reported experiencing more positive than negative emotions when thinking about their parents. Although children of incarcerated parents reported negative judgments of people who had contact with the legal system in prior work (Dunlea & Heiphetz, 2020), here they did not appear to generalize this negativity to their own parent, whom they viewed positively. Both groups of children also reported more positive than negative responses to their friends, showing that the positivity observed in response to parents generalizes to peer relationships. Study 2 built on these findings to ask how children judge their peers with incarcerated parents. In this work, 5- to 6-year-olds (n=91) and 7- to 8-year-olds (n=71) learned about characters whose parents were, versus

were not, incarcerated. Participants then indicated which character would possess a particular moral belief (e.g., that hitting is wrong) and how certain they were of their answer. Participants also had the chance to share stickers with all characters. Children reported more certainty that peers without, versus with, incarcerated parents held moral beliefs (e.g., that hitting is wrong). This effect was stronger among older children, suggesting that greater social experience may strengthen biases against children of incarcerated parents. Additionally, participants in both age groups shared fewer stickers with peers whose parents were, versus were not, incarcerated. Thus, elementary-schoolers viewed peers with incarcerated parents as less moral, and less deserving of pro-social actions, then peers whose parents were not incarcerated. Although children of incarcerated parents reported positive evaluations of close others (Study 1), their peers viewed them in relatively negative terms and exhibited less generosity toward them as compared with children whose parents were not incarcerated (Study 2). Taken together, these studies clarify how parental incarceration shapes moral judgment.

S9.3   Student Perspectives on Police and Fairness in Schools

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The manner in which schools respond to misconduct and harm teaches students meaningful lessons not only about their safety and whether they belong, but also about fairness and justice within the school and by extension the broader community. Much of this legal socialization happens informally - as when students witness or experience administrators responding to misconduct with exclusionary discipline or with more restorative approaches. However, students now also regularly experience more formal legal socialization, with the presence of embedded police, or School Resource Officers (SROs). The proliferation of SROs on school campuses has outpaced research studying their impact. Efforts to understand their impact have focused largely on administrative level data (e.g. arrest rates, weapon confiscations) and show mixed results, though consistently more negative effects for under-represented groups. We solicited high school students' own perspectives - using mixed methods including focus group conversations and quantitative surveys - to understand what the presence of these officers teaches students about fairness and justice. Further, we explored how SROs, if embedded in a context of more restorative or exclusionary practices, might be differently perceived. First, qualitative data were collected through structured conversations with five focus groups (n=45). We used grounded theory to code focus group transcripts. Of the key themes that emerged using inductive thematic analyses, we the following to dominate: students discussed their lack of voice (a hallmark of procedural justice), overall limited interactions with school disciplinary actors (e.g. SROs, administrators), ad were mixed as to whether the presence of SROs made them feel more or less safe. Next, quantitative data were gathered from an online survey administered to students from three midwestern high schools (n = 442). Student rated how frequently they perceived school administrators to use restorative and exclusionary disciplinary practices, as well as the frequency with which they believed students interacted with the SRO(s). Of these factors, perceived restorative practices most strongly predicted school fairness perceptions. However, a three-way interaction emerged such that students' increased interaction with SROs was associated with greater perceptions of school fairness, but only when embedded within a climate of restorative justice, and especially when exclusionary practices were rarely used. Thus, what students learn about justice from interactions with school-based police depends in large part on the school disciplinary context in which those officers are situated. While youth learn about law and their own role as citizens through both vicarious and direct experiences with legal actors, the role of non-legal actors like school administrators can also meaningfully shape their legal socialization. We find that these

two kinds of interactions can importantly inform one another, especially when occurring within and shaping the same environment.

Symposium 10: Inferences about interpersonal utility across human development

S10.1   Emotion responses to others' goal-directed actions

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We are happy when our favorite sports team wins, even though we did not play. One explanation of this phenomenon is that we adopt our affiliates' utility, and thus share their emotional appraisal of situations. Do early concepts of affiliation involve this expectation of adopted utility and thus congruent emotional reactions to others' outcomes? Infants expect others to be happy when they achieve their own goals, but not when they fail (Skerry & Spelke, 2014). In three pre-registered looking time experiments, we ask if infants also expect social partners to emote congruently to one another's outcomes. In Experiment 1, 60 10- & 11-month-old infants (M=11.09 months, SD=0.56) were introduced to two affiliated agents who moved synchronously with each other and a third, non-affiliated agent, and then saw two blocks of familiarization and test trials. In each block, familiarization trials showed one agent ("the Jumper") intentionally jumping over a wall to a blue mat, while another agent ("the Observer") observed. Then infants saw test trials in which the Observer emoted either positively (i.e., smiling and laughing) or negatively (i.e., frowning and crying) after the Jumper successfully completed their goal of reaching the mat (two positive and two negative trials, in counterbalanced ABAB order). Across blocks, the Observer was always one of the affiliated agents. In one block the Jumper was the other affiliated agent, while in the other block the Jumper was the non-affiliated agent (order counterbalanced). We found a main effect of reaction type, with longer looking to negative reactions (Mdifference = 2.15s, $F(1,56) = 24.73$, $p < .001$). Infants looked longer at the negative reaction during the affiliated block than during the non-affiliated block (Mdifference = 1.54s, $t(59) = 2.34$, $p = .023$, $d = .30$; Figure 1A). These results indicate that infants expect others to react positively to observed success, and suggest that this expectation may be influenced by affiliation. Do infants just expect Observers to react positively to the Jumper, not the Jumper's success? To address this question, Experiment 2 depicts an affiliated Jumper failing rather than succeeding. A second block of trials replicates Experiment 1's affiliated block, with successful goal completion. Data collection is ongoing. Preliminary data from 18 10- & 11-month olds (M=10.64 months, SD=0.50, preregistered N = 30 infants) suggest infants do not expect Observers to emote positively when the Jumper fails (Mdifference = 0.17s, $t(17) = 0.07$, $p = .944$, $d = 0.02$; Figure 1B). Data from the second block replicate the finding that infants do expect Observers to emote positively to the affiliated Jumper's success (Mdifference = 2.40s, $t(17) = 3.61$, $p = .002$, $d = 0.83$). Finally, evidence for an effect of affiliation status on emotional expectations in Experiment 1 was weak. To address this, Experiment 3 will introduce infants to two anti-affiliated agents who engage in conflict, and then fill the Observer and Jumper roles. We will test infants' emotion expectations for the Observer following the anti-affiliated Jumper's success. We expect that infants should be surprised (i.e., look longer) when the Observer emotes positively toward the anti-affiliated Jumper. Overall, our current findings show that infants expect observers to react positively to affiliates' success, but not their failure.

S10.2   Toddlers' understanding of help and need

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By 18 months, children demonstrate a robust propensity to help others in need. However, the mechanisms underlying this behavior are unclear - what social and/or cognitive abilities relate to toddlers' emerging ability and desire to help others? Further, how might toddlers' willingness to help others relate to their own requests for help? In a study with 46 18-month-olds, we assessed participants' helping, understanding of others' needs, and spontaneous help-seeking behavior. Toddlers first engaged in an instrumental helping task, adapted from Warneken and Tomasello (2006), in which an experimenter dropped three sets of items (15 items total). The number of items children retrieved was used as a metric of their propensity to help. Participants were then presented with a tool-use task, in which each trial increased in difficulty, to assess their problem-solving abilities (Bates, Carlson-Luden, & Bretherton, 1980). Unexpectedly, during this task, almost all toddlers spontaneously sought help from the experimenter or their caregiver. To investigate this behavior, help-seeking bids (such as pointing and vocalizing) were identified. Finally, toddlers were shown a series of vignettes on an eye-tracker to assess their understanding of others' needs (Köster, Itakura, Omori, & Kärtner, 2019; Köster, Ohmer, Nguyen, & Kärtner, 2016). Over four blocks of trials, participants observed a helpful agent assisting either an individual in need (expected outcome) or an individual who does not need help (unexpected outcome). Toddlers' predictive looking between the helpful agent and needy individual were collected, as well as their looking times to both types of outcome. We replicated previous findings find that toddlers at this age reliably understand others' needs (looking predictively to a character in need in 69.4% of trials in an eye-tracking task) and voluntarily provide instrumental help (61% of participants helped). We further found that most toddlers (92.7%) spontaneously sought help at least once during the problem-solving task, despite lack of response or intentional elicitation. Help-seeking was both frequent and adaptive, significantly increasing with problem difficulty ($p < .0001$). Based on prior literature, we predicted that toddlers' understanding of others' needs in the eye-tracking task would indirectly relate to their helping behavior, and that social interactive skills may modulate this relation. However, we found no significant correlation between children's helping, needs understanding, and an aspect of their interactive skills (vocabulary size), all $ps > .23$. We hypothesized that children's help of others - that is, their ability and willingness to solve instrumental problems collaboratively - may relate to their propensity to seek help when faced with instrumental problems themselves. Further, a robust expectation that helpers will assist individuals in need may support toddlers' elicitation and use of others' help. Exploratory analyses relating help-seeking behavior to participants' helping and needs-understanding found no significant relation, all $ps > .14$. However, help-seeking behavior was significantly related to toddlers' vocabulary size ($p < .001$). Our findings suggest that children's various social behaviors and social-cognitive skills may not all strongly relate early in development, and depend on distinct factors and supporting abilities (e.g. help-seeking relates to communicative skill, while help-provision does not).

S10.3 Toddlers evaluate helpers based on others' needs

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The capacities to reason about and evaluate others' actions are fundamental to human social interaction and cooperation. A large and growing body of research has found that infants and toddlers engage in social evaluation, preferring to look at and reach for agents who help others over agents who hinder others in the pursuit of their goals. In three experiments (N = 94), we asked whether 16-month-old toddlers' social evaluations are sensitive to others' needs, based on the objective difficulty of tasks and the abilities of the individuals facing those tasks. We presented toddlers with agents who differed in

their need for help as a test case for determining whether early representations of need and action cost inform toddlers' understanding of social actions. Would toddlers prefer agents who choose to help someone in greater need (with a difficult, high-cost task) over agents who choose to help someone in less need of help (with an easy, low-cost task)? In Experiments 1 through 3, two helpees (agents who could be helped) sought to push boulders up hills in the presence of two observers (helpers). In Experiments 1 and 2, we manipulated who needed more help based on objective task difficulty: Both helpees were equally strong, but one hill was steeper than the other. In Experiment 3, we manipulated who needed more help based on helpee's strengths: Both helpees had the same task, but one was weaker. In all experiments, in alternating events, after helpees attempted to push boulders up hills, one helper chose to help one of the helpees, and the other helper chose to help the other helpee. Finally, we examined toddlers' preferences for the helpers. If toddlers indeed consider need in their evaluations of helpers, then they should prefer the helper who helped the helpee facing a steeper hill in Experiments 1 and 2, and the helper who helped the weaker helpee in Experiment 3. We found that toddlers preferred reaching for (Experiment 1; Fig. 1A) and looking at (Experiment 2; Fig. 1B) an agent who chose to help someone facing a high-cost task (climbing a steep ramp) over an agent who chose to help someone facing a low-cost task (climbing a gentle ramp). This preference was specific to contexts of helping: An additional group of toddlers in Experiment 2 looked equally at agents who chose to perform the harder vs. easier task when the agents did so in solitude, and their actions could not be construed as helping (Fig. 1B). In Experiment 3, when two individuals faced the same task but one was weaker, toddlers preferred looking at an agent who helped the weaker individual over an agent who helped the stronger individual (Fig. 1C). Taken together, these findings reveal that the capacities of action understanding and social evaluation are interconnected in toddlerhood. Specifically, these findings suggest that toddlers engage in need-based evaluations of helping, using representations of action cost, varying across both environments and agents, to evaluate others' social actions. Such early-emerging abilities to reason about social behavior in relation to others' physical constraints, abilities, and dispositions to act on others, may be a key foundation of human social intelligence.

S10.4 Children and adults utilize cost and need in generosity evaluations

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It is broadly demonstrated that children and adults form judgements about others' generosity using a range of factors. Need and cost are two factors implicated in first-person generous actions. Children, and even infants, demonstrate an ability to register the costs of others in helping behaviors (Jara-Ettinger et al., 2015; Sommerville et al., 2018). Similarly, children recognize the needs of others in instrumental helping tasks (Paulus, 2020). However, while it is intuitive to assume that children and adults use need and cost when evaluating the generosity of others, it has not been formally demonstrated. The present set of studies investigated whether 4- to 7-year-old children and adults consider need and cost when evaluating others' generosity, and whether these factors are considered across multiple circumstances. Studies 1, 2, and 5 investigated whether 4- to 5-year-olds (n = 64), 6- to 7-year-olds (n = 24), and adults (n = 64) consider need and cost when asked to compare the generosity of two givers. Participants were shown scenarios involving two givers and two recipients, with half manipulating the cost of the giving actions and half manipulating the need of the recipients. Each scenario portrayed a different cost (e.g., opportunity cost, scarcity of resources) or a different need (e.g., hunger, pain) to assess whether differences in sensitivity to specific needs and costs. Following

each scenario, participants chose which character they thought was more generous. Results show that children and adults considered need (younger: $t(63) = 12.49$, $p < .001$; older: $t(23) = 16.27$, $p < .001$; adults: $t(61) = 34.41$, $p < .001$) and cost (younger: $t(63) = 6.02$, $p < .001$; older: $t(23) = 8.00$, $p < .001$; adults: $t(61) = 46.39$, $p = < .001$) in their evaluations of others' generosity. These effects were generally consistent across scenarios, except for children's opportunity cost evaluations (all p's > .07). These results suggest that children and adults rely on systematic factors (need and cost) when making comparative generosity inferences, but that understanding of particular costs may depend on cognitive development. In the real world, individuals often evaluate others without comparison points; thus, we also sought to determine whether our findings extended to circumstances involving stand-alone judgements. Studies 3 and 4 investigated whether 6- to 7-year-olds (n = 36) and adults (n = 96) consider need and cost when rating givers individually, using a continuous scale. Participants completed the same task as before, however each scenario featured one giver and one recipient, and participants rated the generosity of the giver as "a little," "a medium amount," or "a lot" generous. We found a similar trend to the within-subjects studies: children and adults incorporated need (children: $F(1, 35) = 5.25$, $p = .03$; adults: $F(1, 95) = 31.66$, $p < .001$) and cost (children: $F(1, 35) = 8.90$, $p = .005$; adults: $F(1, 96) = 220.97$, $p < .001$) into their generosity inferences. The results of studies 3 and 4 provide a conceptual replication of studies 1 and 2, while showing that need and cost are used systematically in a range of circumstances. Overall, our study suggests that children and adults consider need and cost when making comparative and stand-alone prosocial evaluations. Contrary to the belief that prosocial evaluations are unique to situations, we show that children and adults rely on systematic factors when evaluating generosity.

Symposium 11: Automated gaze-tracking and gaze-annotation for online studies of cognition and development

S11.1   Webcam-based online eye-tracking for behavioral research

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Experiments are increasingly moving online. This poses a major challenge for researchers who rely on in-lab techniques such as eye-tracking. Researchers in computer science have developed web-based eye-tracking applications (WebGazer; Papoutsaki et al., 2016) but they have yet to see use in behavioral research. This is likely due to the extensive calibration and validation procedure, inconsistent temporal resolution (Semmelmann & Weigelt, 2018), and the challenge of integrating it into experimental software. Here, we incorporate WebGazer into a widely used JavaScript library among behavioral researchers (jsPsych) and adjust the procedure and code to reduce the burden of calibration/validation and improve the temporal resolution (from 100-1000 ms to 20-30 ms). We test our Webgazer/JsPsych combination with a decision-making study. The study attempts to assess the relationship between gaze and choice in value-based decisions, specifically choices of which snack food to eat (Krajbich et al. 2010). This research tests the attentional drift diffusion model (aDDM), a dynamic model of how decision makers accumulate and compare evidence until one option is deemed sufficiently better than the other. The aDDM posits that attention shifts back and forth between the options, amplifying the value of the attended option (Smith & Krajbich, 2019). As a result, options that are looked at longer are also more likely to be chosen. We set out to test the prediction of this model in an online sample.   125 people from Amazon MTurk participated in the study. Participants rated how much they liked 70 different food items, and made 100 binary choices between unique pairs of foods. Calibration and validation phases

were used throughout to screen out participants with poor quality eye-tracking data. Of all the initially recruited subjects (N=125), 49 successfully passed the initial calibration + validation and completed the study. Importantly, we found little degradation in spatial or temporal resolution over the course of the experiment. We were able to maintain a spatial hit ratio of over 80% and a temporal resolution of 50 Hz. Turning to the results, we replicated previous in-lab findings on the aDDM relationship between gaze and choice (Fig. 1): 1). correlations between dwell times and choice: subjects were more likely to choose the option that they looked at longer; 2). the effects of individual dwells: the duration of the first dwell positively predicted the probability of choosing the first-seen item; 3). last fixation bias: participants were more likely to choose the last-seen option, though this effect was attenuated relative to the in-lab study. Results were also fairly consistent at the individual level; 68% of participants showed a positive correlation between total dwell time and choice. This provides evidence that online web-based eye-tracking is feasible in behavioral research in adults. However, it is an open question whether the WebGazer+jsPsych framework (i) would also successfully replicate findings from other tasks and domains, and (ii) could be used for studies of infants and young children. Papers 2 and 3 from this symposium address these questions.

S11.3 Validation of an open source, web-based, eye-tracking method (WebGazer) for research on cognitive development: Comparison of anticipatory looking behavior in toddlers tested via web-based vs. in-lab eye-tracking

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Compared to manual coding of gaze behavior, eye-tracking can automatically and accurately track gaze patterns on more complex stimuli with higher spatial and temporal resolution. Best practices for using in-person eye-tracking with young children have been outlined (Oakes, 2012); however, to date eye-tracking with children has required in-person testing using commercial eye-tracking systems. In adults, remote automated web-based eye-tracking has been established in both computational (e.g., Valliappan et al., 2020) and behavioral research (Schneegans et al., 2021; Semmelmann & Weigelt, 2018; Yang & Krajbich, 2020); yet, to our knowledge none of these systems have been validated for use with young children (for automated gaze coding of already recorded videos, see, Cao et al., 2021; for an overview, see, Kominsky et al., 2021). Having such a tool would open up new possibilities for developmental psychological research by providing a low-cost eye-tracking method that makes it easier to scale up for large and more demographically diverse samples (e.g., linguistic diversity, racial/ethnic/cultural background, SES) compared to typical in-lab samples. Following the ManyBabies framework, we aim to test the precision of a web-based eye-tracking system that uses the participant's webcam. Our experiment is based on WebGazer.js (Papoutsaki et al., 2016) and jsPsych (de Leeuw, 2015). WebGazer captures gaze coordinates by predicting the participant's gaze location on the screen from the head and eyes position recorded via webcam, relative to the displayed stimuli. To evaluate whether this method is comparable to lab-based eye-tracking, we aim to replicate findings of an in-lab paradigm of the ManyBabies2 project which revealed spontaneous goal-directed action anticipation measured by anticipatory looking using commercial eye-tracking systems (Schuwerk, Kampis et al., 2021). Our experiment tests whether toddlers generate predictions about other agents' goal-directed actions (in

Figure 1, which box the bear will search for the mouse). The task consists of an initial calibration, two data quality checks (to quantify decrease in eye-tracking quality over time), and four test trials. During test trials, we will measure anticipatory looking towards an agent's goal-congruent action outcome. For an additional data quality check, we create for each trial a replay displaying the stimulus material, overlayed with the participant's gaze plot and the time-synchronized webcam video in the upper-left corner (Figure 1). These videos are visually inspected to identify trials that have to be excluded due to gaze tracking errors, e.g., resulting from fussiness. We will present results of the comparison of already collected in-lab data of N = 65 toddlers (18-27-month-olds; Schuwerk, Kampis et al., 2021) with web-based eye-tracking data of at least N = 90 age-matched toddlers collected by ten labs across the globe (data collection currently underway). An online pilot study with adults revealed above-chance anticipatory looking towards the goal-congruent action outcome, which was comparable to in-lab findings. If we replicate in-lab results with our remotely tested toddler sample, web-based eye-tracking via the participant's webcam will be an attractive alternative to in-lab eye-tracking for research on cognitive development. Moreover, with our open-source tool, we will be able to provide the community with a free and powerful method for future research.

S11.4   iCatcher: Robust and automated annotation of infant gaze from video collected via webcam
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Studies of human infants provide a window to the origins of the mind, but discovery is constrained by the slow pace of data acquisition. Online platforms (e.g. Lookit; Scott & Schulz, 2017) enable faster data collection by allowing families to participate in studies via webcam. Nevertheless, it remains labor-intensive to manually annotate gaze from recorded videos: a 5-10 minute video can take 20-60 minutes to annotate, depending on the complexity of the measures and characteristics of the video (movement, lighting, etc). In this project, we built on a system for automatic gaze annotation in human infants, iCatcher (Erel et al., 2021), and added two key additional features: a more robust infant face detector, and a gaze estimator that takes into account not only the features of the selected face, but where and how far it is from the screen. We trained and tested the performance of this system, iCatcher+, on 96 videos of infants engaging in a preferential looking study, collected over Lookit (Schulz, 2021; 33 infants aged 4-13m, majority White, with parents/guardians holding bachelor degrees or higher, from the United States). iCatcher first extracts all possible faces in a video frame, and then the infant face is selected by an infant selector; then, the gaze direction is classified based on both the selected face and its location and size relative to the screen. iCatcher+ was trained on 57 videos (>600,000 frames) using two variants of the gaze estimator: one that categorizes gaze from one single frame at a time, and a second that takes as input 5 consecutive interleaved frames. In this abstract we focus on 2 main findings. First, when presented with 600 potential faces from the Lookit videos extracted by an off-the-shelf face extractor (Bradski, 2000), the new infant face selector was able to identify the ground truth (i.e. whether the patch had an infant face in it or not) with 95% accuracy, compared with the 60.5% performance from the heuristic-based face selector from the original iCatcher. Second, the most accurate variant of iCatcher+ (85.17%) approached human performance (93.13%) in classifying left, right, and away looking behavior. Left and right performance was high (89.28% and 89.60%, respectively) with the weakest performance in the "away" class (80.38%). In sum, results were

promising, despite variability in camera angle and quality, lighting, screen size, background, and infant position in the Lookit dataset. Nevertheless, we see 3 key areas for improvement, which we are currently pursuing. First, we are working on further technical features, including fine-tuning the trained network to specific new videos before classifying them. Second, we are building a larger dataset with more racially and geographically diverse participants in order to assess generalization. Third, we are developing intuitive evaluation metrics and visualizations to allow developmental researchers to understand and scrutinize performance. In the future, we hope to engineer iCatcher as a tool that the developmental community can utilize in addition to or instead of human annotation. Eventually, we hope to integrate iCatcher with Lookit in order to enable fully automated infant-contingent behavioral experiments. We see this work as a key step towards enabling rapid, high-powered research on the origins of human knowledge and learning.

Symposium 12: Barriers and supports for cognitive development and academic outcomes among marginalized youth

S12.2   Mathematics Identity and Sense of Belonging to Mathematics: Unique or overlapping constructs?

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Recent research has focused on students' perceptions of themselves in math class, such as math identity (seeing oneself as a "math person") and their sense of belonging (feeling oneself to be a valued member of a community) to math. Prior work indicates the importance of sense of belonging to math in algebra performance for Black and Latinx adolescents (Barbieri & Miller-Cotto, 2021). Each of these constructs can individually impact student success and persistence (Cribbs et al., 2021; Good et al., 2012; Seymour & Hunter, 2019), yet no work has examined and compared them within the same sample given their similarities. We examine the relations between mathematics identity and sense of belonging to better understand their overlap as well as their divergence. We present data from a small-scale pilot (N = 34) and a larger sample of middle schoolers who completed surveys on mathematics identity (Cribbs et al., 2015) and sense of belonging to mathematics (Good et al., 2012). Our pilot sample completed surveys via Qualtrics and our larger sample will complete paper-and-pencil surveys in math classrooms. Sample items on the mathematics identity scale include, "Do the following people see you as a mathematics person? 3) Your mathematics teacher, 4) Yourself" (1 = No, not at all, 6 = Very much). Sample items from the sense of belonging to mathematics scale include, "I feel like I am part of the math community" and "I feel accepted" (1 = Strongly Disagree, 6 = Strongly Agree). Exploratory principal components factor analysis followed by a varimax rotation on our pilot data revealed four factors with eigenvalues over one which accounted for 73.08% of the variance. All eight sense of belonging items loaded highly onto one factor. Two items related to interest and enjoyment loaded onto their own factors indicating that they differ from identity items that ask about whether they themselves as well as others see them as a "mathematics person". One item from the mathematics identity scale did not load highly onto either of these factors (Math Identity and Interest in Math): I understand the math I study. One's perceived understanding of mathematics may not necessarily contribute to one's identification as a math person. On the contrary, "I can do well on exams" did load highly on the main Math Identity factor (factor 2). Some items revealed approximately equal loadings on two factors. Potential overlap in constructs within our pilot data will be explored in our larger sample and implications for both theory and practice will be

discussed. The larger sample will allow for confirmatory factor analyses to determine how well belonging and identity items measure their respective intended constructs. When a meaningful factor structure is obtained, it will be used to predict mathematics performance outcomes. We will also explore differences in these relationships for Black and Latinx students compared to their White classmates. Our findings suggest that the distinctions between belonging and identity in mathematics classrooms are not clear and point to an important area in need of further investigation.

S12.3 "We are going to be stranded": Marginalized High School Students' Beliefs about Math

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To achieve equity in education and life outcomes, we need to better understand how students of marginalized races and socioeconomic statuses view and experience school math. Math classrooms are often exclusionary and unsupportive of marginalized students (e.g., Akiba et al., 2007; Ladson-Billings, 2006; Martin et al., 2017). This is troubling for several reasons including that students' math beliefs and course work are strong predictors of their academic and career options, choices, and achievement (e.g., Seo et al., 2018; Wang, 2012). The current study aimed to understand the math beliefs of marginalized high schoolers while centering their voices. Participants were 251 10th and 11th graders (56% female) in a metropolitan school district in the Southeastern US. The sample was 81% Black and most were experiencing low income and economic marginalization (78% in homes with a family income less than $50,000 and 62% with caregiver's highest education level being a high-school diploma or less). Each student participated in a 30-minute, audio-recorded focus group which was then coded by a small team using a coding scheme developed from the literature (e.g., Cribbs et al., 2015; Boaler & Staples, 2008; Lauermann et al., 2017). Groups were created so we could consider the impact of students being in an advanced versus general math track (Oakes, 1986) and their race-gender identity (Crenshaw, 1989). The current analyses focus on the focus group questions about students' math beliefs. First, consider students' responses to the question "How might the math you are learning in school be useful for your future jobs?" Overall, many students seemed to misunderstand the usefulness of mathematics for their desired future careers, with comments like "Addition is the math I'll use for psychiatry." Notably, students in advanced math courses were significantly more likely to say that math beyond arithmetic would be useful for their future careers (82%) than students in general math courses (50%). Additionally, groups of Black boys were substantially more likely to say that math beyond arithmetic would be useful for their future careers (67%) than groups of Black girls (29%). Next, consider students' responses to the question "Are you good at math? How do you know?" Overall, students seemed to have a broad understanding of what it means to be mathematically capable, with comments like "I'm doing good in my classes; I am understanding more. I am understanding it more, focusing in it more". General math groups were somewhat more likely to have at least one student consider themselves bad at math (52%) than advanced math groups (32%). Additionally, Black girl groups were much more likely to have at least one student who considered themselves bad at math (71%) than Black boy groups (14%). Notably, when describing whether they were good at math, the Black girl groups discussed their interest more often than other groups. Overall, the study highlights the importance of research focused on marginalized students' math beliefs, including the impact of racial-gender identity and tracking. Implications for future research and practice will be discussed.

S12.4 Family social capital helps protect Black and Latinx students' academic outcomes and beliefs from racial-ethnic discrimination

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Research has consistently shown that Black and Latinx students report experiencing racial/ethnic discrimination by the faculty and their peers at their universities, which lead to a range of negative academic outcomes, including lower self-efficacy beliefs, lower sense of school belonging, lower grades, and lower likelihood of graduation (see Brown, 2017). This is especially true of students at predominantly White institutions, and exacerbated when students come from low income families. While family social capital, such as encouragement from family to attend college, has been shown to positively predict college success, it has not previously been examined as a buffer against negative academic pressures such as discrimination. The current study examined how academic outcomes (e.g., GPA, retention to second year, perceived school belonging, and attitudes about math and verbal skills) of Black and Latinx first-year college students were (a) negatively associated with experiences with racial/ethnic discrimination and perceived social status on campus, but (b) buffered by their family social capital. Participants were 380 Black and 257 Latinx first-year undergraduates attending a predominantly White public land-grant university in the southeastern United States. Students were recruited through their introductory communication classes and/or an academic preparedness class. Student-reported measures were collected across three time points over the course of the first two semesters of students' first year, and grade point averages and retention data were obtained through university records. Results indicated that experiences with discrimination on campus were not uncommon. Approximately 20% of students experienced racial/ethnic discrimination in the first two weeks of the semester and 38% had by the end of the semester. Those perceptions of discrimination in the first semester predicted lower perceived school belonging (b = -.12, $p < .05$), lower math self-efficacy (b = -.15, $p < .05$), and lower likelihood of retention into the second year of college (b = -.13, $p < .05$). Feeling a lower subjective social status relative to other students (but not relative to other people in the US) also predicted lower perceived school belonging (b = .19, $p < .05$), lower GPAs (b =.16, $p < .05$), and lower likelihood of retention (b = .16, $p < .05$). Importantly, however, family social capital provided boosts to academic outcomes. Specifically, having parents who attended college predicted an increased likelihood of retention (b = .11, $p < .05$) and higher GPAs (b = .13, $p < .05$), even in the face of discrimination and lower subjective social status. Having someone in their lives support their decision to go to college also predicted greater perceived school belonging (b = .12, $p < .05$), while having parents encourage non-college paths was associated with lower GPAs (b = -.12, $p < .05$) and more fixed mindsets about math ability (b = .14, $p < .05$) and verbal ability (b = .20, $p < .05$). Taken together, the study highlights the importance of examining within-group differences for historically marginalized students' academic outcomes.

Symposium 13: Understanding social structures: the inputs of caregivers, temperaments, and racial identity

S13.1   Infants use the interactions between their parents and new people to infer social connections.

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Infants are born into rich social worlds with existing social groups, relationships, and social networks. How do infants learn about their social networks? Here we test the hypothesis that infants use social interactions between their parents and unknown others to learn about their own social connections. To

do so, we build on previous research showing that when infants observe strangers, they see imitation as a cue of affiliation (Powell & Spelke, 2016). In the first study, 12-month-old infants saw one set of videos in which their own parent imitated one puppet and not another and another set of videos that featured another infant's parent and a new set of puppets. Infants reached preferentially for the puppet imitated by their own parent, but not for the puppet imitated by another infant's parent (N=20, cut short due to COVID-19, Bayes Factor of 8.25 in favor of the alternative hypothesis). What might be driving this reaching behavior? We hypothesized that infants combined knowledge of their own relationship to their parent, along with an inferred social link between the imitated puppet and their parent, to infer a social connection between themselves and the imitated puppet. We tested this hypothesis by presenting an ambiguous audio-visual matching test: while both puppets moved their mouths, one voice called the infant's own name in infant-directed speech. In two online studies (N=22; N=24), infants looked more at the puppet their parent had imitated during this test (BF=12.5 in favor of the alt. hypothesis). This looking preference did not occur when the two puppets were silent when the two puppets were presented with music, nor when the imitator was another infant's parent. Together, this suggests they use the behavior of their parents to learn to whom they are socially connected. In a final study, we asked whether infants use social information directed towards them to infer that individual's relationship to their parent. When a puppet spoke in a friendly manner and used the infant's name, infants expected that puppet, as opposed to a puppet who danced to positively-valanced music, to respond to their parent's distress. They did not have this expectation when reasoning about who would respond to the parent of another infant. Thus, infants inferred a social connection between their parents and individuals who appeared to know the infant. These findings provide evidence that infants learn who is in their social world both by observing their caregiver's interactions with unknown others and by experiencing their own social interactions with others who appear to know them. An open question is whether infants generalize from these observed interactions and what practical implications these findings have for infants learning about social groups such as those based on race, accent, or social class.

S13.2   Children's social wariness toward a different race peer depends on individual differences in social fearfulness

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By preschool age, children show social preferences based on race: Children often prefer to be friends with a same race than different race peer (see Hailey & Olson, 2013; Waxman, 2021 for reviews). However, these studies are based on asking children to make a forced choice between two pictures of people. Less is known about how these race-based social preferences manifest in daily social interactions - especially in peer interactions. When examining peer interactions, a significant factor to consider is children's own individual differences, namely individual levels of behavioral inhibition. From the temperament literature, we know children's wariness toward novel peers are significantly predicted by individual differences in behavioral inhibition (Coplan et al., 1994; Degnan et. al., 2014). Yet this literature has often neglected to examine whether racial identity of the children play a role in predicting social wariness toward peers. Thus, the current study bridges a gap across these literatures and asks whether the race of a peer moderates the association between social wariness displayed by children in social interactions and their own individual difference in behavioral inhibition. We conducted a secondary analysis of a longitudinal dataset that collected measures of children's temperament. From

ages 2 to 7 each year, children were randomly paired to interact with each other (i.e., an age-matched unfamiliar peer) for a 10-minute free play session visit at the laboratory. The peer was categorized as an ingroup if peer's race matched the child's race and as an outgroup otherwise. For bi-/multi-racial children, if a peer shared at least one of the racial categories identified for the child, then the peer was categorized as an ingroup. Children's behavior was coded for wariness (e.g., hesitant movements, hovering, standing in one location, watching without acting) and unfocused/unoccupied behavior on a scale of 1 (no behaviors observed) to 7 (observed throughout) in 2-minute epochs and averaged to create a social wariness composite score per visit. Parental reports of temperament at each time point were also collected. For analysis, z-scored social fear or shyness subscale scores from Toddler Behavior Assessment Questionnaire (Putnam et al., 2006) for ages 2 to 3 and Child Behavior Questionnaire long form (Rothbart et al., 2001) for ages 4 to 7 were used. The sample analyzed was 626 children (333 female) who provided data at least once and was 63% White, 16% Black/African American, 2% Asian, 3% Hispanic/Latinx, 1% Other, and 15% bi-/multi-racial. A mixed model with child ID as a random intercept with log transformed composite social wariness as the dependent variable revealed a significant interaction between peer race and social fear (b = .016; SE = .007; p = .034). Specifically, greater social wariness was displayed by children with higher social fear if they interacted with an outgroup (b = .04) than ingroup peer (b = .02). This interaction held when controlling for children's gender, maternal education, race, and children's age at test. There were no age-related differences. These results suggest that starting at age 2, individual differences in social fear could impact how much children engage with a different race peer. These results point to the importance of considering children's race in temperament literature and present a nuanced view of how children start to navigate interpersonal interactions with different race people.

S13.3 Learning to see the ingroup: Categorization of ambiguous faces by white, black, and biracial children and parents

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Categorizing racially ambiguous faces can be difficult and cognitively taxing. Adults' judgments in racially ambiguous categorization may be driven by the one-drop rule, a heuristic whereby any amount of Black ancestry identifies a mixed-race individual as Black (Davis, 1991), also known as "hypodescent" (Halberstadt et al., 2011; Ho, Sidanius et al., 2011; Peery & Bodenhausen, 2008). Yet, hypodescent may reflect the ingroup overexclusion effect (Castano et al., 2002; Knowles & Peng, 2005), which suggests people exclude ambiguous group members from one's ingroup to protect group boundaries. It has been difficult to distinguish when hypodescent overlaps with ingroup overexclusion in face categorization because most studies to date have tested only White participants (but see Roberts & Gelman, 2015 for one exception). Moreover, less is known about children's categorization of ambiguous faces, and how these relate to parents' categorizations. To address these issues, the current study tested White, Black, and Biracial children and their parents to explore the role that both racial group membership and social context play in the development of these social perceptions. To provide the clearest test of hypodescent and ingroup overexclusion, White participants came from majority White neighborhoods and Black participants from majority Black neighborhoods (with Biracial participants from more racially diverse neighborhoods), therefore causing our two key samples to have prominent racial ingroups. White (N = 71; 35 female; Mage = 5.1), Black (N = 61; 30 female; Mage = 5.0), and Biracial (N = 83; 49 female; Mage = 5.1; 16 Black/White, 28 Asian/White, 20 White/Latino, 19 Dual Minority) children were asked to categorize 12 racially ambiguous biracial Black/White faces as either White or Black. Parents completed

the same categorization task. Next, children were shown four additional ambiguous faces and selected one of eight skin-tone-colored crayons to color in a blank face to look like the target face as another measure of skin-tone perceptions. Lastly, parents completed parent socialization scales and measures of diversity contact. White children and parents categorized faces significantly more often as Black whereas Black children and parents categorized faces significantly more often as White, and Biracial children and parents did not differ from chance. Both White and Black children and parents categorized faces more often as racial outgroup members, indicating hypodescent and ingroup overexclusion for White participants, ingroup overexclusion for Black participants. Biracial participants showed no bias, perhaps due to their exposure to two ingroups. These categorization biases were also seen through children's crayon selections. Although White children had more White contact and were in Whiter neighborhoods than Black children, neither intergroup contact nor parent socialization strategies were predictive of children's face categorizations. Yet, the more parents categorized ambiguous faces as Black or as White, the more their children did as well, suggesting these categorizations may be learned implicitly. These findings suggest the ingroup overexclusion effect is present early in social development and persists into adulthood. Furthermore, these data are also informative of children's processing of faces and the social factors that contribute to the development of person perception.

Symposium 14: Advancing methods in developmental cognitive neuroscience

S14.1   Parameterizing neural power spectra: An innovative approach to studying the development of brain activity

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Spectral power analyses of the electroencephalogram (EEG) examine EEG activity in terms of frequency content, and offer a valuable approach to investigating brain functioning over development. EEG Frequency can be examined during tasks and 'baseline/resting' 'non-task' states; both can reveal underlying neural organization and functional maturation. Traditional spectral power analyses typically examine pre-defined frequency bands of interest (e.g., theta, alpha) and ignore the background aperiodic activity also present in the power spectrum. However, recent studies suggest that aperiodic activity contains meaningful physiological information that dynamically changes with age in the human brain. In this talk, we demonstrate a novel approach to EEG spectral power analyses that focuses on this aperiodic activity present in the raw power spectrum. Specifically, we illustrate how aperiodic activity, in both task-related and resting EEG, can reveal patterns of neural activity associated with cognitive and behavioral development. We will first briefly introduce methods for acquiring EEG, traditional computations of spectral power, and the links between spectral power and cognitive processes. We will then present an overview of background aperiodic activity ubiquitous in the EEG, and discuss how it could inform investigations of the influence of early experience on cognition. Findings from computational models as well as recent animal and human research suggest that changes in the 'exponent' parameter of the aperiodic activity reflect changes in the ratio between excitatory (E) and inhibitory (I) currents in neural populations. Research suggests that differences in the E:I ratio are associated with cognitive functioning and attention problems (e.g., ADHD). Thus, patterns of E:I balance as indexed with the aperiodic exponent may be of particular importance to typical and atypical brain

development and attention. Despite the potential significance of changes in the aperiodic exponent and their relation to excitatory and inhibitory neural activity, few studies have examined their link to cognitive functioning. We present data from two studies that address this gap. In the first study, EEG was recorded from 13- and 15-year-olds during a Flanker task and at rest. In both situations, we observed significant age-related reductions and sex-related differences in the aperiodic exponent, as well as in the aperiodic 'offset'--a second parameter that characterizes aperiodic activity. In the second study, we present data from the National Institutes of Health's Environmental influences on Child Health Outcomes (ECHO) project which examines the effects of early adversity (e.g., prenatal exposure to substances and toxins) on child brain activity across the preschool and school age period. EEG was recorded at rest from groups of children ages 4, 5, 7, 9 and 11 years. We will identify the offset and exponent of the aperiodic activity at each age, and relate these metrics to measures of maternal exposure during pregnancy. The innovative methods and data presented in this talk demonstrate the utility of examining aperiodic activity in the raw EEG power spectrum as related to brain functioning over development, and reveal critical links to both adaptive and maladaptive cognition and behavior. Such findings illustrate the value of this novel approach, and may point to critical neurodevelopmental periods for cognitive and behavioral change during childhood.

S14.2   Advantages of Linear Mixed Effects Models for Analyzing Event-Related Potentials in Developmental Research

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Event-related potentials (ERPs) are advantageous for investigating cognitive development, and reveal the real-time neural responses associated with processing specific events of interest. However, their application in infants and children is challenging given children's difficulty in sitting through the multiple trials required in an ERP task. Common ERP analytic approaches involve averaging trials within subjects, and excluding subjects with too few trials due to low signal-to-noise ratio in averaged ERPs. However, this approach introduces bias in measuring the neural signal. We demonstrate an alternative approach to ERP analysis--linear mixed effects (LME) modelling (LME)--which offers unique utility in developmental ERP research. LMEs include all artifact-free ERP trials, even if children have only one artifact-free ERP trial. Critically, LMEs have clear advantages over commonly employed ERP analyses (e.g., ANOVA). We will first briefly introduce the ERP method and then provide an overview of LMEs and their general advantages. We then demonstrate with both simulated and real ERP data that commonly employed ANOVAs yield biased results that become more biased as subject exclusion increases. In contrast, LMEs yield accurate, unbiased results even when subjects have low trial-counts, and are better able to detect real condition differences. Specifically, we simulated data for a common ERP component--the Negative Central (NC)--in two hypothetical conditions. We compared mean NC amplitudes estimated from ANOVA and LME models. We systematically manipulated trial-level data loss in order to examine how increasing percentages of excluded subjects due to low trial-count might bias amplitude estimates (low trial-count percentages were taken to match those common in existing studies based on our review of publications in the journal Developmental Cognitive Neuroscience in the last 10 years). ANOVA yielded estimates that were negatively biased compared to the known (simulated) population mean, and these biases increased at greater percentages of low trial-count subjects. In contrast, LME models yielded accurate, unbiased results even at the highest percentage of low-trial count subjects. Paralleling our simulation, we analyzed real preschooler NC data extracted from passive viewing of emotional faces. Children (N = 38; Mage= 59.92 months, SD = 6.85) viewed female actors expressing

four emotions: neutral, happiness, anger, and fear; and marginal means were analyzed to detect differences in amplitude across emotion conditions. We conducted traditional ANOVAs in which children with fewer than 10 or 15 artifact-free trials were excluded from analysis, which were compared to LME analyses that included all subjects and employed maximum likelihood to account for missing trials. Both LME and the ANOVAs revealed a significant omnibus effect of emotion. However, the LME revealed two condition differences (i.e., mean NC differences in Angry vs. Happy, and Angry vs. Neutral), whereas ANOVAs revealed only one condition difference, and the specific condition effect that emerged differed depending on the trial-count exclusion criteria (either 10 or 15 trial cut-offs). Thus, we demonstrate that, in contrast to mean-averaging for ANOVA analyses, LMEs provide a more accurate and robust estimate of mean ERP amplitude effects, and we encourage developmental ERP researchers to adopt this superior approach when possible.

S14.3   Using functional near-infrared spectroscopy to study developmental aspects of naturalistic narrative comprehension

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Functional near-infrared spectroscopy (fNIRS) can reveal brain activity underlying cognition, behavior, and development. fNIRS has advantages over other neuroimaging methods such as functional magnetic resonance imaging (fMRI), particularly for studying language, because it is silent and does not interfere with auditory processing. Neuroimaging research has revealed much about child language development and its disruption in language-based learning disorders. However, the majority of neuroscientific findings come from experimental manipulations requiring children to make decisions about language sounds, meanings, or grammatical structures. These paradigms are potentially problematic because the artificial experimental protocols may induce task-specific processing that confounds interpretation, and obscures our understanding of children's naturalistic, everyday language processing. In this talk, we illustrate a novel, alternative approach to investigating the brain activity associated with language processing that employs a 'naturalistic listening paradigm'. This paradigm captures the brain bases of language processing in terms of naturally-occurring linguistic deviations in narrative contexts (e.g., Willems et al., 2016). It has been applied successfully with adults using fMRI (Brennan et al., 2016, Willems et al., 2016, Henderson et al., 2016) and children using MEG (Brennan et al., 2018). We demonstrate for the first time how this naturalistic listening paradigm helps investigate narrative comprehension in young children of varied language (dis)ability with fNIRS. Combining the naturalistic listening paradigm and fNIRS provides a principled, child-friendly, and ecologically-valid approach to capturing the neural mechanism of language development. We will first briefly introduce the fNIRS method, and then detail the naturalistic listening paradigm, which is an adaptation of a standard narrative comprehension task. Narrative comprehension tasks capture children's emerging language abilities because they challenge children to synthesize linguistic information to arrive at a successful interpretation. In our naturalistic listening version of the narrative comprehension task, participants simply listen to an audiobook story during brain imaging. Then, a computational psycholinguistic analysis is used to model the collected brain signals in relation to the linguistic input. We demonstrate the success of this technique in 25 typically-developing children and 26 children with dyslexia (ages 6 - 12 years). Specifically, participants passively listened to a chapter of Alice's Adventures in Wonderland during fNIRS recording. Each word in the story was modeled in terms of its linguistic predictability (Brennan et al., 2016). Based on those predictability values across the entire story, coupled with hemodynamic convolutions, we explored the neural mechanism underlying everyday language

processing, and how children with dyslexia differed from typically-developing children. We will show how this paradigm can address many research questions regarding narrative comprehension - in our case, the neural difference (or lack thereof) between dyslexic and typically-developing children. We will discuss how this naturalistic paradigm can address questions in other domains of cognitive development (e.g., social cognition) and how it can be used with other neuroimaging methods (e.g., fMRI, ERP, and MEG) to study cognitive development more generally.

S14.4   Insight on Early Memory Development from Functional NeuroImaging of the Sleeping Toddler Brain

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Studies conducted with functional Magnetic Resonance Imaging (fMRI) advance our understanding of how the brain supports various aspects of human cognition including episodic memory (i.e., memory for past events with specific detail). fMRI methods have been particularly influential in elucidating the function of subcortical structures, which cannot be easily investigated with other methods. One of these structures--the hippocampus--is essential for episodic memory, thereby making fMRI the primary method to investigate its functioning. There are challenges to investigating the role of hippocampal activity in the development of memory. Episodic memory emerges during infancy and improves in early childhood. Developmental processes in the hippocampus are hypothesized to play a critical role in the emergence of abilities to form and maintain complex and detailed memories of life events. However, the methodological challenges of acquiring task-related fMRI data from infants and toddlers have limited investigations of how the brain supports episodic memory development. In particular, young participants have difficulty entering the scanner to participate in tasks because of the uncomfortable, dark, and noisy scanner environment. These challenges affect fMRI investigations of many domains of cognitive development, and are especially limiting to the study of hippocampal (and other subcortical) processes which cannot be easily targeted with alternative, more child-friendly neuroscience methods (e.g., fNIRS). To address these challenges, we have recently developed new fMRI paradigms that examine brain processes associated with auditory stimuli presented to sleeping toddlers. Specifically, we probe the function of the hippocampus by delivering auditory stimuli associated with toddlers' previous laboratory experiences during their natural nocturnal sleep. Across three separate published studies, we collected fMRI data from 24- to 32-month-olds during the delivery of learned and novel stimuli (Prabhakar et al., 2018, N=22; Mooney et al. 2021, N=48; Johnson et al. 2021, N=38). We found that greater hippocampal activation (during sleep) for learned versus novel stimuli was associated with memory performance assessed behaviorally in subsequent lab visits. Results were consistent across changes in the nature of the auditory stimulus (i.e., songs, words) and the nature of the dependent measure (i.e., memory for the room in which a song was learned, the game associated with a new song, newly learned words). In this talk, results of univariate analyses reported in our published manuscripts will be complemented by new results obtained using multivariate approaches such as Representational Similarity Analysis (RSA; Kriegeskorte, 2008). Our preliminary results suggest that these multivariate approaches are advantageous. Specifically, hippocampal representations assessed with RSA appear to capture memory for elements of the learning context, which are common across learned stimuli regardless of whether they are presented in their original or altered form during scanning (e.g., a song played in its original 'forward' form during scanning has similar hippocampal representations to those for a song played in an altered 'backward' form). Overall, our results demonstrate the promise of

leveraging sleep to gain new knowledge on early memory representation and retention. We will also discuss how our approach can be used to examine other cognitive functions.

Oral Sessions

Oral Papers I

O1.1 FMRI evidence that infants' brains process faces, scenes, and bodies as perceptually distinct object classes

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Philosophers and psychologists have long debated the relative roles of built-in structure versus learning in the development of the human mind. Yet it is only relatively recently that evidence from whole-brain measurements of awake infants has become available to inform these debates. Previous functional magnetic resonance imaging (fMRI) research found neural responses to faces and scenes in human (n=9) and macaque (n=3) infants. But, unlike adults, these face and scene responses did not appear to reflect specialized processing for these categories because objects evoked similar responses in the same regions. Thus, initial fMRI evidence seemed to support the idea that category-specific structure emerges slowly, presumably from learning. In adults, brain regions engaged in high-level visual perception are located on the ventral surface of the brain, a difficult part of the brain to image. Thus, it is possible that category-selective responses were present in infants but went undetected due to the challenges of awake infant fMRI. Here, we built a new coil and used a high-resolution acquisition sequence to collect fMRI data from infants (2-9 months) while they watched videos of faces, bodies, objects, and scenes. We collected enough low-motion data for a functional region of interest (fROI) analysis from 19 infants. For fROI analyses, we used anatomical constraint parcels for face-selective FFA, scene-selective parahippocampal place area (PPA), and body-selective extrastriate body area (EBA) generated from adult data. Infant fROI analyses revealed that the face response in FFA was greater than the response to bodies, objects, and scenes (all Ps<0.001); the scene response in PPA was greater than the response to faces, bodies, and objects (all Ps<0.01); and the body response in EBA was greater than the response to faces, objects, and scenes (all Ps<0.05). Thus, infants have face-, scene-, and body-selective responses in the FFA, PPA, and EBA, respectively. Why do category-selective responses emerge in stereotyped locations across individuals? According to the proto-architecture hypothesis, category-selective responses emerge in areas of cortex that maximally respond to corresponding co-occurring low-level stimulus properties. Specifically, face-selective responses emerge in areas of cortex that preferentially respond to images that are high in low spatial frequency and curvilinear content whereas scene-selective responses emerge in areas of cortex that maximally respond to rectilinear and high spatial frequency content. Thus, we next measured the curvilinear, rectilinear, and spatial frequency content of our stimuli. The pattern of response in FFA, PPA, and EBA did not correspond to the pattern of low-level statistics in our stimuli, indicating that the proto-architecture account is not sufficient to explain category-selective responses in infant cortex. Although these results do not rule out a role of experience in cortical development, they powerfully constrain accounts of development: If experience is necessary for the emergence of face-, scene-, and body-selective regions of cortex, then just a few months of experience is enough.

O1.2 Children's use of causal structure when making similarity judgments

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Understanding any phenomenon requires knowing how its causal elements are related to one another. Further, recognizing shared causal structure across phenomena may be useful for understanding novel processes. For example, understanding how multiple factors contribute to cost-of-living estimates may facilitate understanding of how multiple causes also contribute to the rise of carbon dioxide in the atmosphere (Rottman et al., 2012). Although prior research provides evidence that children can learn individual causal relations (Schulz, 2012), no previous work has explored whether children recognize similar causal structures across distinct events. Here, we examine whether children match causal narratives based on shared causal structure. In Study 1, we present 64 4- to 7-year-olds (n = 16 per age group) with three-variable causal stories over Zoom. For each story, illustrated events unfold according to either a common effect or a causal chain structure (e.g. "The sun shone very bright and warm, which made the dirt dry. The dry dirt made the flowers droopy."). We then ask children to make judgments about which stories are the most similar. Results indicate that the ability to recognize and use abstract causal structure as a metric of similarity develops gradually between the ages of 4 and 7: While we find no evidence that 4-year-olds recognize the common causal structure between events (M = .59, 95% CI [.35, .84], p >.05), 7-year-olds demonstrate a relatively mature understanding of shared causal structure when making similarity judgements (M = .91, 95% CI [.76, 1.0], p < .001). Five- and 6-year-olds show mixed success. Despite this initial evidence, it remains possible that children may have used subtle language cues within individual stories to support their judgments (e.g., noticing similar language among stories of the same structure). We address this possibility in Study 2 (ongoing), which aims to replicate the findings from Study 1 with 5- to 7-year-olds. In Study 2, we precisely control the language of each story to remove any low-level cues that children may have used in Study 1, and include short, animated videos of each to ensure that children are representing the intended causal structure. Additionally, to measure causal understanding, we ask children a counterfactual question about the events in each target story. While data collection is ongoing (current N = 33; pre-registered N = 96), the current trend is consistent with the claim that, by 7 years of age, and potentially as early as 6, children can use abstract causal structure as a metric of similarity, even in the absence of any superficial cues. That is, 6- and 7-year-olds (n = 9, M = .72, 95% CI = [.43, 1.0] and n = 15, M = .77, 95% CI = [.55, .98], respectively) tend to match stories based on their causal structure, while 5-year-olds do not (n = 8, M = .50, 95% CI = [.15, .85]). This suggests that children are using causal structure information to match stories, rather than a low-level language cue. We also find that 6- and 7-year-olds perform well on counterfactual questions (M = .89, 95% CI = [.68, 1.0] and M = .83, 95% CI = [.64, 1.0], respectively), providing additional evidence that they are using information about causal structure to match stories, rather than relying on low-level cues. These results extend the literature on causal reasoning, and open new avenues for exploring how the recognition of causal structures may support learning and transfer in children.

O1.3   No Matter if sliced? The influence of food processing and neophobia on children's edibility judgments

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Distinguishing between foods from non-foods is a crucial human ability (Rozin, 1990). Misclassifications of foods as non-edible can lead to unnecessary rejections (e.g., an unfamiliar dragon fruit). More critically, misclassifications of non-foods as edible can lead to poisoning (e.g., household products; Schwebel et al., 2015). There is an extensive body of research describing how children's food knowledge develops across the preschool years (see Cognition Development, Special issue on Children's Food cognition, 2020). Here, we will focus on children's understanding of the relation between edibility and food processing because it has been claimed that food processing (i.e., signs of human intervention such as slicing) conveys information about food edibility (Fischler, 1988). We studied this influence of food processing and its interactions with food familiarity and children's food neophobia (i.e., the fear of uncertain eating situations) in a food versus non-food categorization task. We hypothesized that, first, children would categorize more often processed stimuli (sliced) as foods than unprocessed stimuli (whole) and, second, that children with high food neophobia scores would have poorer performance compared to other children. 137 children, aged 57.14-72.02 months, performed a computerized categorization task. They were shown a series of 16 food and 16 non-food items, whole or sliced. Each food was paired with a non-food perceptual match (i.e., similar in both shape and color). Children's food neophobia scores were assessed with the CFRS food rejection scale (Rioux et al., 2017). Children were asked to categorize whether or not each item was a food or not by pressing a "Yes" or "No" button. Children's hits and false alarms were recorded to compute discriminability indices and decision criteria. Results indicated that children were better at discriminating foods from non-foods in the whole condition than in the sliced condition ($F = 18.63$, $p < .001$, $d = 0.74$). Actually, children considered sliced items as foods more often than whole items ($F = 32.75$, $p < .001$, $d = 0.98$). Furthermore, children with higher food neophobia scores had poorer discrimination abilities than children with lower food neophobia (Spearman's $r = - 0.205$, $p = .017$). Interestingly, as sown in Figure 1, the highly neophobic children displayed a more conservative criterion of decision than their more neophilic counterparts ($r = 0.354$, $p < .001$), categorizing more often actual edible items as non-foods. In conclusion, children distinguish more easily foods from non-foods when whole, and that food processing appears to be an important cue for edibility that can even lead to dangerously incorrect categorization. We also discuss the costs and benefits of being a neophilic or neophobic individual. Indeed, even if children with higher food neophobia had poorer food categorization abilities than children with lower food neophobia, highly neophobic children displayed a more conservative criterion of decision that could protect them from dangerous false positives.

O1.4 What are the units for statistical learning? How different segmentations effect the prediction of vocabulary development and semantic category learning

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Children's ability to learn distributional statistics is well established and is hypothesized to be important for many aspects of cognitive development. One question that arises for statistical learning theories and models is, what are the units over which statistics are calculated? The units that are used to calculate distributional statistics can have a significant impact on what ends up being learned. In the current work, we tested the question of whether language that is segmented into whole words or into morphosyntactic units (i.e. treating units like -s, -ed, and -ing as separate units) better predicts child vocabulary development and semantic category learning from distributional statistics. Previous work has

shown that if infants segment morphological endings like -ing, this better predicts and explains the age at which children can recognize verbs (Willits, Seidenberg, & Saffran, 2014). Does treating morphological inflections as "units" in distributional learning help predict other aspects of language development? In both of the experiments described below, we used the CHILDES corpus (MacWhinney, 2000) obtained through the childes-db website (Sanchez et al., 2019). We created two conditions, a "raw" condition leaving the corpus standardly transcribed (with each token being a traditionally defined word) and a "parsed" condition splitting the inflectional morphemes -s, -ed, -ing, -ie, and -y from nouns and verbs and leaving them in the corpus as separate tokens. In Experiment 1, we compared these two versions of the corpus in terms of their ability to predict child vocabulary acquisition (using MCDI data obtained from the Wordbank website, CITATION). Previous work has shown that distributional predictors like word frequency, contextual diversity, and the proportion of known words with which a word co-occurs all significantly predict the proportion of children of a given age who produce a word (Goodman & Dale, 2004; Braginsky et al, 2020, Flores et al., 2021). We found that overall ability to predict vocabulary development is significantly higher in the morphologically parsed condition. In Experiment 2, we compared ability of the two versions of the corpus to be used by a distributional learning model to learn words' semantic categories. Previous research has shown that distributional models learning from the CHILDES corpus can predict the semantic categories of words with high accuracy (Huebner & Willits, 2020). In this experiment, we found that the distributional models learned significantly better from the parsed version of the corpus. In fact, the parsed version of the corpus reached the level of performance of the raw version of the corpus in about one-third the time, requiring only about 2 million words of input compared to six million words. Across two experiments, we show that taking into consideration the units over which statistical learning is operating can significantly affect the predictions one makes about the capacities of distributional learning models. In support of previous research (Willits et al., 2014), predicting both child vocabulary development and semantic category learning from distributional statistics significantly improve if children are treating morphological inflections as separate units during distributional learning.

O1.5   Didactic culture affects children's learning from play

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Recent evidence shows that free play can bring about learning, even as well as didactic experience can (Sim & Xu, 2017). While the mechanism behind it is not fully understood, it is believed that an exploratory component is necessary for play to effect learning. If so, a culture that favors rigidly defined play over free exploration may not be conducive to learning from play. We test this expectation in the Chinese culture, given evidence that Chinese parents act and perceive themselves as teachers and not playmates for their children (Lin & Li, 2018). In three studies we tested Chinese three year-olds' generalization learning from play. We used an identical paradigm to Sim & Xu (2017), where children saw a machine that made a sound when certain blocks were put atop it. A rule governed the sound activation (e.g., same-shape rule: the machine made sound if the block's shape matched the machine's). The question was whether children can learn and generalize this rule--at test they had to select one out of three blocks to activate a previously seen machine (First-order test) and a new machine (Second-Order test). Study 1 compared children (N = 60) in Free-Play vs. Didactic conditions. Children in Free-Play were given the machines and blocks to play by themselves for 5 minutes, while children in the Didactic

condition were explicitly shown which blocks activated the machines (without being told the rule). Children learned well in the Didactic condition (First-order test: 77% correct, t-test against chance .5, t(29) = 3.40, p = .002), Second-order test: 73% correct, (t(29) = 2.84, p = .008). However, children did not learn from Free-Play: accuracy of First-order test was 53% (t(29) = 0.36, p = .722), and 47% in Second-order test, t(29) = -0.36, p = .722). These results differ from Sim & Xu (2017) where U.S. three-year-olds learned the rule from both Didactic and Free Play. In Study 2 (N = 31), we asked whether promising children with reward would change their play behavior and subsequently learning outcome. It did not; 3-year-olds' accuracy in Free-Play-Reward condition was still at chance (First-order test 39%, t(30) = -1.270, p = .214; Second-order test 45%, t(30) = -0.533, p = .598). There is evidence that Chinese parents respond to their children's failures and mistakes, but not to successes (Ng, Pomerantz, & Lam, 2007). If so, it's possible that children's exploratory play depends on children's sense of success and failure. To test this, we modified Study 1's Free-Play condition where instead of giving a predetermined rule for the machine's activation, the rule was determined by the child (but unbeknownst to them) by their very first try/action. Children in Study 3 were randomly assigned to either the Play-Success-First where the child's first action became the rule, or the Play-Failure-First where the opposite happened. Everything else was identical to Study 1 Free-Play--children played freely by themselves for 5 minutes. Amazingly, initial success determines whether play effects learning: Play-Success -First children were 77% accurate (t(29) = 3.395, p = .002), while Play-Fail-First children did not learn from free play (37% accuracy, t(29) = -1.490, p = .147), just like children in the Free-Play conditions in Studies 1 and 2. Overall, our results revealed that across cultures, children can learn from free play. Culture, however, may constraint exploratory tendency during play, resulting in (at times) non-learning from play.

Oral Papers II

O2.1   Individual differences in children's mathematics learning from instructional gestures

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Instructional gestures have been shown to benefit learning in a number of domains, including mathematics, science, and language. For example, instruction about the meaning of the equal sign (i.e., mathematical equivalence) that includes gesture improves student understanding more than speech-only instruction (Cook et al., 2016; Singer & Goldin-Meadow, 2005). Despite the overall efficacy of instructional gestures, many children fail to learn from either instructional format. The present research examines whether individual differences in cognitive resources previously shown to correlate with mathematical equivalence understanding (i.e., executive functions and cognitive reflection; Young & Shtulman, 2020) predict students' learning from instructional gestures. 2nd-5th graders (N = 162) participated in an online pretest-intervention-posttest study via Zoom. Students completed 12 mathematical equivalence problems with operations on both sides of the equal sign (e.g., 2 + 3 + 8 = _ + 6) at pretest and posttest (unique items for each test). Students also defined the meaning of the equal sign, a conceptual measure of mathematical equivalence understanding. Most U.S. elementary students provide incorrect operational definitions (e.g., "it means put the answer") rather than correct relational definitions (e.g., "it means the same amount"; Hornburg et al., 2018). Students were randomized to

speech-only or speech+gesture instructional videos used by Koumoutsakis et al. (2016). In a classroom setting, Koumoutsakis found both videos improved overall student understanding, but speech+gesture led to greater learning. Prior to the pretest, students also completed measures of set shifting, working memory, and a developmental measure of cognitive reflection (i.e., the tendency to reflect on one's own thinking; Young & Shtulman, 2020). To assess learning, we examined the posttest performance of students who had poor problem solving (0 or 1 correct; N = 129) and an incorrect definition (N = 86) at pretest. We fit Bayesian regressions with condition (speech-only vs. speech+gesture) and children's age, cognitive reflection, set shifting, working memory, and their interactions with condition as predictors. There were two main results. First, there was a condition by cognitive reflection interaction for problem solving, such that more reflective children benefited more from speech+gesture (over speech-only) than less reflective children. Second, there was a condition by working memory interaction for definitions, such that children with higher working memory capacity benefited more from speech+gesture (over speech-only) than children with lower capacity. Bayesian model selection suggested both interactions were important for out-of-sample predictive performance. The present results suggest individual differences in cognitive reflection and working memory predict who will learn from instructional gestures. Overall, children with greater cognitive resources were more likely to benefit, which is in contrast to suggestions that instructional gestures might be particularly supportive of students with fewer resources (e.g., Begolli et al., 2018). A better understanding of how cognitive reflection and working memory interact with features of the learning environment (e.g., speech+gesture vs. speech-only instruction; solving problems vs. defining the equal sign) will allow researchers to design more effective instruction to improve academic achievement.

O2.2   A unified model of arithmetic

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Arithmetic is a complex topic involving the application of four basic operations to various types of number, including whole numbers, decimals, and fractions. Arithmetic development is similarly complex, with each type of number posing distinctive challenges to both children and researchers seeking to explain development. For example, single-digit addition involves a transition from counting to fact retrieval, multi-digit whole number arithmetic involves column algorithms based on place value, decimal arithmetic involves modified versions of these column algorithms, and fraction arithmetic involves an entirely different set of procedures. Cognitive models have been proposed to explain development in each of these domains of arithmetic, but a unified theory that explains all of them does not yet exist. To address this challenge, we extended a domain-specific theory of arithmetic to a new domain. Braithwaite, Pyke, and Siegler (2017) previously developed FARRA, a computational cognitive model, to explain children's fraction arithmetic. We hypothesized that FARRA's key assumptions would also apply to decimal arithmetic. To test this hypothesis, sixth and eighth grade children (N = 92) solved 12 decimal addition and multiplication problems; strategies were coded based on written work and think-aloud protocols. Consistent with the hypothesis, children displayed three phenomena analogous to ones previously observed in fraction arithmetic and explained by FARRA: (1) most errors involved overgeneralizing strategies that would be correct for problems with different operations or types of number; (2) accuracies on different types of problems paralleled the frequencies with which the problem types appeared in textbooks; and (3) children displayed four patterns of strategy use predicted

by the theory. To account for these similarities between different domains of arithmetic, we created UMA--a Unified Model of Arithmetic. UMA is a theory of arithmetic learning and development implemented as a computational model. The model's theoretical assumptions are shared with FARRA, but unlike FARRA, UMA simulates arithmetic not only with fractions, but also with single- and multi-digit whole numbers and decimals. Simulations performed with UMA displayed each of the three phenomena observed in our empirical study of children's decimal arithmetic. UMA generates these phenomena by virtue of three assumptions: (1) arithmetic errors are caused by small deviations from standard correct procedures, of which strategy overgeneralization is the most common type; (2) the likelihood of selecting a correct procedure for a given problem depends--via a reinforcement learning mechanism--on how often similar problems have been encountered previously; and (3) continuous variation among children in the parameters governing learning leads to discrete differences in patterns of strategy use. The present findings, together with those of Braithwaite et al., (2017; see also Braithwaite at al., 2019) show that these assumptions can explain empirical phenomena in children's arithmetic with both fractions and decimals, despite large differences in the details of arithmetic procedures in these two domains. More generally, we argue for the viability of UMA as a unified theory of arithmetic development.

O2.3   Mechanisms supporting children's estimation in number, length, and area

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Children possess remarkably rich intuitions about quantity. Without counting or measuring, they can rapidly judge which of two jars has more candy (number), which piece of licorice is longer (length), or piece of chocolate is bigger (area). Through development, they learn to attach language (number words) to these perceptual magnitudes, allowing them to verbally quantify their intuitive, imprecise representations (e.g., judging that there are "one-hundred-and-two" candies in a jar). What mechanisms support children's interface between number words and perceptual magnitudes? We test two competing mechanisms. Under a structure mapping (SM) account, if children understand the logic that underlies how number words are attached to perceptual representations, then the very moment children can verbally estimate in any one dimension (e.g., number), they can readily estimate in others (e.g., length, area). Instead, if their interface relies on creating item-specific associations between number words and specific perceptual states, consistent with an associative mapping (AM) view, then children would need to learn to map number words to each dimension independently, with knowledge in one dimension not transferring to another without additional learning. Ninety 5- to 11-year-olds completed two tasks. In the Verbal Estimation (VE) task, children judged "how many" items they saw in number, length, and area, with novel units provided for each dimension (Figure 1). We calculated the coefficient of variation (CV; variability) and the slope (accuracy) of their mean estimates across target values shown. To test if differences in VE could be accounted for by differences in children's underlying perceptual representations, children also completed a Perceptual Sensitivity (PS) task. Here, they judged which side of a display had more dots (number), which line was longer (length), or which blob was bigger (area), with ratio (difficulty) varying within each dimension, and accuracy (%correct) as a measure of individual differences in perceptual acuity. Across ages, children readily linked number words to novel units and these dimensions, despite some not having had formal experience in length/area estimation. They were even able to map number words to completely novel number units (i.e., "one" unit

represented by 3 dots; Figure 1), which is rather remarkable considering that children had potentially competing associative links that had to be inhibited (e.g., "one" and 1 item) and that our youngest participants had not yet learned to formally multiple/divide. Further, any differences in VE were not explained by mere perception, suggesting that SM mechanisms likely support this interface. In ongoing work, we examine the extent to which children can flexibly link number words to different number units (e.g., "one" represented by 1 dot, 3 dots, or 5 dots) and demonstrate intuitive multiplication/division. Understanding this link between number words and perceptual magnitudes is especially important from perspective of development, considering children have access to perceptual representations from birth and acquire number words slowly through development. Our findings show that the link between number words and perceptual magnitudes is a major developmental achievement and one that is not built in piecemeal: once children can map language to one perceptual dimension, they can easily map number words to other dimensions and units.

O2.4   Intuitive beliefs about others' numerical judgments

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Humans and a variety of non-human species have demonstrated the ability to perceive numerical quantities since early infancy, suggesting that these abilities may be rooted in biological inheritance instead of explicit learning and instructions (Dehaene, 2011). In contrast, recent research using verbal descriptions and responses revealed biases in both adults and young children to think basic cognitive abilities including quantity approximation to be late emerging in humans and require learning and instruction (Berent et al., 2019; Wang & Feigenson, 2019). However, these results are limited by the method, which requires explicit reasoning about others' mental capacities based on verbal descriptions, leaving it unclear whether such biases remain when people are asked to make intuitive judgments of others' behavior. How do children and adults predict numerical behaviors of other agents? Specifically, do children and adults ascribe the same kind of numerical judgments they are capable of making to agents that differ in age or species? In three experiments, we explored this question in children and adults by showing participants an agent facing two different quantities at a time (e.g., 9 vs. 27 blueberries), and asking participants to predict which of these the agent will choose. The agents varied in age and species (a human adult, a human child, a human infant, an adult chimpanzee, and an adult ant). Additionally, participants completed baseline trials with no agent present and they judged which quantity was more. In Experiment 1 we found that 6- to 8-year-old children (N = 58; 33 female) performed at ceiling in these baseline trials (M = 0.98, 95% CI [0.97, 1]. Critically, a Generalized Linear Mixed-effects Model predicting participants' choice (with a logistic link) during the test trials revealed a significant effect of Agent Type, $\chi2$ (4) = 392.82, p<.001: children predicted the human adult and human child to choose the larger amount (M = 0.95, 95% CI [0.93, 0.98]; M = 0.84, 95% CI [0.80, 0.89]). In contrast, they predicted the human infant, adult chimpanzee, as well as the ant not to choose the larger amount reliably (M = 0.42, 95% CI [0.36,048]; M = 0.64, 95% CI [0.58, 0.69] ; M = 0.46, 95% CI [0.40, 0.52], respectively) (Fig. 1). We then asked whether this tendency to think human infants and non-human species cannot make reliable quantity judgments is specific to children in Experiment 2. We tested adults (N = 50) with the same questions and found that adults show a similar pattern, predicting that the adult and child would choose the larger amount more consistently than the other agents (M = 0.89, 95% CI [0.85, 0.93]; M = 0.84, 95% CI [0.80, 0.88]). In Experiment 2b (N = 50) we found that there

was no difference between adults' judgments for the human infant and the non-human species and the random coin flip, suggesting that participants believed these agents would pick the bowls at random. Our ongoing experiments are investigating whether children and adults attribute specifically an inability to differentiate quantities to human infants and nonhuman species, or whether they rather feel unsure about these agents' behavior in general. Together, these studies so far point to an early emerging intuition of others' numerical judgments varying by age and species, which may be informative for our reasoning about other minds.

O2.5 Children's spontaneous gesture use predicts their propensity to learn from instructional gesture: a story of individual differences

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Gestures - hand movements that accompany speech and express ideas - can help children learn how to solve mathematical equivalence problems (e.g., 5+3+2=_+2), and flexibly transfer that learning to novel problem-solving contexts (Novack et al., 2014). Yet not all children benefit equally from gesture instruction. Here, we consider two factors that may impact whether gesture leads to learning in a given instructional scenario: (1) whether a child spontaneously produces gesture when they explain their solutions to equivalence problems (Congdon et al., under review); (2) and whether the child is seeing the gesture during instruction, or doing the gesture themselves (e.g. Dargue et al, 2019). 145, 3rd grade children (Mage = 9.19 years) participated in a training study aimed at teaching children how to correctly solve mathematical equivalence problems. No children solved any pre-test questions correctly. They were asked to explain their (incorrect) problem-solving solutions as a measure of spontaneous gesture. One-third of the sample (31%) produced no spontaneous gesture on any of the six pre-test explanations (see Table 1). Next, children were randomly assigned to one of four one-on-one training conditions: Doing Action (DA), Seeing Action (SA); Doing Gesture (DG); or Seeing Gesture (SG). Children in all conditions expressed an equalizer strategy in speech ("I want to make one side equal to the other side") and either observed or produced a grouping strategy in gesture, or a grouping strategy in action (indicating that the first two addends can be summed to arrive at the correct answer). After training, children were given a post-test with two types of problems -- "trained" problems, which matched the form of problems children saw during training and measured learning directly, and "transfer" problems, which were novel in form and measured children's ability to flexibly generalize any conceptual gains to novel contexts. Raw average scores are shown in Figure 1. Overall, posttest performance indicated that children's spontaneous inclination to gesture during pre-test interacted with their training condition, particularly for transfer problems. Two separate models were built to predict learning performance (Model 1) and generalization performance (Model 2). Follow-up analyses on Model 1 (trained problems) revealed that pretest gesture status did not significantly predict performance in the gesture training conditions ($X2$ (1) = 2.349, p = .125) or the action training conditions ($X2$ (1) = 0.176, p = .675). However, for Model 2 (generalization problems) results showed that within the Do Action training condition, pre-test non-gesturers performed significantly better on transfer problems than pre-test gesturers ($X2$ (1) = 7.164, p = .007). The opposite pattern emerged in the Do Gesture condition: pre-test gesturers performed significantly better on transfer problems than pre-test non-gesturers (2 (1) = 4.305, p = .038). These differences did not emerge in either the See Action ($X2$ (1) = 2.056, p = .151) or See Gesture ($X2$ (1) = 1.321, p = .250) conditions. Results have implications for predicting which individuals may benefit

most from gesture-based instruction, and suggest that there may be benefits to aligning instruction with children's natural communicative tendencies.

Oral Papers III

O3.1   Children rate English speakers as more likeable and more knowledgeable than foreign language speakers, but these judgements varied by neighborhood linguistic diversity

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Starting early in life, language is an important social category that children use to divide the social world: monolingual English-speaking children privilege English over foreign language speakers as friends (Kinzler et al., 2007) and informants (Corriveau et al., 2013). However, it is unclear whether children prefer English speakers or dislike foreign language speakers when questions are asked in a forced-choice comparison. Further, why children privilege information from English speakers is unclear: is it because they think foreign language speakers are not knowledgeable and/or because they like English speakers more? Moreover, how does this selectivity relate to children's exposure to linguistic diversity? Thus, the current study used rating scales to examine children's social preferences for and epistemic perceptions of foreign language speakers and quantified the linguistic diversity in children's neighborhoods and social networks. Eighty-two 6-year-old English-speaking children (52% females; 49% White; 40 monolinguals; 26 exposed to other languages; 16 bi/multilinguals) with no exposure to Korean participated in the study. Children completed (1) the Liking task and (2) Knowledge tasks in counterbalanced order. In each task, children saw and heard four foreign-language (i.e., Korean) speakers and four English speakers in random order. In the Liking task, after listening to each speaker, children's liking was assessed on a 3-point scale (1=don't like very much, 2=maybe like, 3=like very much). In the Knowledge task, children saw along with the speaker a picture of either familiar objects (e.g., ball) or novel objects (e.g., unfamiliar objects from the novel noun database), and their judgments were assessed on a 3-point scale (1=speaker doesn't know what this object is for, 2=maybe knows, 3=does know). In addition, children's home zip codes were used to extract neighborhood demographics from the U.S. census, and parents were interviewed to collect demographic information about the people in children's social networks. Children rated liking English speakers (M=2.5) more than Korean speakers (M=2.0), $F(1,79)=59.4$, $p<.01$. Children showed a significant preference above the ambivalent choice ("maybe like") for English speakers ($p<.01$), but not for Korean speakers ($p=.9$). Children judged English speakers (M=2.4) as more knowledgeable than Korean speakers (M=2.2) regardless of object types, $F(1,79)=14.6$, $p<.01$. Both Korean and English speakers were judged as knowing familiar objects (ps< .01) but at chance (not different from "maybe know") for knowing novel objects (Korean: $p=.33$; English: $p=.17$). Children's liking and knowledgeability ratings of Korean speakers were correlated, $r=.35$, $p<.01$, but not so for English speakers, $r=-.33$, $p=.8$. We also found marginal evidence that monolingual children living in neighborhoods with a high percentage of foreign-language speakers rated Korean speakers as more likeable than children in neighborhoods with a low percentage of foreign language speakers ($b=-.3$, $p=.05$) and this neighborhood effect was most prominent in children who have no linguistic diversity in their social networks. Our results suggest that the foundation for social bias against foreign language speakers may be rooted in both judgments about likability and knowledgeability, and that linguistic diversity in children's neighborhoods could play an important role in shaping children's perceptions of foreign language speakers.

O3.2   A new measure of children's attitudes and beliefs about the internet

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Nearly 98% of American households with a child under 8 (Rideout, 2017) and 94% of Chinese households (CNNIC, 2019) have access to the internet, yet our understanding of children's attitudes and beliefs about the internet is limited. The current studies explore how children's views of the internet vary with age, experience, and culture. We developed and validated a new measure - the Children's Internet Attitudes Scale - in order to examine these questions. Six- to 10-year-old children (N=413; Mage = 8.43) from China and the United States indicated their experience with the internet by stating if they had engaged in each of 6 different types of internet-based activities, such as watching a video or finding the answer to a question. Children then indicated their degree of agreement with each of 16 statements using a four-point scale. Upon confirming that these data were appropriate for an exploratory factor analysis (EFA), four factors were extracted based upon Kaiser's rule (eigenvalues > 1). Four factors explained 52% of the total shared variance in the model. The four latent variables were: comfort using the internet, perceived accuracy of the internet, perceived scope of the internet, and comparison of print sources to the internet. All factor loadings were significant (ps<.001). A confirmatory factor analysis (CFA) was then performed with a new sample of 6-10 year old children from both countries (N=417; Mage=8.17) who completed the same procedure. The final model fit was adequate (X2 p value=.15, RMSEA=.028), confirming the loading of factors into the four latent variables. All factor loadings were significant (ps<.001). Finally, the same CFA model and sample were applied to a structural equation model (SEM) that was used to explore the factors that contribute to differences in children's responses to questions about the four latent variables. Children's age positively predicted their comfort using the internet, but negatively predicted their beliefs about the accuracy of the internet. Experience positively predicted children's comfort when using the internet, and negatively predicted their preference for print sources. Culture predicted children's beliefs about the scope of the internet, such that American children believed the internet had broader scope than Chinese children. Culture also predicted children's beliefs about the internet's accuracy and their preference for print sources, where Chinese children indicated that the internet was more accurate and they had a stronger preference for print sources, despite reporting similar levels of comfort with the internet as American children (all ps<.001). These results demonstrate that culture, age, and previous experience all play a role in shaping children's understanding of the internet. Considering these factors together allows researchers to garner a robust understanding of children's beliefs and attitudes. Age and culture are related to experience, but their contributions to children's beliefs and attitudes regarding the internet are not mutually exclusive. These results also set the stage for future research using the Children's Internet Attitudes Scale to explore individual differences in internet attitudes and how they relate to children's trust in and learning from the internet and internet-based devices.

O3.3   Do children have an intuitive belief in God(s)? Children's teleological explanation preferences and intentional design

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Are children naturally predisposed to believe in God(s) or other supernatural beings? Some theories suggest that children are intuitively theistic (Kelemen, 2004) and may even have a broadly agentic worldview (i.e., over-ascribing intentionality to all of nature; Rose, forthcoming). These perspectives are based in part on how children are inclined to *explain* the world around them; children's explanation preferences in response to 'why' questions may suggest an affinity for understanding nature as designed by some (supernatural) agent (e.g., Kelemen, 1999). Yet existing research has largely overlooked how children may understand the *questions* that precede these answers. Here, we explore how children's pragmatic understanding of 'why' questions may shape their explanation preferences, with downstream consequences for these broader theories of intuitive human cognition. Indeed, adults' pragmatic expectations about 'why' questions shape their preferences for the explanations that follow. Adults (1) interpret "Why?" as asking a specific implicit question (i.e., *either* "What is the purpose of x?" or "How did x come to be?"); and (2) endorse the explanation that happens to answer the most relevant question (Joo, Yousif, & Keil, 2021, PsyArXiv). Thus, when adults endorse teleological answers (e.g., that giraffes have long necks so that they can reach the leaves of tall trees), they think that this answer can address the question (e.g., what the giraffe's neck is for) that someone was really meaning to ask in the first place. These findings raise a critical question about children's understanding of explanations: Do children (1) share these pragmatics about 'why' questions, and (2) if so, how might these expectations affect their explanation preferences (and the broader theories that revolve around them)? We investigate this question across three experiments. First, we find that children develop an adult-like understanding of 'why' questions around age 6 (Experiment 1), at the same time at which they develop consistent explanation preferences (Experiment 2). Collectively, these experiments demonstrate that children have specific expectations about 'why' questions that may relate to their explanation preferences: They understand 'why' questions about different kinds of objects to imply *either* a 'how' or a 'purpose' question. But do these implicit questions actually shape how children subsequently reason about the explanations that follow? Here, we find that children do think of particular kinds of explanations as answers to specific, disambiguated questions ('how' vs. 'purpose'; Experiment 3). By the time they develop specific expectations regarding 'why' questions, children also treat teleological vs. mechanistic answers as resulting from *different* questions. These findings therefore suggest that children, like adults, may prefer 'explanations' that answer the most relevant implied question-- regardless of whether or not these answers are best able to actually explain why something exists. In other words, children may be drawn to teleological explanations *not* because they innately think nature was intended by God(s) for this purpose, but simply because they want to know (and think others want to know) what different things may be for. This view of children's explanation preferences thus has critical implications not only for the study of explanation, but for the broad theories of human cognition that build upon it.

O3.4   Developmental origins of preferences for powerful vs. prestigious leaders

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There are wide divides in what people look for in leaders. Research with adults underscores the extent to which people differentially prioritize strength and power vs. competence and prestige in leaders, and suggests that powerful leaders are more preferred in contexts of actual and perceived competition (e.g., Kakkar & Sivanathan, 2017; Sprong et al., 2019; Lausten & Peterson, 2015). Here, we investigated the

developmental origins of preferences for powerful vs. prestigious leaders during times of competition vs. cooperation. Across three pre-registered experiments, we introduced 3-6-year-old children (N = 288; from 34 U.S. states; with racial and socioeconomic diversity) to a fictional group (the Dotis) facing a problem (a water shortage) and varied the way this problem was framed. Across experiments, children learned that the Dotis were choosing between two possible leaders: The "biggest and strongest" Doti that is "seen as being powerful" (powerful); and the "most skilled and smartest" Doti that is "seen as being respected" (prestigious) (order counterbalanced). We asked children which Doti (powerful, prestigious) they thought would be the leader. In Experiment 1, we framed the problem (between-subjects) as involving within-group cooperation ("The Dotis need to work together as a group to get more water") or between-group competition ("The Dotis need to work against another group to get more water"). By age 3, children's leader choices depended on framing: Whereas children in the within-group cooperation condition tended to choose the prestigious leader, children in the between-group competition condition tended to choose the powerful leader (Wald $X^2(1)$ = 11.80, p < .001). Independent from condition, children's choices also shifted with age: Across ages 3 to 6, children were increasingly likely to choose the prestigious (vs. powerful) leader (Wald $X^2(1)$ = 7.92, p = .005). In Experiment 2, we replicated these findings using framings that always involved another group (between-group cooperation vs. between-group competition). In Experiment 3, we asked whether these results would extend to indirect framings of competition vs. cooperation--the relative scarcity vs. abundance of resources. Following Rhodes & Brickman (2011), we told children that to get more water, the Dotis go to a well to which many other groups also go. Between-subjects, children heard that the well had "a lot of water; always enough for all of the groups" (resource abundance) or "only a little water; never enough for all of the groups" (resource scarcity). Children more often chose the powerful leader in the scarcity (vs. abundance) condition (Wald $X^2(1)$ = 5.62, p = .018). Children were again increasingly likely to choose the prestigious leader with age (Wald $X^2(1)$ = 9.16, p = .002). We further examined whether children's parents' political orientation may influence their choices. In Experiments 1 and 2 (but not Experiment 3), older (but not younger) children with more conservative parents were more likely to choose the powerful (vs. prestigious) leader (regardless of condition) (Experiment 1, age x political interaction: Wald $X^2(1)$ = 4.16, p = .041; Experiment 2, age x political interaction: Wald $X^2(1)$ = 4.89, p = .027). Together, these findings suggest the impact of competition vs. cooperation on leadership preferences has deep developmental roots and that preferences for power vs. prestige may have different developmental trajectories.

O3.5   Can people believe whatever they want? Children and adults' intuitions of the controllability of beliefs

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Beliefs are foundational to our lives. Currently, beliefs about the danger of a virus and the existence of climate change lead to critical personal and social consequences and spark hostile conflicts in public discourse. We often get angry at others when they do not possess the beliefs we think they should hold. But how responsible are we for our beliefs? Can people freely decide to choose one belief over another? In philosophy, whether beliefs are voluntary is controversial (James, 1937; Ganapini, 2020). Yet, recent psychological work indicates that adults endorse the ability to control one's mental states, especially beliefs (Cusimano & Goodwin, 2019). However, much is still unknown about how we judge the

controllability of beliefs, particularly if different kinds of beliefs influence judgments of control. For example, can people decide to think it's sunny outside if they have been inside all day without windows or access to the weather report? Can people decide to think it's sunny if they look outside and see that it's storming? Additionally, even less is known about how children judge these cases. While research has investigated children's judgments of the controllability of actions (Kushnir et al., 2015), to our knowledge nothing is understood about their judgments of the controllability of beliefs. In two pre-registered studies, we tested how 5-6-year-olds, 7-8-year-olds, and adults judge the controllability of others' beliefs. Specifically, how perceptions of control may depend on the available evidence for a belief (Study 1) and the morality of a belief (Study 2). In Study 1 (N = 120), children and adults judged that people have control beliefs that are not supported by evidence or contradicted by evidence. In other words, a person could freely choose to hold other beliefs if they wanted to. These judgments of control were identical to that of choosing possible actions. However, children and adults judged that people have much less control over beliefs that are supported by strong evidence. These evidence-backed beliefs were judged as less controllable than possible actions, but more controllable than impossible actions. In Study 2 (N = 120), children and adults judged that people have control over opinions and immoral beliefs, identical to possible actions. Yet, children and adults judged that people have less control over moral beliefs. Similar to evidence-backed beliefs, moral beliefs were judged as less controllable than possible actions, but more controllable than impossible actions. Additionally, developmental differences emerged in judgments of the controllability of moral beliefs, such that adults viewed these beliefs as more free than younger children. Thus, our results suggest that judgments of how much of a choice people have over their beliefs greatly depends on the belief in question. Moreover, it seems already at a young age, children have advanced intuitions of the controllability of beliefs and how these beliefs are constrained.

Oral Papers IV

O4.1 Considering cultural-ethnic background as a factor in the development of U.S. infants' prosocial behavior

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Cross-cultural work has shown that the expression of prosociality is influenced by cultural experience (Callaghan et al., 2011). Yet, there has been little empirical work on how cultural variations within in the U.S. may related to the expression of infants' prosociality. Cultural-ethnic groups are known to vary in the socialization values, goals, and behaviors that they display towards their children, even within mainland U.S. (Tamis-LeMonda et al., 2008). Specifically, cultural psychology studies suggest that Asian-American and Hispanic-American parents have socialization practices that generally differ from the practices of White-American parents (Markus & Moya, 2010). Both Asian and Hispanic/Latinx groups in the U.S. emphasize an importance of noticing and actively helping others to achieve their goals, rather than a more self-oriented pursuit of their own individual goals at the expense of strangers (Rogoff et al., 2017). Yet, little is known about whether cultural factors are significantly influencing prosocial behavior in very young U.S. Asian and Hispanic children. Prior research constructed a situation that afforded 19-month-old infants with the opportunity to share valuable, personally valued items (e.g., their own teddy-bear) with a stranger (Barragan et al., 2020; Barragan & Meltzoff, 2021). Here, analyses focused on specifically comparing Asian-American infants and Hispanic-American infants to White-American

infants using this large sample (N = 192). We find that, despite being exposed to the same broad environment of the metropolitan Seattle area, infants of Asian-American and Hispanic-American were significantly more likely than White-American infants to share valued items with strangers. This suggests the interesting cultural hypothesis that already at 19-months, cultural-ethnic experiences may be shaping U.S. infants' behavior towards strangers. These findings reveal certain "strengths" in the infants of Hispanic/Latinx-American families, and thus we wish to counter the "deficit view" often offered for this stigmatized group. Discussion focuses on developmental mechanisms within Asian-American and Hispanic-American families that may explain the (obtained) elevated group-level generosity and sharing shown by these infants. Moreover, we posit how these mechanisms within Asian-American and Hispanic-American families may specifically inform both theories of social development and also theory-based interventions designed to promote prosociality within the child population as a whole.

O4.2   Children's understanding of temporally mediated emotions

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Counterfactual thoughts and their associated emotions have received considerable attention from developmental psychologists. In particular, studies have explored children's ability to experience and understand the emotions of regret and relief. The literature suggests these emotions emerge relatively late in childhood given the sophisticated counterfactual abilities required to experience them. However, recent theories suggest relief also occurs following the end of an unpleasant episode (e.g., Hoerl, 2015). In these so called 'temporal relief' instances, the emotion may not arise from complex counterfactual reasoning, but simply from an ability to appreciate that a negative event is now over and in the past. Until recently, developmental psychologists had only examined counterfactually mediated relief. Moreover, although previous work has explored children's ability to use past events to infer current emotional states (see Lagattuta, 2014), less is known about children's ability to understand how others feel immediately after events (positive or negative) are over. The current study explored children's ability to integrate temporal information into their emotion judgements and contributes to a literature which heretofore has only focused on counterfactual relief. Nine vignettes were presented to 100 4-6-year-olds (40% female). In each story, one protagonist went through an episode that subsequently ended. Character's attitudes were manipulated such that there were temporal relief stories, in which the episode was very unpleasant for the character, and temporal disappointment stories, in which the episode was very pleasant for the character. To gauge children's understanding of how the cessation of events can impact emotions, we asked participants to judge whether the characters felt better, worse, or the same after the event was over. We reasoned that characters in the temporal relief and temporal disappointment stories should feel better and worse than before respectively. We also compared judgements in these trials to control stories in which the character felt neutral towards episodes and as such should feel indifferent when the event ends. We found that even 4-year-olds were above chance levels at judging the characters in the temporal relief stories as feeling happier than before. The main analyses did, however, indicate that the 6-year-olds made significantly more target judgements than the 4-year-olds, OR = 4.40, SE = 2.94, p <.001, suggesting that the tendency for children to make these relief attributions increases with age. Unexpectedly, participants' judgements were more accurate in the temporal relief stories than in the disappointment and control stories (both p values <.001). This may be

a result of individual differences in expectations about how people feel at the end of positive and neutral events. Overall, this study suggests that children are capable of attributing relief to others earlier than previously estimated in studies of counterfactual relief. This has implications for theories suggesting relief is best thought of as an emotion with two subtypes that have distinctive antecedents and cognitive prerequisites. Moreover, we provide evidence that 4-year-olds can integrate knowledge about the cessation of events into emotion judgements. This adds to a body of research which suggests young children are capable of taking past events into account when making judgments about how people feel in the present.

O4.3   "No fair!": Children's and adults' perceptions of fairness norms

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Children are sensitive to (un)fairness. But little is known about the extent to which children perceive fairness as a moral vs. a conventional norm. Through five studies with 193 children and 540 adults in the U.S., this work establishes how children understand fairness norms, how children's fairness understanding changes with age, and the role of harm in the moralization of fairness norms. Across a series of studies, 4-year-olds rated moral transgressions (e.g., hitting) as more serious than fairness (e.g., taking more chalk than another child) and conventional transgressions (e.g., wearing pajamas to school), but importantly, they rated fairness and conventional transgressions as similarly serious. In contrast, 6- and 8-year-olds and adults rated moral transgressions as more serious than fairness and conventional transgressions, and fairness as more serious than conventional transgressions. An additional, forced-choice procedure revealed that most 6-year-olds also categorized fairness with moral rather than conventional transgressions; 4- and 8-year-olds' responses did not show systematic patterns. Conversely, adults categorized fairness with conventional rather than moral transgressions. In a series of follow-up studies, the role of harm salience in perceptions of fairness violations was investigated with 4-year-olds and adults. We randomly assigned 4-year-olds and adults to Baseline or Harm Salience conditions. The Baseline condition was identical to the previous study. In the Harm Salience condition, the four Fairness scenarios emphasized the harmful outcome (i.e., "This child took more chalk than this other child, and this other child was sad because he/she got less chalk."). Harm was manipulated only for the Fairness transgression type. Young children's perceptions of harm influenced their norm judgments, such that fairness scenarios with high harm salience (Harm Salience condition) were evaluated significantly worse than scenarios with no additional harm emphasis (Baseline condition). In contrast to the 4-year-olds, adults in the Harm Salience condition evaluated unfairness marginally more seriously than those in the Baseline condition. Across both conditions, adults rated moral transgressions as more serious than fairness and conventional transgressions, and fairness as more serious than conventional transgressions. Furthermore, the forced-choice procedure revealed that 4-year-olds' responses did not show systematic patterns even with the harm emphasis. Once again, adults categorized fairness with conventional rather than moral transgressions in the baseline condition. Interestingly, adults were at chance for grouping fairness transgressions with moral or conventional transgressions. These studies revealed that the amount of emphasis placed on harmful outcomes plays an important role in adults' (and possibly also children's) perceptions of unfairness. This is the first evidence that children and even adults may not equate norms of fairness in resource distribution with

harm-based moral norms. This points to the need for a more nuanced understanding of children's developing perceptions of social norms.

O4.4 Love the group as the self: Children value and promote the interests of their group

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Human beings depend on groups to survive and thrive throughout history, but to what extent do we care about the groups we are a part of? Extensive research has shown that even young children display a remarkable capacity to act prosocially interpersonally, but little is known about our early tendencies to benefit groups. Our research aims to understand how children (aged 4-9) tradeoff their own interests versus the interests of their group, to shed light on early altruistic potential toward groups. Across four studies (three preregistered, total N = 274 children), we examined 4-9-year-old children's valuation and promotion of group interests, in terms of both harm and benefit. Across studies, we developed and adopted a novel paradigm in which children could decide to gain benefit (e.g., a medal made by a 3D printer) for a certain target at the expense of harm (e.g., listening to an annoying noise from the printer) for another target. Study 1 revealed that in the absence of a cost to the self (e.g., forced choice between only benefiting/harming the self versus benefiting/harm both the self and the group), the majority of children benefited (M = .90) and avoided harming (M = .72) their group. In Study 2, children were asked how long they would inflict harm (i.e., an annoying noise, 1= short, 4 = super long) on themselves or their group in order to gain a benefit (i.e., a medal) for themselves, and they decided to impose more harm on themselves (M = 3.07) compared to on their group (M = 2.70), p = .04. They also judged that they should impost more harm on themselves (M = 2.75) than on the group (M = 2.36), p = .014. Study 3 examined the extent to which children would endure cost in order to benefit themselves or the group. We found that children decided to benefit the group (M = 3.32) more than the self (M = 2.91), p = .03, and they judged that they should benefit the group (M = 3.10) more than the self (M = 2.50), p = .0003. In Study 4, children directly traded off decisions for harming and benefitting the group versus themselves. We found that overall children's tendency to avoid harming their group (for their own benefit) was stronger than benefiting their group (at their own cost). Younger children (aged 4-6) chose to benefit themselves over the group (M = .12, p = < .0001), and were at chance for harm decisions. Older children (aged 7-9) were at chance for benefit decisions, but they were more likely to imposed harm on themselves than on the group (M = .69, p = .0003). Our results reveal that children value their group's interest more than their own interests, especially when allocating harm. With age, children increasingly put more weight on group interests, when directly trading off the self and the group. The findings contribute to a better understanding of the early altruistic potential toward groups.

O4.5 Children deny that God could change morality

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Can moral rules change? Several lines of work in moral psychology suggest that children (and adults) may view moral truths as unchanging. However, a separate body of research concerning the cognitive science of religion finds that many people view God as all-powerful, which implies that God could change moral truths. This brings with it an unsightly conclusion, however: God could have made

morality, including seemingly "absolute" aspects of morality, entirely differently (Murphy, 2019). Instead of making murdering a child morally wrong, God could have made murdering a child for fun morally right. We recruited a sample of 132 children from the United States to investigate their beliefs about whether God could change widely shared moral propositions (e.g., "it's not okay to call someone a mean name"), controversial moral propositions (e.g., "it's not okay to tell a small lie to help someone feel happy"), and physical propositions (e.g., "fire is hotter than snow"). We provided children with an opportunity to express their belief (and their confidence in that belief) concerning a given proposition. For example: "This person thinks that it's okay to stomp on someone's foot really hard. This person thinks that it's not okay to stomp on someone's foot really hard. Which person do you agree with more?" We then asked whether God could make the opposite of their choice become true (e.g., "Do you think that God could make it not okay to stomp on someone's foot really hard?"), followed by a second certainty judgment (e.g., "How sure are you that God could/couldn't do that?"). We observed an emerging tendency to report that God's ability to change morality is limited. Children between ages four and six years old did not distinguish among God's ability to change widely shared moral, controversial moral, and physical propositions (ps ≥ .032, Cohen's ds ≥ .21). In contrast, children between seven and nine years old became increasingly confident that God could change physical propositions (t(261.63) = 3.54, p < .001, Cohen's d = -.44) and could not change widely shared moral propositions (t(251.09) = 2.72, p = .007, Cohen's d = .34). Critically, older children--like younger children--denied that God could change widely shared aspects of morality (younger: t(63) = -6.40, p < .001, Cohen's d = .80; older: t(67) = -10.46, p < .001, Cohen's d = 1.27). These findings converge with a well-documented tendency for morality to shape non-moral cognition (Knobe, 2010), including children and adults' judgments of possibility (Phillips & Cushman, 2017; Shtulman & Phillips, 2018), as well as research on the development of God concepts (Heiphetz, Lane, Waytz, & Young, 2018).

Oral Papers V

O5.1   No frills: Simple regularities in language can go a long way in the development of word knowledge

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Recent years have seen a flourishing of models that can mimic vital aspects of human language, such as completing sentences and forming analogies (Landauer & Dumais, 1997; Mikolov et al., 2013; Penninton et al., 2014). These models capitalize on a simple, decades-old idea: It is possible to learn a lot about what words mean based on regularities in the way they are used with each other in language. This idea is commonly referred to as the distributional hypothesis, which states that regularities of word use are informative about word meanings (or semantics) because words with related meanings such as "chicken" and "duck" tend to reliably co-occur with each other, as in "Chickens and ducks lay eggs", and in similar contexts of other words, as in "Chickens lay eggs" and "Ducks lay eggs". Word knowledge that captures these similarities in meaning is vital for language processing in both models and humans (Borovsky et al., 2016; Kutas & Federmeier, 2000; Nation & Snowling, 1999). Does this rich source of information also shape the development of knowledge about word meanings in humans? Although this possibility has been noted for decades (Borovsky & Elman, 2006; Ervin, 1961; Sloutsky et al. 2017), it faces two important challenges. First, the language input to models that capitalize on these regularities differs greatly from language input to young children in both content and sheer amount. Second, models

use learning mechanisms that may be absent or immature for much of human development. Specifically, young learners are indeed sensitive to simple regularities with which words co-occur with each other (e.g., Fisher, 2010; Wojcik & Saffran, 2015). However, models can capture similarity in word meaning even when words do not co-occur with each other, and instead only occur in similar contexts of other words. This capacity requires learning that spans entirely different experiences, such as hearing a sentence about chickens laying eggs on one day, and a sentence about ducks laying eggs on another. Critically, abilities to learn these regularities may develop only gradually throughout childhood and into adolescence (Bauer et al., 2012, 2020; Schlichting et al., 2017; Shing et al., 2019). Equipped with only the limited input and learning mechanisms available during human development, can young language learners develop semantic knowledge about words just from regularities of word use? To answer this question, we investigated whether semantic knowledge can develop just from the simple regularity with which words co-occur with each other in language input to infants and children. In Study 1, we provide a proof-of-principle that that language input to young learners is rich in co-occurrence regularities that can support learning relations between words similar in meaning, such as words for animals, colors, or body parts. Study 2 builds upon this evidence by showing that these regularities can explain early semantic knowledge about words that has been observed across several prior studies. Finally, Study 3 goes further to show that these regularities can account for the strength of children's spontaneous associations between words similar in meaning. Findings from all three studies provide robust evidence that even simple co-occurrence regularities in infants' and children's language input can play a powerful role in shaping their development of knowledge about words.

O5.2   Infants who mostly overhear nonetheless show knowledge of nouns and fine-grained social language

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An extensive literature suggests that children learn best from the speech that caregivers direct to them (child-directed speech, or CDS), compared to other speech that they overhear. However, the practice of speaking to young children is rare in many cultural contexts. Moreover, some researchers have argued that language development unfolds similarly, both in contexts where children receive little CDS and contexts where CDS is common (e.g., Casillas, et al., 2020), raising the possibility that infants adapt their learning strategies to the specific sources of language available in their environments. Here, we seek early evidence of two forms of language knowledge in Tseltal Maya infants--who receive very little CDS, in part because they are almost always carried on their mothers' backs. An adapted looking-while-listening task used infants' relative looking between pairs of pictures to test their knowledge of a set of (1) Common Nouns and (2) Greetings, terms used as greetings between community members, depending on the age and sex of the addressee (e.g., "tatik" is used to greet an older man, while "metik" is for an older woman). Though very frequent in infants' early environments, such greetings would never have been used to greet infants themselves. In the study, infants sat on mothers' laps before side-by-side screens in a sound-dampening tent. On each trial, mothers--whose eyes were closed throughout the study--heard a target noun or greeting over headphones, then repeated it for the infant. Common-Noun trials presented item-pairs of one animate and one food-related image (e.g., baby-corn, horse-soda, 32 trials total), while Greeting trials presented pairs of faces corresponding to distinct terms of address (e.g., older-man--younger-woman, 8 trials). A camera recorded infants' gaze, manually coded

later for left/right direction. 24 infants (5.3-15 months, M=11) and caregivers participated (5 in only Common-Nouns, 3 in only Greetings, and 14 in both tasks, order counterbalanced). Previous work suggests Tseltal infants in this age range rarely (<15%) receive CDS and spend the majority of each day overhearing from their mothers' backs. This was confirmed in interviews with caregivers and ongoing analysis of daylong audio-recordings collected at the same time. Following Bergelson & Swingley (2012), we defined an analysis window from 367-3500ms post-target-word onset, and calculated the mean difference in infants' proportion looking to each image when it was the target, relative to when it was not the target. Positive scores for item-pairs and for individual subjects suggest a tendency to prefer the target image. Notably, based on evidence from Western samples, positive scores on the Greeting trials are unlikely, as they contrast two highly similar and semantically related visual stimuli (i.e., two faces)-- not typically distinguished until 24 months (Kartushina & Mayor, 2019). Our results provide evidence of early context-specific language knowledge in infants who rarely hear CDS. Means for all Common-Noun and Greeting item-pairs were positive (Common-Noun range: 0.01--0.24; M=0.09, 95% CI:[0.055, 0.14]; Greeting range: 0.003-0.22; M=0.11[0.0035, 0.22]). At the individual level, 14 of 19 infants' mean Common-Noun scores (-0.57-0.40; M=0.09 [-0.01, 0.18]), and, remarkably, 10/14 Greeting scores were positive (-0.76-1; M=0.13 [-0.09, 0.37])--consistent with infants adapting their learning strategies to their environments.

O5.3   Does the public know what researchers know? Perceived task difficulty impacts adults' intuitions about children's early word learning

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Constraints, sociopragmatic, and domain-general theories have proposed the cognitive and social processes critical to children's word learning, leading to a corpus of replicable research findings. However, we do not know whether adults' understanding of early word learning aligns with key research findings. This is a critical gap in research because adults serve as the architects of children's learning environments (e.g., Hirsh-Pasek et al., 2015; Rowe et al., 2017; Weisleder & Fernald, 2013). Alignment with research findings is therefore pivotal in supporting children's development. The goal of Experiment 1 was to examine adults' intuitions about the science of children's word learning. A sample of undergraduates (n = 89), adults from the general public/non-parents (n = 93), general public/parents (n = 88), and Speech-Language Pathologists (n = 77) completed a survey with 11 word learning principles. For each question, participants were prompted to select an answer based on the perspective of a preschooler. Questions tested key concepts from early word learning research, such as the mutual exclusivity assumption, whole object assumption, shape bias, and taxonomic bias. Additional concepts included the role of sociopragmatic cues (i.e., pointing, eye-gaze) and the ability to learn from overheard speech. Finally, participants were asked whether children could learn from massed vs. spaced presentation schedules, in varied vs. repeated contexts, and cross-situationally. We predicted that adults' intuitions would be less aligned for principles derived from domain-general theories, regardless of their experience with language acquisition or language instruction. This prediction is based on prior studies revealing adults' inaccurate perceptions of domain-general principles in human memory, such as spaced learning (Kornell & Bjork, 2008). Results supported our prediction: Adults intuitions were aligned for all principles except those derived from domain-general theories (Figure 1), regardless of experience with language development. A follow-up experiment (Experiment 2; N = 91) was designed to test

whether the perceived difficulty of an item (5-point Likert scale; 5 = "Extremely difficult") impacted adults' reasoning about word learning processes. Indeed, domain-general theory principles (M = 2.76, SD = 0.48) were rated as significantly more difficult than sociopragmatic theory (M = 2.49, SD = 0.65), p < .001, and constraints theory principles (M = 2.12, SD = 0.55), p < .001, especially when adults thought a preschooler could not complete the task. These findings suggest that adults use task difficulty as a guide to what will aid children's language learning. Finally, Experiment 3 (N = 97) ruled out level of confidence and interest in the test items as mechanisms to explain the results. Taken together, this study highlight disconnects in knowledge between the research community and general public. Efforts must therefore be made to assess what the public knows and does not know about children's word learning. After all, comparing adults' intuitions to research findings that scientists consider robust is a critical first step in developing an evidence-based plan for disseminating research. The talk will conclude with a discussion of how to address adults' biases against difficult learning conditions, thereby supporting the key stakeholders of children's language development.

O5.4   The development of spoken- and written-word recognition during the school-age years: The Growing Words Project

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It is well known that the processes that support efficient word recognition undergo rapid development in early childhood, and substantial research on this has focused on the first few years of life. However, later childhood offers an intriguing context for continued development of word-level skills: the school-age years include richer language input and the onset of reading education. As a result, children's spoken- and written-word recognition abilities may continue to be refined throughout later childhood. Moreover, the demand for flexible and efficient word recognition is heightened in these ages, with the increase in linguistic complexity that occurs with the onset of schooling and the need for precise phonological representations to support reading. The first part of this talk presents an overview of recent work that shows surprisingly slow development of language skills that were often thought to develop in the earliest years. For example, the efficiency with which children recognize a spoken word and suppress competitors improves between 9 and 16 years. This development is mirrored in written-word recognition. Even more foundational speech perception skills show considerable refinement through age 18, suggesting that these years are a period of considerable development of seemingly low-level skills. Building on this work, our research team recently launched the Growing Words Project, a longitudinal study that traces the development of spoken- and written-word recognition and speech perception during the school-age years. The project aims to characterize the nature of these ongoing changes, and to identify factors that relate to this growth. This project will help further refine theories of school-age language development and investigate individual differences in development across a broad range of children. The second part of this talk reports results from the first year of data collection for Growing Words. Growing Words measures the dynamics of lexical processing for both spoken and written words using eye-tracking in the Visual World Paradigm (VWP). Speech perception is assessed with a continuous-rating-scale task to measure sensitivity to within-category phonemic information. These abilities are related to other cognitive processes, such as cognitive control; to standardized measures of oral language, phonological processing and reading; and to measures of the home language and literacy environment. The battery of measures was collected with 241 children between first and

third grade, each of whom will complete follow-up sessions for the next three years. The Growing Words sample includes a broadly representative sample of children with a broad array of language abilities and backgrounds across the developmental spectrum. Initial results support the idea that the dynamics of word recognition (both spoken and written) reflect a complex intersection of language, cognitive skills and the language environment. In line with previous research, speech perception and word recognition show improvements across grades, even within the narrow timeframe of 1st to 3rd grade. However, these developmental patterns go beyond simple age effects. I discuss how these measures interrelate with cognitive control, standardized assessments and language input in cross-sectional comparisons. These data are used to refine theories of school-age language development, and to detail predictions from longitudinal data collection in Growing Words.

O5.5   The impact of vocabulary ability on word learning in a playful intervention setting

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Many vocabulary interventions aimed at children from disadvantaged backgrounds have exhibited limited success (Wasik et al., 2016; Dickinson et al., 2011), perhaps because they typically teach words through shared book reading, a method shown to have moderate impacts on vocabulary acquisition (NELP, 2008). Teaching words solely through book reading may not be powerful enough to improve the vocabulary ability of at-risk children (Neuman et al., 2011). Moreover, a Matthew effect has been noted by literacy researchers (Stanovich, 1986; Duff et al., 2015); children who demonstrate heightened word knowledge learn a greater number of vocabulary words compared to children who know fewer words. What if we could increase the effectiveness of interventions for children with limited vocabulary? Perhaps we could boost word learning by taking advantage of research showing that children learn best from playful and interactive contexts (Fisher et al., 2013; Weisberg et al., 2016) in which they are active, engaged, and participating in meaningful interactions with adults and other children (Harris et al., 2011). The Language for Reading project did just this, by comparing teaching words through book-reading and play. Teachers in state- and federally-funded, low-income, preschool programs taught 60 difficult words (e.g. caution, gunwale) to students (N = 238; Mage = 54.03 months) over seven months. Vocabulary words were embedded into storybooks that teachers read aloud to students and into playful learning activities that included small-group games, large-group games, music, socio-dramatic play, and a touchscreen game. Some words were taught only in book-reading, others only during play. Students' growth in knowledge of the target vocabulary items was assessed before and after the intervention. Children's self-regulation ability and general vocabulary knowledge (PPVT) were measured prior to start of the intervention (Dunn & Dunn, 2007). A logistic regression predicting correct responses on an experimenter-created receptive measure of vocabulary demonstrated that, after controlling for the effects of self-regulation, children's growth from pre- to post-test on words taught in book-reading was moderated by their PPVT score indicating that children with greater vocabulary learned more target words, B = 0.005, SE = 0.002, p = 0.054. However, after controlling for self-regulation ability, this moderator effect of PPVT score on children's target word growth was not found for words learned from any of the play activities, B = 0.003, SE = 0.002, p = 0.214. That is, children's vocabulary skill did not

impact their learning of the target words that were taught through the playful learning activities. Playful learning permitted children to experience and retain the meanings of the new words. These results suggest that playful and interactive pedagogies used to teach words may be particularly effective for children with low vocabulary, who are most at risk for future academic problems. Future research should continue to examine play as a method for word learning and which types of play might be the most effective.

Oral Papers VI

O6.1   Reading high quality science books as an avenue for early science learning

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Book reading is a potential means of promoting science learning early in development (e.g., Ganea et al., 2011). Past research informed the type of information children learn from book reading. Yet there is limited understanding of the factors influencing science learning from books prior to formal schooling and the extent to which these early factors predict science achievement into elementary school. We bridge these gaps in two experiments. In Experiment 1, we assessed how caregiver's reading styles and characteristics of science books themselves related to preschool-age children's science learning. Caregiver's elaborative talk during reading (providing details, definitions, and examples beyond the text of books) predicts children's language skills (e.g., Price et al. 2009). Whether it also predicts science learning is unknown. Additionally, young children's science books vary greatly in the extent to which their text includes elements expected to facilitate learning, namely, Cohesion (elaborates on concepts to support limited prior knowledge and working memory), and Demand (includes questions and interactive prompts to support active engagement and underdeveloped memory strategies) (Miller et al., 2020). How caregivers' reading styles and books' structural features interact to influence science learning was also unknown. We tested 38 caregiver and their 4-5-year-old children (Mage =4.81 years). Caregivers read to their children four books that were crossed on levels (high, low) of Cohesion and Demand. We measured caregiver's elaborative talk, children's open-ended recall of science facts from the books, and children's verbal comprehension. When controlling for verbal comprehension, Cohesion most strongly predicted children's science fact recall ($F_{1,243.62}$ = 30.10, $p < .001$, d =.70). Additionally, Demand interacted with caregiver's elaborative talk ($F_{1,267.54}$ = 7.72, $p = .006$, d =.34), such that when Demand and caregivers elaborative talk were high, children recalled more science facts from the book. These findings show that properties of the books strongly influence children's early science learning and interact with caregiver's talk to influence such learning. To understand factors influencing later science knowledge, in Experiment 2 we tested the same children longitudinally 2.5-3-years later. We assessed how individual differences in children's recall of science facts from books at 4-5-years and caregiver's reading styles predicted children's science achievement at 7-years of age. Our preliminary sample includes 24 children (Mage=7.49). We assessed children on standardized tests of science achievement and verbal comprehension. In terms of concurrent predictors at 7 years of age, children's science achievement was highly correlated with their verbal comprehension (r_{22} = .65, $p < .001$). Longitudinally, children's recall of science book facts at 4-5-years predicted both science achievement (t_{21}=7.50, p=.003) and verbal comprehension (t_{21}=22.11, p<.001) at age 7, whereas caregiver's elaborative talk was not significant (ps >.625). These preliminary results suggest that children's learning of science facts from books relates to their later science achievement and language skills. In sum, these findings

highlight that reading high quality science books prior to formal schooling can be an avenue for supporting science learning into elementary school.

O6.2   The impact of IXL on Hispanic students' ELA achievement

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This study applies a new theoretical framework (Yeh, 2018) to investigate the potential of using individualized instruction to narrow the academic opportunity gap between White and Hispanic elementary and middle school students. Under Yeh's framework, differential academic outcomes are hypothesized to stem from the way that the current educational system treats "at-risk" students differently from other students (e.g., through class placement), which can lead to demotivation and disengagement. Students may instead benefit more from individualized work and assessments offering frequent formative feedback, which can lead to developing a sense of mastery, increased motivation, and feelings of ownership of their education (see Yeh, 2006). Method. We investigated the effectiveness of technology-based individualized instruction--specifically, IXL, a platform used by 1 in 5 students in the U.S.--in supporting Hispanic students' academic achievement. IXL's design is rooted in learning sciences research (Bashkov et al., 2021) and provides students with exactly the type of supportive, yet appropriately-challenging learning environment that Yeh (2018) recommends. As students use IXL, the software adapts to provide skills at the right level of difficulty. Within each skill, students earn a dynamic proficiency score that can range from 0-100. Students receive frequent, nonevaluative feedback, including detailed explanations of questions they answer incorrectly. Because literacy and language skills are fundamental for success in all academic areas, in this study we examined IXL English language arts (ELA) usage and its impact on ELA achievement. As part of a research partnership with a large, majority-Hispanic district (72% of students) in Arizona, we examined assessment, demographic, and IXL usage data from Hispanic students in grades 3-8 who had used IXL ELA during the 2018-19 school year (N=569; 55% female; 8.3% English language learners; 10% IEP students). This study used a pretest-posttest design, with students' scores on the state's end-of-year assessments in 2018 and 2019 serving as the pretest and posttest measures, respectively. Students' IXL usage was obtained from IXL's database. IXL's usage recommendations highlight the importance of reaching skill proficiency (i.e., a score of 80 or above); thus, we examined students' mean number of skills proficient per week (SP/week). Results. Controlling for students' pretest performance, grade, gender, IEP status, and ELL status, we found that mean SP/week was a significant predictor of posttest assessment performance over and above the other predictors, b=11.92, p=.02. That is, for each additional IXL ELA skill proficient per week, a student could expect their assessment score to increase by about 12 points (.43 SD). Discussion. Reaching proficiency in one additional IXL ELA skill per week was associated with a significant (.43 SD) increase in state assessment scores. In the context of this assessment, these results have enormous practical significance: this increase would be sufficient for many students to reach the state's next-highest proficiency category (e.g., moving from "not proficient" to "proficient"). These results provide empirical support for Yeh's (2018) theory suggesting individualized task difficulty may help improve marginalized students' achievement and show that IXL could significantly reduce the opportunity gap in the United States.

O6.3   Fostering executive function and prefrontal cortex development through combined cognitive-exercise contexts in preschool-aged children: An fNIRS study

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Environmental enrichment is critical in shaping the development of executive function (EF)-cognitive processes that subserve goal-directed behavior-through increased quantity and quality of multimodal input to the prefrontal cortex (PFC; Werchan & Amso, 2017). Fostering EF is important because EF longitudinally predicts academic achievement and learning-related classroom behaviors controlling for IQ and socioeconomic status (Diamond, 2011). One way to create an enriched environment is through contexts that stimulate cognitive and motor functions simultaneously. While there are well-documented beneficial effects of combining computerized cognitive training with exercise on EF in elderly populations, research on children is scarce. Studies with multiple EF assessments and complimentary neuroimaging with children are needed to clarify the unique efficacy combined training has on EF and elucidate the mechanisms underlying changes. This preregistered study filled these gaps by 1) assessing the efficacy of combined training on EF by comparing combined training to cognitive training, exercise training, and an age/sex/classroom-matched control group 2) including multiple EF tasks and teacher reports of EF to assess whether the skills children learn transfer to real-world classroom contexts and 3) investigating the neural mechanisms of training-induced changes with fNIRS. 120 children (ages 4 to 5) were recruited and randomly assigned to 1 of 4 conditions: Combined, Exercise, Cognitive, or Control. Each condition was projected onto a wall with a game step mat with one left arrow and one right arrow. The Combined condition (high exercise & high cognitive activity) was modeled on the Flanker Task, but instead of pressing left and right arrows on a computer, children responded by stepping left or right on the physical game mat's arrows depending on the direction that the central target was facing. The Cognitive condition was identical to the Combined condition, except participants sat on the mat and pressed left or right with their hands (low exercise & high cognitive activity). The Exercise condition was identical to the Combined Condition, except the central target was not surrounded by distractors (high exercise & low cognitive activity). Neural connectivity, performance on EF tasks (Flanker Task, Day-Night Task) and teacher EF ratings (BRIEF-P) were assessed at pretest and posttest. Children in each condition trained for 2 consecutive days for 20 mins/day. Children in the Control group continued their typical activities and just participated in the pre- and posttest assessments. Combined training improved children's performance on the behavioral EF tasks, EF-related behaviors in the classroom, and PFC functional connectivity compared to the other conditions. The Combined condition exhibited significantly stronger changes in connectivity strength within the PFC from pre- to posttest compared to all other conditions (Figure 1A). Only children in the Combined condition exhibited improvement on the transfer Day-Night EF Task and teacher ratings of EF (Figure 1B). This area is particularly timely and important because parents and educators across the world are attempting to find ways to keep children physically active and engaged in the wake of stay-at-home orders. Combined contexts can easily be implemented in children's lifestyles and have high potential to improve essential EF skills that are crucial for academic success.

O6.4   Theory-based bayesian models of elementary school children's belief revision & pupillary surprise during science learning

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Young children rely on "intuitive theories" when reasoning about the world (Gopnik & Wellman, 2012; Carey, 2004; Keil, 2003). The mechanisms underlying belief revision remain important to study. In particular, to comprehensively understand the process of belief revision, three challenges need to be met. First, for any domain, a representation of the learner's current beliefs must be described. Second, we require a model for how these beliefs are updated moment-to-moment as new evidence is encountered, alongside an understanding of how different response modalities affect learning (such as predicting vs evaluating). Third, while Bayesian models have provided a framework with which to capture learning, additional factors remain less understood - how might emotions (e.g., surprise) relate to these models? This is critical to address, as affective states, like surprise, may be vital for finding errors and revising theories (Brod, Hasselhorn & Bunge, 2018). Here, we present work that computationally investigates these three questions with data on elementary school children's understanding and revision of intuitive beliefs of water displacement - as affected by whether they predict or post hoc evaluate (Brod & Theobald, 2021). We first describe computational representations that capture initial representations of individual children's beliefs of water displacement. This provided a domain to measure initial belief and learning where children often have misconceptions (Burbules & Linn, 1988). We found that children's behavior was best described by different generative models that represent possible beliefs that they may hold. Second, we looked to capture learning as it unfolds continuously and to understand the role of prediction in engaging model-based reasoning by using theory-based Bayesian models. We compare three models that vary on whether they account for individual differences in children's prior beliefs or the ability to consider multiple competing theories. Model comparison entailed generating predictions of the choices made by children at each trial by the three models. Across 3000 trials, we found that a Bayesian model that accounts for both factors outperforms competitors that ignore either factor (vs no-Prior Beliefs, $z = 18.36$, $p \sim 0$; vs Single Theory, $z = 18.90$, $p \sim 0$). Third, we describe quantified, "real-time" surprise responses. We generated likelihoods of a surprise response based on prior beliefs, observed evidence, and children's behavior. Then, we compare this "model surprise" with a physiological measure of surprise: pupil dilation. We found that model surprise significantly correlates with children's surprise at the individual level, trial-by-trial ($r(2898) = 0.04$, $p < 0.05$). Further comparing between conditions, we find significant correlations for children making predictions ($r(1436) = 0.05$, $p < 0.052$), but not for those post hoc evaluating ($r(1460) = 0.037$, $p = 0.15$). This fits with past research, highlighting that the process of making a prediction may prompt a stronger surprise-pupillary response compared to others who did not engage prior theories. This work shows the importance of computational models of learning. We describe some first steps toward understanding belief revision as potentially affected by emotions. Future work entails incorporating the measured surprise responses into our models' algorithms, potentially uncovering the effects of affect on learning.

Poster Abstracts

1-B-1   **Language leads to longer looks: Novel labels lengthen fixation duration in two-year-old children**

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As early as infancy, labeling objects enhances cognitive processes such as object categorization, object individuation and memory. In the current study, we examine one potential mechanism through which object naming might influence learning in early development - its capacity to influence visual attention and processing. Two-year-old children (N = 48) viewed novel objects paired with either a novel label (e.g., "Look at the dax") or no label ("Look at this") on an eye-tracker. Although total looking did not differ across conditions (p=.56), children's fixation durations were significantly longer in the Label than No Label condition (p=.033). Moreover, this difference in fixation duration persisted when the objects were presented again in silence (p=.039). Together, these results suggest that the language children hear changes their visual encoding of the objects they see - increasing the amount of time children dwell in each fixation -- and that these attentional processes persist beyond the naming episode.

1-B-2   **Parental depressive symptoms moderate associations between sleep and executive function in preschool children**

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Executive function (EF) involves the ability to engage in higher-order cognitive processes (Anderson, 2002). Parental depression (Gueron-Sela et al., 2018) and child sleep (Dahl 1996) have been proposed to affect EF development, but their role in EF is relatively understudied in preschool children. The present study investigated sleep and EF in 125 children, ages 4.5-5.5 (M=5.011, SD=0.289). Parents reported on child sleep (CSHQ; Owens et al., 2000) and parental depression (CES-D; Radloff, 1997). Child EF was assessed with a Go/NoGo task (He et al., 2010). Go accuracy, indexing sustained attention, related to longer nighttime sleep duration and shorter sleep onset delay (p's<.001). A conditional process model, $F_{(4,118)}=8.534$ p<.001, yielded a Sleep Onset Delay x Parental Depression interaction (b=-.0041, t(113)=-2.104, p=.038). No-go accuracy, indexing inhibitory control, related to greater bedtime resistance, longer sleep onset delay, and fewer night wakings (p's<.011-.036). At high levels of parental depression, sustained attention deficits were more strongly linked to longer sleep onset delay, perhaps because these children are exposed to more stressors at bedtime. Conversely, and unexpectedly, better inhibitory control was linked to more bedtime resistance and longer sleep onset delay. Perhaps children who resist impulsive button-pushing also resist sleep impulses. Results suggest the need for longitudinal research to disentangle the interplay of all these variables.

1-B-3   The role of executive functioning skills in predicting individual differences in children's motor timing in complex perception-action tasks

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Motor timing skills involve performing an action at precisely the right time and place in order to achieve a specific goal. For example, successfully crossing roads with continuous traffic involves learning not only how to choose the right gap, but also how to enter the gap at the right time. Moving too soon or too late could result in a collision with a vehicle. Executive functioning (EF) plays a key role in motor timing as assessed in simple tasks such as interval timing, but little is known about the role of EF in complex perception-action tasks. The goal of the current investigation was to better understand the relations between motor timing in a complex perception-action task and executive functions such as working memory, processing speed, attention, and inhibitory control. Children completed computer-based executive functioning tasks and then performed a virtual pedestrian road-crossing task. We found that children's performance on EF tasks measuring attentional control and inhibitory control was significantly associated with how tightly they timed their entry into the roadway relative to the lead car in the gap in the pedestrian road-crossing task. This project aids in our understanding of the mechanisms that underlie motor timing skills, and how these skills develop along typical and atypical trajectories.

1-B-4   Does childhood executive function predict social, health and behavioral outcomes? A meta-analysis

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Executive function (EF) supports flexible thought and behavior, and is commonly conceptualized as a set of processes best measured using specific laboratory tasks. It is established that performance on these tasks correlates with academic skills (e.g., Allan et al., 2014). It is also often claimed that EF predicts social, health and behavioral outcomes; however, these claims are not based on findings from standard EF paradigms. In an ongoing meta-analysis (k=159 studies), we ask if childhood EF as measured by lab paradigms predicts such outcomes. To date we have meta-analyzed whether EF in childhood predicts concurrently measured BMI, prosociality, and aggression. Using inverse-variance weighted random effects meta-analysis, we found EF is significantly associated with prosocial behavior (k=11; p<.001), but not with BMI (k=6; p=.71) or aggression (k=6; p=.75). Findings are interpreted in light of recent discussions concerning how EF is conceptualized and measured.

1-B-5   The effect of interactivity on toddlers' object search following real-life versus video demonstrations

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The experiment reported here was designed to examine the effect of interactivity on toddlers' video-based symbolic transfer. Eighty children, ages 23 to 37 months, participated in an object-retrieval task in

one of four conditions: 1) watching through a window as an experimenter hid a toy, 2) watching a video recording of an experimenter hiding a toy, 3) interacting by pointing toward the toy (through the window) to see an experimenter hiding the toy, and 4) interacting by tapping the toy (on the touchscreen) to see an experimenter hiding the toy. Across all trials, interactivity was found to enhance children's overall errorless performance when and only when they watched the hiding event in video; however, it did not disproportionately affect the rate of perseverative errors, nor did it affect the latency of children's searches. Together, these findings have implications for the particular mechanisms by which interactivity affects toddlers' symbolic transfer.

C - Categorization

1-C-6 **Investigating the role of sleep on mnemonic discrimination in napping vs. non-napping preschool-age children**

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Early childhood is a developmental period where children undergo drastic changes in both memory performance and sleep as they shift from biphasic to monophasic sleep (Kurdziel et al., 2013). In particular, pattern separation, the ability to create distinct representations of similar events during encoding (Norman and O'Reilly 2003), is believed to improve with age. This ability is measured using a mnemonic similarity task (MST), in which children encode a series of pictures and are then asked to discriminate between pictures they previously saw during encoding (Targets); completely new pictures they have never seen before (Foils); and pictures that are similar, but not quite the same as the pictures they were previously exposed to (Lures). Older children are better able to discriminate between the same stimuli they were previously exposed to and new stimuli that are similar, but not the same as the previously experienced stimuli (Targets versus Lures), known as mnemonic discrimination (Ngo et al., 2017; Canada et al., 2018). Despite several studies investigating age-related differences in mnemonic discrimination in younger relative to older children (Ngo et al., 2017; Canada et al., 2018), there has been only one study to explore the role of sleep on memory performance for mnemonic discrimination in an adult sample (Doxey et al., 2018), which found that mnemonic discrimination was preserved after sleep, but decayed over a wake-filled delay. To address this gap, we administered a mnemonic similarity task (MST) over zoom to 52 preschool-aged children (M = 3.82 years, 27 females, 20 nappers). Participants underwent two sets of sessions with encoding, immediate retrieval, afternoon retrieval (following the child either napping or staying awake), and 24-hour retrieval after overnight sleep. A preliminary 2x3 repeated measures ANOVA with 13 participants, including both nappers and non-nappers, (M = 4.04, range = 3.16-4.90 years, 9 female) revealed that the ability to correctly identify targets was preserved over a nap. However, performance on foils did not significantly differ between the nap and awake conditions and children performed better on rejecting the lures during the awake condition relative to the nap condition. We plan to enroll 60 participants by the time of the conference and continue these analyses by investigating differences between nappers and non-nappers on discrimination of Targets, Lures, and Foils across immediate, afternoon, and delayed retrieval. This study will help elucidate the role of sleep on memory in young children and may have implications for educational practices (e.g., including a nap time during school in early childhood).

1-C-7   **Not yesterday but maybe tomorrow: Children's openness to possibility in the past and future**

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Research suggests that children are remarkably closed to possibility, judging merely improbable events to be impossible (e.g., Shtulman & Carey, 2007). However, we hypothesize this may be because: 1) children have been asked to categorize unusual events dichotomously, and 2) questions have prompted children to draw upon their own experience rather than their general causal knowledge. Supporting this view, Bowman-Smith and colleagues (2018) found that children believe improbable events are more possible in unfamiliar places than at home. We investigated the above hypotheses in two studies. In Experiment 1, 80 5-to-8-year-olds were asked whether possible, impossible, and improbable events, set in either the past (familiar) or future (unfamiliar), were: "Possible and could definitely happen", "Impossible and could never ever happen", or Improbable: "It could maybe happen once but probably won't". Children judged improbable events as more possible than impossible events and were more likely to judge events as possible in the future than in the past, however this was subject to an order effect. Experiment 2 replicated Experiment 1, finding that children are more open to possibility in the future than in the past when asked between subjects. These findings suggest that children more successfully reason about possibility in the future than the past displaying a more nuanced understanding when they are prompted not to draw on their own experience.

1-C-8   **Supporting children's word learning from storybooks with emotional variability**

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Mapping words to referents, although important for language acquisition, relies heavily on memory. Learning a word requires forming associations between labels and referents, integrating examples across time, and retrieving words when needed. Memory supports, such as variability, can be added to word learning events to help children learn words. Due to the prevalence of social and emotional cues in daily experience, this study examined the effect of emotional variability on word learning. Four-year-olds (n = 96) learned eight novel words presented four times in a storybook organized in one of three conditions: no variability, low variability, or high variability. Words with no variability were presented in the same emotional context (i.e., happy, sad, afraid, OR angry). Words with low variability were presented with two emotions (e.g., happy AND sad), and words with high variability were presented with all four emotions. After hearing the book, preschoolers immediately participated in a generalization test. Results show that children learned the most words in the high variability condition (M = 4.09) followed by no variability (M = 3.59) and low variability (M = 2.97, F (2, 90) = 4.14, p = .019). This study informs our understanding of the role of social contextual variability in word learning, and suggests that high levels of variability in emotional content may be beneficial.

1-C-9   **How early does object naming influence object representations?**

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Language exerts a powerful effect on cognition. Even in the first year of life, how an object is named is instrumental to how infants mentally represent it. Evidence from a new recognition memory paradigm (Figure 1) reveals that when a set of objects are named with the same name (Consistent Name (CN) condition), 12-month-old infants represent them as category members, abstracting over distinctions among them. In contrast, if each object is named with its own distinct name (Distinct Name (DN) condition), infants represent them as unique individuals (LaTourrette & Waxman, 2020). That is, infants in the DN (but not the CN) condition encoded the objects with enough specificity to discriminate them from other category members later. Here, we ask: how early do infants establish this tight coupling between naming and representation? First, we replicate the effect in an online version of the task (on Lookit): 12-month-olds in the DN condition (n=12) were more likely than those in the CN condition (n=15) to represent the objects as distinct individuals (ps < .05). Second, we show this effect emerges even earlier, at 7 months. Seven-month-olds in the DN condition (n=20), but not the CN condition (n=15), discriminated the named objects from other category members, indicating they represented them as unique individuals (ps < .05). This suggests infants' nascent representational abilities are linked to naming early enough to support infants as they learn their first object names.

1-C-10   Do young children spontaneously group dolls according to salient social categories?
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We studied how preschoolers group individuals by race, gender, and age. Based on research on children's gender categorization (Levy, 1999), adults' race categorization (Hentges & Campbell, 2007), and infants' conceptual grouping (Mandler & McDonough, 1996), we used a free-play doll task to determine salient social grouping cues. The prevalence of gender, race, and age discrimination (Harnois, 2014) makes it important to see when children begin grouping along these dimensions. We hypothesized that children would group along at least one social dimension. Twenty children (10 male) ages 3-5 (M=3.88,SD=.68) played with dolls (3 male adults, 3 female adults, 3 infants--White, Asian, and Black races), then were prompted to pick 3 dolls. Grouping by age (n=7) was more common than by race (n=3), or gender (n=0). Ten children created heterogeneous mixed-age groups. The race groupings were also mixed-age, such that 13 selected a "family". Family-only was marginally more frequent than family+race (p=.092, two-tailed binomial test). Group type frequency did not vary by gender ($\chi2(2)=.88,p=.65$), but varied by age group via median split ($\chi2(2)=7.50,p=.023$), with older children grouping more by family (n=8) than age (n=1) or race (n=1), and younger children grouping more by age (n=6) than family (n=2) or race (n=2). The data suggest family is most salient. One explanation for age-based grouping is that doll size was salient for younger children, as seen previously (Ricciuti, 1965).

D - Computational approaches

1-D-13   Differences in caregiver sensitivity related to varied patterns of infant engagement of the vagal brake during spontaneous distress.
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Previous work has shown that effects of caregiver sensitivity (CS) on developing regulatory abilities may be observed through measuring infant's modulation of the vagus nerve (Perry, et al., 2015). This study

examines how CS is related to an infant's ability to appropriately engage the vagal brake during distress. A majority of previous work has been conducted within laboratory settings, using structured tasks, therefore, this work aims to study these relationships using data obtained from audio and physio recordings obtained from the infant's natural home environment using spontaneous distress events. Infants (N=18, 1-10 mos, 61% female) had up to 72 hours of audio and ECG data recorded in their homes. Samplings from these recordings containing infant distress were annotated for CS by trained research assistants (ICC=0.83). Infant vagal activity, as measured by respiratory sinus arrhythmia, was calculated using a 15-second moving window technique (Abney, et al., 2021) to create a 5Hz timeseries of RSA for a sampling of spontaneous distress events. Using a median split of average CS ratings, infants from the lower CS group, on average, had both a delayed engagement of the vagal brake (8.8s slower), and less engagement overall (indicated by negative RSA values), compared to infants from the higher CS group (35.8s vs 64.8s). These results indicate that less sensitive caregiving may be related to less efficient infant regulatory strategies.

E – Conceptual development

1-E-14   Conceptual prerequisites for analogical reasoning: The case of proportions
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Analogy is a powerful mechanism of cognitive development, yet often requires cognitive support. Here we investigated whether magnitude understanding is needed for children to make proportional analogies, such as between integers and fractions. This issue is interesting because 1) young children make accurate proportional analogies between magnitudes and integers, yet 2) fail to grasp that fractions are numbers with magnitudes. Without this conceptual understanding of fractions, proportional analogies between integers and fractions are hypothesized to be quite difficult and to require special training. To test this hypothesis, 343 Taiwanese 3rd-to-5th graders were asked to estimate the position of fractions and integers on number lines to assess their pre-existing magnitude knowledge. Then, they were randomly assigned to one of three fraction training programs: Conceptual Knowledge, Procedural Knowledge, and Conceptual Plus Procedural Knowledge. Conceptual Knowledge training emphasized that fractions are a type of number that are used to measure quantities between integers (e.g., 0 and 1). Procedural Knowledge training emphasized the steps to estimate fractions on number lines. Conceptual Plus Procedural training consisted of both interventions. In all conditions, children were shown that 9/10 on a 0-1 number line is identical with the placement of 9 on a 0-10 number line. Then, they were asked to solve two 4-term proportion analogy questions (e.g., 9/10 is to 1 as 9 is to ___; Figure 1A). An additional group of 286 adults completed the same 4-term analogy questions as a comparison group. As expected, better pretest magnitude knowledge predicted higher accuracy on the 4-term analogy problem ($\chi2$ (1) = 12.59, p < .001). More importantly, Concept Knowledge training facilitated better analogical reasoning than Procedure Knowledge (odd ratio = 3.41, 95% CI = [1.08, 10.76]) and Concept Plus Procedure Knowledge conditions (odd ratio = 6.57, 95% CI = [1.51, 28.63]). Strikingly, Conceptual Knowledge training even brought 3rd graders to adults' level of accuracy (Figure 1B). We further analyzed error patterns to examine whether children were more likely to complete analogies based on relation, rather than appearance (the relational shift, Rattermann & Gentner, 1988). Not surprisingly, as grade increased, children were more likely to produce the correct answer (F (2, 298) = 4.52, p < .05) and less likely to produce Other Errors (F (2, 298) = 15.32, p < .001). Interestingly, children were also more likely to produce the Appearance Errors as grade increased (F (2,

298) = 3.54, p < .05), suggesting that the relational shift might be delayed when the context involved more abstract concepts, such as matching numerical relations. Our findings provide both correlational and experimental evidence that proportional analogies depend on magnitude knowledge. Children with poor magnitude knowledge of fractions or integers fail to produce correct analogies, and training children that fractions denote magnitudes led to adult-like levels of analogical reasoning. Previous research has highlighted the importance of cognitive supports for analogy (e.g., alignment of source to target), and the current research suggests that conceptual understanding is another important cognitive support.

1-E-15   Are humans part of the natural world? Children's concept of nature and its role in promoting environmental concern

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Understanding the factors that promote children's conservation attitudes towards nature has never been more relevant. Prior research has found that adults who perceive humans as separate from nature (i.e., exceptionalism) show less eco-friendly attitudes (Betz & Coley, 2021). However, while studies have found that 9- to 14-year-old children do not tend to spontaneously mention humans as part of their "nature" concept (Aaron & Witt, 2011; Tillmann, et al., 2019), little is known about the extent to which younger children conceive of humans as part of nature or how their conceptions might relate to their environmental attitudes. In this research we explored these questions, as well as how a human-inclusive concept of a nature relates to recognition of ecological interdependencies in nature and whether the latter also relates to environmental concern. Adults (N=189, M age=20.41, SD=1.57) and 6-to-7-year-old children (N=68, M age= 6.49 years, SD=0.5) completed three focal tasks. To measure environmental attitudes, participants were presented with four environmental damage scenarios (e.g. logging) and judged the moral wrongness of the damaging acts (0-3 scale). To assess their nature concept, participants were shown 10 cards depicting animals, humans, plants, natural non-living things, and artifacts and asked to sort the cards into two boxes: entities that are "part of nature" and "not part of nature." Participants who included both items in the human category as "part of nature" were classified as having a "human-inclusive" concept of nature. Finally, to measure sensitivity to ecological interdependence (see Coley, 2012), participants performed four trials in which they were told about a target living thing that had a novel sickness (e.g., oak tree). They then chose between a living thing that was ecologically related (e.g., squirrel) versus taxonomically related (e.g., grass) to the target when deciding which was likely to have the same sickness. Children (M=2.19, SD=0.55, Mdn= 2.25) judged environmentally-damaging acts more harshly than adults (M=1.44, SD=0.68, Mdn=1.25) (p= .001). Moreover, children (M=2.26, SD=1.23, Mdn=2) showed greater ecological reasoning than adults (M=1.95, SD=1.45, Mdn=2) (p= .001). However, adults (51%) were more likely to show a human-inclusive concept of nature than children (34%) (p= .02). Surprisingly, having a human inclusive concept of nature did not predict greater environmental concern or greater ecological reasoning by children or adults (ps>.05). Participants' level of ecological reasoning did not predict their environmental concern either (ps>.05). However, a significant interaction effect was found in children. When children had a human-inclusive concept of nature, greater ecological reasoning was related to greater concern about environmental harm (p= .02). This effect was not significant in adults. Findings suggest that while it is possible to have a sensitivity to ecological interconnectedness independent of recognizing that humans

are part of nature, children who have both have increased concerns about environmental harm. This relationship appears to fade by adulthood although future research is needed to determine when this developmental change occurs. These results support the development of environmental education programs that are initiated in childhood and focused on promoting understanding of humans' ecological relationships to, and commonalities with, other natural phenomena.

1-E-16   The development of a naïve psychology of superstition

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Research on children's supernatural thinking indicates that they often attribute outcomes to superstitious rituals (Kelly & Woolley, 2019). However, outcomes that appear to result from rituals are often the result of psychological processes (e.g., forgetting one's lucky charm produces anxiety which affects performance). We explored children's awareness of the psychological phenomena that underly superstitious behavior and outcomes. 66 6- to 9-year-olds and 99 adults heard/read scenarios in which children failed to engage in their usual superstitious rituals, resulting in negative outcomes; participants then assessed whether there was a causal relation between the behavior and the outcome and explained their answer. Results revealed, when participants saw a connection, 9.47% of children's explanations referenced supernatural (e.g., the ritual brought "luck") and 32.58% referenced psychological (e.g., the ritual eased anxiety) phenomena. In contrast, 66.67% of adult's explanations referenced psychological phenomena. Findings suggest that awareness of these psychological processes develops significantly during adolescence.

1-E-17   The temporal dynamics of belief revision in preschoolers

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Although preschoolers' capacity for belief revision is well-established, less is known about the dynamics of children's belief revision, particularly when evidence is self-selected and probabilistic (i.e., disconfirming an initial belief most, but not all, of the time). To investigate the dynamics of belief revision, 3.5- to 5-year-olds (n = 32, 18 girls, 62.5% Caucasian) were recruited to play an online fishing game. First, children were introduced to two ponds and caught three fish from one and three pieces of seaweed from the other. Then, children were given 24 trials to find as many fish as they could. In a between-subjects design, the distribution of fish in each pond during this second phase either probabilistically aligned with (belief-consistent) or contradicted (belief-inconsistent) children's initial beliefs about pond contents. Results suggested that children used the self-selected, probabilistic evidence to update their beliefs. Children in the belief-consistent condition fished systematically from the initially advantageous pond, while those in the belief-inconsistent condition eventually switched to favor the alternative pond (p = .021). Trial-by-trial analyses suggested that children's pond choices were rapidly destabilized in the inconsistent condition following belief-contradictory information, however preference for the alternative pond emerged gradually. Results are discussed in terms of their implications for theory-theory approaches to development.

1-E-18   Developing beliefs in God's intervention in real-world affairs

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Children often appeal to natural causal forces to explain their world; many children also conceive of God as an intentional being. To what extent do children consider God a causal force in their everyday lives? This study addressed the development of children's beliefs about God's tendency to intervene in the people's lives. We also explored the roles of age, perceptions of control, and certainty about God's existence on these beliefs. We expected that interventionist beliefs would increase with age and parent interventionist beliefs, and that children with lower perceptions of control would more strongly endorse God's intervention. Seventy-one 5- to 12-year-olds and their parents were asked about God's agency and intervention in their own lives and in the world more generally. Very few children (10%) claimed that God did not intervene in the world; 52% responded that God intervened "almost every day" (52%) and 38% that he intervened "just at special times." A higher proportion of parents (n = 90; predominantly Christian) held non-interventionist God concepts (23%). Older children had slightly stronger beliefs than did younger children in God's interventionist nature; this did not interact with parent interventionist beliefs. Children who were more certain of God's existence held stronger interventionist beliefs. There were no effects of perceptions of control on children's beliefs.

1-E-19   Conversations about Santa: Children's questions and parental explanations

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Children frequently believe that Santa Claus is real (Prentice, Manosevitz, & Hubbs, 1978; Anderson & Prentice, 1994; Sharon & Woolley, 2004), but eventually, they recognize that he is a fictional character. Parental promotion plays some role in creating and extending children's trust (Goldstein & Woolley, 2016), but children's own developing conceptual understanding of the world (Shtulman & Yoo, 2015) may help them ask better questions about Santa's existence. To better understand children's questions about Santa as well as how parents respond to children's questions, we conducted a longitudinal diary study. Parents (N = 125) were texted digital diaries to complete twice a week during the month of December 2020. In those diaries, parents were asked to report their activities along with the content of any conversations about Santa, including any questions asked and how parents (and other adults) responded. The vast majority of conversations were focused on Santa as if he existed, and the way he worked, instead of questioning any aspects of the Santa myth. Details about children's questions and how parents responded will be discussed. Studying this case of parent-child interaction has implications for understanding children's burgeoning scientific reasoning, and the ways in which parents foster such thinking.

1-E-20   Surprise! Minimally-counterintuitive stimuli trigger greater curiosity than merely improbable stimuli

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Violations of expectations can trigger curiosity in children and adults (Berlyne, 1966; Stahl & Feigenson, 2015). Such violations can differ in kind: an event could be merely improbable or violate an intuitive theory (Shtulman & Carey, 2007). Theories of curiosity have posited that curiosity is maximally piqued by moderately surprising stimuli (Loewenstein, 1994), but this hypothesis has not been explored for different kinds of violations. Drawing on work in other domains (Boyer & Ramble, 2001; Banerjee et al., 2013), we test whether minimally counterintuitive (MCI) stimuli, which involve one violation of an intuitive theory, will be especially effective at triggering curiosity. We presented 77 adults and 36 4- and 5-year-olds with items that were ordinary, unlikely, MCI, and very counterintuitive (VCI). Participants indicated which item in a pair they would like to learn more about. Adults chose Unlikely over Ordinary and MCI over Unlikely, but not VCI over MCI, more often than chance. Children only chose MCI over Unlikely more often than chance. These effects were driven by older children: age in months had a significant effect on children's likelihood of choosing the more surprising item across contrast types. Our results suggest that (i) minimally counterintuitive items trigger greater curiosity than merely unlikely items, (ii) surprisingness has diminishing returns, and (iii) sensitivity to surprisingness increases with age, appearing in our task by age 5.

1-E-21　　　　Looks like a horsie with stripes: The use of comparison in parent-toddler conversation about categories

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Comparison is a powerful tool in parent-child communication which can be used to introduce information to children effectively. However, little is known about how parents actually utilize comparison in conversation with young children. Thus, the current study systematically examined parents' use of comparison in conversation about a picturebook with their 20- and 35-month-old children (n = 32; data from Gelman et al., 1998). Results suggest that parents indeed utilize comparison when talking to their young children. Nearly all parents observed used comparison. Furthermore, comparisons varied in form, including both generic ("A zebra is like a horse") and specific ("It's like the crab in your book") references, comparisons on the basis of appearance ("They look like snakes") as well as category membership ("Seaweed is like a plant"), and those that highlight similarities and differences ("Looks like a horsie with stripes"). The implications of these patterns for children's conceptual development will be discussed.

1-E-22　　　　Comparing the occurrence of impossible content in Chinese and U.S. picture books

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Research suggests that Chinese and U.S. adults evaluate the possibility of fantastical events in similar ways (Gong & Shtulman, 2021). One explanation for this similarity is that fantastical events are presented in comparable ways in Chinese and U.S. media, though work in literary theory suggests

otherwise (Gu, 2006). To investigate this, we coded the occurrence of impossible (i.e., violating causal laws) characters, setting, and objects in bestselling and award-winning picture books from China and the U.S. from 2012 - 2019, (n = 87 Chinese books, n = 81 U.S. books). We found no difference between China and the U.S. in the frequency of impossible characters (t(166) = -0.89, p = 0.377), settings (X^2 = 1.28, p = 0.526), and objects (X^2 = 1.50, p = 0.221). We are also interested in whether impossible characters tended to be explicitly fantastical (i.e., magical). Further investigation revealed that if characters were impossible, they were equally likely to be fantastical in Chinese and U.S. books (OR = 1.92, p = .694). Implications of these findings for children's reasoning about fantasy, possibility, and reality will be discussed.

1-E-23   Uncovering the hidden meaning of canny consumption practices in Guatemalan families' routines: Links to Indigenous children's development of environmental ideas

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Empirical evidence suggests that cultural differences in human-nature worldviews are connected to how adults and children think about nature and act on it (Atran & Medin, 2008; Medin & Bang, 2014; Medin et al., 2013). Previous work on children's development of environmental concepts has mainly operated from a Western paradigm with a focus on mainstream practices (e.g. recycling) even when working with diverse populations. With the goal of understanding how Indigenous-descent youth from the Americas develop ideas about the environment through everyday cultural practices, I interviewed 20 Indigenous-descent families from urban and rural areas of Guatemala. I specifically focused on a set of practices that I term canny consumption practices and define as finding innovative ways to use resources and avoid waste (e.g. reusing containers as planters) and how they connect to beliefs and values about the natural world. Preliminary analysis shows that each parent reported at least one canny practice. Canny practices mentioned by both groups included reusing water from cleaning vegetables to water plants and saving small pieces of soap to form them into a ball for reuse. Rural parents were especially likely to report using all parts of the maiz (corn) such as burning the cob and using the husk to make food or compost. In ongoing coding, we will uncover whether parents in the two groups connect canny practices with Indigenous views of nature.

1-E-24   Children's perception of gender constancy in others

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Historical patterns in gender constancy literature indicate that before the age of six, children lack the ability to understand gender as constant across changes in physical appearance such as when someone tries on clothing associated with another gender (Emmerich et al, 1977). We tested whether 3-5-year-old children (N=32) believe that putting on clothing associated with another gender turns someone into that gender, or if they can understand that these changes are temporary. Participants were given a classic version of a gender constancy measure and a new task, in which children were given a reason why a child put on a counter-stereotypical outfit (e.g., the other clothes were dirty). In the new task, children were asked about the child's subsequent gender category and a future preference (e.g., what

outfit they would wear the next day) while they were seeing a perceptual conflict - the target was still wearing the counter- stereotypical clothing, making the task more difficult. Children asserted that gender was constant on the new task 65% of the time, more often than on the classic test which was 52% of the time (t(27)=2.93, p=0.01). These findings are preliminary but suggest children at these ages generally do not think that a target's gender changes in a permanent way when they put on counter-stereotypical clothing. Instead, they appear to believe that gender is constant by the preschool years.

1-E-25 Infants' knowledge of object functions and word meanings

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Adults' word meanings are associated with rich information about an object's appearance, category, and function. Although infants are sensitive to semantic similarity between words, it is unclear whether these features are included in infants' word meanings. Do infants encode a particular semantic feature, object function, and does this knowledge vary across infants as a function of word comprehension? That is, does an infant that knows the word toothbrush also have expectations about how a toothbrush is used? Forty 23- to 25-month-olds will complete a two-phase task via Zoom that tests infants' word recognition and functional knowledge of 4 objects. In Phase I, infants see two objects appear on the screen and hear a sentence labelling a target object. In Phase II, infants see pairs of videos that demonstrate typical and atypical functions for an object (i.e., brushing teeth with a toothbrush and eating a toothbrush). We predict that infants who are more accurate in recognizing the object words would also be more surprised by, i.e. look longer to, the atypical functions. Preliminary results from a subset of 22 infants suggest that infants look longer to the atypical functions (M=0.54; SD=0.068). Interestingly, the preliminary data suggest that infants who are more accurate in recognizing the object words also are more surprised by the atypical functions (r=0.48; p=0.03). Results from the full sample will reveal whether object function is integral to some word meanings.

1-E-26 Learning to draw depth: Comparing adults' and children's drawings of layouts and objects

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Even young children start to capture spatial information in their drawings--including objects' sizes, positions, and overlap--to convey pictorial depth (Freeman et al., 1977). Nevertheless, most prior work exploring children's drawings has focused on objects alone. Investigating cues to pictorial depth in drawings of layouts is important to understanding how children's use of depth for navigating layouts in everyday life (e.g., Lee et al., 2012) may translate into their picture-making. One prior study had suggested that when given a simple room or a toy model of the room (Fig. 1A), young children tended to include more cues to pictorial depth in their drawings of the room. For example, children assigned to draw the room were more likely to position the walls above the objects or overlap the objects and walls (Morfoisse et al., 2020; Fig. 1B). Here we asked 61 college students, who had received no advanced art training, to draw either the same room or the same toy as children drew in that study. A preliminary analysis of 24 coded adult drawings suggest that, unlike children, adults show no difference in their use

of depth cues in drawings of rooms versus objects. In particular, adults tended to consistently overlap objects and walls regardless of spatial context (Fig. 1C). Either adults have learned a schematized way of drawing or their use of depth is more flexible across spatial domains, allowing them to draw both layouts and objects in depth.

F – Cross-cultural approaches

1-F-27 **'The scientists are going to figure it out': Parent explanations in times of pandemic uncertainty**

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How do parents across cultures explain illness transmission, especially when uncertain? We systematically explored parents' explanations of the origins, spread, and mitigations of COVID-19 to children, and potential relation to parent-reported increases in children's anxiety-related behaviors. Parents in Northern Ireland, USA, and Colombia completed a Prompted Explanation Task responding to four questions as if speaking to their child, and reported children's anxiety-related behaviors. In Northern Ireland, mechanistic explanations were most common. As child age increased, parents were more likely to reference uncertainty (r= .26, p=.01), but uncertain responses also tended to be reassuring (r=.24, p=.02). Fewer parents provided dogmatic explanations, but when they did so they tended to be the only explanation provided, and were positively related to children's anxious behaviors (r= .25, p=.02). Our poster will also include incoming data collected in the U.S. and Colombia, to explore social-cultural variations in caregiver explanations of illness under conditions of uncertainty.

1-F-28 **Children's essentialist beliefs about religious identity in Northern Ireland and the Republic of Ireland**

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Northern Ireland is a post-accord society with ongoing tension between two ethno-religious groups: Catholics and Protestants. The Republic of Ireland has no recent history of ethno-religious conflict as it is predominately Catholic. By comparing the two cultures, we can get a clear picture of the effect of conflict on cognitive development. We examine how conflict shapes essentialist beliefs about religion. We aim to recruit 160 4-to 10-year-olds in Northern Ireland and 50 4-to 10-year-olds in the Republic of Ireland. Half of our sample will be collected by April. Participants will respond to an essentialism measure for three social identities (religious, gender, SES; gender and SES are included for comparison). For example, the religious items are: (1) Are Catholics born Catholic and Protestants born Protestant? (2) Can you tell who are Catholics and who are Protestants by looking at their insides, like their blood, brains, and bones? (3) Are Catholic people's souls different from Protestant people's souls? (4) Is it possible for Catholics to become Protestants? We will conduct a linear mixed-effects model with average essentialism as the dependent variable. We will include social identity type (religion, gender, SES; within-subjects), child age (continuous; between-subjects), and culture (Northern Ireland, Republic

of Ireland; between-subjects) and their interactions as predictors. In the model, we will also include both random intercepts and random slopes for participant.

1-F-29   US and Chinese young children's sensitivity to inequality: The case of household labor

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Recent work has paid considerable attention to the cognitive and sociocultural mechanisms that underpin children's understanding of fairness and inequality. Here, however, we investigate a commonly experienced, but understudied aspect: children's understanding of their own family's division of household labor. One-hundred-twenty US children 3 to 9 years of age (M = 6.27-years, SD = 1.96-years, 65 girls) and seventy Chinese children (36 girls, Chinese data collection ongoing) and their parents were asked to state which parent (mom, dad, or both equally) performed household (e.g., cleaning, fixing appliances) and childcare (e.g., bathing, diapering) tasks. Across all ages, children's reports aligned with parents' reports, suggesting an emerging sensitivity to inequality within the household (p < 0.01). By age 3, children state that moms do more housework, and by 6, children also state that moms do more childcare. Ongoing cross-cultural analyses will reveal the extent to which children's recognition of household labor varies across cultural contexts.

G - Diversity

1-G-30   Leveraging racialized experiences to acknowledge expressions of self-regulated learning: the twice-as phenomenon

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Self-regulated learning (SRL) research has blind spots regarding how SRL plays out in racially oppressive environments, which could impact conclusions about diverse students' educational experiences. Here, we evaluate an SRL behavior that emerges particularly among racially minoritized students: the Twice-As phenomenon. This refers to when someone must work twice as hard to get half as far, and is frequently experienced by students of color compared to their White counterparts. To understand the Twice-As Phenomenon, we conducted focus groups, informing the development and validation of a survey to identify students' engagement in the Twice-As phenomenon. We use this to explore how this phenomenon manifests in students' academic behavior, including demonstrating high SRL as well as burnout. We discuss the use of the survey for students in in online versus in-person learning and the survey's usefulness for understanding racially minoritized students' learning experiences, ultimately to inform instructors' perceptions of their efforts.

1-G-31   Tinkering at home: Creating equitable engineering and spatial learning opportunities for Latine children and families during the COVID-19 pandemic

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With the COVID-19 pandemic, more cognitive development research is being conducted using online data collection methodologies. Although this approach has its advantages, researchers need to be

cognizant that online studies can inadvertently exclude families from diverse communities and from communities that have less access to technology. In this project, we describe a museum-researcher partnership and our approach to designing an online study focused on providing equitable at-home tinkering experiences for Latine children and their families. Our aim was to uncover and support Latine families' use of engineering (e.g., testing, redesigning) and spatial language (e.g., big, triangles) in an activity that could connect with everyday problem-solving practices. Fifty-two Latine parents and children (Mage = 7.69) watched a video invitation, recorded in English and Spanish, that prompted families to make a hat out of materials and tools they had at home. We then observed families as they tinkered at home, and in a follow-up reflection session weeks later. All data collection occurred via Zoom. We used a variety of recruitment strategies to reach Latine families and provided tablets to those who did not have a web-enabled device. Families naturally used engineering and spatial talk during tinkering and in their reflections. We discuss the implications of how equitable, online studies can advance understanding of Latine children's early engineering and spatial learning.

1-G-32 The face inversion effect in toddlers with Williams syndrome: A study of featural, holistic, and 2nd-order configural processing

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Typically developing (TD) infants and children process relational (i.e., holistic and 2nd-order configural) information in upright but not inverted faces starting in the first year of life. Experience is thought to drive this face inversion effect. Toddlers with Williams syndrome (WS), a rare genetic neurodevelopmental disorder, exhibit an extreme interest in faces. Cashon et al. (2013) found that 26-mon-olds with WS show holistic processing for upright but not inverted faces, however, featural and 2nd-order configural processing were not studied. In the present study, we examined how toddlers with WS process featural, holistic, and 2nd-order configural information in upright and inverted faces. Participants (N = 24; M(age) = 25.2 mos.; range = 18.3 - 35.3) were tested in a habituation switch paradigm (Fig. 1A). As shown in Figure 1B, toddlers looked longer at the featural, holistic, and configural test faces than the familiar test face in the upright condition (ps < .05) but longer at only the featural face in the inverted condition (p = .012). Results replicate and extend previous findings, showing that 25-mon-olds with WS process holistic and 2nd-order configural information of upright but not inverted faces and featural information of upright and inverted faces. Findings are consistent with the pattern of perceptual expertise found in TD infants and children and provide support for the hypothesis that experience drives perceptual expertise for upright face processing.

H - Education

1-H-33 Variability's impact on children's pattern practice

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Concrete materials (e.g., objects, pictures, graphics) are widely used in early learning environments and often believed to be helpful with learning. However, they are not always beneficial in all circumstances (Carbonneau et al., 2013). Variability in the materials (i.e., using different materials vs. the same materials) could be an important factor in the effectiveness of concrete materials. Opposing predictions

have been made about the effect of variability on learning. The Abstraction account (Bruner, 1966; Dienes, 1967) favors variability in materials. It proposes that using multiple sets of materials with different superficial features allows learners to abstract the core structure across examples and prevent learners from confounding core structure with superficial features. The Dual Representation account (Deloache, 2000; Deloache et al., 1997) favors uniformity in materials. It proposes that concrete materials are both a symbol and an object itself, and using different types of materials emphasizes the salience as an object, making it harder for young learners to use its symbolic nature to abstract the core structure and learn the intended concept. The current study compared how different levels of variability in concrete materials influenced children's learning about repeating patterns (e.g., ABB-ABB-ABB). 94 participants aged 4 to 6 (M age = 5.22, SD = 0.80, male = 53) completed an online experimental session via Zoom in which they completed a brief pretest to assess prior knowledge and a pattern training session. The training included nine trials - three sets of three pattern items. Children were randomly assigned into low, medium and high variability training conditions (see attached Figure 1). In low variability, the same items were used across all items, and they varied in one feature (e.g., shape). In medium variability, three sets of items were used across all items, and they varied in two features (e.g., shape and color). In high variability, three sets of items were used across all items, and they varied in three features (e.g., shape, color, and size). On each item children selected from one of two options which object completed the pattern and the experimenter provided explanation and feedback. Overall, children performed well on the first set of three training items (M = 87.2%, SD = 21.8%), and on the second set of three items (M = 92.0%, SD = 16.6%). But performance on the last set of three items dropped to 74% (SD = 28.7%), which was significantly lower than performance on the first two sets (ps < .001). Further, an ANOVA on performance in the last set of three items showed an interaction between prior knowledge (as measured by a pretest) and variability condition ($F(4,87) = 2.80$, $p = .031$), indicating that high variability is less beneficial for novices than for knowledgeable learners. This trend aligns with previous studies with adults suggesting that variability could benefit knowledgeable learners more than novices because novices are less able to detect underlying similarity across various structures (Braithwaite & Goldstone, 2015).

1-H-34   Conceptual and empirical overlap in early childhood education self-regulation research: An interdisciplinary systematic review

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Young children's social-emotional skills generally, and self-regulation skills specifically, are linked to an array of important academic, social, and behavioral outcomes across the lifespan (MacCann et al., 2020; Moffitt et al., 2011) and school stakeholders widely agree that social-emotional learning (SEL) skills, of which one primary component is self-regulation (SR), should be prioritized in schools (Corcoran et al., 2018; Lawson et al., 2019). Despite broad agreement about the importance of these skills, the diverse field of SEL is rife with a lack of clarity in both conceptual definitions and measurement (e.g., Jones et al., 2016). Similar conceptual clutter extends to many of the sub-domains of SEL, especially SR, with many different terms and definitions used interchangeably. These challenges have been described by several scholars in the field, independent of the broader conceptual overlap problems in the SEL literature, and have focused on analyses of construct definitions and patterns of findings across subfields (e.g., Hofmann et al., 2012; Morrison & Grammer, 2016; Zhuo et al., 2012). However, few of these efforts

have investigated patterns in how SR related variables are operationalized to identify empirical overlap across definitions and terms. With an interdisciplinary systematic review of early childhood SR research, we aimed to add to these efforts by cataloguing which SR variables researchers measure and the specific methodological choices they make to capture such variables (e.g., measurements used, informant patterns). Two independent coders conducted a systematic literature review following the PRISMA protocol by searching PsycInfo and Educational Resources Information Center for peer-reviewed articles published between 2010-2020 using the following search terms: emotion* regulation, challenging behavior*, executive function*, behavior problem*, self-regulation, self-management + school + early childhood or preschool*. This initial search yielded 3,586 unique articles which were further screened for inclusion based the following criteria: (a) participants aged 3-8 years in a school setting in the U.S.; (b) featured a measurement related to our search terms. This yielded 319 articles from which we extracted the following data:(a) variable term; (b) measurement tool; (c) informants. Inter-rater reliability was calculated across all items coded for 30% of the articles (87.8% agreement) and Cohen's k = .74. This revealed 11 distinct variable terms used widely in the literature to refer to SR related skills or characteristics and behavior problems was overwhelmingly the most frequent. With the exception of self-regulation and executive function, which were both more likely to be measured via direct child assessments, studies of other variables relied heavily on adult-reports and the majority of these were from teachers. The use of multiple informants (Kraemer et al., 2003) to measure variables was uncommon and the use of combinations of child-level measurements and adult-reports (e.g., Duckworth & Kern, 2011) was rare, but both of these practices were more common among studies measuring self-regulation and executive function than for any other variable terms identified. These findings further highlight the conceptual clutter in SR research, point to possible points of empirical weaknesses in the measurement of these skills, and identify some empirical overlap in how variables are being operationalized in the literature.

1-H-35   Sense of belonging as a predictor of perceived helpfulness in a college statistics course discussion forum
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Help-giving behavior--the act of responding to a student's request for help--enables those struggling with course material to fill in gaps in their knowledge and thus plays an important role in learning. The present study aimed to contribute to work on help-giving in academic environments by exploring student characteristics that may predict how helpful one finds replies to requests for help posted to an online discussion forum. To this end, we surveyed 231 college students enrolled in an introductory statistics course on their sense of belonging in the course, as well as how helpful they found 20 examples of replies to requests for help posted to a statistics course discussion forum. Results of hierarchical regression revealed a significant, positive relationship between sense of class belonging and overall perceived helpfulness of discussion forum replies, above and beyond what can be predicted by demographic characteristics alone. In other words, students who reported lower levels of class belonging found help-giving replies to be, on average, less helpful for their learning, when compared to those who reported higher levels of class belonging. These findings point to the importance of exploring how help-giving replies can be crafted to better attend to the learning needs of students who may feel excluded or alienated in classroom environments.

1-H-36   Bridging the environment and neurodevelopment for children's health: A study

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Researchers have found associations between children's physical environments and their academic achievement. However, these associations remain underspecified. In this study, we tested whether real-time exposure to PM2.5 correlates with children's executive function and mathematical skills. We recruited 30 children for two study rounds, six months apart, in Winter 2020 and Summer 2021. In each round, children wore a small sensor that measured PM2.5 air pollutant concentration for three days. On the last day, children completed cognitive assessments indexing their working memory (n-back), inhibitory control (Go/No-Go), nonsymbolic math skills (dot comparison), and arithmetic skills (equation verification). Preliminary results showed that there was no statistically significant difference between 3-day-average PM2.5 readings in Round 1 (R1; median = 3.66) and Round 2 (R2; median = 3.02), using a Wilcoxon signed-rank test (p = .18). There was no significant change in cognitive outcomes over time (ps = .07 to .61). Spearman's rho correlations show that PM2.5 was not significantly correlated with cognitive outcomes in R1 and R2. However, correlational patterns suggested that increases in PM2.5 were associated with worse inhibitory control, nonsymbolic skills, and arithmetic skills in both rounds. PM2.5 negatively correlated with working memory in R1 but not R2. Final analyses will be conducted to understand how children's built environments impact their cognitive development.

1-H-37   Museum facilitation and families narratives about tinkering in a children's museum

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Our work explores narrative information during engineering activities relating to families' narrative and engineering talk. Narrative can be a powerful source of meaning making and learning across diverse families (Bruner 1986). Informal learning environments (ILE) may aid in this process of meaning making and learning (Allen, 2004). 37 Families participated in a tinkering challenge. We examined the talk of museum facilitators, parents, and children regarding the engineering design process, including discussing testing and redesigning, as well as their narrative talk. Analyses revealed associations between museum facilitators' narration and families' storytelling talk during tinkering, and between facilitators' narration and children's engineering/storytelling talk in their post-tinkering narratives. Discussion of these findings will highlight ways that developmental science research can contribute to our understanding of how storytelling encourages engagement for families within ILEs.

1-H-38   Associations between preschool activity contexts and children's developing language

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Preschool teachers use activity contexts to organize the day and give children opportunities to interact and learn. Here, we assess how differences in the proportion of time in activities relates to the language

abilities of children with and without developmental disabilities (DD). During monthly observations, 74 3-5-year-old's (44 with DD) time in structured (e.g., circle time) and unstructured (e.g., free-play) activities was recorded. Children's language abilities were assessed via the PLS-5. Increases in the proportion of time spent in structured activities were positively associated with language, and this association did not differ with disability status. Notably, the association was stronger for expressive than receptive language. This finding could indicate a mechanism by which structured activities, in which teachers elicit verbal responses through routines, provide children with more opportunities to practice language and build their expressive skills. Overall, findings highlight the importance of context in creating opportunities for cognitive development.

1-H-39   Promoting learning agency outside of the classroom: Effects of autonomy-supportive language on child engagement in informal STEM learning

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In this study, we explore how variation in the level of autonomy-supportive speech provided by five high-school-aged museum guides to 114 four- to six-year-old children (~23 children per guide) might affect children's verbal and non-verbal engagement in an informal semi-structured STEM learning activity. Multilevel linear regressions (92 interactions) revealed that higher levels of autonomy-supportive speech from guides were significantly associated with a higher levels of child verbal ($\beta = 0.28$, SE = 0.11, $p < 0.01$) and nonverbal engagement ($\beta = 0.20$, SE = 0.06, $p < 0.01$). Overall, this research indicates that learning partners' level of autonomy-supportive guidance differs even when using the same semi-structured activity and suggests that increasing learning partners' autonomy supportive speech may promote higher child engagement. Future research studying how to foster children's active engagement in informal STEM activities should consider the role of autonomy-supportive speech in the design of interventions.

1-H-40   Changes to schooling due to the COVID-19 pandemic are affecting parents and children in the US

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This study focused on exploring how the COVID-19 pandemic impacted the schooling experiences of parents (children in k-12, n = 126 [F20], n = 50 [S21]) and children (4th-12th grades, n = 18 [F20], n = 14 [S21]) during the fall of 2020 and the spring of 2021. Parents and children completed an online survey about their experiences. From the fall 2020 data, parents stated that they have gone through pandemic related challenges and are experiencing increased stress levels compared to the start of the pandemic. Parents also reported that they are having positive experiences in relation to the current school arrangements and their family/home life. Children stated that they miss social interactions, feel supported by their teacher, are experiencing academic concerns, have increased stress related to technology demands, and are having difficulty with following the new COVID-19 guidelines. While much of the experience seems to be the same during the spring 2021 phase of data collection, parents did indicate decreased agreement with the statements "My stress level has increased since the start of the

pandemic" and "I feel overwhelmed" suggesting that some relief from the heightened negativity of the pandemic was beginning to subside. These data help us understand the experience that parents and children are facing during the pandemic and how that experience is changing overtime. We plan to continue to survey parents and children to see how these experiences continue to evolve.

1-H-41   Independent exploration and instructions support problem-solving in 6-year-olds

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Receiving instructions is an efficient way to learn (Kirschner et al., 2006), but independently exploring also supports learning (Piaget, 1966). To test the contributions of instruction and exploration in problem-solving, 120 six-year-olds played an online computer game where they learned rules to unlock locks with keys. Children received instruction, independently explored, or explored prior to receiving instruction (N = 40 per condition). Children were then tested on their rule-learning and generalization. Initial results (N = 100) suggest that children in all conditions generalized the rules at above-chance levels. However, exploration prior to instruction streamlined children's subsequent behaviors towards behaviors that supported generalization. To better understand whether and how exploration supported rule-learning, 160 6-year-olds learned the unlocking rules in the same online game by exploring before instruction, exploring after instruction, receiving two instructional experiences, or receiving two exploratory experiences (N = 40 per condition). Results indicate that the timing of exploration relative to instruction affected generalization: Children who explored after instruction demonstrated better generalization than those who explored before instruction. Informed exploration could be particularly beneficial for generalizing novel rules. Results from both studies highlight the role of independent exploration in supporting young children's problem-solving.

1-H-42   Does a substitutive conception of the equal sign enhance students understanding of equivalence and algebraic problem solving?

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Algebra is often viewed as a gatekeeper to higher level math, and the equal sign as a gatekeeper to algebra. A relational view of the equal sign is critical for student success. A relational view has generally been described as the understanding that the equal sign means "the same." However, recent evidence highlights the importance of a different dimension of relational understanding: a substitutive conception. In this online study, participants (N=146, Grades 4 and 5) received a lesson about the equal sign focused on either (1) a singular Sameness conception; (2) a dual Sameness + Substitutive conception, or (3) a Control. More students in the Sameness + Substitutive condition produced substitutive definitions of the equal sign after the lesson (67%) than in the Sameness (16%) or Control (2%) conditions. Ongoing analyses are investigating the roles that Sameness and Substitutive conceptions play in students' performance on items tapping understanding of equivalence and algebraic problem solving.

1-H-43 Are you listening? A pilot study on parent-child conversation while listening to podcasts

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This study aims to examine the strategies parents use to scaffold their child's learning while listening to a science podcast. Podcasts provide a novel medium for children to engage with and learn new information. It has been found that parent-child conversation in informal learning contexts (e.g., museums) supports children's engagement and learning outcomes (e.g., Crowley et al., 2001; Jant et al., 2014), however, there is a lack of research examining the nature of parent-child conversation while listening to podcasts. We recruited families of 7- to 8-year-olds and asked parents to record themselves and their children listening to and discussing a children's podcast episode about dinosaurs (Patterson & Escamilla, 2019). Trained coders coded parent-child conversation about the podcast which includes parents' open-ended questions, parents' yes/no questions, parents' statements, parents' connections to children's prior knowledge, children's responses to parents' questions, and children's spontaneous talk (Jant et al., 2014). Preliminary results (N = 5) have found that, on average, 31.48% of the conversation is parent podcast-related talk and 25.74% of the conversation is child podcast-related talk. Out of total parent podcast-related talk, parents asked open-ended questions 25.87% of the time and prior knowledge connections were rare. Future work will examine how parent talk supports children's learning from podcasts.

1-H-44 Exploring the interplay of metamemory and teacher language on mathematics and memory performance

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Children's metacognitive knowledge has been linked to both their strategy use on deliberate memory tasks and their math performance (Bellon et al., 2019; Schneider et al., 1998). Teachers' use of metacognitively-rich language (Cognitive Processing Language; CPL) also predicts students' use of memory strategies and math achievement (Coffman et al., 2008; Hudson et al., 2018). Exposure to high CPL appears beneficial for subgroups of children (e.g., low-regulated; Ornstein & Coffman, 2020), but little is understood about the interplay of the classroom context and children's metamemory (knowledge about memory processes) on the development of cognitive outcomes. As part of a longitudinal study, 75 kindergarteners were assessed on a battery of cognitive and academic tasks. Four groups (see Figure 1) were created based on median splits of children's initial metamemory level and teachers' use of CPL during math lessons to explore the interplay of metamemory and CPL. Consistent with previous findings, preliminary analyses focused on comparisons between the students with low metamemory who were placed in low-CPL classrooms and the other three groups. At the end of the year, there were significant differences (p=.039) in math fluency between these children (M=8.8) compared to their peers (M=12.1 to15.6). Similar patterns were found for performance on a free-recall memory task. These findings suggest the classroom context may be important for students with lower levels of metamemory.

1-H-45 Elementary school teachers' views of young children's capacity to learn complex scientific concepts

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Research shows that children as young as 5 can develop an accurate understanding of complex biological concepts like natural selection (e.g., Kelemen, et al., 2014). However, US education standards recommend only minimal instruction on natural selection in elementary school (Achieve, 2013). Given this disconnect, we examined elementary school teachers' views of young children's ability to learn this concept. 127 teachers indicated whether they thought 5-8 year old children could understand natural selection on a 100-point scale (0=no; 100=yes). Although the average rating was relatively high (M=78.17, SD=29.51), 17% of teachers provided a rating of 50 or lower. Furthermore, the teachers themselves often had misconceptions about natural selection (M=7.74/15, SD=2.97) and had low confidence in their own understanding (M=60.25/100, SD=29.00). Despite this, teachers' ratings of children's abilities were positively correlated with their own knowledge of natural selection (r=.22, p=.01) and confidence in their own understanding (r=.21, p=.02). Thus, even among teachers who do not robustly understand natural selection, those with greater understanding and more confidence had more positive views of children's abilities. Fostering an accurate and confident understanding of natural selection in elementary teachers is therefore likely to enhance both their sense of children's capacities to learn it and their own capacity to teach it.

1-H-114 In a covid-19 world, ensuring that play is a part of every school day is more important than ever before

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With the school year halfway over and COVID-19 continuing to be a factor, children's health is at the forefront of many minds. Of course their physical health is of concern, but so is their mental health. Play has strong, positive impacts on children's physical, socioemotional, and even academic health. Now, more than ever, play must be a regular part of children's school days. I surveyed 27 teachers and parents of 59 children in Pre-K - 3rd grade. 100% of teachers and parents believed play should be a part of the school day every day (teachers suggested about 71.85 minutes and parents about 81.18 minutes per school day). Both groups overwhelmingly agreed that play incurs social, emotional, and academic benefits. Additionally, parents of 18 children asked them questions about playing in school. The majority of the children expressed a desire to have more time to play at school. They knew that they need the occasional break from school work, and that playing enables them to pay better attention later. Several also recognized that learning and play do not need to be mutually exclusive, and that play can make learning more interesting. With children spending roughly 40% of their waking hours in school on most days, incorporating play into the school day matters. In a world filled with uncertainty, full schedules, a very frightening pandemic, and high levels of anxiety, giving children the opportunity - and the time - to play is perhaps more important now than ever before.

1-K-46   Close is not good enough: Semantic similarity does not facilitate cross-situational word-learning from caregivers ambiguous utterances

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Infants' earliest words are learned by observation, mapping words to co-present referents (Tsui et al., 2019). However, the mechanism for such learning remains unclear. Previous work using the Human Simulation Paradigm (HSP), in which adults guess word meanings from muted videos of caregiver-child interactions, suggests adults guess correctly for only a fraction of word-learning exposures--but these momentary insights drive word-learning (Medina et al., 2011). Yet recent work suggests even incorrect HSP guesses tend to fall within correct semantic neighborhoods (e.g., guessing "sandwich" for "bread") (Johnson et al., 2020). By relying on that neighborhood, learners could home in on meanings across exposures. Here, we find evidence for a weak semantic neighborhood effect: incorrect guesses are similar to correct meanings (Study 1). More problematically for the semantic neighborhood theory, this effect is not associated with successful word-learning (Study 2). Previously, Johnson et al. (2020) demonstrated adults' incorrect guesses in an HSP task are rated by other adults as more similar to the guesses' target nouns (correct meanings) than to both other target nouns and guesses from different trials. Even incorrect guesses put learners in the right semantic neighborhood. Here, we tested this semantic similarity effect in an HSP study featuring varied words (nouns and verbs as targets) and referential contexts (videos from homes, not labs). Following Johnson et al.'s design, we recruited 300 adults to rate 3184 incorrect guesses from a previous HSP task, assessing if each guess (e.g., "yummy") was more similar to its corresponding target word ("bite") than to a different trial's target word (Target-Lure condition: e.g., "book") or a guess from a different trial (Guess-Lure condition: e.g., "read"). Adults correctly paired guesses with their targets at above-chance rates (M=55%, SD=5.5), p<.01, with no effect of Lure Type, p>.3, or lexical category (noun/verb), p>.5. However, target-guess similarity was lower than in Johnson et al. (M=75%, SD=6). Thus, semantic similarity may be a weaker cue in more varied environments but could still offer a viable word-learning strategy. In Study 2, we tested that possibility, asking if adults in a previous HSP cross-situational word-learning task utilized semantic similarity to learn a word across five exposures. If learners guessed word meanings based on the previous guess's semantic neighborhood, then each guess should be more similar to that learner's guess on the previous trial than to a different learner's guess on that previous trial (e.g., guessing "yummy" should lead to guessing "bite"; whereas guessing "read" leads to "book"). Moreover, if semantic-neighborhood-based inference facilitates word-learning, this effect should be stronger for correct guesses than incorrect. Results indicated a small semantic neighborhood effect: adults (n=135) paired learners' guesses with their previous guess at above-chance rates (M=52%, SD=4.4), p<.001. However, this tendency was stronger for incorrect guesses (M=53%, SD=4.6) than correct (M=48%, SD=17), p<.01, with the latter at chance, p>.5. While learners tended to remain in previous guesses' semantic neighborhoods, this did not benefit word-learning. Critically, correct answers showed no semantic neighborhood effect. Thus, early word-learning may be driven by informative cues available in-the-moment, not by gradual exploration of semantic space.

1-K-47   How activity context and parental language input support toddler use of math talk during play

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Concrete nouns and social scripts dominate early word learning, but by age two, toddlers begin to use abstract words (Bates et al., 1994), including words that refer to math concepts (e.g., numbers, prepositions, comparatives). Individual differences in early math talk have downstream effects on children's math skills (Toll & Van Luit, 2014). Yet math words pose a challenge to young learners because one word can refer to very different perceptual experiences. For example, "circle" describes a round button and cul-de-sac just as "three" refers to three people, three fingers, three turns, and so on. Thus, identifying the invariant features of the referents of such words is a tall order. Math talk also occurs in context, with social and physical cues potentially reducing ambiguity and eliciting certain types of talk over others. Here, we describe the activity context and parental language input that accompany toddlers' math talk during play. To increase generalizability of our findings, we included a diverse sample of families, who varied in home language (English and Spanish) and family socioeconomic status. We also included interactions with not only mothers, but also fathers, who are under-represented as caregivers (e.g., Hart & Risley, 1995; Pruden et al., 2011). Fifty-nine two-year-olds (M = 30.71 months, range = 24.33 to 36.43 months; 30 girls) played with four sets of toys with their mother and fathers (separately): a number book, a grocery shopping set, a magnet board shape game, and a shape sorter. Each interaction lasted three to five minutes. Interactions were videotaped and coded for six types of math talk separately for parents and toddlers (see Table 1). For activity context, we tested whether children's math talk differed by toy set. Although children did not differ in their overall use of math talk across tasks, activity context shaped types of math talk children used. As select examples, more children used numeracy talk during number book and grocery shopping with mothers ($\chi2(3) = 50.50$, $p < 0.001$) and fathers ($\chi2(3) = 40.59$, $p < 0.001$). Reciprocally, more children used intrinsic spatial talk during magnet board and shape sorter with mothers ($\chi2(3) = 64.29$, $p < 0.001$) and father ($\chi2(3) = 55.10$, $p < 0.001$). More children used magnitude comparisons during magnet board and grocery shopping with mothers ($\chi2(3) = 10.26$ $p = 0.017$), but not fathers. For language input, we examined whether parent math talk related to child math talk during each interaction. Logit regressions indicated differences in associations when crossing toy set and types of talk. As select examples, mother numeracy talk related to child numeracy talk during number book ($z = 2.82$, $p = .005$) and shape sorter ($z = 2.32$, $p = .020$). Mother intrinsic spatial talk related to child intrinsic spatial talk during magnet board ($z = 2.35$, $p = .019$) and shape sorter ($z = 2.09$, $p = .037$). Mother and father magnitude comparisons related to child magnitude comparisons during magnet board (mother: $z = 2.31$, $p = .021$; father: $z = 2.44$, $p = .015$) and number book (mother: $z = 2.39$, $p = .017$; father: $z = 2.22$, $p = .027$). Both activity context and language input relate to toddlers' use of math talk, with parent-child associations varying by task, social partner, and the type of math talk. Findings have implications for how children learn math words and the types of toys and activities that pull for the learning of specific types of abstract words seen in everyday math talk.

1-K-48   The prosodic cues of pedagogical and information-seeking questions during parent-child interactions
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Questions are most often thought of as means to seek out new information, or as a means to make a request, or make a point. But other times, questions are specifically used with an intention to teach. Indeed, at least since Socrates, questions have been considered central to learning and recent research shows that when intentions of questions are explicitly marked, children show superior learning in pedagogical question contexts (Yu et al, 2018; Daubert et al, 2020). Thus, interpreting these different goals of questioning accurately is critical for young learners. Complicating matters, the very same question can be information-seeking - if asked by a person who does not know the answer - or pedagogical - if asked by a person who knows the answer and has an intention to teach. Understanding how and why the goals of questions are interpreted accurately remains an open challenge for research. Here, we present evidence that prosody of language serves as a cue to pedagogical or information-seeking intent.   In a recent study, we showed that when asked to produce a pedagogical or information-seeking question, adults use prosodic cues that differ systematically between the two types of questions. Namely, pedagogical questions are characterized with longer duration, lower F0 variability, and a non-canonical pitch contour compared to information-seeking questions. In a separate study, we showed that naïve adult listeners can differentiate between pedagogical and information-seeking questions based on prosody alone. In addition, we have preliminary evidence from an ongoing study that young children can explicitly differentiate pedagogical from information-seeking questions at least since age 5 by pointing out who the teacher is when two individuals ask the same question.   Here, in a pre-registered study, we sought to replicate and extend the results described above. We asked if naïve parents (target sample n=32) spontaneously modulate the prosody of a question when asking pedagogical versus information-seeking questions. Parent-child pairs participated in two activities: i) child-teacher and ii) parent-teacher game. In both games, parents asked their child questions about various fun facts. In the child-teacher game, the parent did not know the fun facts, but the child did. Therefore, the questions asked in this game were information-seeking. In the parent-teacher game, the parent knew the fun facts, but the child didn't. Parents asked questions in this game as teachers ask questions when they teach. Therefore, the questions asked in this game were pedagogical. The data collection is ongoing, and it will be completed by the end of this year. We predict that a separate sample of participants will be able to accurately differentiate the pedagogical from the information-seeking questions produced in this study. In addition, we predict that we will replicate the results about the acoustic features of pedagogical and information-seeking questions described above. However, even if these predictions are shown to be false, the results of this study will inform us about the nature of the prosodic cues of pedagogical and information-seeking questions during parent-child interactions.

1-K-49   Structural integrity of the brain underlies associations between maternal language input and child vocabulary knowledge
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Introduction: Environmental and biological factors shape children's vocabulary development (McLaughlin & Gabard-Durnam, 2021; Raizada et al., 2008). Greater quantity and higher quality language input in the home environment is associated with greater cortical surface area (Merz et al., 2019) and greater functional activity (Romeo et al., 2018a) in language-related brain regions, which in turn promote children's vocabulary knowledge. Although highly informative, these studies do not describe how environmental influences may alter the mechanical integrity of neural tissue, which

biologically precedes surface area and function. The current study uses magnetic resonance elastography (MRE) to examine how children's language environments may underlie neuronal plasticity, characterized as brain tissue composition and organization, in turn promoting vocabulary knowledge. Methods: Twenty-five children, ages 5-7 years old (Mage = 6.5, SDage = 1.03, Number of females = 14), and their primary caregiver participated in a 20-minute play session. This play session utilized the three-box task (Hirsh-Pasek et al., 2015), introducing children to three different toys as their audio and video was recorded. Following this play session, children completed the Picture Vocabulary Task (PVT) within the NIH Toolbox and participated in an MRI, where magnetic resonance elastography and anatomical images were acquired as children watched an animated movie. Analysis: Trained research assistants transcribed the video footage collected during the play session using the Systematic Analysis of Language Transcripts (SALT) software program. Given quality has been shown to be more predictive of child vocabulary than quantity (Hirsh-Pasek et al., 2015), we calculated the average between parent's mean length utterance and number of different words they produced (similar to Sarsour et al., 2011; Hurtado, Marchman & Fernald, 2008; Reynolds et al., 2019) to calculate a composite measure of quality. MRE data was processed through a nonlinear inversion algorithm (NLI)(McGarry et al., 2012), which is used to calculate maps of viscoelastic shear stiffness and damping ratio. Each subject also had a T1-weighted image which was utilized to extract average mechanical property values in the following bilateral regions-of-interest (ROIs): the inferior frontal gyrus (IFG), the superior marginal gyrus (SMG) and the temporal gyrus. Lastly, raw scores from the PVT were included in all subsequent analyses. Results: When controlling for age, maternal education, and number of child and parent utterances, higher quality input was associated with greater stiffness in the bilateral IFG (LIFG; R = .47, p = .03; RIFG; R = .44, p = .05) and left temporal gyrus (R = .50, p = .025; Fig. 1), whereas greater vocabulary knowledge was associated with lower damping ratio in the right IFG (R = -.43, p = .03). Damping ratio and stiffness were not correlated with one another. Discussion: These findings provide the first evidence suggesting changes in neural composition (e.g. stiffness) are sensitive to more malleable aspects of the environment, whereas brain organization (e.g. damping ratio) is more strongly associated with outcome measures, such as vocabulary. Notably, these associations were independent of maternal education, suggesting more proximal measures of a child's environment may be the source of differences in neural tissue that underlie variability in vocabulary outcomes.

1-K-50   Shared book reading practices and potential implications for cognitive development
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Children learn language from the words and sentences they hear. To better understand learning mechanisms, researchers aim to understand how particular patterns in the language environment relate to patterns of learning. One aspect of the environment that contains unique patterns is shared book reading, caregivers reading picture books to young children. The language generated during book reading may be systematically different from other contexts and may uniquely contribute to language learning. Reading to young children is positively associated with language outcomes (e.g., Arterberry et al., 2007; Demir-Lira et al., 2019; Fletcher & Reese, 2005; Payne et al., 1994), so encouraging caregivers to read to children is seen as a potential avenue for improving outcomes (Dickinson et al., 2012; Sharif et al., 2002). Despite widespread advice to read to children, we know little about the underlying mechanisms. In order to draw plausible connections between picture book reading and language

outcomes, we need to better understand what occurs in homes during shared book reading. We aimed to better understand practices associated with naturalistic shared book reading in American homes. 150 parents in each of three age groups (0-9, 10-16 and 17-30 months) were surveyed using Amazon Mechanical Turk. Questions assessed: 1) demographic information, 2) home picture book reading practices, 3) parent's own reading habits, 4) Other home language habits 5) MCDI vocabulary inventories, and 6) practices unrelated to language to obscure the purpose of the survey. After excluding participants who likely did not have a child of the target age, we analyzed data from 281 participants. Shared book reading was very frequent: 92% of caregivers across all age groups reported reading to their child at least once a week. Over half of caregivers of the 0-9 month-olds and nearly three quarters of caregivers of the 10-16 and 17-30 month-olds reported reading to their children daily. Unlike some prior work, we found only weak relationships between caregiver education or family income and reading frequency. We found stronger relationships between the number of books in the home, and the parent's own reading habits with picture book reading frequency. While reading books, caregivers almost universally reported both reading the text on the page and engaging in extra-text conversation. Parents of older children and children with higher MCDI scores reported that book reading was more interactive. However, perhaps counterintuitively, older children also spent more time quietly listening to the text of the book. We interpret these findings as suggesting that age and language skill support both extra-text conversation and the ability to appreciate and enjoy narrative story. We also asked caregivers about their beliefs about language development. Nearly all caregivers believed that parents help children learn language by talking to them, and that reading and speaking to children is helpful even if the child cannot yet speak. Caregivers are quite savvy and hold beliefs consistent with those of developmental psychologists. We present data about the frequency of book reading, and more importantly, many reading practices that contribute to the language generated in these episodes. These findings identify language patterns that characterize book reading and will help establish links between language input during book reading and language outcomes, if such links indeed exist.

1-K-51 **Knowledge vs. belief: Young children produce 'know' earlier and more often than 'think'**

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Analysis of children's early production of mental-state vocabulary has often focused on the verbs 'know' and 'think' because these two verbs (i) are the most frequently produced verbs of cognition and (ii) can be plausibly linked to children's developing understanding of knowledge and belief (Bartsch & Wellman, 1995). However, researchers have typically grouped both verbs together as cognitive verbs rather than seeking potential differences between them. Such differences are feasible because 'know' is a factive verb that presupposes the truth of its complement whereas 'think' is not. We compared the production of these two verbs in a large sample (N=135) of English-speaking children, ranging in age from 12 to 60 months. Two main findings emerged. First, children start producing 'know' at an earlier age than 'think'. Second, they produce 'know' more frequently overall during the 48-month period (see Figure 1). The predominance of 'know' over 'think' cannot be attributed to the input that children hear. Although adult interlocutors used the two verbs with increasing frequency in the course of the 48-month period, 'know' did not predominate over 'think. Analysis of the framing of each verb, with respect to person (i.e. 1st vs. 2nd vs. 3rd), function (declarative vs. interrogative) and type (affirmative vs. negative) is planned in

order to shed more light on their differential role in children's meta-cognition and theory of mind (Harris, Yang & Cui, 2017).

1-K-52 **Social and referential cues shape 8-month-old's processing of talker variability during word learning**

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Recent work finds that exposing 8mo's to talker variability when teaching them a new word-object pairing (e.g. "neem"+dog toy) leads them to appropriately generalize to new talkers, but fail to reject incorrect labels (e.g. lof+dog toy; Bulgarelli & Bergelson, 2022). We made 2 changes to this prior study, asking whether social and referential cues might help infants process talker variability appropriately. 8mos (n=36) first viewed a video of a female adult labeling a new object 2x (social cue) and were then habituated to a novel word-object pair with highly acoustically variable tokens of the label embedded in a referential sentence frame (e.g. "Look at the neem", referential cue). At test, we asked whether infants dishabituated to a new male talker producing the word (TalkerSwitch), a new word paired with the object (WordSwitch), or a new object paired with the trained word (PictureSwitch). Participants increased their looking time to all three types of changes, but the increase to the change in object was larger than that to the new talker and the new word (t = 2.41, p = 0.018), which did not differ from each other (t = 0.004, p=0.99), see Figure. Combined with the Bulgarelli and Bergelson results and prior work, this suggests that social and referential cues help 8mos establish word-object links just as it does older infants (Fennell & Waxman, 2010; Tsuji et al. 2020), even in a challenging high-talker variability context.

1-K-53 **Use of cognitively-rich personal narratives by children with and without brain injuries and their families**

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Previous research (Frausel, Richland, Levine, & Goldin-Meadow, 2021) suggests that for typically-developing (TD) children and their families, personal narrative serves as a rich context for higher-order thinking talk (HOTT). HOTT is a type of cognitively-rich language where speakers link together two or more representations, through inferences, comparisons, abstractions, and hierarchies (e.g. Richland & Simms, 2015). As these skills are fundamental to achieving academic success (Frausel, et al., 2020), a better understanding of the conditions under which parents and children invoke HOTT may be essential to understanding how to support the development of critical reasoning skills in children. The current study draws on transcripts of naturalistic parent-child observations to examine whether children with early pre- or perinatal brain injury (BI) and their parents also invoke HOTT at greater rates in narrative than in non-narrative. We find that compared to TD children, children with BI use less HOTT overall, and begin incorporating HOTT into narratives later in development. These findings are in line with previous research demonstrating that children with BI have difficulty with more complex aspects of language (e.g., Demir, et al., 2015). Moreover, parents of children with BI used less HOTT overall, in both narrative and non-narrative, suggesting effects of parental input may differ as a function of biological characteristics of the learner.

1-K-54   **Using children's errors to learn about word inferencing strategies**

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A vital and often overlooked aspect of language development is the ability to build deep semantic knowledge by continually updating word meanings. This complex skill includes holding potential meanings in mind and adjusting as new information becomes available (Maguire, et al., 2018). Here we study differences in children's ability to dismiss incorrect information in the face of new data by studying error types in a word inferencing task. Forty-seven 8-9-year-olds read 3 sentences that all ended in a final nonsense word and were asked to identify the meaning of the last word. We were interested in two types of errors (1) giving an incorrect word meaning that fits at least 1 sentence and ignores the third, thus failing to update the meaning as new information becomes available and (2) stating that there is no word that fits all three sentences, thus acknowledging more information is needed. When controlling for the number of correct responses and age we found significant correlations between responses and vocabulary. Children with large vocabularies were more likely to state they did not know or not respond (r = .303, p = 0.045) whereas children with smaller vocabularies were more likely to fail to incorporate the third sentence (r = -.399, p = .007). These findings indicate children with poor vocabularies may be at risk of incorrectly guessing an unknown word rather than seeking further information to clarify the word meaning.

1-K-55   **How words can be learned by observation depends on what is meant by "learned"**

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Word learners experience naming events differing widely in their referential quality. Whereas referents of some naming events are transparent from their extralinguistic contexts, referents of many naming events are ambiguous. Word learning theories are divided in whether learners mainly learn from a few transparent events or whether learners also aggregate across ambiguous ones. Data consistent with the former view are evident in the Human Simulation Paradigm (HSP) in which naïve observers must identify parents' words from muted vignettes of parent-toddler interactions. The HSP reveals that even adults struggle to identify the identity of parents' words across ambiguous vignettes. Our work revisits the HSP by examining how alterations to its dependent variable affects the conclusions about the naming events that shape learning. This work underscores how one's definition of learning has implications for both accounts of the mechanisms of learning as well as accounts of the relevant input into those mechanisms.

1-K-56   **Language frequently used in best-selling storybooks can thwart their intent to inspire girls**

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Women are currently underrepresented in many prestigious careers. To reduce the gender disparity, an exploding market of storybooks intends to boost young girls' interest in these areas. However, these books often contain language that may undermine this goal. Comparisons to boys as the reference point (e.g. "girls are just as good as boys at __") have been shown to actually maintain stereotypes against girls' abilities and thus may limit girls' aspirations. Contrasting femininity with interest in target careers (e.g. "while other girls played with dolls, she did __") may prevent feminine girls from identifying with women in that career. Depicting women in a career as exceptional (e.g. "better than anyone else") may seem daunting to girls, who already by age 6 think they lack exceptional talent. Here, 5- & 6-year-olds (N = 96, Zoom) were read excerpts from best-selling books that contain these elements; with these elements edited out; or nothing. Among children who read the original books, girls were less interested than boys in the target careers, just as children who read nothing at all. However, girls and boys were equally interested in the target careers after reading the edited books. Best-selling books on the market today may not effectively address gender gaps in certain careers. Yet, by removing comparisons to boys, contrasts with femininity, and exceptionalism, storybooks can boost girls' interest and ultimately reduce gender gaps in male-dominated careers.

1-K-57   Do preschoolers ask questions about words in online formats?

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As we experience more virtual learning platforms, a crucial question is whether children employ active learning strategies online. A potent active tool is question asking. In person, preschoolers target their questions toward potential information gain, by asking more questions about unknown than known words (Janakiefski et al., 2022). Online environments present challenges that may interfere with information seeking: reduced social signaling, greater attentional demands, lower engagement. We tested whether preschoolers' tendency to ask questions about unknown words is robust in the face of these challenges. Five-year-olds participated in a Zoom call with an experimenter and had 6 of their toys to use in the study. Children were asked to complete instructions that included known ("Wiggle the dog") and unknown verbs ("Invert the cow"), using the same procedure and words as in Janakiefski et al. (2022). Across in person and online environments, 5-year-olds asked more questions about unknown verbs (M in person=6.105, M online=5.789) than known verbs (M in person=0.105, M online=0.684), $F(1,36)=137.93$, $p<.001$. Importantly, the overall rate of question asking across platforms was equivalent, $F(1,36)=0.05$, $p=.82$. These findings suggest that children have access to active learning tools even online, such that their frequency of question asking about words is robust across environments. A key question for future work is whether use of these tools benefits learning and memory.

1-K-58   Single language speaker preference among bilingual children in Lebanon: Implications for pedagogy in multilingual settings

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Past research has shown that bilingual children but not monolingual children prefer speakers who do not engage in language switching, despite being a common linguistic behavior among bilinguals. These

studies suggest that bilingual speakers prefer speakers who only speak in English, but not a mix of English and a second language. Importantly, these studies have primarily examined the influence of language switching in contexts where English is perceived as a high status language. As a result, it remains unclear whether this preference is in fact a preference for those who speak English exclusively, or if this single language preference generalizes to other languages as well. In the current study, Lebanese bilingual children between 4 and 6 years of age were asked about their trust in and social preferences towards single language speakers of Arabic, single language speakers of English, and speakers who mixed English and Arabic. Data collection is ongoing. Results of this study will shed light on the boundaries of single language speaker preference and will have direct impact on pedagogical practices in multilingual settings.

1-K-59   **Parent and child math language and relations to child spatial ability**

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Previous studies have shown relations between quantity of parent-child spatial language and child spatial ability (Pruden et al., 2011), and quantity of parent-child math language and child math ability (Gibson et al., 2020). Few studies have examined cross-domain relations such as the quantity of parent and child math language and relations to child spatial ability, the goal of this study. Forty-four 4- to 7-year-olds (23 males; M age=5 years) and their parents participated. Dyads constructed a Lego house from a set of instructions for 10 minutes, and children's spatial ability was tested using the Children's Mental Transformation Task (CMTT; Levine et al., 1999). The language used by parents and children while playing was transcribed and coded for math talk using a coding scheme adapted from Ramani et. al (2015). The quantity of parent math talk was significantly related to child CMTT, $t(40)=2.28$, b=0.09,β=0.53, p=.028, 95% CI =0.01, 1.59, such that parents who talked more about numbers had children who performed better on the CMTT. The quantity of child math talk was significantly related to child CMTT scores, $t(40)=2.50$, b=0.93,β=0.28, p=0.017, 95% CI =0.20, 1.66, such that children who talked more about numbers also did better on the CMTT. Our results suggest that parent-child math talk is related to spatial ability, providing evidence of cross-domain effects on spatial ability. Future research should examine teacher math talk in relation to child spatial ability.

1-K-60   **Choosing the right book: Assessing the textual characteristics of Spanish-English bilingual storybooks**

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Dual-language storybooks (DLBs) are designed to be read in two languages and span various genres and formats. For instance, each sentence might be displayed in both languages (e.g., "Lisa has a little llama. Lisa tiene una llamita") or the languages might be mixed (e.g., "Lisa has una llamita"). To date, limited research has investigated the role of DLB format on word learning. The current project addressed this gap in the literature by investigating which formats are common in existing Spanish-English storybooks. We conducted a content analysis of 100 Spanish-English DLBs. Results revealed that most DLBs targeted

English-dominant children who are learning Spanish and typically used full-sentence translations. In contrast, very few storybooks included code-switching. Our next step is to assess which format is most effective for children's novel word learning. The goal of this research is to help develop educational materials that support language learning in dual-language learners.

1-K-61   Person reference by pronouns and verbs in toddlers predicts later false belief understanding in preschoolers

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Personal and possessive pronouns are closed-class elements related to grammatical as well as social development (e.g. Loveland, 1984; Lewis & Ramsey, 2004). The referents of pronouns depend on the context, and especially the first and second person may be confusing in this respect, unless children have a good understanding of people's communicative intentions. However, no study known to us examined the relations between children's mastery of pronouns and the false belief (FB) tasks, which are commonly viewed as milestones in social-cognitive development. In our longitudinal study, we examined whether the mastery of personal pronouns and person-inflected verb forms predicted the success in false belief tasks. Sixty-one Czech children participated in a two-wave (29 and 43 months) study that examined elicited and spontaneous production of pronouns and verb inflections, as well as a FB task (unexpected transfer, children explaining observed behavior of a protagonist). Regression analyses revealed a number of significant unique effects of person reference at 29 months on the FB score at 43 months, above and beyond the effects of general language skills measured by MLU and comprehension vocabulary. Both the elicited and spontaneous pronoun data show effects of second-person mastery, while the spontaneous verb-person also first-person. Overall, pronouns and person-inflected verbs in 2-year-olds are related to subsequent development of social cognition.

1-K-62   The development of real-time phonological competition and semantic activation in adolescence

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Previous research suggests that real-time word recognition processes are stabilized in early childhood (Fernald et al., 2006). However, recent work suggests these processes are protracted throughout adolescence (Huang & Snedeker, 2011; Rigler et al., 2015). This study aimed to investigate whether these developmental changes are based in the lexical system or are due to domain general changes. We also aimed to investigate the development of real-time lexical-semantic processing. We assessed semantic processing, phonological competition and non-linguistic skills using two Visual World Paradigm experiments in 43 7-9-year-olds and 42 10-13-year-olds, and 30 16-17 year-olds. Older children were quicker to fixate the target word, in both trials with semantic and phonological competitors, and they exhibited earlier onset and offset of fixations to phonological competitors. Visual/cognitive skills explained significant, but not all, variance in the development of these effects. Older children also exhibited greater peak semantic activation, with marginally earlier onset and offset times. However, this

was largely attributable to phonological competition resolution. These results suggest that the concurrent development of linguistic processes and broader visual/cognitive skills lead to developmental changes in real-time word recognition, while semantic processing is stable across these ages.

1-K-63   What features of parental language influence children's gender beliefs?
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Problematic gender stereotypes emerge in early childhood (Bian et al., 2017; Mandalaywala et al., 2020). In a multi-session longitudinal study, we examined mechanisms that contribute to the development and transmission of these stereotypes. In Session 1, parent-child dyads (n = 117; M age = 4.6 yrs; 41% male) read a picture-book designed to elicit conversations about gender. We transcribed and coded the conversations for language form (e.g., labels, generic claims) and content (e.g., stereotypes). In Session 2, children completed measures of gender-typing and essentialism. Children whose parents produced more generics (p = .02; Figure 1a) and stereotype affirming statements (p < .001; Figure 1b) were less likely to express interest in activities that are stereotypically associated with the other-gender (whereas these features of language did not influence interest in own-gender-typed activities). Children whose parents produced more generic claims also endorsed more essentialist beliefs about gender (p = .01; Figure 1c), whereas the stereotype-relevant content of parent speech did not relate to essentialism (p = .8; Figure 1d). These findings identify core features of parent's natural language that contribute to the development of gender essentialism and gender stereotypes in early childhood.

1-K-64   Metavocabulary: Do children understand the implications of knowing words?
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Knowing words matters. Indeed, the size of children's productive vocabulary is highly predictive of future cognitive skills (Kuhn et al., 2016), academic achievement (Morgan et al., 2015), social-emotional functioning (Longobardi et al., 2016), economic prosperity (Chetty et al., 2010), and more (Hartas, 2011). But what do children understand about the implications of having a large vocabulary? And do they know what types of experiences are most likely to contribute to having a large vocabulary? The current study examined what 5-9 year-old children (N = 131) know about the factors that contribute to word learning (e.g., reading more books), as well as the various outcomes of someone who has larger vocabulary knowledge vs. someone with smaller vocabulary knowledge (e.g., who will do better in school?). Results revealed even the youngest children in the sample demonstrated metavocabulary knowledge. That is, 5-year-olds had a strong understanding of the factors that promote word learning. Moreover, children demonstrated knowledge of links between vocabulary and being smart/doing better in school, but were less aware of links to more distal academic domains (e.g., math) and social-emotional outcomes (e.g., having more friends). Finally, children demonstrated no knowledge of links between vocabulary and health outcomes (e.g., number of colds). The implications of these results for theories of word learning and applied settings will be discussed.

1-L-65 **Rethinking the gap between exploratory learning and scientific reasoning: Causal logic within the control of variables task**

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Young learners are often considered 'intuitive scientists,' acquiring and updating their knowledge through self-directed exploration. However, children also struggle with formal scientific reasoning. For example, they often fail to correctly apply the control of variables strategy (CVS)--manipulating a single variable while holding all others constant-- in their untrained experimentation. Here, we investigate a novel explanation of this gap between formal and informal scientific inquiry. Specifically, we examine whether difficulty with CVS may stem from a mismatch between the presentation of the task and learners' causal intuitions. In traditional assessments of CVS (e.g., Tschirgi, 1980; Croker & Buchanan, 2011) participants observe three variables combine to produce an outcome. They must then select a test of the hypothesis that one variable caused the outcome, and the other two variables are non-causal. We demonstrate that, when considered from a causal perspective, this task is not a coherent test of experimentation. First, the hypothesis not only claims that the outcome is causally dependent on one variable, but also that it is causally independent of the other two. However, applying CVS to test this independence claim (e.g., holding the suspected cause constant while changing the other two) is considered to be an "uninformative," incorrect response. Second, for a test of either independence or dependence to be informative, the learner must make several assumptions that are counter to causal learning in the real world (e.g., assuming variables never inhibit or combine). Our experiment asked whether clarifying the causal logic of the traditional CVS task improved learners' performance. Seven- and 9-year-olds' and adults' are introduced to a machine that lights up when a circle, square, and triangle block are placed into the differently shaped slots on top. They learn that blocks called "blickets" cause the toy to also play music when it lights up. An uncategorized block of each shape is placed into the toy, which lights up and plays music. As in CVS, participants are asked to select an experiment to test the hypothesis that one variable (e.g., the uncategorized square) is causal, and the other two (the uncategorized circle and triangle) are not. However, unlike in the traditional task, participants choose between an informative and confounded test of either the dependence or independence claim. This design also clarifies the necessary assumptions about inhibition and combination effects, resulting in an unambiguous choice between an informative and uninformative experiment. At all ages, a significant majority of participants selected informative experiments (92% of adults, 65% of 9-year-olds, and 60% of 7-year-olds,). These results contrast the longstanding belief that learners cannot recognize or employ CVS in experimentation without training. It is also consistent with recent novel explanations for learners' simultaneous characterization as effective informal scientists and unsuccessful formal experimenters (e.g., Lapidow & Walker, 2021). Self-directed learners are neither unable nor unwilling to conduct informative experiments, however, they naturally approach scientific inquiry with intuitions and goals particular to causal learning and reasoning. This understanding both resolves a long-standing disconnect within the literature and has important implications for STEM education.

1-L-66 **Improving fraction magnitude knowledge: Is analogy or partitioning more effective?**

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Children's ability to estimate the size of a fraction on a number line is a robust predictor of their success in fraction arithmetic, algebra, and high school mathematics (e.g., Torbeyns et al., 2015; Booth et al., 2014; Siegler et al., 2012). Multiple theoretical perspectives suggest that learning to represent a fraction as a single magnitude is essential for later math reasoning (Moss & Case, 1999; Siegler et al., 2011; Vamvakoussi & Vosniadou, 2004). Despite its importance, many children and adults struggle to estimate and compare fraction magnitudes (e.g., Braithwaite & Siegler, 2018). One strategy for teaching students how to estimate where a fraction x/y goes on a number line is partitioning: break the line into y pieces, and shade in x of them. This strategy is commonly used in schools and has recently been found to improve students' fraction magnitude knowledge after only a brief intervention (Gunderson et al., 2019; Hamdan & Gunderson, 2017). However, partitioning focuses on counting up or adding parts, which may be counterproductive if the goal of fraction instruction is to move students towards advanced multiplicative thinking. Alternatively, students could be taught to estimate the position of x/y using an analogy based on their pre-existing whole number knowledge. For instance, if a child locates 3 on a 0-7 number line, then 3/7 is exactly that large relative to 1. We compared Partitioning and Analogy fraction number line estimation (NLE) interventions, as well as a Control lesson using a square area model, in an online study with 2nd and 3rd graders (N = 85, Mean = 8.83 years, 54% female, 70% White). We used a pretest-intervention-posttest-delayed posttest design over three sessions to investigate: 1) Whether the advantages of analogy over control replicate in virtual environments, 2) whether Partitioning or Analogy is more effective, and 3) whether learning is sustained after a 1-week delay. We regressed posttest accuracy against pretest accuracy and condition to compare intervention effects. On the target task of fraction NLE, both Analogy (p = .005) and Partitioning (p = .04) groups improved more than the Control group from pretest to immediate posttest. To test whether these improvements generalized beyond a number line context, we also analyzed children's fraction magnitude comparison scores. On this transfer task, the Analogy lesson was more effective at promoting generalization to a fraction magnitude comparison task than the Partitioning lesson, which was itself more effective than the Control lesson. Current results show that brief fraction NLE lessons, which were effective in person, can also effectively improve students' fraction magnitude knowledge when delivered online. Importantly, these results emphasize the need for delayed follow-up testing in math intervention research and cognitive development research more broadly. Ongoing analyses, which will be available by June, will show whether student characteristics like prior knowledge, working memory, and visual proportion skills moderate the effectiveness of the interventions. Our future work may also adapt these lessons for larger group or classroom instruction, including more self-explanations and reflective prompts to target principles of fraction estimation.

1-L-67   Childhood maltreatment alters explore-exploit decision making and action learning in adolescents

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Study objective Childhood maltreatment is often associated with problem behaviors later in life. This study investigates explore-exploit decision-making as a cognitive mechanism potentially mediating this association. In uncertain environments, making decisions poses conflicts between staying with a known option (exploitation) versus trying a new, unknown alternative (exploration). Children and adolescents gather information and learn about their environments through sampling and exploration, rather than exploiting existing knowledge. It is possible that childhood maltreatment impairs social learning and

leads to maladaptive behaviors through discouraging sampling and exploration. In this study, we will examine whether childhood maltreatment is associated with reduced exploration. If so, we will test whether the reduced exploration may be explained by an inaction bias in the context of reinforcement learning. Past research shows that acute stress suppresses adults' learning to act (Go) in a Go No-Go task. We ask whether chronic early life stress biases children to refrain from taking actions, selectively impairing their Go responses. We also hypothesize that parental unpredictability, an important characteristic of maltreating parents, may disrupt exploration and learning beyond the well-established risk factor of parental harshness. Methods In this ongoing study, we have recruited 76 10-13-year-old adolescents to complete online tasks and questionnaires. Participants completed a Horizon task (decision-making; Wilson et al., 2014) and a Go No-Go task (action learning; Archy et al., 2016) in counterbalancing orders. Participants reported parent-child conflict (harshness) and unpredictability using the Parental Environment Questionnaire Conflict Subscale (Miller & Hauser, 1989) and the Questionnaire of Unpredictability in Childhood (Glynn et al., 2018), respectively. We assessed adolescents' working memory and socio-economic status as control variables. Results Horizon task: Children reporting more parental unpredictability and harshness generally explored less (β = -0.05, p = 0.005). Children with unpredictable, but not harsh, parents were less likely to adjust their decisions based on the future utility of exploration (OR =0.72, 95% CI (0.58-0.89), p = 0.002), suggesting a less future-oriented decision-making strategy. Go No-Go task: Contrary to our hypotheses, children with unpredictable, but not harsh, parents, showed a selectively impaired performance in No-Go trials instead of Go trials, as they had significantly more Go responses in No-Go trials even after repeated feedback (OR =1.69, 95% CI (1.22-2.34), p = 0.002). Conclusions Children with more maltreating parents (unpredictable and harsh) showed reduced overall exploration; children with unpredictable, but not harsh, parents, showed reduced strategic exploration and impaired learning to withhold their actions. This finding suggests a potentially divergent effect of parental unpredictability and harshness, such that exposure to unpredictability alone may selectively impair future-oriented exploration and inhibitory control. This altered explore-exploit decision-making and impulsive actions may result from an adaptation to the demands of an unpredictable parenting environment. Yet they implicate compromised learning abilities and problem behaviors that we often see among individuals who experienced severe childhood maltreatment.

1-L-68   Anecdata: children's and adults' evaluation of statistical and anecdotal evidence

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Personal stories can exert powerful influences on people's beliefs. For example, the internet is rife with anecdotes connecting vaccines to autism, while the data show no such connection. Nevertheless, many continue to resist the scientific evidence and believe that the two are causally related. Why are people swayed by anecdotal evidence over statistics, and what are the ontogenetic roots of this trend? In this study we examine participants' use of statistical and anecdotal information in four different contexts: medical healing, animal behavior, sports performance, and academic performance. Fifty-four 7-year-olds, 53 10-year-olds, and 65 adults heard or read vignettes in which they needed to help various characters achieve an outcome by choosing one of two potential solutions. In each case, one solution was supported by anecdotal evidence (i.e., a true story from a single individual), and the other by statistical evidence (i.e., a bar graph). Results showed that reliance on statistics increased significantly

with age (p < .001); 43% of 7-year-olds, 60% of 10-year-olds and 75% of adults made recommendations based on the information in the graph (vs. that in the anecdote). Context differences were present in the 10-year-olds and adults and are illuminated by participants' explanations.

1-L-69   The transmission of negative information through naturalistic parent-child conversations: Implications for fear learning

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Snakes and spiders are two of the most commonly feared animals worldwide, yet little is known about how these fears develop. Here we examined whether parents use more negative information about snakes and spiders compared to animals, and whether explicit instruction about the impact of negative information on children's fears would reduce both parents' use of negative information, and as a result, children's fear. In Study 1, 27 parents/child dyads read a picture book with snakes, spiders, turtles, frogs, and lizards, and their conversations were coded for positive and negative information. Participants also completed a self-report measure of fear toward each animal. In Study 2, 54 dyads read the same book, but half were primed with information about the role of negative information on children's developing fears. Participants provided more negative and less positive information (Study 1: $F(1,50) = 11.06$, p < .01; Study 2: $F(1,49) = 23.87$, p < .001) about snakes and spiders and also reported more fear when of snakes and spiders compared to other animals (p's < .001). In Study 2, parents in the instruction condition used less negative information, $F(1,47) = 3.48$, p =.07, and their children reported less fear of snakes and spiders when compared to the control condition, $t(46.52)= 2.07$, p = .04. Our results highlight the availability of negative information in parent-child conversations about snakes/spiders, and the impact of parental input on children's fears.

1-L-70   Get a hint: An investigation of the development of help-seeking behaviors during learning

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Students engage in many different study strategies such as reading notes, testing themselves using flashcards, and seeking helpful information to improve their learning. Research examining ways in which students learn suggests testing (e.g., independently retrieving information) leads to significantly better learning than re-study strategies (e.g., re-reading notes). Critically, research has yet to examine how help-seeking compares to test and restudy strategies in terms of learning outcomes and how the benefit of certain strategies may change across development. The current study conducted two experiments with children ages 8- to 13-years-old. In Experiment 1, we examined how being provided with helpful hints compared to study and test strategies impacts long-term learning. Results revealed both providing hints and testing significantly increased retention of learned facts compared to restudying information. In Experiment 2, we investigated children's ability to seek different types of help (i.e., help in the form of a hint vs. answer). Results revealed older children asked for help in the form of hints more than answers. Older children were also more efficient in their help-seeking such that they were most likely to seek help

when they were the least confident in their response. The results of this study contribute to our understanding of self-regulated learning and can help inform educational learning practices.

1-L-71 **"This is hard!": Children's and parents' talk about difficulty during dyadic interactions in two observational datasets**

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Motivational frameworks correlate with academic achievement from elementary through high school (Park et al., 2016; Paunesku et al., 2015). Yet research on children's pursuit of challenging goals takes for granted that children can identify what will be "hard" and "easy". We investigated parent talk as a potential source of children's developing concepts of difficulty by coding "hard" and "easy" talk in parent-child interactions from the longitudinal Home-School Study of Language and Literacy Development (Study 1, 82 mother-child dyads from age 3 years to grade 4) and one site of the NICHD Study of Early Child Care and Youth Development Study 2, 107 1st-graders with their mother and father). Across studies, parents often talked about difficulty (45-70% of parents), statements were often general in content (e.g., "That's hard!"), and child gender did not predict frequency of parents' difficulty statements. In Study 1, mothers talked less about how "hard" tasks were as children got older. In Study 2, fathers talked about how "easy" things were more than mothers, and boys talked more about how "easy" and "hard" tasks were than girls. Frequency of mothers' - but not fathers' - difficulty talk referencing a specific feature of a task was correlated with frequency of process praise, suggesting a functional similarity in these kinds of talk. Understanding parents' difficulty language could inform future work on motivational framework development, persistence, and goal choice.

1-L-72 **The link between 4- to 6-year-old children's numerical confidence and active information seeking**

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Children actively choose what to learn, and those with more interest in numbers are more likely to succeed in math. What impacts children's interest in numerical information? Here we test whether changes in children's numerical confidence impact their active information seeking. Previous research showed that children perform better on a numerical comparison task when starting with easier trials (e.g., 20 vs. 10) and progressing to harder ones (e.g., 10 vs. 9), compared to children seeing the same exact trials in the reversed order, an effect termed "confidence hysteresis" (Odic et al., 2014). How does numerical confidence influence children's active information seeking? Here we replicated the confidence hysteresis effect in 4- to 6-year-olds (N = 68). Following the numerical comparison task, children were presented with 10 opportunities to choose between numerical (e.g., how many trees?) or non-numerical information (e.g., what type of tree?) in a choose-your-own-adventure storybook. We found that children who saw the easy-to-hard numerical comparison task were also more likely to seek numerical information afterwards.

1-L-73   The development of kindergartners' deliberate memory skills: The moderating role of metamnemonic knowledge

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A rich literature has documented how the use and effectiveness of appropriate strategies for remembering improve across the elementary school years (Ornstein, Haden, & San Souci, 2008). However, there remains a limited understanding of the role that individual-level factors may play in the development of children's effective deliberate memory skills (Schneider & Ornstein, 2015). In an ongoing longitudinal study, we observed developmental changes in children's performance on a series of memory and cognitive tasks. 94 children entering kindergarten (55% female, 58% Caucasian, 31% students of color), drawn from 5 schools, were assessed with a battery that included deliberate memory and metamemory tasks. Researchers coded children's strategic efforts during a 2-minute study period in an object memory task (Baker-Ward, Ornstein, & Holden, 1984), and assessed their subsequent recall of 15 stimulus items. Preliminary findings support the moderating effect of children's metamemory skills on the association between their strategy use and recall ($\Delta R2 = .05$, $p < .05$), suggesting that children who evidenced higher levels of metamnemonic knowledge were better able to benefit from strategy use than were their peers with lower metamemory skills. These and other results, evidencing children's emergent metacognitive knowledge, will be presented in order to characterize developmental change in strategy use and recall in kindergarten.

1-L-74   Children's strategy variability affects responsiveness to math instruction

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Research shows that gestured instruction benefits math and science learning (e.g., Koumoutsakis et al, 2016; Ping et al, 2021). But we do not know who and who does not benefit from gestural input. We examine strategy variability (the number of strategies produced during math problem-solving tasks; Shrager & Siegler, 1998) as one factor influencing receptivity to mathematical equivalence instruction with gesture. Data on 282 public school children (Mage = 7.86 years, 50% nonwhite) who participated in a pretest-video instruction-posttest design and failed the pretest of mathematical equivalence problems were analyzed. Children were randomly assigned to watch speech + gesture or speech only video instruction. Children learned more from gestured than speech-only instruction. Surprisingly, children with lower strategy variability learned more than children with greater variability, especially in response to gestured instruction. These results suggest that instruction with gesture should be modulated depending on the complexity of the learner's problem-solving capacity.

1-L-75   The development of children's spatial, fraction number line estimation, and calculation skill: A latent growth curve approach

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Researchers have found robust links between spatial ability and mathematical skill, but more research is needed to uncover the nature of this relation and to paint a better developmental picture. This study addresses these relations by using latent growth modeling (LGM) to explore how links between spatial visualization, fraction magnitude knowledge, and general calculation skill develop longitudinally. We targeted spatial visualization as the spatial subskill of focus given that it has a strong and unique relationship with mathematical skill. Data were collected as a part of a longitudinal and cross-sectional (cross-sequential) dataset spanning three years that followed two cohorts: one cohort which began in 2nd grade (n = 171) and another which began in 5th grade (n = 79) cohorts. Although, preliminary results of the study suggest that early spatial visualization is predictive of future calculation ability, LGM also allows us to examine these relations in multiple years and compare rates of growth of these three skills. Further, we discuss the role that initial spatial visualization skill and fraction number line estimation skill play in the growth trajectories of calculation skill in both cohorts.

N – Methods and statistics

1-N-76   Reciprocal associations between parenting behaviors and children's self-regulation in the transition from early to middle childhood

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Introduction: Extant literature highlights the significant role that parenting behaviors play in the development of children's self-regulation (Williams & Berthelsen, 2017). While it is clear that positive parental behaviors facilitate regulatory skills, less attention has been paid to how children's regulatory skills influence parenting behaviors. The current study integrates family systems theory and the transactional model of development to examine the reciprocal associations between parent and child behaviors across early childhood and in the transition to middle childhood. Methods: Using data from the Fragile Families and Child Wellbeing Study, a Cross-Lagged Panel Model with latent variables was used to examine the reciprocal associations among parental warmth, parental lack of hostility, and children's self-regulation development across three time points (3, 5, and 9 years). The analytic sample included 3,821 children (Mage at age 3 = 35.69 months, SDage = 2.5). All models were fit using Weighted Least Square Mean and Variance Adjusted estimator with theta parameterization to account for the ordered categorical nature of the items using Mplus 8.7. Longitudinal measurement invariance (i.e., loading, threshold, unique) was established prior to fitting the structural model. Results: The model had acceptable fit (CFI = .91, TLI = .90, RMSEA = .03, SRMR = .10; see Figure 1 for details). All variables' auto-regressive paths were significant over time. Children's lack of self-regulation at age 3 was significantly associated with higher rates of parental hostility at both age 5 (b = -.29) and age 9 (b = -.69) and significantly associated with reductions in parental warmth at age 9 (b = -.13). Increasing parental lack of hostility at age 3 significantly predicted increasing parental warmth at age 5 (b = .17). Discussion: This study shows how children's regulation skills can influence parenting behaviors in the transition from early to middle childhood. Targeted and holistic programs should intervene in the family system to better educate parents on the nature of children's behaviors and be able to co-regulate parenting reactions to different types of children's behaviors.

1-N-77   Comparing analytic approaches to infant functional near-infrared spectroscopy data

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Near-infrared spectroscopy (NIRS) is increasingly used to study brain function in infants, but the development and standardization of analysis techniques for use with infant NIRS data has not paced other technical advances. Here we quantify and compare the effects of different methods of analysis of infant NIRS data. Specifically, we analyzed two independent NIRS datasets involving 6-9-month-old infants contrasting results from more traditional, fixed array analyses with several functional channel of interest (fCOI) analysis approaches. In addition, we tested the effects of varying the number and anatomical location of potential data channels to be included in the fCOI definition. Over two studies we find that fCOI approaches are more sensitive than fixed array analyses, especially when channels of interests were defined within-subjects. Applying anatomical restriction and/or including multiple channels in the fCOI definition does not decrease and in some cases increases sensitivity of fCOI methods. Based on these results, we recommend that researchers consider employing fCOI approaches to the anlaysis of infant NIRS data and provide some guidelines for choosing between particular fCOI approaches and settings for the study of infant brain function and development.

1-N-78   Comparing methods of social category preference assessment in childhood

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Do children report different social preferences when assessed with a forced-choice procedure versus a rating procedure? In an ongoing study, we assess gender-, race-, and accent-based preferences in 5-6 year old children using both a forced choice measure and a rating measure (on a 1-6 scale). Two main findings have emerged with half of the preregistered sample collected (N = 40). First, replicating past work, children prefer other children of the same gender, race and accent, regardless of whether preferences are assessed by forced choice or rating, all p's<.05 (except for rating-assessed race preferences, on which children show no ingroup preference). Second, ingroup preferences appear more pronounced with a forced choice than with a rating design. A 3 (domain: gender, race or accent) x 2 (assessment type: forced choice or rating) repeated measures ANOVA shows a significant main effect of assessment type, ($F(1,39) = 66.13$, $p < 0.001$), with no main effect of domain ($F(2,38) = 2.83$, $p = 0.07$) and no interaction between domain and assessment type ($F(2,38) = 0.13$, $p = 0.88$). These preliminary results suggest that two common methods of assessing children's social preferences may lead to divergent estimates of social bias, with forced choice either exaggerating the strength of ingroup preferences, or rating scales diminishing them. This finding has important implications for how studies are compared to one another and how studies are designed in the future.

O - Miscellaneous

1-O-79   Relations between fearfulness and inhibitory control in emotionally salient contexts

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Temperament is one source of individual differences in inhibitory control in emotionally salient contexts. High levels of fearfulness indicate dysregulated use of avoidance or withdraw to self-regulate in

emotionally salient contexts. We hypothesized children who are fearful would exhibit poorer inhibitory control over emotional cues which we tested in 4- to 5-year-old children (N=30) using standard Day-Night and Happy-Sad Stroop tasks. Fearfulness was measured using the CBQ. We found higher levels of fearfulness were associated with better inhibitory control on Happy-Sad, r=.39, p<.05, but not Day-Night, r=-.001, p >.10, and the degree to which inhibitory control improved during Happy-Sad relative to Day-Night, r=.51, p<.01. These findings indicate children who are higher in fear show heightened inhibitory control over emotional cues, but also children low in fear show lower levels inhibitory control over emotional cues. Implications for understanding how temperament and cognition work together in control of behavior will be discussed.

1-O-80　　　"It's okay if you flap your hands": Non-autistic children do not object to individual unconventional behaviors associated with autism

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Young children favor what they perceive as normative behavior and people who act in normative ways. This preference for normativity could negatively affect non-autistic children's attitudes towards autistic peers--individuals who (by definition) act in unconventional ways. In Study 1, we investigated how non-autistic 4- to 7-year-old U.S. children (N = 112) evaluated several unconventional behaviors characteristic of autism and the characters who engaged in them. Surprisingly, children generally did not object to individual autistic-like behaviors or the characters who engaged in them, although they evaluated them less favorably than normative behaviors and characters. In Study 2, we investigated why gaze aversion was the most negatively evaluated autistic-like behavior in Study 1. Six and seven-year-old U.S. children (N = 34) indicated that characters who averted their gaze as a teacher was talking were less attentive and less respectful than characters who looked at her as she was talking. Young children do not appear to object to individual autistic-like behaviors or peers who engage in them unless--as in the case of gaze aversion--they could signal a willful violation of classroom norms.

1-O-81　　　Why parents intervene in their young children's struggles

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When parents take over and complete difficult tasks for preschoolers, it decreases children's motivation. In a preregistered study, we explored which factors lead parents of 4-5-year-olds (N=96) to take over. The top reasons parents reported for taking over were 1) to help their child and 2) to protect them from negative emotions. Moreover, although past work has focused on academic domains, parents reported taking over most when their child was getting dressed. We found that parents consider both their child's abilities and the context when deciding whether to take over. Parents who said they take over more often viewed their child as less competent (Fig 1A), and when presented with hypothetical scenarios, parents endorsed taking over more in the following conditions: when in a rush, when the task was hard, and in the absence of a reputational threat (Figure 1B-D). Finally, parents reported that two strategies would be most effective at reducing their intrusive behavior: knowing when taking over is appropriate, and knowing that a little bit of struggle will not hurt their child. Collectively, these results suggest

parents take over to help and protect their children and that these decisions are informed by their child's perceived abilities and contextual cues. By exploring factors that lead parents to take over, this work lays the foundations for reducing this well-intentioned, yet often detrimental parental behavior.

P - Morality

1-P-82 To whom should punishment communicate? Children's and adults' divergent perceptions of punishment's message

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Punishment functions as a tool to communicate with people. For example, adults and children punish with a motive to communicate with transgressors (e.g., teaching a lesson; Crockett et al., 2014; Marshall et al., 2020). However, existing literature has not focused on punishment's communication to victims (e.g., letting the victim know that justice has been done). The present study assessed how adults (n=160) and 4- to 7-year-olds (n=84) evaluate punishers who communicate the enacted punishment to different people. Participants learned about individuals who punished a transgression in a way that was evident to only the transgressor, only the victim, both, or neither (Fig 1). We asked participants to rate the goodness, niceness, and rightness of each punisher's behavior, and averaged these items into a composite score. While both adults and children evaluated letting both agents know most positively, adults evaluated letting only the transgressor know more positively than letting only the victim know about the enacted punishment (p<.001). However, children viewed letting the victim know more positively than letting the transgressor know (p=.01; Fig 2). While adults consider transgressors as a more important target of communication than victims, 4- to 7-year-olds understand punishment as a way to communicate with victims more than with transgressors. This result implies that communication to victims is a key aspect in children's conceptualization of punishment.

1-P-83 When do children and adults repair past injustices?

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Children, like adults, find some inequalities unjust and others desirable (e.g., Blake & McAuliffe, 2011; Shaw & Olson, 2012; Starmans et al., 2017). However, relatively little work has investigated how children and adults repair existing inequalities, and to our knowledge, none have examined the role of time in such decisions. We investigated this question in three studies examining the judgments of 5-to-8-year-olds (N=240) and adults (N=300). Participants viewed two characters who currently had unequal resources due to a distribution that occurred the same day (Study 1 and 3) or a year ago (Study 2 and 3). They were told this had occurred either due to hard work, bias, or luck, and were given additional resources which they could distribute to these characters. Younger children (5-6 years) distributed resources equally regardless of the cause of inequality or when it occurred. Older children (7-8 years) and adults reduced inequalities that had been created due to bias or luck, but amplified inequalities that had been created because of hard work. Older children were equally likely to reduce inequalities that occurred in the past and present, while adults corrected present inequalities more than past inequalities. These findings suggest that a willingness to unequally distribute resources to correct

inequalities perceived as unjust develops around 7 years of age, and that with increased age, the amount of time elapsed since the injustice can dampen this willingness.

1-P-84   Do 2.5-year-old toddlers understand obligatory and supererogatory actions?

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Prior work suggests that young children expect individuals to help ingroup members, but hold no expectation for help to outgroup members. Our studies built on these findings and asked two questions. Using a novel persistence measure, Study 1 sought converging evidence that 2.5-year-olds expect individuals to help ingroup members in need. In computer-animated events, a protagonist's ball landed out of reach on a high walkway; either an ingroup or an outgroup character stood on the walkway. After a 10-s pause, the character returned the ball to the protagonist. During the pause, toddlers persisted more in looking when the ingroup character was present, as though waiting for it to come to the aid of the protagonist. Confirming prior results, toddlers looked equally when either character helped the protagonist. Study 2 examined whether children view helping an ingroup member as an obligatory action, but view helping an outgroup character as a supererogatory, virtuous action. After each character helped the protagonist, the two characters were displayed side by side. Children looked preferentially at the outgroup over the ingroup character, suggesting that they realized that although both characters helped the protagonist in the same way, the ingroup character was obligated to do so whereas the outgroup character was not and, as such, gave evidence of kindness. By 2.5 years, children thus view helping ingroup members as obligatory and helping outgroup members as supererogatory.

1-P-85   Children's moral judgments about necessary and luxury resource inequality in unprovoked and retaliatory situations

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By middle childhood, children distinguish between necessary (e.g., food) and luxury (e.g., toys) resources when asked to make moral judgments about resource inequality (Rizzo et al., 2016). Beginning in preschool, children rate in-kind retaliation as less serious than unprovoked moral transgressions (Smetana et al., 1999). To examine how children reason about different types of resource inequality in unprovoked and retaliatory contexts, 77 4- to 8-year-old children's moral judgments and justifications were assessed in four resource inequality situations. A 2 (resource type - within) x 2 (transgression type - within) x 2 (age group) mixed ANOVA revealed a significant resource x transgression interaction, $F(1, 75)=4.16$, $p=.04$. Across all ages, children rated unprovoked necessary inequality (M=1.01, SD= 0.71) as more serious than unprovoked luxury inequality (M=0.81, SD=0.79) but did not differentiate between retaliatory necessary inequality (M=0.54, SD=1.12) and retaliatory luxury inequality (M=0.58, SD=1.05). Additionally, children provided more harm-based justifications for unprovoked necessary inequality compared to all other inequality situations, $F(1, 74)=28.87$, $p<.001$, These results suggest that children are aware of the greater harm caused by necessary resource inequality, which may simultaneously lead to harsher moral judgments for unprovoked inequality and more lenient judgments for retaliatory inequality to rectify the original harm.

1-Q-86 **Predicting individual differences in executive function during early childhood from functional brain networks**

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Executive function (EF) is involved in the top-down control of behavior and plays a foundational role in human development. Recent theory posits developmental change in EF reflects changing strength of interconnectivity across brain regions. Little is known about how brain networks relate to EF during early childhood, a period when EF changes rapidly. We identified individual differences in functional networks and tested whether network strength would predict individual differences in EF. Resting EEG was recorded from 3-5-year-old children (N=95; 86% white; median annual income $100-125K) and EF was measured using a standardized scale. A new data-driven method identified complex functional networks relating to EF in a subset of children. We then tested whether the strength of those networks extracted from the remaining children would predict their EF, which networks did at levels exceeding chance. Implications for our understanding of the brain basis of EF during early childhood will be discussed.

1-Q-87 **Neural correlates of attention to emotional faces and evocative scenes predicts childhood anxiety**

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Children integrate information from their environment to inform their social interactions. Information comes from both social expressions of others, and cues from the surrounding scene. Individuals with anxiety have increased attention to emotional faces and scenes. Thus, it is possible that anxious individuals' brains may process emotional content from faces and scenes differently. However, how the neural correlates of attention to emotional faces and scenes, in combination, may predict children's anxiety has not been examined. The present study uses event-related potentials (ERP) to investigate whether and how 6- to 8-year-old children's (N = 38) neural correlates of attention to emotional faces (i.e., Happy, Angry, Fearful, Neutral expressions from the NimStim database, Tottenham et al., 2009) and evocative scenes (i.e., pleasant, unpleasant, and neutral images from the International Affective Picture System, Lang et al., 2008) interact to predict child-reported anxiety (Modified Spence Children's Anxiety Scale). We focused on two ERP components--the 'Negative Central' (Nc) and the 'Late Positive Potential' (LPP)--given they are shown to index attention to emotional content (de Haan et al., 2003; Kujawa et al., 2015). We found that the combination of heightened attentional components to emotional faces (Nc) and scenes (LPP) predict increased symptoms of anxiety and social phobia (see figure 1). Results shed new light onto the developmental mechanisms of anxiety.

1-Q-88 **Contingent and responsive caregiving shapes the infant brain to support their emerging social behavior**

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Caregiving behavior that is dependent or contingent upon infants' changing cues and states predicts infants' positive social engagement. However, it is unknown how this caregiver responsiveness may

influence infants' brains and social development, and infants' real-time neural responses during caregiver-infant interactions are little explored or understood. We examined how caregiver responsiveness to 4-month-old infants longitudinally predicts infants' brain and social development assessed at 10-months-old. Four-month caregiver responsiveness was coded from caregiver-infant 'free-play' interactions. At 10 months, we used electroencephalography (i.e., EEG alpha power) to assess infants' 'baseline' brain activity as an index of general neural maturation/organization, as well as infants' real-time neural responses to their mothers' behaviors during mother-infant interactions. 10-month-old infants' prosocial behaviors were also assessed in response to an experimenter feigning a hurt finger. Greater caregiver responsiveness during interactions with 4-month infants predicted greater 10-month infant functional brain maturity (N=59), as well as stronger 10-month infant neural responses to real-time contingent maternal behaviors (N=20) (Fig 1A). Moreover, infants' real-time neural responses were associated with increased prosocial behavior (Fig 1B). Findings demonstrate a clear role of caregiver responsiveness in shaping infants' brains to support their emerging prosocial behavior.

1-Q-89   The neurocognitive mechanisms of arithmetic verification in children
Brian Rivera[1]
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The ability to distinguish between correct and incorrect arithmetic equations (e.g., 2 + 2 = 4 vs. 2 + 2 = 5) is key for arithmetic reasoning. Previous research indicates that brains process correct and incorrect equations differently. While the brain mechanisms correlated with the processing of correct multiplication answers have been studied in both adults and children, mechanisms correlated with processing incorrect multiplication answers have not yet been studied.The present study investigated the neural correlates of incorrect multiplication processing in children. Data from a previously published fMRI study with 132 children who completed a multiplication verification task inside an fMRI scanner was used for the analysis. Results showed greater activation in the Inferior Frontal Gyrus (IFG) when brain activity between correct and incorrect answers was compared. IFG activation is associated with control and retrieval of semantic knowledge and selection of competing representations. This result offers a link between the processing of arithmetic operations and general mechanisms of response verification.

S - Pretend

1-S-90   Early childhood understanding of prayer and imaginary companions
Hea Jung Lee[1], Rebekah Richert[1]
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One form of a social relationship in early childhood that many children experience is interactions with imaginary companions (Gleason, 2017; Taylor et al., 1993). Also during this time, children from religious homes begin to interact with another abstract being (God) and start to understand prayer and its physical characteristics as a way to communicate with God (Phelps & Woolley, 2001; Shaman et al., 2016). The current study investigated the relation between children's views of communication with these two kinds of abstract entities. Participants were 263 children (162 female; Mage = 4.63, SD = .80), and 138 of them had an imaginary companion. All participants were interviewed about their views on prayer and children who indicated having an imaginary companion were also interviewed about them.

Older children were more rigid and less flexible in their views of prayer than younger children. Furthermore, children, on average, indicated people should perform prayer using specific actions, but not necessarily because they believed God cared if they used those actions. Additionally, children with imaginary companions were more flexible in their views of prayer actions than children without them. Moreover, imaginary companion status was a significant predictor of prayer flexibility, even after controlling for age. The playful experience of developing a relationship with an imaginary companion is related to children's social interactions with other unseen beings, such as God.

1-S-91   Young children and parents do not prefer magical solutions to magical problems

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How do young children and parents reason about everyday magical problems (e.g., monsters under the bed)? Previous research suggests children are adept at creating boundaries between reality and fantasy and among different genres of fantasy. But, parents often attempt to solve magical problems using real-world solutions. Two studies involving preschoolers and one survey of parents with young children explored how participants reason about magical problems. Children heard stories of real and magical problems and, for each, had to choose whether the character should employ a real or magical solution. Overall, children selected the same number of magical solutions for both problem types. But, older children were less likely to select magical solutions for real problems (See Figure). Children rated the solutions as more effective overall when they matched the genre of problem. Parents completed a survey about magical problems faced by their children and what types of solutions they attempted. Results indicate that 41% of parents could recall at least one magical problem experienced by their child. Parents who reported using magical solutions to those problems were significantly more likely to be imaginative thinkers themselves. Taken together, these results suggest that parents and preschoolers do not expect that magical problems will always have magical solutions. Only more imaginative parents opt to try magical solutions even though children rate them as more effective.

1-S-92   Pretending to be a dedicated scientist boosts young girls' persistence in science

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It is a long-lasting issue that women are underrepresented in the STEM domain. To tackle this gender gap in early childhood, recent work shows that pretending to be a successful scientist increases girls' persistence in science (Shachnai et al., 2020). The present study examines the key factors that influence the effectiveness of this strategy, that is, the extent to which children find the role model identifiable. Given the gender stereotype against women's intelligence (Bian et al., 2017), we expect that linking a scientist's success to effort, but not raw intelligence, would encourage girls to identify with the role model and thus promotes their engagement in science. Four to 7-year-old children played a science game in one of three conditions (Baseline, Brilliance, Dedication). Before the science game, children in the Brilliance and Dedication conditions were told a story about a gender-matched scientist possessing the respective trait and asked to pretend to be the scientist during the game. Persistence was measured as the number of trials completed in the game. Preliminary results (N = 81) suggested an interaction

between gender and condition: Girls persisted less than boys in the Baseline condition, but longer than boys in the Dedication condition. There was no gender difference in the Brilliance condition. Thus, pretending to be a scientist that girls can identify with boosts their persistence in science, which may help reduce the gender disparity in science fields.

1-S-93   Fantasy engament and imaginary companions: Parents' attitudes and relation to theory of mind and executive functions

Natalia Velludo[1], Debora Souza[1]
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The present work aimed to test possible correlations between fantasy engagement, theory-of-mind and executive functions in a sample of 44 Brazilian preschoolers (M_{age} = 4.9 years; SD = 6,8 months), as well as to explore parents' perspectives on imaginary companions (n= 24). Spearman correlation tests revealed significant associations between theory of mind and fantasy orientation level, but the effect size was weak; between the score on the Bear/Dragon task and on the Less is More task; between performance on the Bear/Dragon task and PPVT scores; and between performance on the Less is More task and PPVT scores. Consistent with results from previous studies, parents have different points of view, varying from a balanced perception of the phenomenon, including both positive and negative aspects of high engagement in fantasy (41,7%) to an extremely positive view (29,2%). Only one participant showed and extremely negative attitude (4,2%).

T – Prosocial behavior

1-T-94   The ontogeny of children's social emotions in response to (un)fairness

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By around age 3 to 4 years of age children express negative emotional and behavioral responses to resource distributions that disadvantage them (Blake & McAuliffe, 2011; Lobue et al., 2010), suggesting that children's concern with fairness towards themselves emerges early in ontogeny. By contrast, before 7 to 9 years, children have been found to be accepting of unequal resource distributions that advantage them with a rejection of such resource allocations emerging gradually during school age (see McAuliffe et al., 2017 for a review). The emotional roots of children's sense of fairness towards others, however, remain poorly understood. Here, we ask if and when children show a negative social emotion, similar to shame or guilt, in response to advantageous unfairness. To this end, we are presenting children between 4 to 9 years of age with a scenario in which one child (the actor) selects one of two opaque boxes each containing rewards. In a nonsocial condition the reward distribution affects only the actor, while in a social condition the reward distribution affects the acting child and a peer recipient. The actor's choice of boxes results either in an equal (1,1) or an unequal (4,1; advantageous) resource distribution, and children's emotional expression is measured thereafter using a Microsoft Kinect depth sensor imaging camera (that records children's body posture). The crucial question we ask is if and when children show a lowered body posture (indicative of negative, shame- or guilt-like emotion) in response to advantageous unfairness. In addition, we are assessing children's rejection of advantageously unequal resource distributions (Blake & McAuliffe, 2011), and self-attributed emotions. Preliminary analyses (N =

169 out of planned 192) of children's rejection of the (4,1) resource allocation indicate a trend towards a two-way interaction of condition and age, b = 0.77, z = 1.8, p = .072, suggesting that children with age tended to increasingly reject advantageous resource allocations in the social, but not in the nonsocial condition (see Fig. 1). Moreover, analyses of children's self-attributed emotions indicate the presence of a three-way interaction of condition, distribution and age, b = -0.38, t(329) = -2.14, p = .033. In the nonsocial condition children reported, on average, more positive emotions in response to advantageous than to equal resource distributions. On the other hand, in the social condition, children, with age, reported more negative emotions to gaining an advantage over a peer than in response to equal distributions of resources (see Fig. 2). To summarize, preliminary findings indicate that children's costly behavior to reduce unfairness towards others gradually co-emerges with a negative emotional response to advantageous inequity. Children's negative emotional and behavioral responses to advantageously unequal resource allocations are, moreover, specific to a social context, in which a peer partner is disadvantaged by inequity. Data collection has been delayed by the pandemic, yet is currently ongoing, as are the analyses of children's body posture (link to preregistration: https://osf.io/xem8k/). We anticipate that both will be completed by the time of the conference.

1-T-95   The impact of household pets on children's daily lives: Differences in parent-child conversations and implications for children's emotional development
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Living with a pet is linked to a host of socioemotional health benefits for children (Melson, 2020). Yet, few studies have examined the mechanisms that drive the relations between pet ownership and positive socioemotional outcomes. The current study examined one of the ways that pets change the environment through which children learn, and whether childhood pet ownership might promote empathy through parent-child conversations about emotions and mental states (EMST), which has previously been linked to children's empathy development (e.g. Brownell et al., 2013; Aram & Shapira, 2012). Participants included 123 parent-child dyads (118 mothers, 4 fathers; 65 female children, 58 male children, M= 39.50 months) who were currently living or have never lived with a pet dog. As hypothesized, we found that pet-owning parents used a greater proportion of EMST language with their children when playing with their pet dog than with a lifelike toy, F(1,58) = 11.67, p = .001, but pet ownership was not related to children's empathy or prosocial behaviors. Interestingly, we found that parent's use of EMST language was related to children's prosociality when controlling for age, F(2, 56) = 3.61, p = .034. Our findings provide strong evidence that the presence of a household pet impacts the child's environment by altering the kinds of parental input that children receive at home, and over time, such changes in input may promote prosocial development.

1-T-96   When is it okay not to share? The effects of the origin of the resources on prescriptive sharing decisions
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[1]Yale University

People might decline sharing their resources with the less fortunate if they think they deserve their extra resources (Bègue et al., 2008). Here we asked whether children consider how the resources were acquired when deciding whether someone deserves to have more resources than others. Our data suggests that adults (N = 100) believe a person who has extra resources should share less of these resources if they acquired them due to hard work (i.e., merit condition) compared to the cases when they acquired them due to luck (i.e., windfall condition) ($p < 0001$) or because their parents have access to more resources than others (i.e., family resources condition) ($p < 0001$). Adults also believe less resources should be shared in the family resources condition than the windfall condition ($p = .03$). A follow-up experiment (N = 95) confirmed this difference between the family resources and the windfall conditions ($p < .0001$). However, data from 8-9 year-olds (N = 60) suggests that while children also believe less resources should be shared in the merit compared to windfall ($p < 0001$) and family resources ($p < 0001$) conditions, they do not differentiate the family resources from the windfall condition ($p = 1$). We are now running a follow-up experiment with 8-9 year-olds (target N = 60, estimated completion date: 2/28/22) to replicate these results. These findings suggest that children might have different beliefs than adults about the deservedness of extra resources.

U - Reasoning

1-U-97   Living in a digital world: Children's reasoning about how social history influences the value of virtual and real-life objects

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The non-obvious historical paths of objects are an essential part of how children interact with and assign value to objects (Gelman, 2013). In one experiment, we explored how children (ages 5-12) weigh two different histories when reasoning about object value in virtual and real-world settings. Children judged which of two objects a fictional peer liked and thought was special: one a peer created with a friend ("social history") and another created independently ("non-social history"). Using a GLMM (binomial), we found a main effect of value (like vs. special, $p < .001$). Specifically, children viewed social history as more important for determining an object's specialness than its like-ability. This effect grew with age ($p < .049$). This study is the first to demonstrate that young children differentiate between social and non-social histories of objects in assigning object value. It also suggests that children assign value in similar ways to virtual and non-virtual objects.

1-U-98   Children are sensitive toward the lack of significance in activities

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To live a meaningful life, we need to pursue work and activities with significance (i.e., the sense that something matters beyond the trivial or momentary) (Martela & Steger, 2016). Are we sensitive toward the lack of significance from early in life? We investigated 4-9-year-olds' valuation of significance in their evaluations and decisions about productive activities. In Study 1, we presented children (N = 81) with two games in which they could put together heart puzzles, one without significance (their work is taken apart), and one with minimal significance (their work is kept). Children were randomly assigned to play these games either repetitively or only for one round. We found that children across ages were more

likely to evaluate the game with minimal significance as being better and mattering more than the game with no significance across contexts (M = 0.70, p = 0.0003). Preliminary results from Study 2 (target N = 120, data collection ongoing) revealed similar patterns in children's motivation to play the games. The results provide initial evidence that children are sensitive toward the lack of significance in productive activities.

1-U-99   Is there a common resource for reasoning about confidence in childhood?

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Correlated individual differences point to a common resource for reasoning about confidence in adulthood (akin to 'g' for intelligence), but there is mixed support in childhood. Here, we use a within-subjects design to test for a common resource in which confidence representations exist in a common unit that is interchangeable across domains. Ninety-five 4-7-year-olds and 111 undergraduates answered episodic memory and area perception questions. On each trial, participants answered two questions, either from the same domain (e.g., memory and memory, "Within-Domain" condition) or from different domains (memory and perception, "Across-Domain" condition), and then indicated which answer they were most sure was correct (Confidence choice). Adults were more accurate on chosen (high confidence) than discarded items, with no accuracy cost for comparing confidence across-domains relative to within-domains, consistent with a common resource. Children were also more accurate on chosen than discarded items, but this effect was stronger for Within-Domain trials than for Across-Domain trials (data collection still ongoing). Thus, although children can compare their confidence for memory and area, there is an additional cost in Across-Domain trials. This could point to domain-specific differences in the confidence representations for memory and perception tasks that do not appear in adulthood, against a strong account of a common confidence resource.

V - Self

1-V-113   Implicit and explicit self-esteem diverge from each other during childhood: Implications for social-cognitive development

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Self-esteem remains one of psychology's central constructs. Based on dual-processing models, there is robust evidence from research with adults that explicit and implicit self-esteem are distinct constructs with different correlates and consequences. However, this conceptual and empirical distinction has been understudied in children, due to limited availability of measurement tools until very recently. To obtain a more complete understanding of self-esteem and its implications for social-cognitive developmental theory, we tested both explicit and implicit self-esteem in the same children. These assessments were done at two different ages, which allowed us to evaluate age-related differences, differences between girls and boys, and the relations of both types of self-esteem to math and language achievement. Our assessments were conducted at two key time points: (a) in early childhood (Mage = 7.5 years), and (b) in middle childhood as children transition to early adolescence (Mage = 11.5 years). A sample of 375 children in Grades 1 and 5 (190 girls) completed one explicit and one implicit measure of self-esteem. The explicit measure was the Global Scale of the Self-Perception Profile for Children

(Harter, 1982). For the implicit measures, the Child Implicit Association Test (ChIAT) was used, which is an adaptation of the adult IAT using nonverbal methods. The underlying principle of the ChIAT is that children find certain associations to be more natural, and they respond to them faster. For example, if children have high self-esteem, they will respond more quickly to me = good than to other control pairings. Importantly, we also measured the same students' math and verbal achievement, using math and language grades. Three new findings emerged (see Fig. 1). First, self-esteem was lower in older than in younger children on explicit (t = 5.54, p < .001), but not on implicit measures (p = .16). Second, gender differences favoring boys at the older age were demonstrated on explicit (t = 2.59, p = .01), but not on implicit measures (p = .42). Third, explicit self-esteem was positively related to higher math and language achievement for both genders (rs > .15, ps < .05), but implicit self-esteem accounted for additional unique variance in predicting girls' language achievement only (β = .19, p = .009). Collectively, results show that explicit and implicit self-esteem diverged from each other in multiple ways. The contrast between the implicit (no age difference for girls; stronger self-esteem in older boys than in younger boys) and explicit results (lower self-esteem in older children of both genders than in younger children) documents that implicit self-esteem is comparable between early childhood and early adolescence, whereas explicit self-esteem is lower in early adolescence than in early childhood. Explicit and implicit self-esteem are conceptually and empirically differentiable in childhood and we will discuss divergent downstream consequences for later stereotype development, identity formation, in-group affiliations, and academic learning.

W – Social categories and groups

1-W-100   The development of social group concepts and stereotypes about wealth and urban-rural geography

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Across the United States, inequalities persist based on the amount of money people have and where they live (Kuhn et al., 2017; Lichter & Brown, 2011). Lifestyle differences among wealthy versus impoverished and urban versus rural people - social, cultural, material - impact children's lives across domains ranging from social development to academic opportunity (Kraus et al., 2012; Tine, 2017). Stereotypes based on geography and wealth further perpetuate these existing inequities (Spencer & Castano, 2007). Yet, the scope of children's reasoning about wealth and geography as intersecting social properties remains unclear. We conducted research with 298 4-11-year-old children to gauge children's knowledge of inequalities and stereotypes based on wealth and geography. Study 1 participants (N=144 in upstate New York) indicated which of four target children could be described by various traits, knowledge, and behaviors; target children consisted of one urban impoverished child, one urban wealthy child, one rural impoverished child, and one rural wealthy child. There were many effects based on target wealth. For instance, participants selected wealthy targets as more likely to be smart (OR=3.43, p<.001), leaders (OR=3.88, p<.001), and knowledgeable about world travel (OR=5.30, p<.001), but selected impoverished targets as more likely to be hardworking (OR=0.17, p<.001). Some effects also changed with age; for example, younger participants selected wealthy targets as nice (p<.05), but older participants selected impoverished targets (p<.001). Relative to participants' wealth-based responding, there were few effects of target geography. See Figure 1 for a graph of Study 1 results. Study 2 participants (N=80) completed the same task as Study 1 but were sampled from rural Arkansas to probe replicability among a qualitatively different sample. The Study 2 results largely replicated Study

1: Impoverished targets were selected as more likely to be hardworking (OR=0.20, p<.001), whereas wealthy targets were selected as more likely to be smart (OR=3.56, p<.001), leaders (OR=15.77, p<.001), and knowledgeable about world travel (OR=3.41, p<.01). Again, there were few effects of target geography. Following Studies 1 and 2, it was unclear whether participants did not have a robust conceptualization of geography as a socially relevant property, or whether instead geography was overshadowed by information about wealth. Study 3 asked children about geography stereotypes in isolation, without providing wealth information. Study 3 participants (N=74) answered the same questions as in Studies 1-2 about urban and rural targets. Here, participants were more likely to select a rural target as hardworking (OR=4.11, p<.001) and an urban target as smart (OR=.24, p<.001) and a leader (OR=.05, p<.001). We also added a new question about who was likely to be rich or poor. Participants selected an urban target as rich (OR=.06, p<.001) and a rural target as poor (OR=14.20, p<.001), providing evidence of overlap in children's concepts of wealth and geography. Overall, Studies 1-3 suggest that children reason about both wealth and geography as socially relevant properties, but wealth may be more salient. This work also illuminates the content of children's wealth and geography stereotype knowledge. An ongoing Study 4 (target N=144) investigates the knowledge of children from urban and wealthy environments, which were largely absent from the present samples.

1-W-101 Effects of learning about systemic racism on children's reasoning about unequal outcomes

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Does teaching children about structural racism impact their understanding of inequality? Children display a complex understanding of race and racism by the time they enter elementary school, yet school curricula may not adequately cover issues of racial inequality in contemporary America. This study tests whether a lesson on the historical roots of structural racism can affect children's perceptions of inequality, how it manifests across various situations, and their reasoning about fairness. We predicted that learning about systemic racism would improve children's ability to recognize, reason about, and explain how social structures negatively impact opportunities and life outcomes of Black Americans. Preliminary data (n = 56) suggests that 6- to 11-year-old children who receive a lesson about structural racism are more likely to assign Black individuals as having unfavorable outcomes and White individuals as having favorable outcomes across a variety of inequitable situations (e.g., discipline in schools, access to healthcare). Initial findings support the benefits of teaching children about structural racism, with implications for including race in school curriculums and how parents talk to children about the history of racism and its role in American society.

1-W-102 The effects of racial in-group biases on white American children's social learning and social preferences

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There is a revitalized call and sense of urgency to redress racial injustices by understanding the developmental roots of racial biases. We examined whether White monoracial children's racial in-group

biases reduce in response to positive epistemic and moral information about Black informants. Four- and six-year-old White children (N = 95) participated in a brief intervention in which they heard stories of a Black informant engaging in prosocial actions (e.g., helping others) in the Moral condition or competent actions (e.g., accurately naming animals) in the Competence condition. Compared to their baseline preferences, children were more likely to selectively learn new information from the Black informant over the White informant after the intervention (p = .0006); Children's preference to learn from the racial-outgroup member in the Competence condition was also significantly higher than chance (p = .009). By contrast, children's explicit social preferences for racial in-group members was attenuated in the Moral condition (p = .01), but not in the Competence condition. Taken together, these findings indicate that children make distinct use of epistemic characteristics when learning from racial out-group members and moral characteristics when socially engaging with them. This project may have direct implications for parenting and education practices that serve to reduce White children's racial biases in learning and social contexts.

1-W-103   **Tell me more! Children's use of evidence to evaluate negative claims about social groups**
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Children consider group membership and behavioral evidence as important information when evaluating social groups (Baron et al., 2015). This study is the second of two examining if children require different amounts of behavioral evidence before accepting or rejecting a negative claim about social groups. Data collection is ongoing over Zoom (N=59 of 72 7- and 8-year-olds). Children are assigned to an experimental condition (EC) with a minimal group prime, or a control condition (CC) without one. They must decide if three negative claims about each group are "true" or "not true". Participants can decide with no additional information, or they can learn up to four pieces of evidence about the group in question. Given that children may be more hesitant to accept a negative claim about their in-group as true, we hypothesized that children in the EC would hear more evidence about their in-group. A Linear Mixed Model with amount of evidence used as the response variable and the interaction of condition and group as predictors found no interaction of condition and group, meaning that similar amounts evidence were used to evaluate negative claims about both groups. Results were similar in our previous study in which children evaluated claims about individual in- and out-group members, suggesting that although children may show in-group bias, they are open to new evidence about in- and out-group members. Implications for potentially undercutting stereotyped beliefs will be discussed.

1-W-104   **Children's evaluations of helped students across academic domains**
Lesenia Fish[1], Lindsey Hildebrand[1], Shannon Hayes[1], Sara Cordes[1]
[1]*Boston College*

What do children think about students who need help in the classroom? Do their expectations of who needs help align with common gender stereotypes? In this study, we asked what gendered expectations children (N = 168; Mean age = 7.77) had for students receiving help in math (male-stereotyped), reading (female-stereotyped), and general classrooms. Results reveal that although children show an own-

gender bias for students needing help with general classwork, they expected boys to need help with both math (marginal p = 0.052) and reading (p < 0.001) classwork. Moreover, children judged other students who did not need help as being nicer, smarter, and better at school than those who did, and were more likely to want to befriend those who did not need help. Together, results suggest that students who need help in the classroom may suffer from negative evaluations by their peers both in terms of ability in the classroom and likability.

1-W-105 **Young children associate both competence and confidence with boys more than girls: Evidence for the early emergence of gender stereotypes about agency**

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Agency, conceived as both competence and assertiveness (confidence), is largely associated with men (e.g., Eagly et al., 2020). Here, we ask: when do children begin to associate agency with men and boys more than women and girls? Previous investigations have revealed evidence of an early association between competence and men (e.g., Bian et al., 2016), but less research has focused on beliefs about confidence, and no study has investigated the development of these facets simultaneously. We elicited 180 4-8-year-olds' 1) gendered expectations about competent, confident, not competent, and not confident children, and 2) explicit confidence and competence gender stereotypes. With age, children expected confident and competent individuals to be boys. Children's expectations about who is not confident and not competent were more nuanced and varied across age and gender. Explicit items suggested patterns of social desirability effects for competence but not confidence items. Both boys' and girls' explicit associations between gender and competence reflected own-gender biases at young ages but no bias at older ages. Conversely, girls' explicit associations between gender and confidence revealed a switch from own-gender bias to bias in favor of boys with age, whereas boys indicated consistent boy-confident associations. Results provide the first evidence that beliefs associating boys with agency emerge early in childhood but that these beliefs show importance nuance.

1-X-106 **The doctor doesn't know anything, but he should answer this question: How inaccuracy affects children's judgments of expert knowledge**

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Experts are individuals who have specialized knowledge or mastery in a particular domain or task. Previous research has suggested that by age 5, children understand the knowledge an expert has in their domain and trust experts to answer questions in that domain more than experts in an unrelated domain (e.g., Lutz & Keil, 2002). Also, children distrust informants who show a history of inaccuracy (e.g., Koenig & Harris, 2005). However, little is known about how kids think about an expert who gives incorrect answers. Because experts do not know everything (Tetlock, 2006), and sometimes make mistakes (e.g., giving a misdiagnosis; Singh et al., 2014), it is important to know how children make judgements about inaccurate experts' knowledge. Across two studies, 6- to 9-year-olds (N = 160; 82 males, 78 females; 75% White) were introduced to two experts in different domains (a doctor and a mechanic) and initially rated how much each expert knew about their relevant domain using a 7 point scale. Then, over 4

consecutive trials, participants heard one expert give obviously incorrect answers to questions in their domain (e.g., Q: "Which body part do people use to kick?" A: "People kick with their ears"). After each incorrect answer, children explained why they believed the expert gave the inaccurate answer (open-ended in Study 1 and forced-choice in Study 2) and again rated both experts' level of knowledge. Finally, children chose which expert knew more about each domain of expertise (bodies and vehicles). Study 2 also included an additional task where children were told that they would be playing a question game and they could choose themselves or one of the experts to answer difficult questions about bodies and vehicles (similar to Danovitch et al., 2019). Across both studies, children's ratings of the inaccurate expert's knowledge decreased as they heard the expert give more inaccurate answers, regardless of the type of expert, $Fs > 88.20$, $ps < .001$. In Study 1, children's age and explanations predicted their knowledge ratings ($R^2 = .18$; $F(8, 309) = 8.204$, $p < .001$), such that younger children and children who described the expert's mistakes in terms of negative traits gave lower knowledge ratings to the inaccurate expert than children who did not describe the expert in that way and older children. Also, children who endorsed the inaccurate expert's answers (e.g., explained that the expert's statements were correct) gave higher knowledge ratings to the inaccurate expert than children who did not endorse his answers. In the question game in Study 2, children assigned questions in the inaccurate expert's domain to the inaccurate expert 77% of the time, suggesting that despite the expert's inaccuracy, they continued to trust him to answer questions correctly. Together, these studies demonstrate that children view an expert who provides inaccurate information as not knowledgeable, although younger children may be less sensitive to an expert's repeated errors than older children. These results also suggest that judging an expert's knowledge in one task may not relate to children's need for that expertise in a different task (Boseovski et al., 2017). If the goal of social learning is to receive the best answer from the best possible informant, children might prioritize expertise above all for future learning (i.e., asking a new question) but not prioritize it when making overall judgements about the individual's knowledge attributions.

X – Social cognition and social learning

1-X-107 **Conversations from Arendelle: How do children construct musical meaning in a narrative context?**

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Children's memory for song lyrics, including the use of music as a memory aid for sustained learning, has been broadly investigated in the psychological literature (e.g. Calvert & Tart, 1993; Good, Russo, & Sullivan, 2014; Wallace, 1994), but little is known about the developmental course of children's ability to construct meaning from songs containing both concrete and metaphorical language presented in a narrative, multimedia context. The ubiquity of the Frozen movie franchise among children offers a unique opportunity to study age-related change in children's understanding of musical meaning in such a context. The current study examines age-related change in children's understanding of the affective meaning of the hit song, "Let It Go" using a brief visual comprehension measure and a semi-structured interview conducted one-on-one, virtually through video conferencing (Zoom). Participants include children from 3- to 10-years old whose parents report that they are familiar with and enjoy Frozen. Their global comprehension of the song, "Let It Go," is assessed using a series of two-alternative forced-choice visual responses, yielding a percentage correct (adult participants perform at approximately 100% on this measure). Children then watch the music video of "Let It Go," with the researcher pausing at three

points in the song to ask how the child thinks Elsa is feeling and how the child knows. These open-ended answers are then coded by trained research assistants for reference to lyrics, musical elements, and visual elements from the accompanying movie. Forty-six children have currently participated, and data collection is still ongoing. Preliminary results show that only 3-year old children perform at chance (50%) on the global comprehension measure, with all older children at approximately 89% accuracy, on average. Additionally, we are examining the types of cues children report using to construct their understanding (lyrical, non-lyrical musical, narrative, behavioral, and appearance), and preliminary analysis suggests a reliance on Elsa's appearance, her actions onscreen, and the narrative as a whole to construct an understanding of the song, "Let It Go." Children from the entire age range tested only report using song lyrics as a cue to meaning 17% of the time and non-lyrical musical elements 14% of the time. Younger children are less likely to mention using any musical cues at all. Children's verbal assessment of how Elsa is feeling at the three subsequent checkpoints also varies with age, with older children more likely to perceive an affective transformation over the course of the song. The current study begins to illuminate developmental change in how children construct meaning from a familiar song in a multimedia context, contributing to our understanding of children's multimedia engagement and their emerging sensitivity to musical emotion.

1-X-108   **Children's trust of an inaccurate robot depends on the robot's motives**

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Children in the current world are not only learning from adults, but also from technologies, such as robots. Prior work has found that children learn from accurate humanoid robots (Brink & Wellman, 2020), but it remains an open question as to whether children would still learn from a robot that, after giving accurate information, is suddenly inaccurate. With humans, a single instance of inaccuracy might be forgivable if perceived as mistake. Will the same be true for robots? In this study we compare robots that respond to being inaccurate in a way that signals that the error is accidental ("oops I made a mistake") or intentional ("haha I told you the wrong one"). In one condition, we add an apology to the accidental mistake, suggesting that the robot, though inaccurate, has pro-social motives. We explore if children will continue to learn from each robot as compared to a human who makes the same response (mistake, mistake and apology, and intentional error). Four- to 7-year-old children (Current N=60, M=5.52, SD=1.10; data collection ongoing) played a word-guessing game with a human or Nao robot informant over Zoom. Children were shown novel objects and saw the informant say what they think it's called. For the first four trials (Accuracy Phase), the informant gave the right answer, so endorsing their answer led to children getting it right. For the next four trials (Inaccuracy Phase), the informant gave the wrong answer, so endorsing their answer led to children getting it wrong. The informant responded to getting the question wrong either by admitting their mistake (mistaken), or by adding an apology (apologetic), or by signaling that the inaccuracy was intentional (intentional). For each trial, we measured if children picked the label that the informant gave. For children in the robot conditions, we also followed this with an interview probing children's agency judgments of the robot. Preliminary results show that, at the end of the Accuracy Phase (at Trial 5), most children trust the human and robot at similarly high rates (see Fig. 1). We compared children's trust for each subsequent trial to Trial 5 to investigate when children lost trust in the informant. We found that children's loss of trust depended on agent and condition. For the human, children lost trust after two trials, regardless of whether the

inaccuracy was accidental, apologetic, or intentional, ps<.03. For the robots, children immediately lost trust in the mistaken robot after only one error, p=.03. Children lost trust after two errors when the robot was intentional, p=.01. Importantly, for the apologetic robot, children maintained their trust until the last trial, p=.02 (see Fig. 1). These social cues also influenced children's perceptions of the robot's agentic qualities. Children judged the mistaken robot as computer-like (M=0.67/4, SD=0.87), while children judged the apologetic and intentional robots as in between a computer and person (apologetic: M=1.56/4, SD=1.13; intentional: M=1.60/4, SD=1.51). Children also said that the apologetic robot could think (M=1.60/2, SD=.70) and be their friend (M=1.70/2, SD=.48) more than the intentional robot (think: M=1.00/2, SD=.67, p=.06; friend: M=1.00/2, SD=.82, p=.03). Together, these findings suggests that children's trust of an inaccurate robot depends not only on the robot's humanoid features or past history of accuracy, but also on cues that signal human-like moral qualities, both prosocial and antisocial.

1-X-109   **Dialogic reading promotes parent mental state talk during shared reading**

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When caregivers talk about mental states, young children's emotional understanding increases (LaBounty et al., 2008; Ruffman et al., 2002). One way to promote regular emotion-focused talk is dialogic reading (Whitehurst et al., 1988), an intervention that fosters shared conversation during storybook reading. U.S. parents and children (3-5 years, 77 dyads) completed a 2-week (10 session) home intervention using either: 1) an experimental eBook with a character who modeled open-ended dialogic questions; 2) a control version without the character; or 3) chose which version to read each day. The intervention did not focus on mental state talk. Pre- and post-intervention, we recorded family reading sessions, and coded parents' mental state talk using King and La Paro's (2015) mental state word list. Condition differences emerged post-intervention for emotion, $F_{(2, 74)}=5.58$, p=.006, cognition, $F_{(2, 74)}=10.78$, p<.001, and perception words, $F_{(2, 74)}=6.26$, p=.003. Parents exposed to the dialogic questioner eBook (experimental and choice condition) used significantly more mental state words than parents in the control condition. This method could advance children's emotional understanding by exposing them to parent talk about story characters' internal states and emotions.

1-X-110   **Why do people experience failure? Perceptions of the rich and poor**

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When we see someone fail, we tend to view the outcome differently based on their SES. If they are wealthy, we blame their failures on situational factors, but if they are poor, we blame the person for the bad outcome (and vice versa, Iatridis & Fousiani, 2009). The current study aims to investigate the source of these biases. We evaluate 1) how children make attributions about failure, 2) if their attributions are biased by SES, and 3) if these attributions change during development. We presented 5- to 10-year-old children (N=55, target N=117) with scenarios where low- and high-SES characters experience failure. Children then used Likert scales to judge the contribution of "the person" and "the situation" (SES) to the outcome. We found significant AttributionxAge, SESxAttribution (person/situation), and SESxAge

interactions. Post-hoc analyses revealed that older children's Likert judgements were significantly higher than those of younger children. We also found that children in all age groups tended to blame SES and personal factors equally when low-SES people failed, but that they blamed personal factors more than SES when high-SES people failed. This result contradicts prior findings with adults. Finally, older children blamed people significantly more than younger children, and older children blamed SES significantly less than younger children. These findings suggest that concepts of blameworthiness undergo dramatic changes over the course of development.

1-X-111 Perspective taking on relationship quality: Parent versus child beliefs about child attachment security

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Parents and children do not share the same perspective on children's emotions: Parents judge that children feel more optimistic and less worried than children self-report, and parents expect their children's emotions to align with their own (Lagattuta et al. 2012). We examine parent versus child views of children's attachment. This is of theoretical and empirical importance as researchers often rely on parent reports in children under 8 years. It is an open question how reliably children can reflect on the parent-child relationship, as well as how well parents can take their child's perspective. Four- to 10-year-olds (N=154) reported the frequency (5-point scale) they experienced emotions and thoughts reflective of secure attachment using a questionnaire adapted from Brenning et al. (2011, 2014). Parents predicted how their child would respond to the same items. A subset of dyads (N=90) repeated the measure one week later. Although parent and child reports correlated in children 6 years and older (rs>.34, ps<.016), parents of 4- to 7-year-olds expected their children to be more securely attached than children reported (ps<.001), with no difference between 8- to 10-year-olds and parents (p=.889). All age groups and parents exhibited strong test-retest reliability (rs>.62, ps <.001), indicating that they held stable views of the relationship. Further analyses will examine whether parents' attachment to their own caregiver biases their ability to take their child's perspective.

1-X-112 Parental authoritarianism negatively predicts accuracy in identifying children's interests

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Authoritarian parents seek to shape their children's attitudes and behaviors (Baumrind, 1966). The current study examines whether authoritarianism relates to parents' accuracy when judging their children's interest in science (and non-science) topics. Children (N = 146, ages 7-11) rated their level of interest in 5 science and 5 non-science topics on a 4-point scale (Williams, Danovitch, & Mills, 2021). Separately, parents rated their child's interest in the same topics. Parents also completed the Parental Modernity Scale, a measure of authoritarian vs. progressive beliefs about parenting (Schaefer & Edgerton, 1985). Preliminary analyses revealed children reported high interest in both science (M = 3.20, SD = 0.62) and non-science (M = 3.29, SD = 0.49) topics overall, but there was significant variability. For this abstract, accuracy scores were constructed by taking the absolute value of the difference between

parent and child ratings for each item. Authoritarian beliefs correlated with accuracy, such that parents who more strongly value authority are less accurate at judging their children's interests, r = .378, p = .001. For CDS, a truth and bias model (West and Kenny, 2011) will be used to examine how authoritarianism relates to both accuracy and to specific kinds of bias.

2-A-1   Instruction in the eye of the beholder: How children interpret gesture and action strategies in a math lesson

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When teachers provide instruction in a math classroom, they use many tools to help children learn. Two commonly used tools are actions performed on manipulatives and co-speech gestures - hand movements that represent information. Action and gesture both support learning (see Goldin-Meadow, Levine, & Jacobs, 2014, for a review), and one assumption made is that children benefit from these tools because they pick up on the problem-solving strategies embodied in the specific actions and gesture used during instruction. However, it is not clear what meaning children attribute to action and gesture strategies. Furthermore, as not all children benefit equally from action and gesture instruction, understanding the variability in children's interpretations of these strategies may lead to insight into when to employ these tools for individual learners in a classroom. In the current study, we directly asked 202 children (8- to 10-year-olds) to interpret gesture- and action-based instructional videos on mathematical equivalence, a pre-algebraic concept that lays the foundation for success in algebra. During a Zoom session, children watched two videos in which a teacher presented an equalizer strategy for solving a mathematical equivalence problem in speech (e.g., 2+3+9=_+9; "I want to make one side equal to the other side. Two, plus three, plus nine equals fourteen and five plus nine equals fourteen, so one side is equal to the other side") while producing a grouping strategy in either action or gesture - picking up number tiles over the two and three and holding them in the blank (action), or producing a V-point to the two and three and then pointing to the blank (gesture) (see Novack et al., 2014 for similar method). The children were then asked several questions about the videos, such as "Can you tell me what happened in that video?" and "What was she doing with her hands?" We also collected individual differences measures (working memory, general gesture processing, and prior knowledge of math equivalence) that could influence a child's interpretation of mathematical equivalence instruction. Preliminary analyses suggest that, despite the explanatory power of gesture and action strategies, children rarely mention them when asked to describe instruction. Children in the gesture condition never mentioned the teacher's hands, and only 10% of children in the action condition mentioned the hands, in the context of moving number tiles. But the presence of these forms of movement does affect how children view otherwise identical lessons: Children who watched videos of action instruction were more likely to describe the instructor's goal as teaching or explaining how to solve the math problems, compared to children who viewed videos of gesture instruction. However, when directly asked about the instructor's hand movements, children who saw gesture instruction were more likely to interpret the instructor's movements as conceptually meaningful. Together, these results suggest that children overlook the pedagogical value of both actions and gestures. But when pushed to focus on the movements, children find gestures to be more meaningful, which may underlie differences in how gesture and action impact learning.

A – Action

2-A-2   Human factors for children: optimizing buttoning in relation to children's spatial and motor skills

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Buttoning is an adaptive behavior comprised of motor and spatial skills. We examine how children coordinate these skills and whether children's clothing is optimally designed to promote buttoning. Forty-eight 5- to 7-year-old children, buttoned shirts with small (9mm) or large (20mm) buttons. Younger children more often inserted larger than smaller buttons, but older children performed equally well with both sizes (Age x Button Size interaction, p < .001; Figure 1a). Similarly, younger children took longer to insert smaller than larger buttons, but this difference decreased with age (Age x Button Size interaction, p < .001; Figure 1b). In Study 2, we performed an environmental scan of children's shirts (N=274) in three department stores. Smaller buttons (median split, 16mm) were more common than larger buttons on girls' and boys' shirts (ps < .0001; Figure 1c). Collectively, findings suggest that larger buttons aid motor control, and thereby promote children's independent dressing.

2-A-3   It takes two: Process praise during trying and success is associated with greater infant persistence

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Persistence has been linked to positive developmental outcomes (Banerjee & Tamis-Lemonda, 2007). Prior research established that persistence can be cultivated in infancy through process praise (i.e., praise for effort; Lucca et al., 2019), which may support a positive association between effort and success (Inzlicht et al., 2018). We hypothesized that parental use of process praise both during moments of trying and success may help children appreciate the association between hard work and success. In Experiment 1, behavioral coding of archival data was utilized to investigate how differences in the timing of praise relate to effort. Raters identified how the process praise of 18-month-olds' (n = 29, mean = 18.50 months, 11 female) caregivers during a semi-naturalistic, dyadic task overlapped with two key infant behaviors: trying and success. The number of key times infants received process praise was positively correlated with persistence both on the dyadic task (r = .41, p = .03) and an independent task (r = .41, p =.03). Further, the benefits seemed to depend on receiving praise at both times, as there were no differences between infants who only received praise during one key time (i.e., trying/success) and those who received no overlapping praise (p's > .67). In Experiment 2, we seek to extend these findings to participants' own homes while integrating an eye gaze paradigm to explicitly test whether receiving temporally aligned praise builds effort-success associations.

2-A-4   A parent-based intervention program for training prospective control skills in children

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We investigated whether training parents to use a prospective gap communication strategy when crossing virtual roads with their children (i.e., alerting children to a crossable gap prior to its arrival), resulted in safer road-crossing performance not only when the child crossed roads with the parent, but also when the child subsequently crossed alone. Thirty-eight 6- and 7-year-old children and their parents participated. Parents in the intervention group were trained on how to use the prospective gap communication strategy. Parents and children first crossed the virtual road together 20 times and then the child crossed the road alone 20 times. Parents in the intervention group were significantly more likely to use the strategy compared to parents in the control condition. Parents' use of a prospective gap communication strategy predicted a .21 second decrease in children's timing of entry relative to the lead car in the gap during the joint crossing task, indicating that children timed their entry more tightly when parents indicated which gap to cross prior to its arrival. When children crossed alone, there was no significant effect of condition on timing of entry, but there was a marginal effect of condition on time to spare; being in the treatment condition was associated with a .23s increase in time to spare. This investigation shows promising effects of a parent-based training program to increase young children's prospective control over movement while crossing roads.

2-B-5   Longitudinal executive function skills in youth: Relations to age, puberty, and ADHD

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Executive function (EF) skills in childhood are predictive of academic achievement, health behaviors, and mental health outcomes. Previous literature has linked ADHD with EF abilities, but the nature and direction of the relationship is not fully understood. Therefore, examining longitudinal variation in EF abilities in youth with and without ADHD could be useful for predicting and improving health and academic outcomes. Utilizing 3 years of annual longitudinal data from a community sample heavily recruited for youth with mental health diagnoses (n=99, M age year 1 = 12.77, range year 1= 8.05-19.14 years), we examined how age, self-reported puberty (PDS Scale), ADHD diagnosis, and ADHD symptom burden related to EF abilities across time. At year 1, 56 youth had at least one mental health diagnosis, including 46 youth with an ADHD diagnosis. We examined response times (RT) and accuracy on 7 EF tasks, which were combined to make 3 sub-component scores of EF (inhibition, working memory and switching), as well as a composite EF score. We examined EF performance across a parent-report of ADHD symptom burden, youth self-report of ADHD symptom burden, and diagnostic status. Using mixed effects regression modeling, we found that EF strongly improved across age, but the longitudinal developmental pattern differed depending on the aspect of EF being examined. Youth age and puberty levels interacted to predict composite EF accuracy, such that older youth with lower puberty scores had better EF performance than those with higher puberty scores, suggesting slower puberty is advantageous to EF growth. We then turned to the relationship between ADHD and EF. Using mixed effects regression, we found EF abilities predicted ADHD symptom burden across development, while accounting for age and sex, such that lower EF accuracy scores and higher EF RT related to higher levels

of ADHD symptom burden. Similarly, ADHD symptom burden predicted EF abilities across development. ADHD diagnostic status, or mental health diagnostic status in general, did not predict EF abilities across development. Next, we tested whether EF abilities or ADHD symptom burden predicted future change in the other using cross-lag panel models. EF accuracy scores at year 1 predicted future youth self-report levels of ADHD symptom burden at year 2 and year 3, while controlling for youth age, sex, and year 1 ADHD symptom burden levels. The same pattern of results were found for the parent report of youth ADHD symptom burden, and similar results were seen for EF RT. Critically, when testing the other direction (ADHD to future EF), the results for any year-to-year change were not significant. Thus, while longitudinal measures of ADHD and EF abilities predict one another, cross-lag panel models indicate EF abilities more strongly influence future levels of ADHD symptom burden rather than the reverse. These results suggest EF abilities could be a protective factor for the development of ADHD, such that better EF could predict a trajectory of lower ADHD symptom burden. Early assessment of EF skills may serve as an important tool to assess whether ADHD symptoms will later remit or persist.

B - Attention

2-B-6   The relation between memory for temporal context and executive function in preschool and school-age children

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Time is an essential feature of episodic memory--memory for events from a specific time and place (Tulving, 1972). Temporal memory (i.e., memory for 'when') development is important for cognitive and socio-emotional outcomes. Memory for temporal context (e.g., placing events on conventional time scales) improves substantially from 4 to 6 years of age (Pathman et al., 2013). To recall the temporal context of events, Friedman (1993) discussed how adults and children reconstruct the time of an event by combining recalled details with time knowledge. Reconstruction abilities also emerge in early childhood and show marked development during the transition to middle childhood (Friedman, 2014). To engage in reconstruction, children may use executive function (EF) skills given the need to manipulate event representations and consider flexibly episodic information and semantic knowledge. The goal of the current study was to use a novel design to examine how the development of reconstruction from early to middle childhood relates to EF. Eighty-one 4- to 7-year-old children heard two stories about child characters participating in actions outside (e.g., blowing bubbles) that took place in specific temporal contexts (e.g., Fall, Morning; Spring, Night). For each story, the experimenter included temporal cues (e.g., leaves changing colors, sun coming up) but never explicitly stated the season or time. After a delay, participants answered forced-choice temporal context questions about the season and time of each story, as well as forced-choice questions about all the temporal cues. We calculated temporal context scores by summing the number of correct responses to the season and time questions (4 total). These scores provide a measure of reconstruction abilities given that participants need to recall temporal cues from the story and combine that with their time knowledge to respond correctly. We calculated temporal cue scores by summing the number of correct responses to the temporal cue questions (8 total). These scores provide a measure of children's memory for contextual information that is related to the temporal context of the stories. We used the Dimensional Change Card Sort (Zelazo, 2006) to measure cognitive flexibility and the backward digit span (Wechsler, 2003) to measure working memory. We calculated an EF composite score by converting scores for these measures to z-scores and averaging them. We conducted correlations among temporal context scores,

temporal cue scores, and EF for younger (i.e., 4- and 5-year-olds) and older (i.e., 6- and 7-year-olds) children. For younger children, only temporal cue scores were related to EF, $r(39)=.414$, $p=.008$. This aligns with previous findings that EF is related to memory for contextual information during the preschool period (Rajan et al., 2014). For older children, only temporal context scores were related to EF, $r(40)=.543$, $p<.001$. In this task, participants needed to draw on their memory for temporal cues to recall the season and time of each story. The pattern of results could suggest that older children reconstructed the temporal context, whereas younger children did not, suggesting that age-related differences in EF make it more difficult for younger children to use reconstruction.

2-B-7   Between-task and between-year intraindividual variability in cognitive performance: associations with children's attention problems

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Identification of attention problems in children is crucial for optimal academic and social development. Intraindividual variability (IIV) in cognitive performance tasks is an indicator of attention problems, even after controlling for average levels of cognitive performance (Kofler et al., 2014). Previous work has primarily focused on between-task and between-trial IIV, rather than assessing if longer range IIV indicators (i.e., between-year) also predict attention problems. The present study assessed between-year and between-task IIV (quantified using the coefficient of variation) in cognitive performance using three waves of data (when children were 6, 7, and 8) from the Western Reserve Reading Project (N = 607). Between-year and between-task IIV in cognitive performance were computed and correlated to test the association between the two types of IIV. Multiple regression was used to test if between-year and between-task IIV predict child attention problems. Results found that between-year and between-task IIV were significantly positively associated with each other. Controlling for average levels of cognitive performance, between-task IIV significantly predicted worse child attention at age 8 ($b = -.63$, $SE = .26$, $p = .017$), but not at age 6 or 7. Identifying behavioral cognitive performance attributes that are related to children's attention problems is important in informing targeted interventions to reduce problems and promote positive outcomes.

2-B-8   The effects of distraction on attention and math and phonics performance in kindergarteners and 2nd graders

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Previous research has shown that distraction impedes performance and attention during the preschool (O'Toole & Kannass, 2021) and teen years (Pool et al., 2003), but little is known about how televised distraction may affect attention and academic performance in early elementary school aged children. This project investigated the effects of distraction on kindergarteners' and 2nd graders' attention and math and phonics performance. Seventy-nine kindergarteners and 2nd graders completed paper and pencil math and phonics tasks during two 4-minute trials (1 task per trial) and were recorded via zoom. Participants were assigned to either a distraction or no distraction condition. In the distraction condition, a PBS kids show played continuously on a laptop in front of the child. Coders recorded looking

to the task; task scores were calculated. Children looked significantly less at the task in the distraction condition, and performance on the math problems were more susceptible to distraction.

2-B-9   Yawning with the cool kids: Children's contagious yawning to infants, kids, and adults

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Contagious yawning (CY) is a form of mimicry and emotional contagion that occurs in approximately 40-60% of the adult population. Children begin exhibiting CY around five years of age. Several factors are reported to be associated with CY in adults, including relationship to the model and empathy. Seven- to 9-year-old children (N = 41) saw videos of infants, children, and adults, each with and without yawning. We predicted children would show higher rates of CY to same-aged peers, possibly driven by affiliation motivation or experience. Children yawned more in response to yawn videos than to control videos (t(40) = 2.74, p = .009, d = 0.43). However, the number of yawns across yawn videos of different age groups did not differ (F(2,78) = 1.25, p = .294), suggesting children were not yawning more to same-aged peers. Similar to adults, we found stable individual differences: children who yawned more to one video also yawned more to another video (rs = .50-73, ps < .003), suggesting that children vary in their susceptibility to CY. We detected no correlations between CY and either cognitive empathy or age (ps > .05). In line with CY in adults, 43% of children demonstrated CY, however, they did not selectively yawn to peers. Additionally, we did not find evidence for a relationship between CY and empathy, as suggested in adult studies, therefore; future studies should explore aspects of social cognition that may play a role in CY in children.

C - Categorization

2-C-10   The development of conceptual knowledge about food and its links with food rejection in young children (3-7-years-old)

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Children as young as two years old interpret the appropriateness of objects and situations based on conceptual features, such as script knowledge (i.e. items at a party) or thematic knowledge (i.e. a rabbit and a carrot). Such conceptual knowledge is abundant in the food arena, as we interpret and understand food for the context in which it is situated (e.g. pancakes are considered appropriate breakfast food). This is true for adults, with studies showing that conceptual knowledge of food, namely script and thematic associates, heavily influences whether we choose to consume food. However, little research has investigated how young children mentally represent the food domain, and even fewer have investigated how children's conceptual knowledge guides food acceptance. The first objective of this research was to determine the developmental trajectories of different conceptual structures available in the food domain. Two studies in the US (n = 36) and France (n = 129) tested 3-5-year-old children's conceptual development across meal scripts (e.g. soup for dinner), event scripts (e.g. cake at a party), thematic associates (e.g. bread and butter), and functional associates (e.g. knife and steak). Results demonstrated that 3-year-old children already have access to functional thematic relations, followed by thematic co-occurrences. Knowledge of meal script associates is mastered later than thematic relations, but by 5 years old, children have an established knowledge of conventional script and thematic food

associates. Therefore, the research then sought to determine whether an impoverished knowledge of food scripts and thematic associates could be an explanatory mechanism for the increased prevalence of food rejection tendencies (namely food neophobia and food pickiness) witnessed in early childhood. If children are already tending to thematic and script notions when confronted with food but lack an exhaustive repertoire of such knowledge, could this lead to increased feelings of uncertainty when confronted with potential foods that deviate from their limited conceptual representations? To respond to this novel line of inquiry, two additional studies were conducted with 4-7-year-old children in France. The third study used a thematic and taxonomic food analogy task with children (n = 85) between 4 and 7 years-old. The results revealed that children with poorer thematic understanding demonstrate higher levels of food rejection. The final study used a situation-based task, pitting a thematic food associate and a script food associate, with 72 4-7-year-old children. Increased levels of food neophobia were significantly predictive for poorer appropriate thematic and script food selection. When interpreted collectively, our results demonstrate that food rejection tendencies in young children are linked with a poorer ability to flexibly draw upon thematic or script food associates. Children's inability to draw upon the correct conceptual relation potentially drives unfamiliarity and uncertainty, subsequently leading to food rejection. Such investigation is seminal in informing researchers, policymakers, and caregivers on how knowledge-based interventions should not solely capitalize on children's naive theory of biology, but also address the rigidity of children's cultural food categories.

2-C-11   Spacing and variability in children's word learning
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Not all categories are made the same. Some categories have high within-category variability (e.g., "vehicles" can look very different) and some have low within-category variability (e.g., "apples" are pretty similar). Categories can also vary on their between-category variability where some categories are very similar to each other (e.g., "apples" and "oranges") and some are very different (e.g., "apples" and "vehicles"). Studies have found that categories with high within and between variability are learned best in massed formats, and categories with low within and between variability are learned best in interleaved formats. However, the unique contribution of each of these kinds of variability (i.e., within and between) have not been studied independently. Two studies investigate the unique contribution of within- and between-category variability to 2-year-old children's word learning in interleaved and massed presentations. The results inform existing understanding of interleaving in word learning and how category variability impacts learning.

2-C-12   Beliefs on category membership for foods and non-foods based on their origins
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When an item ceases to belong to its category differs based on its origins, i.e., whether an item is natural or human-made. Yet, it is unclear how foods fit in these categories since these can be both natural and human-made. The research examines the effect of transformations on judgments of category membership of artifacts, natural kinds, natural and processed foods. Ninety-two 4- to 5-year-olds, 6- to 7-year-olds, and adults were told stories about items that underwent three transformations: removing insides, crushing and melting. Participants were asked after the transformation if the item was part of the original category or not (e.g., "Is it an apple or is it not an apple?"). A linear mixed-effects model analyzing the probability of giving same category membership responses revealed an Item x Age ($\chi 2(6)=35.32$, $p<.0001$), Transformation x Age ($\chi 2(4)=77.50$, $p<.0001$) and Transformation x Item ($\chi 2(6)=38.06$, $p<.0001$) interactions. Results indicated that adults provided more category membership responses and applied category membership differently by item (processed foods > natural foods > natural kinds > artifacts) as compared to children. All participants judged natural kinds and artifacts were the same after being crushed and their insides taken out, but only did so for foods after being crushed. The results suggest that the criteria that determines when foods are no longer part of their category develops with age and foods are reasoned about differently than non-foods.

2-C-13   **Parent generic language input about categories in a sample of North American English**
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Object categories are defined by shared features. Yet, children may not always have experience with various category members in order to identify shared, or diagnostic, features. Thus, generic language (e.g. "Dalmatians have spots") may be particularly valuable for category learning (Rhodes et al., 2012). What kind of generic language input do parents provide in day-to-day life? We examined parents' naturalistic generic language use in the North American English CHILDES corpus (MacWhinney & Snow, 1990). Descriptive utterances (N=326) were identified and coded as generic (e.g. "balls are round") or specific (e.g. "this ball is red"). A group of adults (N=20) rated the diagnosticity of the adjectives used to describe each noun on a continuum from not diagnostic (1) to very diagnostic (5) and the category level of each noun from narrow (1; e.g. baseball) to broad (5; e.g. toy). We predicted the likelihood of a generic statement (generic vs. specific) from adjective diagnosticity and noun category level. Parents were more likely to use generic statements to describe more diagnostic features of nouns (b=0.895, 95% CI=[0.155,1.634], z=2.371, p=0.0018, OR=2.447) and to describe more narrow nouns (b=-1.104, 95% CI=[-1.692, -0.515], z=-3.676, p=0.0002, OR=3.016). This suggests that parents' generic language input provides valuable categorical information, in particular, for learning about diagnostic features of narrow categories, which infants may have less direct experience with.

2-C-14   **Development of gradiency in phoneme categorization: Implications from the first year of the Growing Words Project**
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The development of phoneme categorization was long thought to take place primarily during infancy. However, recent research now shows this development continues until at least adolescence, and

refinement of phoneme categories is occurring in observable ways throughout the school years. This has important implications for both theories of language development and applied topics like reading instruction. However, it is unclear what factors drive the development of speech perception during this period. In the current study, Year 1 of the five-year Growing Words Project, first through third graders (n = 242) participated in a novel speech categorization measure using a touch screen tablet. In this task participants heard tokens from five seven-step auditory continua spanning several phonological contrasts (e.g., voicing: dime-time, vowels: net-nut, fricatives: sip/ship and others). Participants used a continuous rating scale to indicate where each stimulus fell between the two words that comprised the endpoints of the continuum. This continuous rating task - rather than a traditional forced-choice task - can separate differences due to noise from differences in the fundamental structure of the categories. Older children had a steeper response function and better identification of endpoint stimuli. We also examine correlations between this task and participants' oral language, reading, and phonological processing skills, and discuss predictions for longitudinal data collection.

2-D-15   Fun is not easy: Children optimize for difficulty when playing for fun vs. playing to win

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The "explore-exploit" dilemma trades off behavior with two distinct objective functions. Children who explore (e.g., try a new flavor of popsicle) optimize for information gain. Children who exploit (e.g., choose a familiar flavor) optimize for a known reward. But what of the child who waves their popsicle like a sword, or makes a drip design on the kitchen floor?
 Here, we take a step toward finding the reward function of play, by contrasting children's choices in a game when they are playing versus when they are exploiting. In Exp. 1 (ongoing), we introduce n=44 participants aged 5-10 years (M=7.6, SD=1.5) to a game in which players toss beanbags and batons to knock down blocks on a court. We ask children 8 forced-choice questions about how to structure the game when playing for fun ("to have as much fun as you can") vs. playing to meet a win-criterion ("to knock down all the blocks to win stickers"). Questions concerned either "goal-relevant" factors that affect the likelihood of knocking down blocks, or "goal-irrelevant" ones (see Fig. 1).
 If play is similar to exploration, it may pattern as random behavior, with responses roughly uniform across the options for each factor, or it may pattern as an 'injection' of noise on top of existing exploitation policies. In contrast, some accounts propose that play may be linked to problem-solving (Chu & Schulz, 2020), or behavioral flexibility (Fagen, 1982). Following these latter accounts, our predictions were: 1) For goal-relevant factors, children will select more difficult specifications in "fun-mode" than in "win-mode"; 2a) For goal-irrelevant factors, there will be no difference between conditions; and 2b) For goal-irrelevant factors, children will opt for specifications that demand flexible behavior (e.g., high novelty and randomness; see Fig. 1).
 Overall choices in fun-mode follow a coherent pattern, and contrast with choices in win-mode. For each participant, we calculate a weighted average for both Fun and Win responses for each factor, and a difference score between these averages (Fun-Win). Difference scores for goal-relevant factors (M=0.34, SD=0.60) differ significantly from goal-irrelevant (M=0.16, SD=0.37); t(42)=1.71, p=.04; see Fig. 1 (right). For goal-relevant factors, difference scores are significantly positive, indicating a preference for difficulty in Fun, t(43)=3.80, p<.001. For goal-irrelevant factors, we find a smaller difference between Fun and Win, t(42) = 2.91, p=.002, and a preference for options that fall between "medium" and "high" (weighted average M=2.05, SD=0.21). Difference scores are not correlated with age for goal-relevant factors (r=0.21,

p=0.20) or goal-irrelevant, (r=-0.02, p=0.91).
 In Exp. 2, we replicate these results using a between-subjects design. First, children (n=15; M=7.1 years, SD=2.3) play the game with all factors set to "medium." Then, they are randomly assigned to Fun or Win (i.e., are told the goal of the game) and, as in Exp. 1, are asked to make a choice for each factor. So far, weighted averages differ between Fun vs. Win for goal-relevant factors, t(13) = 4.39, p<.001, but not for goal-irrelevant, t(13) = -0.72, p=0.47.
 These results suggest that school-aged children challenge themselves more when playing than when they are optimizing for a specific goal. Our findings support a competence-based curiosity account of play, where playing optimizes for information gain about one's action capacities.

D - Computational approaches

2-D-16   Learning causal overhypotheses through exploration in children and computational models

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Human children are proficient explorers, using causal information to great benefit. In contrast, typical AI agents do not consider underlying causal structures during exploration. To improve our understanding of the differences between children and agents--and ultimately to improve AI agents' performance--we designed a virtual Blicket experiment to test childrens' ability to leverage causal information while exploring a novel environment. This experiment doubles as an RL environment with a controllable causal structure, allowing us to evaluate exploration strategies used by both agents and children. Our results demonstrate that there are significant differences between information-gain optimal RL exploration and the exploration of children: in particular, children appear to consider a wide range of creative overhypotheses, including stochasticity, total weight, object ordering, and more. We leverage this new insight to lay the groundwork for future research into efficient exploration and disambiguation of causal structures for RL algorithms.

2-D-17   Háblame Mamá: Acoustic detection of vocal affect in Spanish speaking mothers

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Existing research shows that maternal depression is associated with lower word count and emotional expressivity (Goodman & Gotlib, 1999), with implications for emerging language development. Symptom detection is relevant as depressive symptoms affect more women, and subclinical symptom severity predicts various child outcomes continuously (Meany, 2020). Successfully classifying depressive speech using naturalistic, toddler-worn audio recordings could pave the way for just-in-time interventions. Therefore, our aim was to develop an acoustic classifier for maternal depression symptoms in a Latinx Spanish-speaking sample. No study to date has classified acoustic depression in a Spanish sample using in-home audio. Audio was collected using LENA sensors worn by toddlers from 11 families (M=28.75 months, SD=4.58 months). 136 acoustic-features were extracted from maternal speech and classified as depressed or non-depressed using the parent-stress index questionnaire. The classifier reached an F1 score of: 0.422 (precision: 0.6, recall: 0.36), with low success classifying depression in Spanish speech. We speculate that key determinants in the home environment may have

intervened in the final classification score. Namely, the presence of background media or multiple speakers, linguistic patterns emphasizing prosody, and dynamic changes in mood following the questionnaire. Collectively framing crucial aspects of children's language environment that we strive to examine in our model.

E – Conceptual development

2-E-18   An inconvenient truth: Educational media increases preschoolers' worry about the environment, but not their knowledge

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As the Earth's future caretakers, children should begin learning about conservation from a young age. One effective way to educate children is through educational media (e.g., Hopkins & Weisberg, 2017). However, no one has yet examined the effect of media on environmental beliefs and attitudes specifically. This study investigated whether watching educational media about environmental conservation could positively impact children's environmental knowledge and views about conservation. During pre-test, four- and five-year-olds (N=66; mean age = 58.86 months) were asked questions about water conservation strategies (e.g., should you leave the faucet running or turn it off?) and general conservation strategies (e.g., should you draw on both sides of a piece of paper or just one?). They were also asked about their self-efficacy regarding how much they thought they could help nature (self-efficacy) and how worried they are about nature, both rated on a 5-point scale. Participants were then randomly assigned to watch one of two episodes of the PBS Kids show Nature Cat. They watched an episode either about water conservation (Experimental condition, n = 33) or about dragonflies (Control condition, n = 33). The experimental episode contained information on water-saving techniques (e.g., take short showers) while the control episode contained information about the natural history of dragonflies (e.g., they live near water). At post-test, children assessed again on their knowledge of water conservation and general conservation strategies, their self-efficacy, and environmental worry. At pre-test, there were no significant differences between groups on water conservation knowledge, general conservation knowledge, environmental self-efficacy, or environmental worry (all p-values > 0.45). Contrary to our hypothesis, children who watched the water conservation episode of Nature Cat did not show significant improvement in water conservation knowledge, $t(32) = -1.56$, $p = 0.129$, or general conservation knowledge, $t(32) = -0.81$, $p = 0.423$. Children in the Control group also did not show significant improvement in water conservation knowledge, $t(32) = 0.89$, $p = 0.379$, or general conservation knowledge, $t(32) = 0.35$, $p = 0.730$. Similarly, children's self-efficacy ratings did not show significant increases from pre-test to post-test for either the Experimental condition, $t(32) = -1.13$, $p = 0.269$ or the Control condition, $t(32) = -1.31$, $p = 0.199$. However, children in the Experimental condition showed a significant increase in worry for the environment, $t(32) = -2.63$, $p = 0.013$, while children in the Control condition showed a significant decrease in worry, $t(32) = 2.27$, $p = 0.030$. Thus, watching an episode of Nature Cat about water conservation may have raised children's awareness of the problem of water conservation without necessarily providing them with the knowledge to address this problem. Given children's frequent engagement with educational media and the high degree of usage of educational television among diverse audiences (Mares & Pan, 2013), such media have the potential to increase children's awareness of environmental issues. Future work should ensure that these media are as effective as possible.

2-E-19 **Scene and heard: Infants categorize scenes with language**

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In everyday life, infants interact with and learn about objects, places, and people in varied ways. For example, infants start to manipulate objects in early infancy and frequently hear objects labeled by caregivers (Sandhofer et al., 2000). In contrast, they do not start moving through places on their own until much later (Adolph & Franchak, 2017) and may rarely hear labels for the places they navigate. Despite these differences between infants' first-person action experience and their language input about objects and scenes, they may nevertheless be able to learn about objects and scenes in similar ways using language. In this study, we ask whether language facilitates infants' scene categorization like it facilitates their object categorization.

 In a first preregistered experiment (Experiment 1), we tested 24 full-term 12-month-old infants in a novelty-preference looking-time paradigm (after Fulkerson & Waxman 2007; see Figure 1). Families participated on Lookit (Scott & Schulz, 2017), an unmoderated online lab for infants and children. During a familiarization phase, infants watched eight 20 s videos of either empty fields or empty rooms, each video labeled twice with a nonsense noun ("Look at the toma!" "There is the toma!"). During the silent 20 s test video, infants saw two scenes simultaneously, one new example from the familiar, labeled category and one example from the novel, unlabeled category. A mixed-effects linear model revealed that infants looked longer at the scene from the unlabeled category (Munlabeled = 7.36, SD = 3.27; Mlableled = 5.37, SD = 3.15; β = 1.99, p = 0.038), suggesting that they had learned the labeled category.

 Two preregistered control experiments examine the effects of spatial layout and language on infants' successful scene categorization in Experiment 1. Experiment 2 grid-scrambles the scene videos to disrupt the scenes' spatial layouts but preserve their other low-level visual features. Experiment 3 replaces language with tones. We predict that, just as in object categorization, infants will need scenes' intact spatial information (Landau et al., 1992; Park et al., 2011) and language (Fulkerson & Waxman, 2007) to learn scene categories. Infants will therefore show no novelty preference in these experiments and their novelty preference will be significantly different in these experiments compared to Experiment 1. Data collection for Experiments 2 and 3 will be completed by March 2022.

 The results from Experiment 1 show that infants successfully categorize scenes given intact spatial information and linguistic labels, just as they categorize objects. While our work is the first to demonstrate this ability, our findings are consistent with recent neuroimaging findings revealing that a scene-selective cortical region involved in scene categorization in adults (Dilks et al., in press; Dillon et al., 2018; Persichetti & Dilks, 2018) is already present in infancy (Deen et al., 2017; Kosakowski et al., 2021). While scenes seem like mere background in the landscape of infants' active learning and exploration, language can nevertheless facilitate their abstraction and generalization into novel conceptual categories.

2-E-20 **Children's acquisition of deictic time words**

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Deictic time words (e.g., yesterday, tomorrow) encode the temporal relationship between events and the present. Children produce these words before age 3, but adult-like meanings emerge years later (Grant & Suddendorf, 2011). Prior work assessing children's ability to place these items on spatial

timelines demonstrates that, during the long period between initial production and adult-like comprehension, children systematically acquire some aspects of meaning, like their past/future status, before others, such as their temporal remoteness (i.e., distance from 'now'; Tillman et al., 2017). These patterns provide insight into how children develop a concept of time and what linguistic cues are important for acquiring preliminary meanings for time words. However, it is unclear to what extent previous findings are task-specific. Here, we test for differences in children's ability to represent the past/future status and temporal remoteness of time words on a continuous timeline and discontinuous calendar task and find task-specific differences in performance.
 English-speakers (n = 116 aged 4-6 and n = 46 adult controls) estimated the locations of items on a timeline (Figure 1A) and calendar task (Figure 1B). In the timeline task, participants mark where deictic items (e.g., yesterday) and events (e.g., breakfast this morning) go on horizontal lines extending from the past ("when you were a baby") to the future ("when you'll be a grown-up"). Because there is no precise location for a given item and multiple items are placed on each line, knowledge of remoteness is measured by comparing the relative distances between children's placements of items to those of adults, which might conflate children's knowledge of one item with their knowledge of other items. Thus, we developed a novel calendar task to measure children's knowledge of individual items more precisely. The calendar task consists of seven squares representing the days of the week, with the center square representing 'today'. Participants place stickers to indicate deictic items and each item is tested separately. While the calendar task might be a helpful scaffold for children familiar with the calendar system, it may also make the task more challenging for younger children who do not have experience using calendars.
 We first asked if children placed deictic items correctly in the past (left) vs. future (right) of now/today on each task (Figure 2). On the calendar task, 65% of four-year-olds correctly assigned items to the past vs. future. On the timeline task, only 55% of four-year-olds did so. Accuracy improved with age on both tasks (ps < .001), but was greater on the calendar task (M = 77% across ages) compared to the timeline task (M = 67%; p < .001). We next asked if children placed items at the correct remoteness from today on the calendar task. Knowledge of remoteness improved with age (p < .001): 57% of four-year-olds, 79% of five-year-olds, and 88% of 6-year-olds placed items at the correct remoteness. Consistent with previous studies, our findings suggest that knowledge of past/future status emerges earlier than knowledge of remoteness. Also, previous studies using the timeline task indicated that knowledge of remoteness emerges after age 7, but the present results from the calendar task suggest this knowledge may emerge as early as age 5.

2-E-21   Exploring the similarity in reality status assessments for god among secular parent-child dyads

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Though parents are a central source of religious education, research has shown that secular parents are less likely to transmit their religious beliefs (or lack thereof) to their offspring (e.g., Luria & Katz, 2019). Missing from this area of research are two important considerations. First, executive functioning (EF) and theory-of-mind (ToM) skills assist children in learning abstract concepts from others (e.g., Gauvain, 2001; Tomasello, 1999). Second, secular adults are remarkably diverse in their religious experiences (McCaffree, 2017). This poster presents the findings from a study on the correspondence between parents and their children's reality status judgments for God with 116 religiously and racially diverse

dyads (Children: Mage = 6.87 years, SD = 1.12, 51% female, 78% non-White). In addition to assessing parents' religious background, children's ToM and EF were assessed. Two sets of patterns emerged. First, parents and children corresponded most when parents were religiously affiliated and more religious in their beliefs and behaviors (see Fig. 1). Second, children's theory-of-mind and executive functioning were unrelated to correspondence and unrelated to whether children believed God was real or pretend. The dynamic interactions between socialization processes and cognitive development, which may account for these findings, will be discussed. Implications for the enculturation of abstract concepts will also be highlighted.

2-E-22   Characterizing exact arithmetic abilities before formal schooling

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Some arithmetic intuitions have been documented in preschool children, but the extent to which children can perform exact arithmetic computations before formal instruction is yet to be systematically characterized. Here we characterized exact arithmetic performance using a non-symbolic subtraction task in two large samples of preschoolers (N = 340, Mean age =4.21). Across two studies, an initial study and a pre-registered replication, we find that preschool children perform above chance on this exact arithmetic task and their performance is a function of the set size being operated over. We further find that individual differences in exact arithmetic performance are related to cardinal number knowledge, particularly on problems where the answer is zero (i.e., N-N = 0). We also find some evidence that older children are more likely to apply approximation strategies to guess the answer. Together these results suggest that children can perform exact arithmetic computations before formal schooling and that these abilities are enhanced with arithmetic logic that is inherent in symbolic number knowledge.

2-E-23   Three- and 4-year-olds recognize the optimal strategy for acting on multiple possibilities.

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Past work has suggested that 3-year-olds have difficulty reasoning about multiple, mutually exclusive possible future outcomes of an action. For example, when asked to catch a ball that is dropped into an inverted y-shaped tube, 3-year-olds place their hands under only one opening (4-year-olds cover both openings; Redshaw & Suddendorf, 2016). We asked whether 3-year-olds may demonstrate greater competence if they are not required to act on the apparatus themselves. Three-and-4-year-olds watched videos of two adults who each successfully caught a marble from the inverted y-shaped tube. One actor covered both openings (correct strategy) while the other covered only one opening (incorrect strategy). Children were asked to choose "who will catch the marble for sure?" if the marble drop is repeated. Both age groups chose the actor who covered both openings (correct strategy) at rates significantly above chance (both p<=.01), suggesting younger children's performance difficulties may be due to difficulty implementing the correct action themselves, and not an inability to reason about the optimal action to take when one is faced with multiple, mutually exclusive possibilities.

2-E-24   Relational scaffolding to support young children's learning in a science museum

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Science museums enable young children to interact with scientific artifacts and models, promoting new ways of thinking about the world. To get the most out of these interactions, museum visitors must connect their experiences within the museum to the world outside of it--for example, by relating the objects and events depicted in scientific models to phenomena experienced in everyday life. In partnership with museum exhibit designers, we developed and tested an exhibit to support young children's learning about the cause of the day/night cycle. We used relational scaffolding--coordinated supports for comparison and structural alignment--to help visitors grasp the connections between modeled events (Earth rotation) and familiar events, like sunrise. Visitors could turn a crank to rotate a 3D model Earth, and a nearby display showed what a viewer on Earth's surface would see in the sky. The Sun would appear in the sky when the Earth-based viewer was exposed to sunlight, and move westward across the sky as Earth rotated eastward. In a study involving a dozen children and their caregivers, we found promising evidence that museum visitors capitalized on the synced-up displays and other forms of relational scaffolding within our exhibit. With the help of a parent, children made causal connections between Earth motion and events in the sky, recognized links between represented and real-world space, and were dissuaded from scientifically-inaccurate ideas about Sun motion.

2-E-25   Connecting faces to emotional events in early childhood: The benefit of emotion labels

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Recent theory has suggested that emotion words may facilitate the development of emotion concepts, but much about this potential mechanism remains unknown. The present experiments examined whether emotion words affect children's performance on an emotion category learning task. In Study 1, 3-year-olds identified which face (among 4) matched how the character felt in scenarios that are typically challenging for this age group (annoyed, disgusted, nervous) for 9 pre-test and 9 post-test trials. Between pre-test and post-test, children were randomly assigned to either hear Explicit emotion labels (e.g., "she feels annoyed") while seeing a face paired with the corresponding scenario, or to hear irrelevant information (e.g., "she sits down"). Across 36 participants, performance improved more from pre-test to post-test in the Explicit compared to the Irrelevant condition ($t(34)=2.26$, $p=.030$). However, it was possible that children didn't need explicit emotion labels, but rather anything helping them attend to emotion. To examine this possibility, we conducted Study 2 which was identical to Study 1 except with a Broad label condition (e.g., "she feels bad") and Irrelevant condition. Data from 36 additional 3-year-olds revealed no significant difference in children's performance between the Broad and Irrelevant conditions ($t(34)=0.72$, $p=.474$). Taken together, these results suggest the potential importance of explicit emotion words when children are learning new emotion concepts.

2-E-26   Longitudinal investigation of the early development of metacognitive monitoring and control

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Metacognition is crucial for understanding and optimizing learning. Here we present a longitudinal study that tracked individual metacognitive development of 97 children over the course of three years, between the ages of 4 and 6. We examined the development of two key aspects of metacognition which prior studies (O'Leary & Sloutsky, 2017, 2019) suggested may have different developmental trajectories: monitoring and control. We observed developmental changes in both components, with the most dramatic improvements recorded between the age of five and six. Overall, monitoring abilities have shown more protracted development than control. Critically, we find that even children (6-year-olds) that are able to track task difficulty (monitoring), struggle to use this information to guide and optimize their behavior (control). We discuss these findings in the context of a competition between metacognitive control and exploration tendency in early development.

2-E-27   Becoming word meaning experts: Infants' processing of familiar words in the context of typical and atypical exemplars

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How early do infants recognize words as referring to a broad category? One possibility is that infants' early word meanings begin narrow, referring to only a small set of typical category exemplars. Another possibility is that infants generalize word meanings to broad sets of typical and atypical category exemplars from early on in development. We investigated the structure of infants' early lexical representations by manipulating the typicality of exemplars from familiar animal categories (e.g., dog). 12- to 18-month-old infants (N=39, mean age = 14.8 months) were tested on their ability to recognize typical (e.g., a beagle) and atypical (e.g., a sheepdog) category exemplars after hearing familiar basic-level category labels in the looking-while-listening paradigm, presented online using the Lookit platform (Scott & Schulz, 2017). We found that infants recognized both typical (M = 55.1%, 95% CI = [51.3%, 58.8%]; chance=50%) and atypical exemplars (M=57.0%, 95% CI = [53.6%, 60.4%]) with similar accuracy in response to hearing their category labels (see Figure 1 for an overview of the timecourse of average proportion target looking in each condition). While overall word recognition accuracy increased with age (t(37) = 3.69, p < .001; linear mixed-effects model), there was no evidence for a typicality by age interaction (p = .43). These results suggest that even young infants associate basic category labels with a broad range of category exemplars.

2-E-28   Preschoolers' adaptive strategy-choice when identifying non-symbolic number partners

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According to the overlapping waves theory (Siegler, 1996), children develop in a cognitive domain by learning to use specific strategies to increase their chance of success (adaptive strategy-choice). A key concept in early math is that numbers can be decomposed into smaller number partners (Fuson, 1992). This relationship can be represented non-symbolically, such as dots on the two sides of a domino. The present study explored whether preschoolers used counting strategies adaptively when identifying number partners for values from two to six. Preschoolers (N = 48; Mage= 4.7) identified which of three dominoes had the same total number as a target value for 16 trials. Each trial was coded from video into one of four counting strategies (see Figure 1 for explanations): a) fast unobservable; b) unobservable; c) observable counting all dots and; d) observable advanced counting. Figure 1 illustrates individual performance and strategy-use across set sizes. Shades of green represent correct and red represent incorrect responses. Children with the highest scores (right of the figure) used more unobservable strategies than those in the center, who relied on more observable counting. However, children generally slowed down or switched to observable counting as set sizes got larger, demonstrating intra-individual variability. Overall, results support that even at the start of developing understanding of decomposition, there is evidence of adaptive strategy-choice.

2-E-29   In reference identification, children rely on descriptions, but adults prioritize grammar
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How do children learn to connect expressions (e.g "that red apple") to the real-world objects they refer to? The dominant view in developmental psychology is that children rely primarily on descriptive information encoded in content words ("red", "apple"). In contrast, linguistic semantic theories of adult language attribute primacy to the grammar (e.g. words like "that", "another"), which first establish the status of potential referents within the discourse context (old, new) before descriptive information can factor in. These theories might even predict that reference can succeed even when the description does not match the referent. We explore this novel prediction in adults and children. Over three experiments, we found that (i) adults relied on the articles to establish the referent, even when the noun description did not fit, consistent with grammar-first accounts; (ii) consistent with description-first accounts, and contrary to adult behavior, 3-5yo children prioritized the descriptions provided by the nouns, despite being sensitive to grammatical information. Thus, children might start out only matching descriptions, and begin to establish reference with incorrect descriptions later in life.

2-E-30   Bland images, rich talk: The role of perceptual richness in informal science learning
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Visualizations, such as diagrams and pictures, are common in educational materials. Prior work shows that visualizations often lead to better learning and generalization (Butcher, 2010), but this benefit depends on the perceptual features of the visualizations (e.g., how detailed the images are, Menendez et al., 2020). One area that has been overlooked is whether the perceptual features of visualizations influence informal science learning settings, such as in shared book reading. To address this gap, we recruited 83 child-caregiver dyads to complete a two-session online study about how people learn about evolution. In the first session, the child and the caregiver completed a pretest to assess their knowledge about evolution. In the second session (approximately 1 week later), the child and caregiver read an e-

book that explains evolution through natural selection, and then completed a posttest to assess their learning and generalization. Critically, we manipulated whether the book had colorful, detailed visualizations or black-and-white line drawings. Transcription and coding of the data is ongoing; analyses will focus on changes in evolutionary knowledge from pre to posttest, and on aspects of the child-caregiver interactions (e.g., caregivers explaining how to interpret the visualizations). This study will reveal whether the perceptual features of visualizations influence informal interactions and learning in informal settings.

F – Cross-cultural approaches

2-F-31   From outcome to process: a developmental shift in judgments of rational reasoning

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Whether someone is rational cannot simply be determined by whether they hold true or false beliefs (outcome), but by how they arrived at these beliefs (procedure). In this pre-registered study, we asked to what extent 4-5-, 6-7-, 8-9-year-old children, and adults from China and the US consider epistemic procedure and outcome in evaluating the rationality of an agent. Participants (N = 192) were introduced to two characters who tried to find their pet by using either a rational (e.g. looking for the pet's traces) or an irrational (e.g. using a spinning wheel) procedure that led them to either the right or the wrong conclusion. The participants were exposed to three conditions: In the outcome condition, we tested whether children have a preference for an individual who holds a true over a false belief. In the process condition, we investigated whether participants have a preference for an individual who uses a rational over an irrational procedure. Finally, in the process-vs.-outcome condition, we pitted outcome against procedure and tested whether participants prefer agents who use rational procedures but arrive at the wrong belief or agents who use irrational procedures but arrive at a true belief. 4-5-year-old and 6-7-year-old children from the US followed an outcome-oriented evaluation of rationality, while 8-9-year-olds and adults are focused on the rationality of the process. Chinese children demonstrated a preference for procedure-based evaluations already at age 6 and 7. Thus, culture might influence the development of rationality judgements.

2-F-32   Characterizing the complete language environment: What could children learn by 'listening in'?

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Despite substantial research on (a) differences in the contributions of child-directed versus overheard speech to vocabulary size (e.g., Weisleder & Fernald, 2013), and (b) the impact of qualitative differences in child-directed speech contexts on language acquisition (e.g., Cartmill et al., 2013), to our knowledge there remains no systematic study of qualitative differences in overhearing contexts as they relate to learning. This is important because overheard speech is common across the world, and because overheard speech is likely to be a more heterogeneous category than child-directed speech, such that understanding the range of roles it may play in young children's lives is critical and not straightforward. In the infrequent cases it is considered, quantitative studies treat overheard speech as monolithic. However, speech directed to the child is likely to be a much more coherent category than speech

around<i/> her, which might be directed to variable audiences, at variable distances, and with variable relevance to the child. The two categories of speech (child-directed versus overheard) undoubtedly differ in their overall rates of features that we know children can use to solidify word-referent mappings. Inspired by qualitative studies typically limited to child-directed speech, we develop a coding scheme designed to characterize all utterances accessible to children in terms of their intended audience (e.g., target child, sibling, adult, phone) and relative utility for the target child's word-learning. We focus in particular on contributors to referential transparency as a well-established and meaningful dimension of language learnability in context. These include the context of the utterance (e.g., mealtime, play), the spatial positions and proximity of the caregivers and children, the clarity of the speech, the caregivers' use of gaze or gesture to illustrate their meaning, the child's visual access to the caregiver or to the referent of the utterance, and the caregiver's use of modified prosody. As a proof of concept, we apply this coding scheme to existing longitudinal naturalistic video corpora (Providence and Forrester) for two English-learning children (0;11-3;6) whose language development is well-documented. We find that both speech directed to the children and speech 'overhearable' by them are highly variable along the qualitative dimensions we coded, such that high-quality language-learning episodes occur in both. However, utterances that were child-directed were both more likely to be prosodically marked (i.e., produced in a sing-song) and to be associated with the child's attention, relative to overheard utterances -- even those directed to an older sibling. Thus, while irrelevant as a referential cue, our results suggest caregivers' prosodic modification may play a functional role in marking speech intended for the young child -- especially given the significant qualitative overlap between overhead and child-directed speech along other dimensions. Taken together, our results shed light on how adults and children co-structure the early language environment and promise to provide similar insights when applied to naturalistic video corpora for children across the world (indeed, coding of Bengali, Spanish, and Mandarin corpora is underway).

2-F-33   Rates of gender representation in children's literature across cultures: A comparison of US vs. Chinese children's books

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Male-protagonist overrepresentation exists in US children's books and varies as a function of author-gender and target audience age (Casey et al., 2021). We investigate whether these patterns appear across cultures by coding 437 bestselling children's books from China and comparing them to the US dataset. Mixed-effects and chi-square models revealed cross-cultural male-overrepresentation. Effects of author-gender showed that books written by American male authors and Chinese female authors were associated with greater male overrepresentation. Effects of target audience age showed that books written for 3-8-year-olds in the US and 3-5-year-olds in China exhibited the most male-overrepresentation, suggesting that children in these age groups may be particularly vulnerable to inequitable gender representation in print media. This is the first study to examine gender representation in Chinese children's books on a large scale and to directly compare rates of gender representation across cultures. Implications for educational practices and literacy development will be discussed.

G - Diversity

2-G-34 **Preschoolers benefit from sentential context when listening to familiar- and unfamiliar-accented speech**

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In a globalizing world, children are increasingly likely to hear speech produced in unfamiliar accents. Processing accented speech is cognitively taxing: children have more difficulty recognizing isolated words produced in unfamiliar accents. But considerably less is known about how accented speech affects children's ability to process words produced in full sentential contexts. Here, we pose a stringent test: We test preschoolers' ability to exploit sentential context in accented speech to a) recognize known words and b) use them to learn new words.   Four-year-olds were randomly assigned to hear sentences in either an unfamiliar accent (Turkish-accented English) or familiar accent (standard American English) during a looking-while-listening task (Fig. 1) that included three trial-types: Neutral (familiar nouns in Neutral contexts), Informative (familiar nouns in Informative contexts), or Novel (novel nouns in Informative contexts). The results (Fig. 2) are promising (data collection still underway). Preschoolers in both Familiar Accent (n=21) and Unfamiliar Accent (n=21) conditions successfully identified the referents of known nouns in informative sentential contexts (Informative and Novel trials; both p's<.05). This suggest that preschoolers' processing of an unfamiliar accent is sufficiently robust to support their identification of the referents of known and novel words. Yet in neutral sentential contexts, only children in Familiar Accent condition succeeded (p<.01).

2-G-35 **Development of speech perception in multilingual and monolingual social networks**

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Contrary to the classic thinking in development, we now know that speech perception develops throughout childhood. Older children were shown to have improved phoneme identification compared to younger children (McMurray et al., 2018). However, it is not clear the degree to which this improvement represents maturation of general cognitive/perceptual skills or if it is driven by the input. This ongoing study (current n=31, planned n=60), part of the Growing Words project, tests 6-11-year-olds using a visual analogue scaling (VAS) task (Kong & Edwards, 2011). In this task, children hear a speech continuum (e.g., beach/peach) and make judgments about how /b/- or /p/-like the sound is. We related the structure of the categories to children's language and social background. Our preliminary results suggest the diversity of languages in a child's environment impacts their speech perception. This has important implications for education and for the role of the linguistic environment in development.

H - Education

2-H-36 **The effects of person vs. computer feedback on children's performance and motivation in mathematics**

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Research in psychology and education indicates that corrective feedback can be a powerful learning tool. Meta-analyses often demonstrate that feedback on students' performance has positive effects on

learning relative to non-feedback control conditions. However, the effects of feedback are quite variable, and can even be negative in certain contexts. This begs the question: which features of feedback are effective in triggering positive cognitive change? One leading theory, referred to as Feedback Intervention Theory, posits that feedback may hinder performance when it directs attention toward the self because less cognitive energy is being used on solving the task at hand. The current aim was to test which features of feedback heighten the learner's attention to the self resulting in underperformance effects. We hypothesize that the source of feedback -- whether feedback is provided by a person or a computer -- would influence key academic outcomes including performance and motivation. Person feedback is hypothesized to direct greater attention to the self, therefore will worsen academic outcomes when compared to computer based feedback. Additionally, we hypothesize that the type of feedback -- whether feedback features only a correct-answer or both a correct-answer and verification -- would also influence key academic outcomes. Correct-answer and verification feedback is hypothesized to direct greater attention to the self, therefore will worsen academic outcomes when compared to correct-answer-only feedback. In this study, 6 to 8 year old children completed an online Zoom based learning activity focused on mathematical equivalence (N =102). During the learning activity, children were assigned to different feedback conditions which varied both feedback source (person vs. computer) and feedback type (correct-answer vs. correct-answer+verification). Children solved open-ended mathematical equivalence items by typing their answers into the chat function of the Zoom call. They then received feedback based on their assigned condition after each item. Performance was measured based on the child's accuracy solving the mathematical equivalence problems. Motivation was measured based on how many problems the child chose to complete (with a maximum of 20). On average, children choose to complete 13.7 problems out of the 20 possible in the learning activity. Of the problems children choose to answer, they answered correctly 64% of the time. Results suggest that feedback type influenced performance: correct-answer-only feedback resulted in higher accuracy than correct-answer+verification feedback (Ms = 69% vs. 59%). Further, results suggest that feedback source influenced motivation: person-based feedback resulted in children choosing more problems than computer-based feedback motivation (Ms = 14.9 vs. 12.6 problems completed). As feedback is an important educational tool which can be used to alter key academic outcomes, this study works to acknowledge that the use of feedback sits in a larger social context of the learning environment. The current findings supported our hypothesis that adding verification to the feedback hindered performance. However, contrary to our hypothesis, person feedback had positive effects on students' motivation, suggesting a greater need to attend to multiple learning outcomes. Understanding the role varied forms of feedback play into early STEM learning can help encourage underrepresented individuals pursue STEM.

2-H-37   How exploration supports children's pattern learning
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Patterns exist all around us, from the parallel veins on a leaf to the black and white stripes of a crosswalk to the polka dots on wrapping paper. Knowledge of repeating patterns is also a foundational skill for the development of early mathematical thinking. Interventions designed for young children often rely on direct instruction or demonstration to teach pattern learning, often explicitly informing children of the underlying repeating unit. Though patterning interventions improve children's mastery of specific

patterns, children still often struggle to transfer their knowledge to new patterns, especially when they are assessed on their recognition of the unit of repeat. One potential reason is because direct instruction represents a passive form of learning in which children do not need to actively construct their own knowledge. Using self-guided exploration as a learning strategy may better support transfer than direct instruction because it can support active engagement and discovery learning. In the current study, we hypothesize that guided exploration will better support children's ability to abstract patterns and transfer their patterning knowledge to a novel context than watching a demonstration. Children aged 5-6 years old (n=68) were presented with a three-unit repeating shape pattern (ABB) with stars hidden under every third shape in each unit. Children were instructed that they could find the stars (up to 3) using a pattern without explicitly mentioning what the pattern is. Exploration condition participants (n=34) engaged with the pattern materials directly, revealing the hidden contents under the shapes. Demonstration condition participants (n=34) watched a demonstration of the experimenter revealing the hidden contents under the shapes. We used a yoked experimental design, in which demonstration condition participants would see the same information in the same order as an age-matched exploration condition counterpart. In a transfer task, participants were given the same ABB pattern with a different set of shapes and colors. Participants had five chances to find all three hidden stars. Performance was measured by the number of stars each participant found. Overall, 6-year-olds performed better than 5-year-olds in both conditions. In the exploration condition, 8 out of 17 5-year-olds found all three stars compared to 11 out of 17 6-year-olds. In the demonstration condition, 5 out of 17 5-year-olds found all three stars compared to 8 out of 17 6-year-olds. We also found evidence that 6-year olds relied on more sophisticated strategies in the transfer task compared to 5-year-olds, with a slight trend towards exploration condition children using more advanced strategies. 11 6-year-olds (7 in exploration condition) used the most advanced strategy of finding all three stars in a row, demonstrating an understanding of the underlying pattern. In contrast, 5 5-year-olds (3 in exploration condition) used this same strategy. Our preliminary findings suggest that exploration may encourage more active engagement and advanced learning strategies for understanding the underlying structure of repeating pattern units. These results may also suggest that different learning interventions may be more beneficial depending on a child's age and development.

2-H-38 Young adolescents' positive perceptions of science and scientists decline during the COVID-19 pandemic

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We examined adolescents' perceptions of scientists before and 1 year into the COVID-19 pandemic in a rural Title 1 school.Data was collected in Jan 2020 and in 2021. 51 students (11.3-14.3 yrs) participated at Time 1 (F=22, M=29). 37 participated at Time 2 (12.44-15.04 years; F=16, M=20). We found a negative trend in students' perception of scientists. The following decreased: Scientists design new things: T1:4.26; T2:3.79, (t=2.54, p=.016), Scientists are smart: T1:4.56; T2:4.25 (t=2.93, p=.006), Scientists know a lot: T1:4.47; T2:4.0 (t=.366, p=.001), Scientists need a lot of education: T1:4.63, T2:3.97 (t=3.89, p=.001), How much did you learn in science class: T1:2.61; T2:2.33 (t=2.14, p=.039), Favorite school subject (science higher): T1:3.6; T2:3.29 (t=1.74, p=.090), and When I come across a science problem, I work until I solve it: T1:3.43; T2:3.0 (t=2.21, p=.034). In turn, science self perceptions improved: future job (code for science): T1:0.18; T2:0.43 (t=-2.78, p=.009), I get a worried feeling when I think about

science, T1:3.37; T2:2.77 (t=2.5, p=.01), and desire to play a game for "kids who are good at science," T1:1.55; T2:1.76 (t =-2.03, p=.051), and for "kids who are smart," T1:1.37; T2:1.57 (t=-1.74, p=.090). Across the pandemic and both negative messages about science and scientists and a cultural ethos of science as the way out of the pandemic, students demonstrated both increased negative perceptions about scientists and increased science self-confidence

2-H-39 How does experience with equivalent fractions support algebra proficiency? A test of possible mechanisms

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Fraction knowledge predicts algebra knowledge, but the mechanisms underlying this relationship are not yet well understood. We investigate a set of potential mechanisms involving fraction equivalence. We propose three ways that fraction equivalence experience could improve algebra proficiency: fraction equivalence experience provides 1) experience maintaining numerical relationships, 2) experience representing quantities flexibly and 3) experience with the equal sign in relational contexts. To test these possibilities, we give middle schoolers (target N = 120) one of three experiences: a fraction comparison control task, a fraction equivalence lesson, or a combined lesson explicitly linking fraction equivalence to algebra. We compare improvements from pretest to posttest in use and endorsement of strategies maintaining numerical relationships, representing quantities flexibly, and understanding the equal sign. Data collection is ongoing. Preliminary results suggest fraction equivalence experience supports maintenance of numerical relationships and promotes relational understanding of the equal sign, but does not affect flexibility in representing quantities. This study provides initial empirical evidence regarding three potential mechanisms explaining the relationship between fractions and algebra proficiency, and is a starting point for investigating how these mechanisms could be leveraged in a classroom context.

2-H-40 Nonverbal expression may be a harbinger of representational flexibility in fraction knowledge

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Foundational for complex mathematics concepts, fractions require flexible application across representations. Because gesture has been shown to index knowledge-in-transition for certain mathematical concepts, we examined children's nonverbal expression of fractions as an index of transition--and as a mechanism driving children's acquisition of--fraction understanding. Nineteen 3rd-5th-graders participated. We used two sources for fraction understanding: (1) An interview to assess representational flexibility (children worked with manipulatives, e.g., fraction circles, number lines) and (2) a diagnostic worksheet to assess general fraction knowledge. Children scoring lower on the diagnostic worksheet generally exhibited (1) lower rates of flexibility in verbal expression and (2) higher rates of nonverbal linking across fraction representations, as compared to children scoring higher.

Verbal expression of representational flexibility was related to general fraction knowledge, whereas nonverbal expression anticipated fraction understanding. We further suggest that nonverbal linking may be a mechanism driving representational flexibility.

2-H-41   Individual differences in how parents and children discuss future concepts

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Mechanisms responsible for the development of future-oriented cognition during early childhood remain poorly understood. This study investigates one possible mechanism: parent-child conversation about future concepts. This study examined individual differences in language use between parents and across 5 prompts about varying future concepts. N=70 parents and their four- to five-year-old children were prompted to talk about 5 topics which spanned Szpunar et al.'s (2014) taxonomy of future thought (near-future simulation, distant-future simulation, prediction, intention formation, planning; see Table 1 for examples). Parent-child conversations were videotaped and transcribed in CLAN. Transcripts were coded for quantity of talk (in utterances) and the extent to which speakers elaborated about the future and drew upon past events. Table 1 indicates that speakers' quantity of talk was similar across the 5 prompts, but that there was significant between-dyad variation. Both parents and children used significantly more future and past references during simulation conversations than other prompts, particularly conversations which prompted the dyad to simulate near-future events. Dyads used the fewest future references during planning conversations. The results of this study suggest that parent-child communication may be an important mechanism for acquiring an understanding of abstract concepts such as the future.

2-H-42   The Kindness Project: Impact of mindfulness training on preschoolers' executive function, cognitive development, and academic performance

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The Kindness Project brings mindfulness training to early childhood agencies serving primarily lower income preschool & 4K children. In the 1st year a randomized-control study demonstrated positive impact of the mindfulness-based Kindness Curriculum (KC) on children's social-emotional & cognitive skills. This paper presents cognitive gains in the 2nd year of the Project. Preschool children, ages 3-5 (n=261, 70% low income; 43% White) in 16 classrooms received the 12-week KC. Teachers assessed children's executive function (BRIEF-P), school readiness (TS-Gold), & academic achievement (report cards) both pre- and post-KC. Despite pandemic challenges, including some temporary classroom closures & hybrid instruction, both children continuing with and those new to the KC improved over time on cognitive & academic skills. Continuing children had significantly higher report card scores on math & language arts than those new to the KC. They also had better scores on cognitive, literacy, & math skills on the school readiness measure. The KC also had positive effects on children's executive function skills including working memory, shifting attention, planning/organizing & mental flexibility. Overall, the KC positively impacted preschool children's executive function, cognitive & academic skills

even during a pandemic. Higher scores in several areas for continuing children demonstrated better outcomes with additional experience in mindfulness skills & highlighted benefits of the KC

2-H-43　　　　Tracing the origins of the STEM gender gap: Childhood spatial skills contribute to women's underrepresentation in STEM college majors

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Despite some gains, women continue to be underrepresented in many science, technology, engineering, and math (STEM) fields. We tested whether spatial skills, measured in middle childhood, would help explain this gender gap, using data from a national longitudinal study of 1,364 children born in 1991 across 10 sites in the U.S. (SECCYD), of whom 690 reported their college major in the age-26 assessment. Using structural equation modeling, we assessed the relation between 4th-grade spatial skills and STEM majors while accounting for competing cognitive and motivational mechanisms. Strong spatial skills in 4th-grade directly increased the likelihood of choosing STEM majors, above and beyond math achievement and motivation, verbal achievement and motivation, and family background. In an indirect path, spatial skills enhanced math motivation, which in turn elevated STEM major choice. Further, model results suggest that gender differences in 4th-grade spatial skills contribute to women's underrepresentation in STEM college majors.

2-H-44　　　　Measurement overlap in self-regulation and executive function research in schools

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The fields of self-regulation (SR) and executive function (EF) research are rife with conceptual and methodological overlap with wide-ranging variable definitions and measurement tools (e.g., Jones et al., 2019; Morrison & Grammer, 2016). Behavioral measures of these skills are widely used but are often used to measure multiple different variables interchangeably, exacerbating the conceptual and validity challenges that plague these fields (Jones et al., 2016). An interdisciplinary systematic review of the last decade of research on early childhood self-regulation related variables in educational settings yielded 98 articles with 164 measurements of eight unique variables related to SR: SR, EF, effortful control, emotion regulation, behavioral regulation, attention, and 'other.' By far the most frequently measured variables were SR and EF. Nearly two-thirds of the articles use multiple tools to capture a single variable - a practice that can bolster validity - and these batteries were most frequently used to measure SR or EF. However, many of the most used behavioral tasks were used to operationalize several of the identified variables; the most overlap in measurement tools was across SR and EF. These findings suggest that while some validity concerns are mitigated in SR research with the widespread use of multiple measurements, conceptual confusion persists due to significant measurement overlap across variables.

2-H-45　　　　Language in the early years: Exploring dual language learning and its impact on working memory and math achievement for kindergarteners using ECLS-K:2011

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Dual language learners (DLLs) with varying skill in their home language and the English language comprise about 32% of young children in the U.S. Extensive research documents DLLs' advantage for executive function, including working memory (WM), the ability to simultaneously store and process information. Theoretically, DLLs have greater WM relative to monolinguals because they constantly monitor their attention between two jointly activated languages. Thus, DLLs may exhibit a mathematical strength relative to monolinguals because competency in mathematics is supported by WM. Using the nationally-representative ECLS-K:2011 dataset, WM at kindergarten entry, growth in WM across the kindergarten year, and math skills in the spring of kindergarten of bilingual children, DLLs with limited English (DLLs-LES), and English-monolingual children were compared. Given the importance of WM in mathematics ability, it was hypothesized that the WM benefits bilingual children receive will explain their comparable or higher math skills in kindergarten compared to DLLs-LES, and monolingual children. Preliminary results indicate that bilingual and DLLs-LES students begin kindergarten with poorer WM but demonstrate greater growth in WM than English monolinguals over the year. Additionally, WM at the start of the year and growth in WM positively predicted end of the year mathematics ability. Control variables- age, SES, child sex, and English proficiency- will be incorporated into the final model.

2-H-46   What is a Pangolin?: The role of prompts in integrating new information with prior knowledge

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To build knowledge, learners must integrate new information with existing knowledge. Previous research has examined integration of two separate lessons of new information, but this is the first examination of integration of new factual information with prior knowledge. In Study 1, adults completed a Spatial Arrangement Method task before and after reading expository paragraphs of taxonomic information about known (e.g., chicken) and unknown (e.g., pangolin) animals. Both pre- and post-test provided evidence of correct taxonomic grouping of known animals. However, there was no evidence of correct taxonomic grouping of unknown animals. This suggests participants did not integrate the new information about the unknown animals with prior knowledge in this unprompted condition. In Study 2, we examined if a direct prompt would facilitate integration. Indeed, integration performance was significantly above-chance (.25) for unknown animals (M = .53; p < .01; range = 0-1). The implications for learning and cognition are discussed.

2-H-47   Elementary school teachers' philosophies of classroom instruction: A thematic analysis

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The use of metacognitively-rich language - termed Cognitive Processing Language; CPL - during whole-class instruction has been linked to children's developing memory skills and academic performance. Previous research has demonstrated that factors such as education level and teaching experience do not account for natural variability in teachers' use of CPL (Coffman et al., 2008; 2019); however, given the linkages between teachers' CPL and children's cognitive skills, it is important to understand more about the factors that may underlie these differences. In order to explore differences in teachers' general teaching philosophy that may be associated with differences in their language use during instruction, we conducted hour-long qualitative interviews with 10 Kindergarten teachers. Preliminary findings provide rich detail concerning the teachers' thinking regarding the facilitation of learning in the classroom. The interviews highlighted the importance of accommodating differences in students' academic performance and emphasized a number of themes about instruction: (a) the importance of memory in the school context, (b) the key role of critical thinking, (c) the use of varied instructional strategies, and (d) the foundational nature of math skills (Table 1). Further analyses will explore the intersection of teachers' perspective with their observed classroom instruction in order to better understand what factors may contribute to differences in teachers' use of CPL.

2-H-48   Bilingualism and mindset: Relations between parents' beliefs about fixedness of ability and raising children who speak a second language

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Speaking multiple languages is an important asset in an increasingly globalized world; however, the literature on bilingualism rarely explores elective bilingualism or the factors contributing to parents' choice to raise their children bilingual. To examine the role of mindset, we administered an online questionnaire to parents of 0-8-year-olds that included Dweck's (1999) general Theories of Intelligence scale, the Parental Beliefs about Ability Fixedness scale (Muenks et al., 2015), demographic information, and details about the children's home language environments and practices. Analysis of our preliminary data of 39 parents (we aim to collect n=80) suggests that, controlling for income and whether the parents themselves speak a second language, parents whose children speak a second language (n=10) have a less fixed mindset about intelligence (-0.78 sd, p<0.05) and about their children's math (-0.99 sd, p<0.01) and verbal abilities (-0.86 sd, p<0.05). The findings suggest interventions that focus on parents' mindset might help encourage bilingualism in early childhood.

2-H-49   Understanding teacher reflection to improve teacher learning online: What factors influence who offers suggestions for improvement after classroom video review?

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In past work investigating teachers' learning about their teaching of elementary math, we invited reflection after watching a video clip of a math lesson and then examined how types of reflections were related to teachers' background characteristics and teaching behaviors. Generally, we aim to use

teachers' reflection as a lever to impact their understanding of math teaching and learning. Because Kersting et al. (e.g., 2012) found that offering Suggestions for Improvement (SI) after watching clips has been linked to their students' learning, we asked: how are SIs related to teachers' backgrounds and the likelihood that they want to improve their practice? To do so, we had 129 teachers complete Kersting's assessment, asked them to watch and comment on new video, asked about their likelihood to change their teaching, and collected background information (e.g., years of teaching). We found no significant relation between background and high SI scores, suggesting that awareness of best practice is not necessarily a function of experience. We also found that teachers with low SI scores were also more likely to endorse changing their teaching, suggesting that teachers who are not attuned to best practice (produce few and low-level SIs) appear to be aware that they need to improve and would be willing to learn about changing their teaching. These findings might have implications for finding and supporting teachers who could benefit from learning about improving their practice.

2-H-50   Metacognitive monitoring in gesture-based digital video learning environments
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Prior research suggests that encouraging students to gesture supports their developing understanding of many complex mathematical concepts. However, there remains a critical need to investigate how gestures can be meaningfully integrated into online instructional contexts. In this study, we examined how metacognitive prompts in a digital video learning environment impacts student metacognition and statistical learning. Twenty-eight undergraduate students completed a pretest, watched instructional videos, and completed a posttest reflecting their understanding of least-squares regression. One group of students was interviewed and asked to explain what they learned using gestures before the posttest. All groups received metacognitive questions throughout the study. Preliminary results show that the group that received the interview before the posttest learned more than students who did not receive the interview. This same group had higher accuracy in their metacognitive monitoring. It is important for students to be more accurate in their metacognition to progress and enhance their mathematical learning.

2-H-51   Preliminary evaluation of a "Smart Speaker" app to increase parent-child conversation during shared book reading
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Dialogic reading (DR) - particularly decontextualized conversations which go beyond the here-and-now - is widely recognized as effective for promoting preschoolers' oral language (Whitehurst et al., 1994; Lonigan & Whitehurst, 1998). However, significant implementation barriers exist to caregiver use of DR (Justice et al., 2015). Technologies such as conversational agents (CA) have shown promise for overcoming these barriers (Warschauer et al, 2021; Stuckelman et al., 2021). These technologies are available on mobile devices and deliver prompts to elicit dyadic conversation while reading. This poster reports on a pilot evaluation of a CA "smart speaker" app for increasing parents' use of decontextualized language during shared reading. Parents of 3- to 5-year-old children (N=18) watched a coaching video

with strategies for decontextualized language use. Dyads were videotaped reading with and without the smart-speaker prior to (baseline) and one month after (follow-up) the coaching video. Results indicated that parents used more decontextualized language (1) reading with the smart-speaker than without; and (2) at follow-up than at baseline. Nevertheless, parents' use of decontextualized language at follow-up increased significantly from baseline while reading books without the smart-speaker (IRR=2.77, p<.001). Altogether, results suggest that CA technology increased DR and transferred to business-as-usual reading sessions. Implications for future research will be discussed.

I – Face perception

2-I-52   The socialization of emotion understanding: Effects of parental emotionality on neural correlates of emotion perception in preschoolers

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The ability to accurately decode others' facial expressions is essential. Previous theories have suggested that aspects of parental emotionality can influence children's emotion perception, but how this influence occurs is unclear. Furthermore, through a combination of mechanisms, parental emotionality may shape how children's brains specialize to respond to emotional expressions. The present study is the first to empirically test this possibility. Participants had their brain activity (event-related potentials; ERP) recorded as they passively viewed faces expressing different emotional valences at full and reduced intensity (from the "NimStim" database). We examined relations between the mean amplitude difference between full and reduced emotions of the N170 component (an ERP component associated with face perception) and parental emotionality (self-reported Emotion Reactivity Scale). Data collection is ongoing. Preliminary findings from 29 children (19 girls, Mage = 4.4 years, SD = 0.59) revealed that children with parents that reported higher emotion intensity show greater neural response towards less intensive angry expressions (b = 4.56, FDR corrected p < 0.01), suggesting parental emotionality sensitizes children to process more nuanced facial expressions. These findings further specify the roles of parents in socializing children's emotion understanding, and have implications for mechanisms underlying the individual differences in children's emotion perception.

J - Identity

2-J-53   Gender identity importance in cisgender, transgender, and nonbinary children

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On explicit measures of gender identity, transgender girls and boys are indistinguishable from their cisgender peers. Whether these groups differ in the extent to which their gender identity matters to them has not been sufficiently explored. Here, we compared gender identity importance in 5-11-year-old transgender and cisgender children. Participants (n=205; Mage=9.69) were recruited as part of a longitudinal study of transgender children, their cisgender siblings, and unrelated cisgender children and were asked whether they are a boy, whether they are a girl, and whether they are nonbinary. For every category to which they responded "yes," participants rated the importance of that identity from 0/Not At All Important to 100/Very Important. A between-subjects analysis of variance comparing binary transgender children (who said "yes" to girl or boy only), binary cisgender children (who said "yes" to girl or boy only), and nonbinary children (who said "yes" to nonbinary only) revealed an effect of group on gender identity importance, $F(2, 193)=5.14$, $p=.007$, $\eta^2=.05$. Pairwise t-tests with Bonferroni corrections

revealed that binary transgender children rated their gender as more important to them (M=81.95, SD=27.34) than binary cisgender children (M=66.95, SD=31.17), p =.006. No other comparisons were significant. Within this sample, being a girl or a boy is particularly important to children whose gender identity does not correspond with the sex they were assigned at birth.

2-J-54   Gender identity and gender-typed preferences in 46, XX girls with congenital adrenal hyperplasia

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Previous research, much of which occurred decades ago, has shown that 46 XX individuals with congenital adrenal hyperplasia (CAH), a genetic disorder in which those affected are exposed to unusually high levels of androgens in utero, have preferences for toys and activities more often associated with boys than girls. In this pilot study, we investigated a wide range of gender-typed preferences and gender identity in 46 XX individuals with CAH, aged 3-12 years, who were assigned female sex of rearing at birth (n=21), and compared them to a group of individuals without CAH with female sex of rearing (N=129). Consistent with past research, girls with CAH showed preferences for more masculine toys (p < .001) and clothing (p < 0.039) than the comparison group. Results on identity measures were more mixed. On a continuous measure of gender identity, girls with CAH indicated feeling more like a girl than a boy (M = 92.74) compared to the control group (M = 80.56), t(76) = 2.14, p = 0.036. The groups did not differ in their perceptions of their current or future categorical gender, or in how similar they felt they were to girls (vs. boys), though at the mean level the general pattern reversed such that non-CAH girls reported feeling more similar to girls (as compared to boys) (M=1.83) than girls with CAH (M = 1.28). These preliminary findings suggest that historic patterns may continue to hold today, though a larger sample is necessary to be certain.

2-K-55   Infant's word learning ability: Effects of maternal work status and educational level

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Maternal education, as a proxy of socioeconomic status (SES), impacts young children's language development (Magnuson, et al., 2009; Maguire et al., 2018), since mothers' educational attainment likely shapes their expectations of children's education and relates to the amount of active language learning activities between mother and child (Davis-Kean, 2005). Maternal work status exerts a similar influence (Laing & Bergelson, 2018). However, it is unclear if maternal work status and level of education affect children's language development differently. The current study includes these two factors in order to examine how they impact young children's vocabulary development and novel word learning ability. One hundred and eight (51 males) 24-month-old monolingual English-learning infants and their families participated in our study. Participating families consisted of mostly Caucasian households from diverse SES backgrounds. Infants' novel word learning was assessed by a Mutual Exclusivity (ME) task (adopted from Bion et al., 2013) in the lab, in which infants were tested on their ability to retain label-referent mappings after using ME to learn two novel words. The caregivers completed the MCDIs Words &

Sentences (Fenson et al., 2006) and also provided family demographics information including maternal education and work status. Maternal education was then categorized into three groups: low (no college degree), middle (college degree), high (graduate-level degree). Maternal work status was coded as working versus stay-at-home. Two 2-way ANOVAs (MaternalEducation X WorkStatus) were conducted on productive vocabulary size and ME performance. There were no significant main effects or interactions for infants' productive vocabulary. Interestingly, there was a main effect of MaternalEducation on ME, $F(2,72) = 5.01$, $p = .009$, $\eta 2 = .12$, and an interaction of the two factors, $F(2,72) = 4.34$, $p = .017$, $\eta 2 = .11$. Post-hoc tests indicated that only when mothers showed low educational attainment, infants with working mothers (who were therefore more likely to be at daycare), compared to those with at-home mothers, were associated with higher novel word learning ability ($p = .020$). Importantly, there were no significant differences in infants' novel word learning ability across the three SES groups with working mothers. The current study illustrates how different components of maternal background relate to two different aspects of young children's language learning. Across three maternal education groups, 2-year-olds with working mothers do not differ on either their concurrent productive vocabulary size or their ability to learn new words, suggesting that childcare may be an equalizer for language development. This is in line with previous research that showed that high-quality childcare is linked to better cognitive and language development in the first 3 years of life (NICHD Early Child Care Research Network, 2002). Interestingly, vocabulary size alone at this age does not capture these variations; infants' novel word learning ability is a more sensitive measure. Together, these findings point to the importance of providing accessible and high-quality childcare, which may be of particular importance to infants and toddlers who are lagging behind on their novel word learning ability.

K - Language

2-K-56   Associations between parental and child mental-state language, household chaos, and theory of mind in father-preschooler dyads

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Introduction: Parental use of mental state language has been consistently associated with child theory of mind development, or the ability to understand the beliefs, desires, and knowledge of the self and others (Wellman, 1990). Parental discussion of mental states (e.g., thinking, knowing, believing) make these concepts more salient to children (Devine & Hughes, 2018; Dunn et al., 1991), and a recent meta-analysis reported an overall modest positive association between parental mental-state talk and both concurrent and longitudinal theory of mind understanding (Devine & Hughes, 2018). However, very little work examines this association between fathers and children or considers the child's own use of mental state language. Additionally, this association is rarely considered within the broader context of the home environment. One potential aspect of the home environment that may influence the association between mental state language and theory of mind development is household chaos. Chaotic households tend to be noisy, unpredictable, and lack routines. Higher levels of household chaos have consistently been associated with a wide range child and family outcomes such as poorer sleep, higher child behavior problems, and lower executive function scores (Marsh et al., 2020). This observed detrimental effect may occur because household chaos may interfere with and disrupt the proximal processes that occurs between children and parents in the home environment (Evans et al., 2005). Higher levels of household chaos may serve to decrease either the amount of interactions that occur or

the quality of these interactions (e.g. less discussion of mental states), resulting in lower theory of mind skill use. Hypothesis: We expect to find that greater parental and child mental state language use will be positively associated with child theory of mind scores. Additionally, we expect that associations between parental mental state language use and theory of mind abilities will vary depending on levels of chaos reported in the household. Specifically, the association between parental mental state language use and theory of mind is expected to be strongest in the context of low household chaos, and weakest in the context of high household chaos. Methods: Data were collected from a community sample of fathers and their 3- to 5-year-old children (N = 88 dyads, Mchildage = 51 months). Children completed tasks to assess theory of mind (Wellman & Liu, 2004). Fathers completed the abbreviated Chaos, Order, and Hubbub scale (CHAOS; Matheny et al., 1995). Father-child dyads completed two 5-minute interaction tasks which were videotaped and coded for mental state language use by parents and children (Ruffman, Slade, & Crowe, 2002). Results: Preliminary analyses show that father use of mental state language was highly correlated with child use of mental state language (r = .428, p = .002). Surprisingly, neither parent mental state language use (r = .054, p = .719) nor child mental state language use (r = .067, p = .656) was correlated with child theory of mind scores, inconsistent with the extant literature. Regression analyses further showed no main or interaction effects of parent mental state language and household chaos on child theory of mind scores. Additional exploratory and contextual variables will be discussed along with future directions.

2-K-57   Learning about differences: The roles of comparison and contrasting language
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Comparison offers an effective way of learning. Based on the structure-mapping theory, comparison involves a process of structural alignment, which highlights common relational structure between the analogs and promotes learning of abstract relational knowledge. In addition, studies show that structural alignment can promote attention to alignable differences--differences that play corresponding roles in the common structure. Research also shows that relational language can interact with comparison process to promote learning. For example, labeling two situations with the same term invites comparison, which can foster learning and transfer of the common structure. In this research, we explore a further question: Can language promote comparison-based learning of alignable differences; and if so, will this learning transfer to new situations and persist over delay? Specifically, we asked whether language would aid children's learning of a key engineering principle--namely, that diagonal braces confer stability in building structures. During training, 69 5- to 6-year-olds (out of a total goal of 100) were shown a pair of model buildings. Within each pair, one building had a diagonal brace and was therefore stable, while the other had only horizontal crosspieces and was unstable. Two factors were varied between-subject: the alignability of the exemplars, and whether contrasting language was used. Half the children saw a highly alignable pair, and half saw a pair that was less easy to align (Fig. 1). All children were asked to wiggle the buildings, and all found out that the braced one was more stable. Half the children in each condition then heard that only the stable one contained a 'brace' (a novel term); the other half was simply reminded that the stable one was 'strong' (Fig. 1). Based on prior research, we predicted that children who saw high-alignable pairs would show better learning of the brace principle than those who saw low-alignable pairs. We further hypothesized that labeling the difference would engage children's curiosity and invite further comparison to discover the difference. This might

especially benefit children in the low-alignment condition, who might not have succeeded in aligning the buildings at first. To assess learning, children were tested immediately on a 'near' repair task: they were asked to show where to add a piece to make a wobbly building stronger. Two-to-six days later, children were again given the near repair task, as well as further transfer tasks with dissimilar objects. Data collection is still ongoing. However, a consistent pattern emerges so far. It appears that children in the high-alignment condition performed better than those in the low-alignment condition. Further, children who received the contrasting 'brace' label performed better than those who did not, and this effect is particularly apparent for children in the low-alignment condition. Fig. 1 depicts performance on the immediate near-repair task. The pattern of results suggests that hearing contrasting language can invite structural alignment and reveal differences that inform children's learning.

2-K-58   The many meanings of "um": Children interpret disfluencies differently across contexts

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Conversation necessitates rapid turn-taking. When processing demands prevent timeliness, speakers produce disfluencies (e.g., "um") to hold the conversational floor while still formulating their utterance. These disfluencies can thus provide insight into a speaker's underlying mental processes, but interpreting their meaning can differ dramatically across conversational contexts. When answering a question like "What do you think about ordering Thai food?" response delays are taken to reflect preference or willingness (Roberts et al., 2011), but when answering a question like "What is the capital of Thailand?" response delays are taken to reflect lower knowledgeability (Brennan & Williams, 1995). In prior work, we have shown that children (ages 4-9) use disfluencies to infer speaker preference (by age 6) and speaker knowledge (by age 4). The current study extends these findings to ask how children draw selective inferences about the likely meaning of "um" across contexts. Children (ages 4-9, n = 120, data collected remotely) were randomly assigned to either the preference or labelling condition. Children heard a story about two speakers and two familiar animals (e.g., a tiger and a zebra). In the preference condition, speakers were asked "Which animal do you like the best?" and both speakers independently stated the same preference, with one using a disfluency (e.g., saying "Um... the tiger is my favorite."). Children were then asked questions about the speakers' relative preferences. In the labelling condition, speakers were asked "What is this animal called?" and both speakers provided the correct label, with one using a disfluency (e.g., saying "This one is a um... tiger". Children were then asked questions about the speakers' relative knowledge. As in our previous work, when asked questions about the mentioned animal (e.g., the tiger), children inferred that the fluent speaker had a stronger preference (in the preference condition) and knew more (in the labelling condition). To test for selectivity in children's inferences, children were also asked questions about the unmentioned animal (e.g., the co-present zebra). In the preference condition, disfluencies indicate split preferences suggesting a relatively stronger preference for the unmentioned, dispreferred animal. Alternatively, in the labelling condition, disfluencies may indicate lower relative knowledge across the domain. Indeed, children by age 6 show precisely this pattern of selective generalization; when asked about the unmentioned animal, children in the preference condition now chose the disfluent speaker as having a relatively stronger preference, but children in the labelling condition still chose the fluent speaker as more knowledgeable. While disfluencies are often overlooked as meaningless errors in production, this work suggests that young

children readily derive social meaning from disfluencies, and draw rich contextualized interpretations by age 6. In ongoing work, we're extending this research to examine real world consequences, testing if children infer that a disfluent response may indicate an unexpected or non-normative behavior (in this case, choosing an opposite gender stereotyped toy). Across these lines of work, we hope to demonstrate children's rich and consequential reasoning about not just what someone says, but how (and how quickly) they say it.

2-K-59   Social robot effects on child speech characteristics during structured interaction

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Social robots are emerging as viable candidates for facilitating educational and therapeutic intervention with school-age children. Questions about the effect of social robots on naturalistic child speech and language remain and have implications for speech and language testing. In this study, 122 children between the ages of 4 and 9 years old completed an open-ended picture description task, guided by a researcher. There were three levels of robot engagement: Absence, General Encouragement, Encouragement +Task Instruction. Preliminary analyses suggest that the presence of social robots results in children speaking more often and with more complex syntactic structure, though less complex vocabulary use was noted as well. Ongoing analyses are looking at whether the extent of robot engagement has any effects. If these trends continue, they will support previous research suggesting robot novelty results in more engagement in interaction, though perhaps less optimal language display than the child is capable of.

2-K-60   Children's story world absorption in avid and occasional readers

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Research with adults has begun to investigate the feeling of being "hooked," or "lost," in a book. Known primarily as narrative, or story world, absorption, it is "...a disposition for having episodes of 'total attention' that fully engage one's representational resources" (Tellegen & Atkinson, 1974). However, very little research has been conducted with children, despite everyday observations indicating that many children do become "lost in books." Understanding how the state of absorption develops and how children experience absorption through reading fiction will likely illuminate children's reading habits and preferences and invite questions about how those can be nurtured. This presentation, based on a study which investigated the mental state of narrative absorption in 9- and 10-year-old children, will address the extent to which avid and occasional readers become absorbed by fiction. Presenting survey data from a story world absorption questionnaire, as well as qualitative interview data on how children articulate what it means to be "lost" in a book, this poster will explore how narrative absorption relates to children's reading engagement, as well as discuss future research directions, including how absorption relates to children's reading comprehension, fluency, attention, and belief-change.

2-K-61   Do parents' spatial talk and spatial activities matter for preschoolers' spatial skills?

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Engaging in spatial activities (e.g., puzzles) positively relates to spatial cognition, and increased exposure to spatial language is positively correlated with children's spatial word comprehension and performance on mental rotation and mapping tasks. In this study, we investigated how different qualities of parental spatial language (e.g., frequency and utterance length) predict growth in children's spatial skills from 4 to 5 years of age. Children (N=113) and their parents participated in a one-year longitudinal study starting when children were four years old. Measures of children's mental transformation and sensitivity to spatial features were administered at each time point. At time 1, dyads engaged in a joint magnet construction task to directly observe parental spatial language input, and parents reported how frequently they engaged in specific spatial activities at home with their child, such as building with blocks, via an online survey. Parents who used longer spatial utterances during the construction task, on average, had children with more advanced spatial skills at age five, controlling for average utterance length, prior spatial skills, etc. The number of spatial utterances and parents' report of spatial activities did not predict child spatial skills. These findings suggest that the complexity of parents' spatial language is particularly important for the growth of preschool-aged children's spatial cognition.

2-K-62   The relationship between children's metacognitive judgments of knowledge and verbal disfluency

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When we [uhh] engage in everyday conversations, our speech is [um] littered with [like] spontaneous pauses and interjections known as "verbal disfluencies". In adults, verbal disfluencies are associated with a speaker's certainty or knowledge level in both speech production and speech comprehension. That is, adults rate both their own and others' confidence lower when they produce more verbal disfluency. Little work has explored whether and when children's verbal disfluency correlates with their own internal sense of confidence. Given that young children struggle with explicit ratings of their own confidence, these implicit cues may provide researchers a window into children's metacognitive awareness. This study examines the association between verbal disfluency and confidence in 4-9-year-olds' naturally produced speech. Children answered fact-based questions about animals and performed numerical comparisons. Then, they rated their confidence about these answers in a forced-choice metacognitive judgment paradigm. We examine the association between verbal disfluency and these explicit ratings of metacognitive confidence, showing that even our youngest children reliably produce more verbal disfluencies when they are feeling less confident.

2-K-63   Can nine- and twelve-month-olds predict a speaker's goal based on her verbal information?

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Verbal information is the primary source of presenting or understanding others' psychological states including goals. The present study used an anticipator-looking paradigm to examine whether nine- and twelve-month-olds not only understand but also predict an agent's goal based on verbal information. Infants first received four familiarization trials where an agent uttered a novel word, "Modi" (different-word condition) or "Papu" (same-word condition) three times, and then grasped one of the two novel objects. In the display trial, the locations of the two objects were reversed. During the single test trial, the agent said "Papu" three times in both conditions and paused until the trial ended. Infants' looking times towards the objects were coded from the offset of the first utterance. The results showed that both age groups of infants in the same-word condition looked longer at the same object that the agent had grasped during the familiarization trials than at the other object, whereas infants in the different-word condition looked longer at the new object that she had never reached. These findings suggest that even infants younger than one year old can not only detect the goal of an agent's action in retrospect but also predict the goal of an agent's future action, by exploiting linguistic information the agent provides.

2-K-64 The role of object novelty in children's and adults' disambiguation and retention of novel words

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Research has shown robustly that children in ambiguous labeling situations assume novel labels to refer to unknown rather than known objects. However, ongoing debates center on the underlying mechanism: Is this behavior guided by lexical constraints, pragmatic reasoning, or children's attraction to novelty? In a pre-registered online study with 2- and 3-year-olds and adults, we examined if object novelty alone (without pragmatic or nameability cues) can account for participants' disambiguation and whether this potential effect is comparable to the classic mutual exclusivity (ME) effect. Further, we assessed whether any selection tendency leads to real word learning instead of a momentary attentional shift. Participants were presented with a completely novel unknown object and either a known (Classic ME) or an unknown pre-exposed object (Novelty) as potential referents for a novel word. Both age groups successfully chose the novel object as the correct referent in the classic ME condition. In the Novelty condition, they selected randomly between objects, with adults showing enhanced uncertainty. After 5 minutes, adults made consistent choices above chance in both conditions while children only did so in the Novelty condition. The pattern of results suggests that object novelty might not be sufficient to guide disambiguation, while raising the question whether factors like ambiguity or engagement during referent selection might potentially enhance the encoding of the scene.

2-K-65 Children's understanding of whispering

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Little is known about children's understanding of whispering and its functions. Study 1 assessed whether children ages 4-8 (n = 98) treat whispering as a cue for privileged information (e.g., secrets). Children watched videos in which two characters described an action, one in a normal register and one in a

whisper. Children then selected the character they believed would share the information. If children know whispering is a cue for privileged information, they should select normal register speakers more often as sharers. Overall children did not select the normal speaker more often than the whispered speakers, however older children (6 and over) selected the normal register speaker more often than younger children, (t(94) = 2.32, p =.022). Study 2 assessed whether whispered information would be remembered better than normal speech by 3- to 8-year-olds (n= 90). Children watched animations where characters spoke in normal and whispered register combinations and were then asked a cued recall question. It was hypothesized that children would remember best when information was whispered AND there was a register change. Results showed memory did not differ between conditions. These studies provide a first look at children's understanding of whispering.

2-K-66   Did you say bottleship? The development of lexical inhibition

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Prior work suggests that development of word recognition is protracted throughout adolescence; younger children are slower to activate the correct word and suppress competitors than older teenagers. It is unclear what changes support this. One possibility is lexical inhibition: listeners must inhibit competing words for efficient recognition. Previous work has measured adults' lexical inhibition using the subphonemic mismatch paradigm where participants hear words with the beginning spliced from another word (e.g., ne(ck)t) or a nonword (e.g., ne(p)t). Here, the early activation of the word neck inhibits the target word net, whereas the nonword doesn't activate a competing word. In general, adults are slower to recognize the target for the word splice condition than the nonword splice. The present study--part of the Growing Words Project, sought to better understand the development of lexical inhibition by testing two groups of school-aged children (46 7-8 y/os and 46 11-12 y/os). Unlike adults, children were equally slowed by word and nonword splices suggesting that inhibition has not yet developed even at 12 years. We conducted a follow-up study with multisyllabic words to further enhance the competition between words. Children in this study (30 7-8 y/os) showed some evidence of lexical inhibition but to a lesser degree than adults. These studies together reveal that the development of lexical inhibition is a process that emerges gradually throughout the school-age years.

2-K-67   Mean length of utterance and index of productive syntax in Czech children

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Mean length of the utterance (MLU) and Index of productive syntax (IPSyn) are well-established measures of language acquisition. We examined the use of these measures for child language transcripts in Czech and relations between them and other language tests. We compared MLU in syllables, morphemes, and words and applied IPSyn adapted to Czech on the same transcripts. We used a corpus of 110 children recorded during free play at two time points: 2;6 years and then at 3;8 (60 children) and 4;4 years (50 children). The children were tested for receptive vocabulary and grammar. The different MLU measures correlated closely (all r's > 0.97), so we used MLU in words in further

analyses. We found strong correlations between transcript-based measures of MLU and IPSyn in both time points (0.88 and 0.77). Both MLU and IPSyn in 2;6 years predict themselves in 3;8 and 4;4 years (β = 0.37 and 0.35 respectively). In the case of IPSyn, the vocabulary test showed a unique effect above and beyond the factors of other predictors (β = 0.37), in the case of MLU, it was at the limit of significance. Our results confirm that MLU in words is an adequate measure. This is an important finding as an automatic calculation of MLU in morphemes or syllables in highly inflectional languages as Czech is complicated. IPSyn seems to be a valid measure since it predicts itself in time with a vocabulary measure as a unique predictor and it also correlates closely with a transcript-based measure such as MLU.

2-K-68 Developmental changes in gamma and theta engagement during sentence processing continue into early adolescence

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By middle childhood and adolescence children appear to retrieve word meanings and integrate them into ongoing sentences with ease, however the neural structures and functions supporting these abilities continue to develop through early adolescence (Schneider 2018). Theta (4-8 Hz), which often corresponds to word retrieval, decreases in power (amplitude) and becomes more localized with age (Maguire et al., 2022). In adults, however, this bottom-up word retrieval process is often paired with changes in gamma (50-100 Hz) which are thought to reflect the ability to predict upcoming words (Prystauka & Lewis, 2019). If and how changes in gamma occur in conjunction with the known developmental changes in theta is unclear. Here we studied developmental differences in theta (4-8 Hz), alpha (9-12 Hz), beta (13-30 Hz) and gamma (50-100 Hz) engagement as children (ages 8-15) read sentences. Using a step-wise regression we replicated previous findings of a significant decrease in theta power with age. Interestingly, gamma power significantly increased with age while beta and alpha exhibited no age-related differences. A subsequent regression revealed that, after accounting for age, decreases in theta over left frontal areas correlated to increases in gamma over all scalp areas. This may indicate that, similar to adults, between middle childhood and adolescence as the ability to predict upcoming language (gamma) increases, the need to devote resources to word retrieval (theta) decreases.

2-K-69 Phonological productivity and voicing assimilation in children's productions of novel words

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Children's ability to apply morphological knowledge to novel words is well-attested. Less clear is whether phonological knowledge is comparably productive in new contexts. This study investigated voicing assimilation in children's speech to determine how closely their novel word productions also resemble real words phonetically. 101 children ages 4-9 performed a Wug test, generating plural word forms from singular forms. Stimulus words varied in whether they were real or novel and whether the word-final sound was phonologically voiced or voiceless. Waveform periodicity and duration of plural affix fricatives were measured for phonetic cues to voicing assimilation. A preliminary analysis of 20

children failed to find consistent evidence of voicing assimilation across real or novel words, regardless of phonological voicing status. This outcome suggested that phonetic voicing assimilation is not robust in children's speech. However, children's similar real and novel word productions indicated that phonological knowledge, like morphological knowledge, may productively extend to novel words.

2-K-70 What do preschoolers know about number gestures?

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Although researchers largely agree about the protracted developmental trajectory of children's acquisition of number words (e.g. "three"), there are several conflicting accounts of how children learn number gestures (e.g. using three fingers to indicate three). Gaps in our understanding of number gestures and their relation to the acquisition of number words are exacerbated by the fact that no single study has measured and compared children's ability to 1.) map number gestures to nonsymbolic quantities, 2.) map number gestures to number words, and 3.) map number words to nonsymbolic quantities. In the present study, we found that children are more accurate when mapping number gestures to either quantities or to number words than when mapping number words to quantities. Moreover, we found that children were more accurate when mapping number gestures to number words than to nonsymbolic quantities and that these three abilities were highly correlated with one another. These results suggest that there are some features of number words (e.g. their arbitrariness) or their usage that may make them more difficult for children to learn but also that children seem to develop an understanding of number gestures and number words in tandem.

2-K-71 Lexical tone serves as a cue during bilingual statistical word learning

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Infants, children, and adults are adept at statistical word learning (SWL)--matching a word with its single referent through co-occurrences across ambiguous scenes (Smith & Yu, 2008; Yu & Smith, 2007). However, less is clear how learners link two words with the same referent through statistics, e.g. translation equivalents in bilingual environments. This study simulated SWL in a bilingual environment, where two words sharing a referent differed in a lexical tonal cue (pre-registration:https://osf.io/kq72m/?view_only=b3b9533a2d4943f4bb7dbae0b0472aa8). We asked 1) whether such a cue affects SWL, and 2) how SWL interacts with language experience. We modified a SWL paradigm where each object co-occurred with two words, either differentiated by a Mandarin lexical tonal contour (Cued condition), or not differentiated (Uncued condition). We tested adults--non-tonal English monolinguals (55) and Spanish-English bilinguals (56), and tonal Mandarin Chinese-English bilinguals (36). Results showed that all groups learned. Chinese-English bilinguals learned better than the two non-tonal groups only in Cued condition (no differences between the non-tonal groups). Together, the study proposes when learning statistics from multiple languages, knowledge of some linguistic feature(s) of one may help scaffold learning of both. This paradigm paves way for testing infants on SWL's developmental course.

2-K-72   Interpreting number words in context: Do children have a large number word bias when making magnitude comparisons in story contexts?

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Number words present unique linguistic challenges for young children, because number words may refer to cardinal or ordinal properties, to continuous or discrete quantities, and to quantities of individual items or described with combinatorial language (e.g., 2 cookies, 2 bags of cookies). Using a novel story-based task, we asked 268 children in Grades PreK to 2 to select which of two story characters had more items. On experimental trials in which the numerosity of some item sets was ambiguous or irrelevant to this magnitude comparison prompt, we recorded if children's responses aligned with the larger of two spoken number words even when the story context did not support that the larger number word referred to the correct (more numerous) set (e.g., "4 pears" is not necessarily more pears than "2 boxes of pears"). We explore if these Large Number Word Bias (LNWB) responses are related to concurrent and future math ability, if vocabulary or executive function (EF) skills mediate these associations with math, and if the predictive value of LNWB responses partially depends on the specific context in which these responses occur. Latent class analysis of LNWB responses across four types of ambiguous contexts reveal developmental and individual differences in LNWB response profiles, and that select profiles are related to lower math ability. These findings suggest variation in young children's sensitivity to story contexts when interpreting meanings of number words.

2-K-73   "But I think she left because she thought I was following her, but I wasn't": the impact of story-sharing circles on preschoolers' character representation

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Across the preschool years, children's character representation shifts toward a focus on the internal worlds or "landscape of consciousness" of narrative protagonists (Bruner, 1986). Nicolopoulou & Richner (2007) have characterized this transition as moving from "actors" in most four-year-olds' stories, to "agents" having simple cognitive abilities in most five-year-olds' stories, to "persons" with well-specified mental representations motivating action. The present study examined approximately 150 stories shared by children (N= 20, mean age= 62.35 months, SD= 4.57) in 12 sessions of story-sharing circles implemented in a 4-week kindergarten readiness program. Sophistication of character representation was coded on an 8-point scale (see Table 1) with high inter-rater agreement (.8 to 1.0). Results support a shift to stories with higher levels of character representation (corresponding to "agents" and "persons") in later sessions compared to earlier sessions. Contrasting patterns for character representation of the self, other, and collective/we characters in children's stories will be presented as well. The advanced character representation levels elicited from preschoolers in our predominantly Black and low-income sample contributes to prior literature suggesting narrative skills as a cultural strength in Black communities and indicates that story-sharing circles may be a particularly powerful context for supporting social cognition in children's personal narratives.

2-K-74   Spoons, Stoppers, and Spiles: Do mothers favor familiar objects for playtime?

Catanya Stager[1], Rachel Evans[2], Sherry Nguyen[1], Samantha Wiley[1], Griffin Howard[1], Mason Craft[1], Kaitlyn May[1], Lily Wiedmer[1], Lucy Gideon[1], Selena Ortega[1], Jason Scofield[1]
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How much does a mother's knowledge about an object affect how she plays with her child? To examine this question, mother-child dyads (N=80 2-4 year olds) completed a 10-minute free play session with 12 objects of 3 novelty levels (Familiar-to-both, Novel-to-both, and Parent-known). Videos were coded for parent time playing with objects (functional-play and symbolic-play). Preliminary findings indicate that while mothers symbolically play with all 3 types of objects for similar amounts of time, with a slight preference for novel objects (Overall Mean = 37.27, Novel Mean = 41.32), mothers spend more time with familiar objects during functional play (Mean = 55.13) than for Parent-known objects (Mean = 8.67) and Novel objects (Mean = 0.82). These findings suggest that mothers play equally with objects of varying novelty in symbolic play but are more likely to functionally play with familiar objects, compared to objects known only to mothers.

L - Learning

2-L-75   Cognitive correlates of self-derivation of new knowledge in elementary school classrooms

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A central goal of development and of formal education is to build a knowledge base. Accumulating knowledge relies, in part, on self-derivation of new semantic knowledge via integration of separate yet related learning episodes. To illustrate, a child may be presented with the true but novel fact "Venus is the hottest planet." In a later episode, the child learns "Another name for Venus is morning star" (Bauer & Varga, 2017). Though the answer to the question "What is another name for the hottest planet?" was not directly given, the child can self-derive it by integrating the separate yet related episodes of learning and drawing the inference that "Morning star is another name for the hottest planet." Self-derivation through memory integration is a valid model of knowledge accumulation. The knowledge gained through the process is rapidly incorporated into the knowledge base (Bauer & Jackson, 2015), endures over delays (Varga & Bauer, 2017), and can be used for further knowledge generation (Wilson & Bauer, 2021). Moreover, it is related to academic achievement in children (Esposito & Bauer, 2017) and adults (Varga et al., 2019). Mirroring the realities of academic performance, there is significant individual variability in self-derivation in the classroom. In the classroom context, one predictor of successful self-derivation is verbal comprehension (Varga et al., 2019). To gain a more complete picture of the determinants of self-derivation performance, in the present research, we examined a more comprehensive battery of potential predictors, and included the first test of metacognition as a correlate of successful self-derivation. The sample was 330 children ages 8 to 11 years, tested in their 3rd, 4th, and 5th grade classrooms. The sample is from a low-income, rural area in the Southeastern US and is racially diverse with approximately equal percentages black, white, and Hispanic children. We measured several cognitive abilities hypothesized to be related to self-derivation performance: children's auditory and spatial working memory, inhibitory control, verbal comprehension, metacognitive awareness, and their metacognitive judgments at test for self-derivation. Metacognition, or thinking about thinking, has been demonstrated to highly relevant for educational success (Dunlosky & Metcalfe, 2009) but it has not been previously studied in the context of self-derivation. Many of the

cognitive abilities measured were related to performance, but only two emerged as significant predictors, $F_{(2,223)}=15.45$, $p<.001$, $R^2=.26$: verbal comprehension (B=.012, SE=.002) and metacognitive knowledge (B=.019, SE=.009). Verbal comprehension often is used as an index of the size of one's knowledge base (Akshoomoff et al., 2013). The present results are thus an empirical demonstration of the adage that knowledge begets knowledge. The novel finding that metacognitive knowledge supports knowledge base development via self-derivation suggests that awareness of how to use one's knowledge further contributes to learning. Thus, the present work replicates and extends both prior laboratory and classroom studies in a large, diverse sample of children in their classrooms, and these findings suggest that both having knowledge and knowing how to use it support further accumulation of knowledge.

2-L-76   Social-emotional touch as a window into children's STEM engagement during parent-child interaction

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Social-emotional touch is used to denote interpersonal relationships and as a mechanism to reduce stress (Dunbar, 2010). What is unknown is how touch relates to learning mechanisms children use during exploration. We analyzed two datasets of parent-child interaction during free play at a children's museum exhibit. In both cases, after families played at the exhibit, we measured children's engagement in the STEM activity. In the first dataset (N=111, 4-7-year-olds), social-emotional touch (but not other forms of touch) negatively predicted children's engagement, controlling for children's age and parent-child interaction style, which had previously been shown to predict engagement. The second dataset (N=64, 4-7-year-olds) found a similar result in a replication of the first dataset, but not in an extension designed to affect parent-child interaction. Subsequent analyses of this surprising finding suggest that the negative role of emotional touch on STEM engagement relates more to parents' than children's need to reduce stress.

2-L-77   Helping children see patterns: Visual support as a tool for understanding repeating patterns

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Perceptual information cues learners to attend to specific relevant features in problems, but past research has focused on school-age children. The current study examined whether adding visual support helped preschoolers understand repeating patterns, an important aspect of math development. Participants were randomly assigned to receive patterns with or without a box frame around the part that repeats to draw attention to the pattern unit (see attached figure). Children (n = 64; mean age = 4.3) were assessed via one synchronous Zoom session. Participants received baseline (n = 3), training (n = 10), and posttest (n = 6) trials. Performance did not differ by condition at baseline. The added frame did not improve performance for training trials (M = .56 vs .55 for frame vs. control, respectively) or posttest trials (M = .44 vs .47 for frame vs. control, respectively) or impact the types of errors children made. These null results suggest that young learners might need alternative visual support. For example,

past research on visual support for mathematics problems has supported existing visual aspects of a problem (e.g. changing the color), instead of adding extra visual information, which in this case may have been too visually complex or confusing.

2-L-78   Can children manipulate the outputs of non-symbolic arithmetic computations?
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Symbolic arithmetic operations are functions: the solutions of operations can be submitted as inputs into other arithmetic operations. We asked whether non-symbolic arithmetic computations operate with similar functional rules. Children (n=49, M_age = 5.9-yr, range:4.01-6.98) were asked to solve two arithmetic-like problems presented non-symbolically with arrays of objects. In one trial, children solved summation problems (e.g. 1+1=x and 1+2=y) and on the other trial children solved addend-unknown problems (e.g. 1+x=2 and 1+y=3). On each trial, children were then asked to choose which of the solutions could be used to balance two unequal sets (e.g. a set of 2 and a set of 3 could be balanced by adding x to 2). Children succeeded in both trials (Summation: 39/49, p<.001; Addend-unknown: 32/49, p =.04). These findings suggest children can manipulate the outputs of non-symbolic arithmetic computations (without ever directly observing the outputs), using them as inputs into new operations.

2-L-79   Using self-report to study mental rotation strategy in middle childhood
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Despite increased interest in mental rotation, much remains unknown about the development of this skill. In particular, little is known about the approach children take to solve mental rotation problems, or how their approach relates to performance. Young children may rely heavily on a piecemeal approach in which they use a unique feature of an object to determine what that object would look like when rotated. This approach appears to persist, to varying degrees, in adults. Some research suggests, however, that adults who are better rotators rely more on a whole object approach which involves mentally manipulating the object as a whole. To date, it is unclear whether the relationship between performance and approach is present in children or when children move from relying on a piecemeal approach to the incorporation of a whole object approach. To address these questions, 90 6-11-year-old children were asked to complete two mental rotation tasks and describe their approach to solving the problems. Children's use of a whole object approach did not differ by age, but across ages children who reported using a whole object approach more frequently, performed faster on one task and had higher accuracy on the other. These findings suggest that there is not a consistent point in middle childhood when children switch from relying on a piecemeal approach to using a whole object approach, but that the approach they use across ages is related to mental rotation performance.

2-L-80   Training perspective taking and mental rotation abilities in typically and atypically developing children and adolescents: A demonstration study
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Spatial abilities, including perspective taking and mental rotation, are crucial for the development of important living skills. Previous studies have demonstrated improvement of these abilities through experience tasks in typically developing (TD) children. This study explores using accessible online materials to train spatial abilities in TD children aged five to nine and atypically developing individuals with Down syndrome (DS) aged 14 to 24. Participants completed two perspective taking (hide and seek and navigation) and two mental rotation (puzzle and building blocks) experiences 16 times each over four months. Spatial abilities were assessed using two perspective taking assessments and a 2D mental rotation assessment at baseline and after four and eight weeks of training. Participants in both groups exhibited improvement in the two abilities over the course of training, demonstrating the malleability of these spatial abilities and the accessibility of this training model.

2-L-81   Examining the developmental trajectory of relational learning in early childhood

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There are some puzzling findings concerning the early development of relational cognition. There is evidence that infants can carry out analogical generalization over examples and form abstract relations such as same (X,X) and different (X,Y) (Anderson et al., 2018; Ferry et al., 2015). Yet, 3.5-year-olds have difficulty with these relations (Christie & Gentner, 2014; Hochmann et al., 2017; Walker & Gopnik, 2016). Further, Walker et al. (2016) find a decline from 1.5 years to 3.5 years on another same-different task (see also Carstensen et al., 2019), while prior studies have found gains in relational reasoning during this period (e.g., Gentner & Rattermann, 1991). To reconcile these findings, we are re-examining this developmental trajectory with a new task that is currently being conducted using an online protocol on Zoom. Four-to-4.5-year-old children (n = 23) were taught to point one direction for pairs of same shapes and another direction for different pairs. The results revealed that 4-year-olds learned same-different relations after two exemplars and generalized to new pairs, t(22) = 2.37, p = .027, d = .495. Ongoing data collection will extend this to younger groups and shed light on the developmental trajectory of relational learning.

2-L-82   Connections between digital storytelling and children's narrative and engineering talk

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In the current study, 84 families with 5-10-year-old children participated in a home tinkering session on Zoom and were challenged to build a six-foot-long ramp with everyday materials (e.g., cardboard, tape). Parents and children engaged in three phases of the study: (1) tinkering, (2) reflection, and (3) two-week follow-up interviews. Families were randomly assigned to one of four conditions: digital storytelling during tinkering, digital storytelling during reflection, digital storytelling during tinkering and reflection, or no digital storytelling. Families in the digital storytelling conditions were asked to talk as if they were

recording a YouTube video for an audience. Families in the control conditions were asked to talk normally. Families' reflections were coded for narrative talk (i.e., talking about characters, settings, actions, emotional/mental states) and engineering practice talk (i.e., setting goals, planning, testing, identifying problems, redesigning). Children with prior experience creating digital stories (M = 43.04) used significantly more narrative talk than children without (M = 24.61), F(1, 75) = 7.44, p < .01. Further, children in the digital storytelling condition during tinkering (M = 11.02) talked significantly more about engineering and math during reflection than children in the control group (M = 7.82), F(1, 78) = 4.28, p < .05. Our work suggests that digital storytelling may support children's narrative talk and engineering learning.

2-L-83   Working to remember: An exploration of spontaneous strategic study behaviors in elementary school students

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Past research documents that children in the fourth and fifth grades are able to spontaneously employ strategies for studying texts (Brown & Smiley, 1978; Coffman et al., 2019). These study behaviors can be predicted by factors such as the instructional context experienced in the first grade and the children's basic memory skills (Coffman et al., 2019). As part of a longitudinal study, a study skills task (Brown & Smiley, 1978) was adapted for use with second and third graders to explore strategic behavior in younger students. Due to COVID-19, this task was administered via Zoom. A sample of 49 students was read a grade-level non-fiction passage, provided a highlighter, pencil, and blank paper, and given four minutes to study the text without explicit study directions. Students' recall and their use of strategic study behaviors were coded. Behaviors ranged from inefficient and unfocused (0) to quite strategic studying (3) of key information. A composite strategy score was created, using the average of the observed strategies. The children displayed a range of spontaneous strategies such as rereading (89.8% of students), highlighting (40.8%), and note taking (36.7%). Preliminary analyses revealed a significant correlation between overall study strategy and recall (r=0.402, p=0.004). These results as well as analyses that highlight earlier predictors of study skills performance (e.g., metamemory) will be explored to better understand strategic studying in elementary students.

2-L-84   Evaluating a relational reasoning intervention for graph comprehension in middle school

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Knowing how to interpret graphs and make decisions based on the presented data are skills that are increasingly important in the workplace and in daily life. As such, U.S. math and science standards include graph interpretation in grades 5-8. However, children and even adults struggle with these skills (e.g., Glazer, 2011). One source of difficulty is with mapping the perceived patterns of relations between variables in a graph to the real-world meaning of these relations. This mapping can be considered a form of relational reasoning (RR), the capacity to map multiple relations among representations. Based on this key insight, we designed and tested a RR-based graph comprehension intervention for middle

schoolers. 289 public school students in grades 5-7 participated in a two-day study conducted remotely during class. They were randomly assigned to one of two lessons on y-intercept and slope. The RR lesson promoted comparison between two lines on a graph and mapping between visual patterns and the graph context. The control lesson promoted definitional understanding and visual pattern identification. The pre- and post-tests measured knowledge of y-intercept and slope and a graph reasoning transfer task. Students also completed a measure of abstract RR. Tasks were administered via Qualtrics with videos for the instructions and lesson. Pre-registered analyses (tinyurl.com/rrgcpr) are ongoing. Findings will inform on the utility of promoting RR in graph interpretation.

2-L-85   Tinkering and storytelling to promote engineering learning opportunities at home

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We studied parents and children engaging in a special tinkering at home activity designed by a children's museum during the COVID-19 pandemic. We asked how connecting tinkering and storytelling might support opportunities for engineering learning. 56 children (M = 8 years; 52% girls; 46% White; 16% Latinx; 13% Black) were observed (via Zoom) as they built a playground ride for a toy friend using everyday materials (e.g., cardboard, tape). Before building, half of the families planned a story about their toy friend and the playground ride they would make. Families in the story-planning condition engaged in the most STEM talk while building, and this was tied to their story (e.g., talk about testing and redesigning in conjunction with the toy characters' wants or needs). Moreover, compared with the no story-planning group (M = 2.88, based on a 5-point scale), the story-planning group (M = 3.68) also evidenced more elaborative and STEM-rich talk 2 weeks later when reminiscing about the experience.

M - Memory

2-M-86   Evaluating the neural signatures of event segmentation and memory in children

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One way we construct meaning from our experience is by breaking it into events. Humans do this naturally, even when not explicitly asked to. Neuroimaging evidence in adults supports the idea that we continuously segment our perceptual input into events, but less is known about how children process and remember events. Using an existing fMRI dataset of children (N=48; 24F, 24M; Mage=5.96y) as well as new behavioral data collected in adults (target N=40) and children (target N=40), we hope to elucidate whether children process events differently from adults, and how event processing is reflected in children's neural activity. Participants in our task will watch the same television show that children watched in the scanner for the existing imaging data. They will be asked questions about the show and complete standardized verbal skills and working memory measures. Participants will also segment the show into events by pressing a button to indicate event boundaries. We will map our participants' segmentation data onto the neuroimaging dataset to determine whether neural activation patterns in children are more similar when pulled from epochs from the same event compared to when pulled from different events. Our goal is to determine whether children behaviorally segment events similarly to adults, whether children's brains track events in ways previously shown in adults, and whether children's event segmentation ability is reflected in their memory performance.

2-M-87   Do children spontaneously encode cues to status?

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Although we know that during childhood, children develop a variety of group-based beliefs, such as stereotypes about gender, race, and status, we know far less about how these beliefs develop. One hypothesis, based on Experiential and Social Role Theories, is that stereotypes form once children spontaneously notice and remember (i.e., encode) relevant aspects of their world, either via community or media exposure. While prior research demonstrates that young children spontaneously encode gender (and sometimes race), no work has examined whether children encode status. In an ongoing study (current n = 75, N ~192 expected, Mage = 7.1), we utilize a "Who Said What" task to ask whether 5-9-year-old children encode three types of cues to status: qualitative (type of car), quantitative (amount of money), and occupational (work attire). Preliminary results suggest that children reliably encode occupational cues (Wilcoxon signed rank test: W = 832, p = .011), but not qualitative or quantitative cues (p > .10). Strength of occupational cue encoding did not vary with age, suggesting that even 5-year-old children readily attend to some, but not all, cues to status. Moreover, if encoding sets the stage for stereotype development, a hypothesis to be tested in follow up studies, young children might be particularly susceptible to racial and gender stereotypes about occupation that tell girls and racially marginalized youth that certain careers are not meant for them.

P - Morality

2-P-88   Gender-based exclusion in STEM classrooms: Exploring the role of theory of mind, critical consciousness, and gender-equitable attitudes in expected bystander responses

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The gender-based disparities prevalent in science, technology, engineering, and mathematics (STEM) fields are of great concern (Cheryan et al., 2017), and may be due to gender bias and discrimination directed towards women (Moss-Racusin et al., 2018). One potential avenue for reducing disparities within STEM education is through bystander intervention. To address this, we explored if college students' (N = 199. Mage = 19.18; 60.3% women) bystander responses to gender-based exclusion within STEM classrooms vary as a function of their theory of mind (ToM), gender-equitable attitudes, and critical consciousness. A hierarchical regression examining the likelihood of saying something to support the victim revealed four significant main effects: ToM (B = 0.13, p = .011), gender equitable attitudes (B = 0.04, p = .009), egalitarian beliefs (B = 0.71, p < .001), and perceived inequality (B = -0.23, p = .001). Participants with higher ToM, more gender equitable attitudes, and greater egalitarian beliefs were more likely to expect to say something to the group. Participants with higher perceived inequality were less likely to expect to say something to the group. This study is an important first step in understanding college students' willingness to intervene in instances of gender-based exclusion within STEM classrooms. Our findings document the importance of encouraging gender equitable attitudes and fostering social cognition in order to encourage college students' inclusivity.

2-P-89 **5- to 8- year-olds' moral evaluations of curiosity about religion and science**

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Curiosity--a desire to possess information that one does not currently have--drives much human behavior. However, idioms such as "curiosity killed the cat" imply that individuals do not always view curiosity positively. This pre-registered experiment probed children's moral evaluations of people who showed curiosity about religion or science. Children from different religious backgrounds may have similar views about scientific curiosity; however, children from religions that emphasize faith (eg Christianity) may respond differently to religious curiosity than children from religions that more often emphasize questioning (eg Judaism). As many aspects of religious cognition change around age 7 (Heiphetz et al., 2013), we compared 5- to 6-year-olds with 7- to 8-year-olds. Children morally evaluated targets who (a) displayed curiosity, (b) lacked knowledge but did not display curiosity, and (c) possessed relevant knowledge. Regardless of whether they evaluated religious or scientific curiosity, children in both age groups and from all religious backgrounds tested viewed curious targets as more moral than targets who were not curious. However, children did not distinguish between curious and knowledgeable targets. This work extends work on moral cognition by demonstrating that children perceive expressions of curiosity positively across development and contributes to conversations about similarities in children's reasoning regarding religion and science (Harris & Koenig, 2006).

2-P-90 **Adolescents' expectations for retaliation against bullying**

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Bullying is a common problem in adolescence and retaliation can be extreme such as school shootings. There are often indicators of this planned retaliation beforehand (Vossekuil et al., 2004). Therefore, it is important to understand what adolescents expect retaliation to look like in order to better target interventions. The current study involved 896 6th and 9th grade students who completed surveys involving scenarios reflecting social and physical aggression. Participants responded to an open-ended question which asked what they thought the victim in the scenarios would do in response to the initial aggression by the bully peer. These open-ended responses were coded into six categories. These responses were then analyzed using a 2 x 4 repeated measures ANOVA with scenario and reaction type as within group measures and sex and school grade as between group measures. The results found significant interactions such that participants expected more psychological retaliation in the social aggression condition and more physical retaliation in the physical aggression condition. Furthermore, the expected retaliations further differed by sex and school year. These results indicate that for different types of bullying, adolescents expect different forms of retaliation and that their gender and year in school further informs their predictions. With this knowledge, anti-bullying interventions can better aid both victims and bystanders in preventing bullying and retaliatory violence.

2-P-91 **Where does moral character come from? The role of early experience in adults and children's lay beliefs about moral development**

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Prior research suggests that adults and children believe that moral knowledge emerges later in development and has empiricist rather than nativist roots (e.g., Wang & Feigenson, 2019). Here, we explored how adults (N=300) and 5-to-8-year-olds (N=80) expect a child's exposure to differing moral norms to contribute to their character. Participants were shown a character who was born into either a moral or immoral family and lived with them for 5 years. We then asked how good or bad they believed the child would be, and whether they would engage in positive or negative behaviors (e.g., hugging vs. hitting). We then told participants that at the age of 5, the child moved to live with a different family with opposing moral values for 5 years, and asked them the same set of questions about the child's moral character at the age of 10. For adults, exposure to immoral behavior interacted with the age the child was when they were exposed, such that later exposure to immoral behavior had a stronger effect on character than earlier exposure to immoral behavior. Children viewed character more positively across the board than adults did, and viewed moral character as equally influenced by earlier and later exposure to moral and immoral behavior. These results provide initial insight as to how we naturally reason about moral character development, suggesting that adults and children differ in their perceptions of moral character based on exposure to moral and immoral influences.

R – Numerical & spatial cognition

2-R-92   Remote assessment of the association between early executive function and specific math skills

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Executive function (EF) - higher-order cognitive skills such as working memory, cognitive flexibility, and inhibitory control - are consistently associated with global math assessments. However, less is known about which specific math skills invoke EF in early childhood. We assessed the relations between EF and number and pattern skills in 111 4-4.5-year-old children remotely. EF was measured via the Minnesota Executive Function Scale, Backward Word Span, and Day/Night, and a composite was created by averaging z-scores. We found good feasibility of remote adaptation, with most children (77%) completing all tasks and showing variability in performance. The EF composite predicted rote counting, magnitude comparison, expressive digit identification, and patterning, but not receptive digit identification, controlling for age and SES. Next, we examined EF components separately and found working memory predicted various specific math skills, indicating working memory was likely driving findings in the EF composite models. We also conducted more fine-grained task analyses; for instance, we found EF did not predict 1-digit receptive digit identification but did predict 2-digit receptive digit identification and both 1- and 2-digit expressive digit identification, indicating some items might be more automatic and invoke less EF skills than more effortful items at this age. These findings indicate EF plays an important role in various foundational early numeracy and patterning skills.

2-R-93   Developmental differences in monitoring accuracy and cue use when estimating whole-number and fraction magnitudes

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Magnitude understanding and metacognition are important in life and for academic achievement. In two studies, we examined children's and adults' metacognitive awareness of their whole-number and fraction magnitude estimates. There were few differences between grades or numerical ranges in third through fifth graders' (8-12-year-olds') and adults' (18-59-year-olds') item-by-item confidence and familiarity judgments, even when there were differences in estimation precision. A brief experience with unfamiliar fractions did not lead to greater familiarity, $F(1, 125)=.07$, $p=.80$, $\eta p2<.01$, or confidence, $F(1, 125)=2.79$, $p=.09$, $\eta p2=.02$, likely because of participants' extensive prior experiences with numbers. A more time-intensive fraction board game intervention increased children's confidence ($ps<.01$, $\eta p2 > .13$ across tasks), despite having no effect on performance on different fraction tasks. Monitoring accuracy--knowing when one was more relative to less precise--was poor across grades (highest M=.20), suggesting it may be limited in number-line estimation. Additionally, participants relied on their familiarity to monitor their performance more during fraction (M=.37, SE=.03) than whole-number (M=.03, SE=.03) estimation, $p<.001$, likely because people thought many large whole numbers were equally unfamiliar. Our data suggest people use different cues to monitor their fraction and whole-number magnitude estimation performance, yet monitoring accuracy is similar across number types.

2-R-94   Weak influence of nonsymbolic ratio processing ability to symbolic fractions equation error detection ability

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Humans have intuitive, perceptually-based access to nonsymbolic representations of fraction magnitude. Prior work suggests these nonsymbolic representations can be mapped onto fraction symbols and that nonsymbolic acuity may relate to symbolic fractions knowledge, even higher mathematics (e.g., Lewis et al., 2015). One possible mechanism underlying these relations is that nonsymbolic ability may guide students to detect error equations if they produce incorrect answer by using analog representations of symbolic magnitudes (Wong & Odic, 2020). We tested this hypothesis with 91 5th and 6th graders. We used a series of tasks assessing nonsymbolic and symbolic fractions abilities, along with other cognitive measures (e.g., digit span, math vocabulary). Tasks included nonsymbolic comparisons, requiring children to choose the larger of two line ratios. Symbolic tasks included fractions equation error detection, asking children whether incorrect answer stimuli presented for equations were lower or higher than correct answers. Results showed that nonsymbolic ability was correlated with symbolic fraction ability, but the relation became nonsignificant when controlling for other cognitive factors, especially math vocabulary. Our results indicate that the low-level perceptual ability for ratios is not uniquely influential for fractions arithmetic ability and suggest that math vocabulary may be more important for supporting complex fraction skills.

2-T-95   The role of values, perspective taking, environmental awareness, and childhood nature experiences in development of nature empathy among children

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Irrespective of the culture, educators all over the world are increasingly finding it challenging to cultivate 'empathy for nature' - the ability to recognize and understand the environmental distress of the natural world among children. Empathy for nature is argued to motivate environmentally responsible behavior. Therefore in this study, we explore the role of values, perspective taking, environmental awareness, and childhood nature experiences in cultivating empathy for nature. Methods used consisted of standardized inventories and rating of the nature distress images. We present outcomes from an empirical study on young children (n=178; M= 10.20 years, SD= 2.78 years). Interesting interaction effects of perspective taking and values (biospheric, altruistic, and egoistic) were observed on disposition empathy for nature and evaluation of nature distress images will be presented. Finally, outcomes from Structural equation modeling that reveal the direct and indirect effects of environmental awareness, perspective taking and childhood nature experience on empathic concern for nature will be presented.

T – Prosocial behavior

2-T-96   Quantity and quality of parent-child spatial talk: The roles of prosocial talk and negative talk

LaTreese Hall[1], Melanie Rengel[1], Hannah Bowley[1], Daniela Alvarez-Vargas[2], Carla Abad[1], Dyamond Overton[1], Shannon Pruden[1]
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Children who hear and produce a richer diversity and quantity of spatial talk (e.g., shape, size, orientation, location/direction terms) demonstrate better spatial thinking (Casasola et al.,2020; Pruden et al.,2011). Yet, no studies have examined the role of social context in parent-child spatial talk, particularly in a majority Hispanic and linguistically diverse sample. Does parent-child prosocial and negative talk relate to the diversity and quantity of their spatial talk? Participants were 51 children (Range age=4-7;M age=5.12 years;25 females;80% Hispanic) and their parents. Dyads built a Lego house for 10 minutes. Sessions were transcribed and coded for parent-child prosocial talk (e.g., praises, behavior descriptions) and negative talk (e.g., criticisms) using the Dyadic Parent-Child Interaction Coding System (Eyberg et al.,2014). We also coded for diversity (types) and quantity (tokens) of parent-child spatial talk. Even after accounting for covariates (e.g., overall talk, Spanish spoken) parent prosocial talk was significantly related to parent spatial types [β=0.36,p=0.001] and tokens [β=0.27,p=0.008] and child prosocial talk was related to child spatial tokens [β=0.52,p=0.007]. There was no evidence that negative talk was related to spatial talk for parents [types:β=-0.09,p=0.28; tokens:β=0.001,p=1.00] or children [types:β=-0.18,p=0.14; tokens:β=-0.06,p=0.55]. Findings suggest parent-child prosocial talk relates to aspects of their own spatial language production.

2-T-97   The development of 4-8-year-olds' tolerance for unequal outcomes

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One of the most critical social issues is the ability to identify and reject inequality. Here, we investigated the development of tolerance for inequitable resource distribution. Sixty-two 4-8-year-olds (mean=6.59)

completed trials in which they were told about two characters that split a reward (10 cookies). The inequality varied from extreme (10/0 split) to slight (6/4 split). Additionally, the characters either worked the same amount (equal merit) or children were told that one worked harder (unequal merit). Younger children followed a linear responding pattern, where they were least tolerant of extreme inequalities and most tolerant of slight ones. Older children were significantly more tolerant of extreme inequalities when one character worked harder, whereas younger children were intolerant of extreme inequalities regardless of why they occurred, suggesting that as children get older, they may become more tolerant of extremely unequal outcomes when those outcomes appear justified.

U - Reasoning

2-U-98 How actual versus anticipated wait time influences children's and adults' emotions

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We plan to investigate children's (aged 4 to 10 years) and adults' (anticipated N = 200) experience of how expectations shape emotions. Specifically, how emotions may change based on varying expected wait time. All participants will wait five minutes to receive a treat (e.g., candy). Before the waiting period, half of the participants will be asked to wait ten minutes (low expectations; unexpected) and half will be asked to wait five minutes (expected). After receiving the treat, participants will report on how they feel about the treat and about waiting using a 6-point pictorial scale ranging from "very bad" to "very good." We hypothesize that older children and adults who wait for a shorter time than expected (low expectations) will feel better about the treat and their wait time than those who waited for as long as they expected, whereas younger children will have similar emotional reactions regardless of anticipated wait time. We anticipate that we will have about 50% of our data by the conference date.

2-U-99 Did she wave her arm or a magic wand? Examining when children use magic to explain outcomes

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Research suggests that children rely on magic to explain events that are impossible in the real world (Shtulman & Morgan, 2017), but as children age, they are less likely to use magic as an explanation. This age-based change may be because children are better at understanding what is possible (Phelps & Woolley, 1994) and have a developing belief that magic is impossible (Chandler & Lalonde, 1994). In an on-going study, we are asking 4-10-year-old children about whether magic was necessary to achieve a series of impossible versus improbable outcomes (For an example of an impossible outcome, see Figure 1). Initial analyses indicate that younger children are more likely than older children to select magical objects as a cause of both impossible and improbable outcomes (Age-based comparison p=.043, Comparison of outcome type p=.669). We will discuss the implication of these findings for better understanding children's developing beliefs about what is possible.

2-U-100   **Differences in spatial ability development: degree of recorded confidence towards resolving mental rotation tests & perspective-taking/spatial orientation tasks contribute to individual differences observed within small-scale & large-scale spatial ability**

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[1]Florida International University

Spatial ability, defined as recognizing & manipulating 2-D & 3-D information (Pellegrino et al., 1984) is associated with interest & success in STEM domains (Wai et al., 2009). Spatial ability is divided into small-scale (mental rotation) & large-scale (perspective-taking/spatial orientation) ability. Research indicates confidence is related to individual & sex differences in small-scale ability (Estes & Felker, 2012). It remains unknown if these differences appear in large-scale ability, i.e. perspective-taking/spatial orientation. The current study aimed to replicate & extend findings demonstrating confidence predicting individual differences in both small-scale & large-scale. 50 undergraduates (34 females, 16 males) enrolled in STEM courses (Biology, Calculus, Chemistry, Physics) completed a 24-item Mental Rotation Test (MRT; Vandenburg & Kuse, 1978) & a 12-item Perspective-Taking/Spatial Orientation Task (PTSOT; Hegarty & Waller; 2004). Below each item, participants reported their degree of confidence regarding their answers using a Likert scale. Results revealed confidence predicted both MRT (B=0.68, t=6.19, p<0.001) & PTSOT (B=0.55, t=4.57, p<0.001) outcomes. Confidence was determined as contributing to individual differences in small-scale & large-scale. Future research will examine whether degree of confidence, along with spatial activity engagement, spatial anxiety experience, & STEM interest/achievement, explain individual & sex differences in spatial ability.

W – Social categories and groups

2-W-101   **Why does parent gender matter? An exploration of effects of gender vs. effects of parenthood in adult-child interactions**

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Parents are a primary source of stimulation for children and how parents interact with their children has been examined repeatedly in developmental science. For example, parenting warmth and praise has been found to predict infant motor and cognitive development (Zimmer-Gembeck, Webb, Thomas, & Klag, 2015). In contrast, negative parent interactions have adverse effects on child emotional and behavioral development (Gulenc, Butler, Sarkadi, & Hiscock, 2018). Further, research examining gender differences between mothers (female) and fathers (male) in parent-child interactions has identified differences in communication and socialization behaviors (e.g., Rowe, Coker, & Pan, 2004). However, the reason for differences between mothers and fathers are unclear. Are the mother and father behaviors driven by mere differences in parenting experiences, or are there inherent differences in the way males and females interact with children? The current study aims to partly address this issue by comparing caregivers of the same gender (female) but with different levels of experience (parent vs. non-parent). A total of 25 adult female parents and 25 adult female non-parents were recorded during a free-play session with a 16-month-old toddler. Experiences with children, gender role perceptions, and gendered interests were measured via self-report using the Experiences, Perceptions, and Interests Questionnaire (EPIQ). Adult-child interactions were rated by trained observers using the Parenting Interactions with Children: Checklist of Observations Linked to Outcomes (PICCOLO; Roggman et al, 2013). Initial analyses of the EPIQ indicate that parent and non-parent females do not differ in gendered interests (t(41)=.01, p=.991) or endorsement of more egalitarian gender role perceptions (t(41)=-.25,

p=.803). In contrast, preliminary analyses of the PICCOLO scores suggest that parents are more likely to engage in teaching behaviors during adult-toddler interactions than non-parents (t(41)=2.41, p=.021). This finding suggests that while parenthood doesn't change how mothers perceive their gendered experiences, the experience of being a parent fundamentally changes how females interact with toddlers. To further confirm an effect of parenting rather than an effect of gender, we plan to code adult-child interactions in an additional 25 adult male non-parents. If no differences are observed between adult male and female non-parents, we can conclude that gender differences between mothers and fathers in parent-child interactions are better explained by their parenting experiences and roles above and beyond the baseline effect of gender. Conversely, if a gender effect does exist between adult male and female non-parents, alternate hypotheses will be tested to determine if the gender differences remain when comparing non-parent males and parent females. Our results will add new reflections on the long-standing debate surrounding the role of gender in parent-child interactions.

2-W-102   The role of gender stereotypes on Brazilian children's preferences for animated cartoons

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The present study was the first to test a possible effect of gender stereotyping on Brazilian preschoolers' preference for animated cartoons. Fifty-two preschool aged children participated, 27 girls (Mage= 5.5 years; SD = 5.9 months) and 25 boys (Mage= 5.15 years ; SD= 7.03 months). They were assessed by the Short POAT measure (Liben & Bigler, 2002; translated and adapted to Brazilian Portuguese). A paired-choice preference software (Silva & Elias, 2017) was used. Cartoons (gender typical and gender neutral) were presented in pairs until all of them were combined. This measure provided a hierarchy of preference, ranging from the favorite cartoon to the least favorite. Results revealed that Brazilian preschoolers show high levels of stereotyping (78.9% are either stereotypical or very stereotypical). Importantly, a significant association was found between the scores in the subscale POAT-AM and children's preferences for cartoons (r= 0,28, p = 0,03).

2-W-103   Children's use of rituals in thinking about group membership

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Children rely on various cues to indicate affiliation between people and determine group membership. From a young age, children expect people who are similar to be friends. However, not all similarities are equally socially relevant. The present study explored whether children were more likely to use similarity to make social inferences when the similarity involved ritual actions rather than purely instrumental actions. Children watched two actors build either the same or different block towers. On one trial, the actors built their towers instrumentally (no rituals). On the other, actors used rituals (causally opaque actions) while building. Results revealed a significant main effect of similarity such that children were more likely to think that actors who built the same tower (as opposed to different towers) were from the same place (B = 0.996, p = .005). However, this effect was qualified by an interaction between similarity and action type (B = 2.138, p = .032i), indicating that similarity mattered more when the

actors' actions were ritualistic as compared to purely instrumental. Future studies will investigate whether rituals are less necessary for making social inferences when the similarity itself may be a good indicator of social group memberships (e.g., food choice).

2-W-104   **Examining U.S. parents' comfort surrounding their children's peer interactions: The role of race, gender, and social class**

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Intergroup friendships are associated with positive intergroup attitudes, but U.S. youth often perceive that their parents are uncomfortable with these friendships (Hitti et al., 2020). Parents' actual comfort with their children interacting with peers from different social group backgrounds is unknown. This study examines parents' intersectional attitudes surrounding their children interacting with peers from different racial, gender, and social class backgrounds. Current participants are N = 356 (goal = 480) parents of 8-to-16-year-olds, sampled equally by parent-reported child race (Black and White), gender (boys and girls), and family Subjective Social Status (SSS) (low, middle, high). Parents viewed 12 pictures of age-matched peer groups reflecting all possible combinations of race, gender, and SSS and: (1) reported their comfort with their child having each group over to their house for a sleepover; (2) described what each group was like. Overall, parents were most comfortable with peer groups who matched their own child's social group memberships (e.g., parents of girls were more comfortable with girls than boys, parents of Black children were more comfortable with Black peers than White peers). Parents described groups in stereotypic ways (i.e., associated wealthy White boys with risky behavior). Full analyses will test all interactions of family and peer group identities on parents' comfort and attributions for each group.

2-W-105   **Examining factors that promote social connections between children interacting online**

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The present research tests methods to promote social connections between children interacting online. In a preliminary study, 5- to 10-year-old children (N = 72) interacted in pairs via video call. Participants within a pair did not know one another prior to the study. Pairs were randomly assigned to complete an icebreaker task in either a high-agency (i.e., participants led the interaction by asking each other predetermined questions) or a low-agency context (i.e., the experimenter led the interaction by asking participants predetermined questions). All pairs then interacted freely for two minutes, and this free interaction was later evaluated by raters who were unaware of condition assignment. Compared to participants in the experimenter-led condition, those in the participant-led condition were rated as having more successful (i.e., fun, comfortable) interactions during the free interaction. An ongoing preregistered study seeks to replicate and extend these findings with an additional control condition and a sufficiently-powered sample size (288 participants), which will allow us to conduct more robust analyses accounting for the nested nature of the data; examine effects on children's self-reported evaluations of their partners; and test for effects in cross- vs. same-gender pairs. Overall, preliminary

results suggest that young children can rapidly develop social connections with peers, but do so more readily and successfully when they have agency in the interaction.

2-W-106   **Gender and negotiation: Examining children's perceptions of negotiating with women and men**

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Gender differences in negotiation contribute to gender differences in the workforce (e.g. wage gap, vertical segregation) and emerge in childhood (Arnold & McAuliffe, 2021). Here, we examined 6- to 12-year-olds' (1) negotiation behavior, (2) perceptions of negotiation, and (3) how these perceptions relate to their behavior across three preregistered studies (Study 1: N = 131; Study 2: N = 128; Study 3: ongoing, N = 128 of 200). For perceptions, we measured children's anticipated backlash (e.g., expecting to be liked less) and prescriptive norms regarding negotiation (e.g., whether it's okay to negotiate). In hypothetical negotiations (Studies 1 and 2), girls and boys negotiated the same regardless of the negotiation partner's gender. Regarding perceptions, children generally anticipated more backlash when negotiating with a man than a woman, but gender differences in perceived prescriptive norms were more nuanced. Both anticipated backlash and prescriptive norms predicted negotiation behavior. In a real negotiation (Study 3), girls' and boys' negotiation behavior differed based on the negotiation partner's gender: Girls asked for less than boys from a man, but all children asked for the same amount from a woman. Similar patterns were observed for anticipated backlash and prescriptive norms. Overall, the present research uncovers the developmental roots of gender attitudes and biases that are relevant to the gender wage gap, shedding new light on this societal issue.

X – Social cognition & social learning

2-X-107   **Does social competence predict epistemic preferences?**

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Testimonial learning is an essential tool for learning about the world. Research indicates that neurotypical (NT) children employ a complex form of epistemic vigilance as they selectively learn from informants (e.g., preferring accurate over inaccurate speakers; Koenig, Clement, & Harris; 2004). However, it is still unknown whether children who are not considered NT, such as children with autism spectrum disorder (ASD), exhibit similar epistemic vigilance during learning tasks. Prior research indicates that children who possess traits associated with ASD often present social and communication deficits, such as deficits in Theory of Mind (Baren-Cohen, 1995; Mazza et al., 2017), that may impact epistemic vigilance. Here, we investigate how NT and ASD children differ in their judgments during a selective trust task. One hundred and four children (49 male) participated. In Phase 1, children's (M = 4;5) parents completed the Social Responsiveness Scale (SRS; Constantino, 2012), which investigates children's level of autistic-like social impairment (with higher scores indicating more impairment). Participants were then divided into two groups based on SRS score: a higher group (N = 51) and a lower group (N = 53). In Phase 2, children (M = 5;3, range = 5;2--5;6) participated in a live Zoom session. First, participants completed an adaptation of the selective trust paradigm from Koenig, Clement, & Harris (2004). Children were presented with four videos of two informants who either accurately or

inaccurately label common objects. Afterwards, children are asked which informant provided the inaccurate labels (explicit judgment question). Additionally, children indicated which informant they would like to ask about the name or function of a novel object (ask question). After hearing the informants' testimony, children were asked which informant's testimony they would like to endorse (endorse question). To examine whether there were group differences in children's responses to the ask and endorse questions, we conducted a series of Wilcoxon rank sum tests. For the ask questions, children in the low SRS group (M = .76, SD = .27) chose to ask the accurate speaker less than children in the high SRS group (M = .77, SD = .30), p = .002. For the endorse questions, children in the low SRS group (M = .80, SD = .29) chose to endorse the accurate speaker's testimony more than children in the high SRS group (M = .76, SD = .31), p = .0019. Furthermore, children in the low SRS group (M = .85, SD = .30) chose the inaccurate speaker more than children in the high SRS group (M = .84, SD = .29) for the explicit judgment questions, p < .001. These findings suggest that children with higher levels of autistic-like social traits may evaluate informant characteristics differently than children who present lower levels of these traits, and that these differences may be influenced by whether children are tasked with asking for versus endorsing testimony. The current study implies that different social and communication skills may be needed to make these various judgments.

2-X-108 **Longitudinal analysis of executive function and social skills in adolescents**

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Longitudinal work found that social ability early in life is predictive of executive function (EF) in later years. Both EF and social deficits have been shown to relate to different mental health diagnoses, such as ADHD and Autism. Longitudinal work is key to understanding the relationship between EF, social skills (SS) and mental health diagnoses in adolescence, a time of heightened social sensitivity. To test this relationship, we collected both EF and SS measures from 99 participants (M =12.7 years , SD =2.7, range=8-19 years), many with mental health diagnoses (N= 56) annually for 3-years. EF was measured using a composite score across several tasks, while SS was quantified using the social responsiveness scale (Constantino, 2013). Using a cross-lag panel model, we found that higher SS at both year one and year two were predictive of higher EF performance at year 3 (p=0.034, b= 0.066; p= 0.005, b = 0.088 respectively), controlling for prior EF, age, gender, and diagnosis. While we do not see a direct relationship between EF and diagnostic status, there was a significant mediation effect of SS between diagnosis at year one and EF outcome at year three (p = 0.039, b=0.114). Our findings suggest that in the transition from adolescence to adulthood, increased social skills might drive higher future EF. Furthermore, lower social ability might serve as one potential mechanism contributing to lower EF for those with a mental health diagnosis.

2-X-109 **No Signs of Automatic Perspective-Taking in an Object Retrieval Task for Toddlers**

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One of the most remarkable features of humans is the ability to imagine the world from others' perspectives. It has been shown that simple forms of perspective-taking are already in place in infancy (Moll, Carpenter, & Tomasello, 2007). Others argued that perspective-taking is not only effortless but even automatic (Apperley & Butterfill, 2009). This would imply that those capable of perspective-taking can't help but use it, even in situations when acting from one's own perspective is beneficial. In two experiments, we used an online adaptation of Sommerville et al.'s (2013) sandbox task to examine whether 3-year-olds automatically take another's perspective during object retrieval and whether joint attention might increase the degree to which others' perspectives are taken. Children (N = 124) were asked to retrieve an object after the object was relocated. They were either alone, in the presence of another, or interacting with another when the object was first placed. Neither experiment detected automatic perspective-taking, regardless of whether the other person remained absent (Exp 1) or returned (Exp 2) prior to the retrieval. Taken together, the study found no support for the automatically triggered perspective-taking in toddlers. Their searches were reality-congruent and not biased toward another's outdated information. This study helps to better understand the nature of early perspective-taking and the ways in which young children make use of this capacity.

2-X-110 **Let's roar like a dinosaur: How young children engage in virtual shared book Reading**

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Structured activities such as book reading can facilitate shared attention and allow children to learn from and build relationships with social partners. However, those social interactions become more difficult over video chat due to the cognitive challenges presented by the screen. We compared children's (N=38, 36-71 months old) attention and engagement during shared reading over Zoom via 3 conditions (researcher holding up book, researcher and child having a copy of the book, and a screen-shared digital version of the book). Children paid the most attention to the screen when they did not have a copy of the book (Figure 1). However, children engaged in more participatory actions (smiling, pointing, vocalizing, and nodding) when they had their own copy (Table 1). Preliminary results indicate they were also the most on task when they had their own copy. Further coding will focus on children's bids for joint attention. Our results suggest that although the adult-book and screen-share conditions kept children's attention on the screen, having copies of the book in both partners' environments facilitated children's engaged behaviors despite the cognitive challenges of determining what their video chat partner could see and where they were looking, and we predict it will also facilitate bids for joint attention. Families looking to facilitate relationship-building between children and remote family members may wish to coordinate book titles so that each family member has a copy.

2-X-111 **The influence of child maltreatment and socio-cognitive factors on children's trust decisions**

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Although there has been vast investigation of the normative processes in children's trust in learning contexts, we know little about the causes of individual differences in trust abilities. The present study examined the impact of child maltreatment and socio-cognitive factors on children's trust decisions. A total of 269 3-year-olds from low SES households completed three versions of a selective trust task (accurate vs. inaccurate, benevolent vs. malevolent, and mom vs. stranger). Children completed a Tunnel task assessing deference to a speaker's claim (adapted from Robinson & Whitcombe, 2003). In addition, participants' mothers completed the Maternal Interview on Child Maltreatment (Cicchetti et al., 2003), Children's Social Understanding Scale (Tahiroglu et al., 2014), and an interview assessing mother's adverse childhood experiences (ACEs). Preliminary results revealed children were more likely to selectively ask the smart/nice/mom agent for information regardless of maltreatment status. Conversely, children who were at risk for maltreatment were more likely to revise their original judgment and defer to an adult, despite having better perceptual access than the adult speaker. Ongoing analyses will assess the influence of maternal ACEs and children's socio-cognitive skills on trust abilities. This study offers the first comprehensive examination of how child abuse and neglect impacts children's selective trust decisions and deference to conflicting claims made by adults.

2-X-112 **More than just agreement: Children's understanding that the power of consensus stems from group composition**

Karen Levush[1], Jenna Alton[1], Lucas Butler[1]
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The power of a group consensus is not that only from mere agreement, but from the independence of individual group members. Two experiments (N=144 5-7 year-olds; 36 adults) investigated children's understanding of group consensus to determine if children use consensus members' group membership to selectively seek out consensus testimony, and, if so, whether use of this information varies as a function of the type of knowledge in question. Participants learned about a novel planet where various 'weird' things happen, either naturally occurring (natural trials), or cultural practices of a select alien group (cultural trials). On each trial, participants identified which of two alien groups - a diverse consensus group with members of different cultures or a homogenous group, comprised of members of the same culture - as the best group to ask for an explanation. At all ages children reliably selected the homogenous group for the cultural trials. Only older children their use of consensus group diversity with diverse consensus group for the natural trials more often than expected by chance, though less reliably than adults. This work suggests that cultural group membership among consensus members is a powerful signal in determining credibility for questions relevant to the consensus group members' culture. However, only between 7-8 years of age do children begin to align their use of social diversity among consensus members according to the type of phenomenon in question.

2-X-113 **Group norms moderate children's expectations about status based on wealth and popularity**

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Children prefer high-status groups and associate wealth and popularity status. Moreover, group norms moderate expectations for intergroup encounters. We investigated the effect of status and norms on children's expectations about intergroup encounters in wealth and popularity contexts. Participants (N = 165; 5-10 years; Mage = 7.72 years) were introduced to either a high- or low-status target who encountered opposite-status groups based on either wealth or popularity dimensions. Participants heard two scenarios where a group member expressed an inclusive or exclusive norm and then predicted intergroup attitudes and inclusion. There was an interaction of status dimension and norm on children's predicted cross-status attitudes (F(1, 157) = 6.49, p = .01). Although norms did not influence predicted attitudes between popularity groups, children predicted less positive attitudes between wealth groups when the norm was exclusive (M = 2.53, SD = 0.99) rather than inclusive (M = 3.20, SD = 0.73). A similar interaction was found for children's predictions of inclusion (F(1, 157) = 11.71, p < .001). Norms did not influence predicted inclusion between popularity groups, but children predicted less inclusion between wealth groups when the norm was exclusive (M = 3.58, SD = 2.16) rather than inclusive (M = 4.52, SD = 1.77). Thus, children may hold more rigid beliefs about wealth status than popularity status and prioritize group norms over status level differences.

Poster Session 3

B - Attention

3-B-1   Learning during a pandemic: Teachers' and parents' perspectives

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COVID19 has impacted families globally for almost two years. This study focuses on the impact on children's education. Most schools world-wide were shuttered in March 2020 and children attended virtual classes. Although there is some research on how children, families, and teachers have fared with virtual instruction (e.g. Reich et al., 2020; Sonnenschein et al., 2021; Stites et al., 2021), much needs to be learned. Using Bronfenbrenner's (1979) ecological model, this work considers how teachers, parents, and their children are coping with virtual instruction. In Spring 2021, U.S. elementary school teachers (n=49; Study 1) and parents (n=186; Study 2) completed an online survey addressing 4 research questions: RQ1) What does the virtual learning context look like? RQ2) What are the challenges experienced by teachers and families? RQ3) How much do children reportedly enjoy virtual learning? RQ4) How much are children reportedly learning? Answers to these questions matter because macro-level crises, such as the COVID19 pandemic, can have long-lasting effects on development (Benner & Mistry, 2020). RQ1 Although virtual instruction often included synchronous and asynchronous activities, the majority of instruction occurred synchronously (Ms≥ 61%). It was the primary mode of instruction across core subject areas of Math, English, and Science. Teachers reported that the majority (64%) of virtual instruction occurred in a whole-class format, a format leveraged more in synchronous instruction than during face-to-face instruction pre-pandemic (p<.001). Across the core subject areas, the majority of teachers (76%-78%) reported that the quantity of virtual instruction was less compared to teaching in-person pre-pandemic. The average synchronous lesson duration was estimated as shorter than the average in-person lesson pre-pandemic (ps≤.02). RQ2 Teachers (80%) reported experiencing moderate to high levels of stress. Moreover, they found it difficult to manage children's attention during synchronous instruction and estimated students spent on average 33% of their time off-task.

Distractions from family members occurred more frequently than off-task behavior related to peers, toys, emojis, virtual backgrounds, chatbox, other technologies, and supplies (ps≤.05). Virtual instruction brought additional challenges for parents. Parents reported greater stress managing virtual instruction than in-person instruction (p<.001). Virtual learning often occurred in the home (88%) where parents/guardians typically guided instruction (73%). Only 45% of children were rated by parents as capable of completing lessons independently. RQ3 According to parent reports, children, on average, enjoyed learning in-person more than learning virtually (p<.001). Although children exhibited mild-frustration while learning, regardless of instructional modality, they demonstrated higher levels of frustration during virtual instruction than in-person instruction pre-pandemic (p<.001). RQ4 Interestingly, despite ongoing pandemic-related challenges, parents generally felt their children's current academic growth was similar to or above the level of their child's peers (M=77%). However, 35% of parents reported their children exhibited less academic growth in Fall 2020 compared to Fall 2019. The findings highlight the need to better understand the challenges teachers and families face coping with virtual instruction during a global pandemic in order to provide more targeted support

3-B-2 Age-related differences in emotion interference

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The prior presentation of emotionally salient stimuli can increase reaction times on a simple discrimination task (Buodo et al., 2003). This "emotional interference effect," observed in adults, may be evidence of bottom-up response mechanisms overriding top-down cognitive responses (Ortner, Kilner, & Zelazo, 2007). A major challenge for research on the early development of emotion regulation has been the relative lack of brief, objective assessments for use in young children. The present study adapted the adult emotion interference task for use with children and administered it to 93 children at ages 5 and 6 years. Analyses were conducted using traditional methods for measuring reaction times (mean RT analysis) as well as novel techniques utilizing generalized linear modeling (GLMM). Children at both ages showed evidence of emotional interference, and interference decreased with age. Notably, the use of a GLMM for RT analysis accounted for trial effects, child age, and picture valance. The GLMM model revealed an interaction of age and valance such that younger children showed higher levels of emotional interference on negative pictures than older children. The present results and novel techniques have important implications for measuring the development of emotion regulation in early childhood.

3-B-3 The emergence of procrastination behaviour in early childhood relations with future-oriented cognition and executive control

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Little is known about the development of procrastination, the tendency to postpone undesirable but necessary tasks, during early childhood. Only one study has measured procrastination behaviour in preschool children, but used a single behavioural task that required children to complete a boring task that day or the next day (Sutter et al., 2018). The present study sought to investigate the emergence and

development of everyday procrastination in preschool children and explore its relations with future thinking and executive function. Parents of 3- to 6-year-olds (N = 396) completed the Preschool Procrastination Scale, the Children's Future Thinking Questionnaire (Mazachowsky & Mahy, 2020), and the Behaviour Rating Inventory of Executive Function - Preschool Version (Gioia, Espy, & Isquith, 2003). Examples of children's procrastination were also collected from parents to capture the domains in which preschool children procrastinated in daily life. Results showed that: (1) procrastination emerges early in development, (2) procrastination became more characteristic with age, (3) future thinking and executive function were negatively related to procrastination tendencies, (4) different aspects of future thinking and executive function predicted younger and older children's procrastination, and (5) children procrastinated in different domains depending on their age.

3-B-4　　　　Decreasing spatial proximity between text and illustrations improves children's learning and attention: An eye tracking study

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Learning to read is a critical skill; yet only a small portion of children in the United States are reading at or above grade level. Attention is one crucial process that affects the acquisition of reading skills. The process involves selectively choosing task relevant information and requires monitoring competing demands. Many books for beginning readers include illustrations, but this design choice may require learners to split their attention between multiple sources of information. This study employed eye tracking to examine whether a commercially available Standard Condition of embedding text within illustrations in children's electronic books (e-books) inadvertently induces attentional competition compared to a Partial Condition in which the illustrations and text are spatially separated. The results showed that spatially separating illustrations from the text in beginning reader books reduces attentional competition and improves children's reading comprehension. This study shows that changes to the design of books for beginning readers can help promote literacy development in children.

3-B-5　　　　Concentration in free-choice preschool settings: Relation with behavioral measures, physiological response, and parent and teacher report

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The ability to concentrate on schoolwork is critical for school readiness. Concentration is a colloquial term capturing components of attention, cognitive load, and self-regulation. While some research of attention-related processes like self-regulation has happened in naturalistic settings (see Blair & Raver, 2015), little has been done in settings where children have free choice of activities. We investigate concentration during periods of free choice in preschool and correlations with laboratory measures. We observed 24 children (M = 4.76 years; range = 3-6 years; 13 F) at a Montessori preschool for two mornings (about 6 hrs), behaviorally coding concentration using a recently developed scale. Children completed measures of attention (a go/no-go task), inhibitory control (the statue task from the Neuropsychological Assessment [NEPSY; Korkman et al., 1998]), and cognitive load (heart rate variability measured during each task). Parents and teachers filled out the Strengths and Difficulties Questionnaire

(Goodman, 2005). We associate these measures, providing foundational information on children's demonstrated concentration during periods of free choice in preschool classrooms. Preliminary findings suggest older children concentrated longer in classrooms, with 3-year-olds having shorter maximum time spent on activities, $F(2, 21) = 3.40$, $p = .05$, $\eta2 = .24$, despite no significant difference on laboratory measures in our sample. Results support the use of observational methods.

D – Computational approaches

3-D-112 **Exploring the opportunities and limitations of natural language processing in understanding parent-child mathematical language**

Chris Chi[1], Qianru Yang[1], Paul Harris[1]
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Emerging literature in psychological science makes use of Natural Language Processing (NLP) to study the human mind and behavior. A promising area of research that may greatly benefit from NLP is the study of parent-child conversation. For example, understanding parent-child talk about mathematical concepts is critical to the modern endeavor of nurturing math-proficient individuals. The present study applied a Latent Dirichlet Allocation model, an unsupervised NLP technique, to analyze the themes of early parent-child mathematical language using transcripts from the Child Language Data Exchange System. The data cleaning process involved identifying utterances that included pre-determined key terms (Table 1). Contextual information was obtained by extracting the 5 utterances prior to and following target utterances. Preliminary results utilizing the Brown corpus that includes 202 transcripts of the longitudinal data for three children are shown in Figure 1. Three topic clusters were generated: requests (e.g., "I want two bunnies."), understanding (e.g., "I don't know what time fourteen o'clock is."), and describing daily objects (e.g., "It's good that she has a big house."). These findings shed light on the feasibility of conducting parent-child conversation research with NLP to efficiently cluster large volumes of text into meaningful themes. More insights on the opportunities of NLP will be presented at the conference based on analyses on the rest of the eligible corpora.

E – Conceptual development

3-E-6 **Integrating quantities across fractions and decimals predicts math achievement: the role of math anxiety and symbolic verses non-symbolic representation**

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Knowledge integration is crucial in children's learning as it allows linking concepts together to support building knowledge and concepts over time and medium (e.g., Bauer et al., 2020). This is especially important in developing mathematics knowledge because math concepts are built through cumulative lessons. Knowledge of rational numbers is particularly important because it predicts later math achievement and STEM careers (e.g., Siegler et al., 2012). Moreover, our previous study suggests that integrating rational numbers by quantity across distinct notations (fractions and decimals) may be even more important to children's math achievement than merely understanding the numbers by notation (Park & Esposito, 2021). However, it is yet unclear whether math anxiety drives the results. Given the established association with low math performance and the tendency to avoid math, children with high math anxiety may circumvent calculation by choosing to represent numbers by notation rather than quantity. Moreover, children are first exposed to rational numbers through non-symbolic representations (e.g., shapes and dots). Given that integration across notation was not found until age

11 with numbers, non-symbolic number representations might capture integration by quantity across notations earlier in their math education. The current study addresses these questions. First, we investigated non-symbolic rational number (i.e., shapes) conceptualization as well as the relation with math achievement and math anxiety (Study 1). Second, we examined whether math anxiety is related to math achievement and rational number conceptualization. To measure non-symbolic and symbolic rational number conceptualization, we developed a novel Shape Spatial Arrangement Methods (SSpAM) and used the Numerical Spatial Arrangement Methods (NSpAM; Park & Esposito, 2021), respectively. These tasks measures whether children focus on surface similarity (i.e., notations) or quantity regarding conceptualization of given shapes and numbers. Additionally, we measured children's math anxiety and math achievement. Children were 8-10 years old (N = 38; Mage = 9.40; 13 female) in Study 1. The results show that children's math anxiety is significantly related to math achievement (r = -.53, p < .001), but not to SSpAM (r = -.15, p = .40) performance. In addition, although the SSpAM showed the predicted shift from notation to quantity with increased age, it was not related to math performance (r = .29, p = .09). The samples for Study 1 and Study 2 overlap, but Study 2 requires an older sample that has been exposed to rational numbers in school (age 9-10 years; N = 19; Mage = 10.15; 11 female). The data collection is not yet complete. Thus far, the results for Study 2 show that math anxiety is not related to the NSpAM (r = -.18, p = .29), but the NSpAM continues to predict math performance (r = .34, p = .04). The results have implications for the role of math anxiety in the quantitative integration of fractions and decimals, the importance for integration to math achievement, and the difference in symbolic versus non-symbolic rational numbers. Further, as the SpAM tasks allow measuring the integration of decimal and fraction without a prompt to use a quantitative strategy, our results build on to the discussion of the role of prompts in children's knowledge integration.

3-E-7   Are core knowledge principles revisable? Evidence from preschoolers

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The core knowledge view (Spelke & Kinzler, 2007) proposes that humans are endowed with a small number of core knowledge systems (e.g., the inanimate object system, the agent system), each accompanied by a set of principles. These principles are early emerging and are foundational for later learning in the physical and the psychological world. Although these principles are unlikely to be represented as propositions by infants (as philosophers and psychologists claim that beliefs are), these principles may be construed as 'implicit beliefs' that guide our reasoning and action. Previous research has shown that for preschoolers, many of their beliefs about the world can be revised given counterevidence (e.g., Kushnir & Gopnik, 2007; Kimura & Gopnik, 2019; Bonawitz, van Schijndel, Friel, & Schulz, 2012; van Schijndel, Visser, van Bers, & Raijmakers, 2015). Previous work has also shown that apparent violations of some of these core knowledge principles lead to exploration and enhanced learning in infants and preschoolers (Stahl & Feigenson, 2015, 2017). Are core knowledge principles also subject to revision, like other later developing beliefs we have about the world? The current study focuses on three core knowledge principles in the physical domain: Solidity (objects cannot occupy the same space as other objects), Continuity (objects exist and move continuously in time and space), and Contact (objects do not interact at a distance). We test the hypothesis that given counterevidence, preschoolers may be able to revise their core knowledge principles. In Experiment 1 (n = 24), 4- to 6-year-olds observed 4 events that either supported (Belief Consistent condition) or violated (Belief

Violation condition) each principle (see Figure 1 for a schematic of the procedure for the Continuity principle). In Experiment 2 (n = 36), we increased the strength of the evidence - children observed 6 events for each principle, and we also included a Baseline condition, where children did not receive any new evidence that supported or violated the principles. After observing the events, children made verbal predictions about new events. They selected between outcomes either consistent with the principles (Belief-Consistent response) or inconsistent with the principles (Belief-Violation response). In Experiment 1, children were more likely to select the BV response in the BV condition than in the BC condition for all three principles (PBV = .67, PBC = .22, p = .001). In Experiment 2, children were overall more likely to select the BV response in the BV condition than in the Baseline condition (PBV = .72, PBaseline = .31, p < .001), and equally likely to select the BV response in the BC condition and the Baseline condition (PBC = .06, p = .95). These findings suggest that when given statistical evidence that contradicts children's existing core knowledge principles, they are able to revise these principles and make predictions accordingly. In an on-going experiment, we aim to replicate these findings with more realistic, three-dimensional stimuli, and investigate whether children can generalize their revised beliefs to new contexts. Whether children generalize to brand new contexts may shed light on if this is simply a form of perceptual statistical learning or if children have indeed revised these core knowledge principles and are willing to apply the revised principles to a wide range of situations.

3-E-8 The development of beliefs about time

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<p>Because it is abstract, time can be conceptualized in many ways. For example, philosophers are evenly split on whether time really "flows" (Bourget & Chalmers, 2021), while physicists favor a static view of time (Fazekas, 2016). Laypeople also have "commonsense" theories of time, which distinguish between past, present, and future, and allow us to navigate everyday situations like scheduling appointments. An important feature of formal and lay theories is that they allow us to make inferences about what is possible within our conceptual frameworks. For example, if time always moves forward, you can't travel back in time. But where do our lay theories of time come from?</p> <p>Developmental research suggests that children have intuitive theories about subjects like physics and biology (Wellman & Inagaki, 1997) and that they distinguish between possible and impossible events from a young age (Shtulman & Carey, 2007). In this study, we investigated adults' and children's beliefs about time. If lay theories of time reflect intuitive theories available early in development, children's beliefs should resemble those of adults from a relatively young age. On the other hand, if these theories require extensive cultural input, we would expect adultlike responding to emerge more gradually.</p> <p>98 3- to 6-year-olds and one of their parents took part in a reality-status sorting task (Dore et al., 2019) administered online via Qualtrics. The survey consisted of 16 items including 13 time concepts such as "an hour," "the past" and "going back in time." First, parents were asked to judge whether the items were real/possible or not real/impossible without their child present. They provided confidence ratings on a three-point scale. Then, children made their own reality judgments and rated their confidence.</p> <p>There was generally high agreement about the reality status of time concepts, whether they were judged to be real/possible (e.g., "the past"; 96% agreement) or not real/impossible (e.g., "change the past"; 95% agreement). Agreement was over 80% for 11 time items. Adults' responses were most mixed on "know the future" and "change the future" (46% and 66% "possible", respectively). Notably, this

pattern was also found in 3-year-olds, who had >80% agreement on all but the same 2 items (39% and 43% "possible"). The correlation between agreement on items and confidence ratings became stronger with age (.60 for 3-year-olds, .93 for adults), indicating that adults may be more aware of which beliefs are generally held and revise their confidence accordingly.</p> <p>We ran a generalized mixed-effects regression to predict children's reality judgments from their age (in months) and the item's modal reality status as judged by adults, including participant and item as random effects. While possibility status was a significant predictor ($\beta = 3.2025$, $p = 0.001$), age was not ($\beta = -0.008$, $p = 0.468$). Given the wide age range we tested, this pattern is consistent with the idea that beliefs about time are driven by intuitive theories that are available early in development. However, we also found evidence that beliefs about some time concepts may develop at different points than others. In particular, children were significantly more likely to give "adultlike" responses for items concerning the past than the future ($\beta = -1.565$, $p = .001$), suggesting that the future is conceptually less intuitive than the past.

3-E-9   **Children's museum exploration provides a window into their belief revision and understanding of learning**

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Children have early emerging capacities for causal reasoning, including the ability to weigh incoming evidence against existing beliefs to draw new conclusions (belief revision). However, much of the work on the development of this ability uses lab-based tasks, making it unclear how children use it in naturalistic contexts. To address this issue, the current study examined how children engage in belief revision and reflect on their own learning during their exploration of a dinosaur exhibit in a museum. Children (N=51; ages 6 to 10 years) wore GoPro cameras to record their first-person perspective during a 10-minute exploration period. They were then asked to reflect on their exploration, specifically whether they had learned anything, and to define learning in general. Focusing just on these post-exploration reflections reveals that most children (80.4%) said that they learned something, with most of those children (73.2%) describing their learning in terms of behaviors (e.g., "I looked inside the skulls") rather than in terms of mental states (e.g., "I thought about how that's how dinosaurs grow"; 17.1%). However, responses to this question did not relate to whether children defined learning as a mental process, as opposed to involving a source or a particular kind of content. Future analyses will aim to relate these reflections to aspects of children's exploration in order to explicate how children's exploratory behavior impacts their belief revision abilities.

3-E-10   **Children's thinking about asymptomatic carriers of illness**

Shruthi Venkatesh[1], Jasmine DeJesus[1], Shaylene Nancekivell[1]
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Prior research has examined children's understanding of disease transmission (Blacker & LoBue, 2016; Bonawitz et al., 2021; DeJesus et al., 2021). The present study focused on children's thinking about carriers of illness with varying symptoms. We tested 6- to 12-year-old children on Zoom (n = 92 to date). Children were introduced to two friends. The first friend either had a novel germ, "Germ X", inside them and felt bad, had Germ X and did not feel bad, or did not have Germ X. The two friends shared an apple.

Children were then asked if the second friend caught Germ X or not after sharing the apple, and how that friend would feel later (not bad, a little bad, bad, or really bad). A preliminary regression analysis revealed no age effect or interactions. We conducted a subsequent analysis with children's judgement of whether Friend 2 caught Germ X and the description of Friend 1 as predictors of children's rating of how Friend 2 would feel later. Children rated Friend 2 as feeling worse if they said Friend 2 had caught Germ X, $b = 1.42$, $SE = 0.21$, $t = 6.78$, $p < .001$, but that difference was smallest for trials in which Friend 1 had Germ X but did not feel bad (interaction: $b = -0.73$, $SE = 0.33$, $t = -2.22$, $p = .027$). That is, if Friend 1 had Germ X but didn't feel bad, participants were less likely to think Friend 2 would feel bad later, even if Friend 2 also had Germ X. These findings suggest that children consider the severity of illness as part of its transmissibility.

3-E-11 Relational language predicts children's science knowledge through child and family science talk frequency

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Science learning is important for the well-being of individuals and society. Acquiring the knowledge necessary for success in science is difficult because science involves relational thinking, or the ability to abstract and generalize from similarities between concepts. Using relational words, or shared linguistic labels that identify commonalities between entities, has been shown to promote relational thinking. However, research has yet to directly link relational language and science knowledge. Thus, this study examined the nature of this link by investigating whether children's relational productive vocabulary predicted their science knowledge above and beyond other factors, such as general vocabulary, demographic variables, and science attitudes and behaviors (N = 80 participants, Mean age = 77.6 months). Results revealed that, contradictory to the main hypothesis, children's relational vocabulary size did not predict their science knowledge above and beyond general vocabulary and demographic variables ($\beta = .1$, $p > .05$). Instead, relational vocabulary was linked to science knowledge by serving as an intermediate step between children's and families' science talk frequency and children's science knowledge ($\beta s > .47$, $ps < .001$). In brief, the findings from this study are a key step towards fully understanding the mechanism(s) by which relational language drives changes in science knowledge.

3-E-12 Children's interest in complex phenomena: The development of sustained question-asking

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Young children express curiosity about novel events that crop up in everyday life. However, close observation suggests that children are also curious about complex and often abstract puzzles. This study uses parental report data to examine 4- to 7-year-olds' sustained lines of inquiry, which we term "Intellectual Projects". Parents (n = 262) were asked to describe three topics that their child had wondered about out loud over the past six months. Responses were coded by two coders with 92% agreement. The data show that most children pursue intellectual projects. Younger children were significantly more likely than older children to have intellectual projects ($X^2(1) = 6.413$, $p = 0.011$). 55%

of 4- to 5-year-olds had at least one intellectual project, whereas 39% of 6- to 7-year-olds did. The most frequent topics of inquiry were death ("Where do you go when you die? Can you make someone alive again?") and biology ("What do organs do?"), each of which comprised 24% of all intellectual projects. Next, extinction and electrical systems comprised 14.2% and 9.8% respectively. The parents in this study come from rural and urban areas with a range of educational backgrounds, yet the topics and questions they reported had striking similarities. Children do pursue complex topics over time, and some topics seem to hold magnetic interest. Analyses suggest that younger children express these interests more than older children. The poster will discuss the implications of these findings.

3-E-13   Young infants can learn physical causation-at-a-distance with light switch events

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Humans learn about physical causation by 6½ months of age, but studies on this topic in early infancy mostly use physical events that need spatial contact between objects (Leslie & Keeble, 1987). We tested if 7- and 15-month-olds (target N = 48) could learn physical causation at a distance with a light switch event in which a button and a light stand apart from each other. In an immediate event, when the button lowered, the light flashed. The delay event was identical except for a 2 s delay between the button's descent and the light flashing. The reversal event switched the order of sub-events. Infants were habituated to the immediate event and tested with all events in a counterbalanced order. Results showed that 7-month-olds (n = 18) looked longer at the reversal trial than the familiar trial, but only if they had a longer total habituation time than the median ($B_{7mo,long}$ = 7.79, SE = 3.91, t(99) = 1.99, p = .049, f^2 = .05). Future research should test if the nonsignificance of the delay was due to infants not perceiving the delay as relevant to a light switch event. Notably, 15-month-olds (n = 18) showed no difference in looking times across trials--it is unclear if this will change with a full sample. In sum, 7-month-old infants with a long habituation time can assign causal roles to objects in a causation-at-a-distance event, like a light switch: spatial contiguity cues is not always crucial to infants' learning of physical causation.

3-E-14   Stereotypes as prototypes for children's gender concepts

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How do children's gender prototypes vary across development and their parents' social political beliefs? In this pre-registered study with children ages 3-10 (N = 219), we asked how gender stereotypes shape children's prototypes across age and parental beliefs. Children made judgements about which members of gender categories (boys and girls) and animal categories (for comparison) were the most representative and informative about their kinds, using simplified scales of five category members varying on a stereotypical feature (e.g., girls wearing more or less pink). Their parents then reported their political views about social issues. Young children chose extreme stereotypes as both representative and informative, similarly for animal and social categories, and this tendency declined with age. Controlling for age, children of more conservative parents also held more extreme

stereotypical prototypes. Thus, stereotypes play a central role in children's gender prototypes, especially young children and those living in socially conservative households.

3-E-15   Children's understanding of COVID-19: Acquiring knowledge about germs and contagion amidst a global pandemic

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The COVID-19 pandemic and the measures instituted to contain it have resulted in unprecedented disruptions to children's daily lives. The goal of the current study was to explore how children understand the COVID-19 pandemic and the virus responsible for creating it. Participants included 92 5-, 7-, and 9-year-old children and a comparison sample of 30 adults. Participants' understanding of COVID-19 and their broader understanding of germs was assessed through a combination of open-ended (e.g., Tell me what you know about COVID-19) and forced-choice questions (e.g., true/false questions about germs). Results showed that children's and adults' knowledge amidst the COVID-19 pandemic reflects the world's intensive focus on germs and contagion: Children and adults talked about germs and contagion frequently and even 5-year-olds showed relatively high levels of reasoning about the transmission of COVID-19. However, talk about of germs as living things that survive and reproduce--the marker of a mature biological understanding of contagion--was extremely rare in children. Moreover, children's knowledge of basic biological principles of germs was limited before age 9. Together, these findings suggest that the COVID-19 pandemic may have accelerated children's development of knowledge about germs and contagion in a way that is likely beneficial for health promotion. However, the pandemic has not widely promoted mature biological ways of reasoning about germs and contagion in children.

F – Cross-cultural approaches

3-F-16   Making sense of the pandemic: Parent-child conversations in three cultural contexts

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Children accumulate knowledge and create and understanding about the world in everyday experiences that often include conversations with more knowledgeable adults (Vygotsky, 1978). Conversations with parents that include active involvement and explanations support knowledge building (Crowley et al., 2001; Hedrick, San Souci, Haden, & Ornstein, 2009). Also, a better prior understanding of the event is related to better understanding afterwards (Sutherland, Pipe, Schick, Murray, & Gobbo, 2003). In addition, parent-child conversations are an important tool for social-emotional development (see Fivush, Haden, & Reese, 2006). Therefore, it is important to know how parents talk to their children about the COVID-19 pandemic and the related changes, how they help them create an understanding of the events, and pave the way for better coping. Method: Parents of preschool children were asked to discuss the changes in children's life during the pandemic and the causes for them. 29 parent from Estonia, 29 from Germany, and 9 from the US provided audio-recorder conversations with their children during the first or second wave of the pandemic. There were 31 boys and 35 girls and one child whose gender was reported as non binary in the sample, the average age of children was 49 months (range 36 - 59 months). Each main clause of the conversations was coded as one of the following: - Corona Talk i.e.,

talk about the disease itself e.g., "What does Corona virus do?" - Descriptive talk about the pandemic related changes e.g., "Now you have to wear a mask." - Explanatory talk e.g., "Why can't you go to kindergarten?", "Because if one has Corona, they will pass it to others, and other children get Corona." - Evaluative talk e.g., "I think it's nice to be inside home and play with Legos." - Emotion talk e.g., "Are you afraid of Corona?" - No pandemic-related content (when the main clause was about other things e.g., wanting to play). The coding system was exhaustive and exclusive; two coders coded 20% of all the transcripts, inter-coder reliability was $\kappa = .80$ for child utterances and $\kappa = .84$ for parent utterances. Results and Discussion: The average length of the conversations was 75 (SD = 51.47, range 13 - 293) main clauses. The length of conversation differed with the US conversations being the shortest and Estonian conversations the longest. The largest part of the conversations was devoted to descriptive talk about the pandemic related changes in all the countries (M = 27.61, range 2 - 69). Differences between contexts appeared in how much of the conversation was devoted to Corona talk and evaluative talk: Estonian dyads talked more about the disease itself than the US dyads and German and Estonian dyads included more evaluative talk than the US dyads. We also calculated the ratio of negative and positive evaluations to all evaluations by the dyad in order to understand the valence of the conversations. The ratio of negative evaluations did not differ between the contexts, but Estonian dyads used fewer positive evaluations relative to all evaluations than German dyads. The results are discussed in light of cross-cultural differences regarding talking to children and how social and cognitive development is supported in parent-child conversations.

3-F-17   Religiosity, valuation of science, and belief in scientific phenomena in Turkey

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Although science and religion have traditionally been seen as conflictual, there is considerable evidence for the coexistence of natural and supernatural thinking (Legare et al., 2012). But if scientific and religious ideas can coexist, what underlies the conflict between science and religion? To explore this question, we collected data from 85 parents (94% mothers, Mage= 38.29, SDage= 4.29) from Turkey, a country with an "unsettled relationship between secularism and religion" (Keyman, 2007).Participants rated their level of:(a) religiosity (from 1 to 5); (b) agreement (from 1 to 5) with 10 items that measured valuation of science; and (c) belief (from 1 to 7) in the existence of a variety of scientific phenomena. As seen in Figure 1a, overall, parents valued science at high levels (M= 4.44, SD= .38) and religiosity had a modest negative relation with valuation science, b= .08, SE= .03, p = .022. Moreover, parents reported a high level of belief in scientific phenomena (M= 6.61, SD= .90), as seen in Figure 1b. Importantly, religiosity had no relation with belief in scientific phenomena, p= .19, except for belief in evolution, b= -.70, SE= .18, p <.001, as seen in Figure 1c. These results add to the previous findings about the relation between religiosity and science (Payir et al., 2020). Conflict, when it occurs, is confined to competing explanations of the same phenomenon (e.g., evolution) rather than being a generalized stance favoring religion over science.

H - Education

3-H-18   Transactional model and measurement of child behavior problems

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The Transactional Model posits that children's and adults' bi-directional interactions over time shape one another's behaviors (Sameroff & Chandler, 1975). This is especially true in the case of young children's behavior problems (BPs). For example, it is understood that warm responsive caregivers can have a mediating effect on child BPs (e.g., Mashburn et al., 2008; Pianta, 1999). However, the most common methodological choices in the field might not align with this understanding and instead focus solely on measures of child characteristics, to the exclusion of the caregivers around them (e.g., multi-informants, measures of caregiver(s) behavior, contextual measures). Two independent data extractors conducted a systematic literature review following the PRISMA protocol (Page et al., 2020). We are presenting data from a subset of included articles (n = 174) that explicitly measured children's behavior problems. Qualitative results include: (1) measures of BPs, (2) school setting type, (3) child demographics, (4) use of multiple informants to measure BPs, and (5) inclusion of measures of adult characteristics, excluding demographics. Our findings indicate that 56% (n = 98) of studies included measures of adult characteristics beyond demographics. Reported adult measures included: classroom climate, maternal depression, teacher-child relationships, home environment, and parenting skills.

3-H-19 Assessing early informal fraction knowledge

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Many students struggle to understand fractions. Yet, from a young age, children can successfully reason about equal sharing and about proportions presented in informal contexts, even though fractions are generally not taught until third grade. However, we currently lack a way to evaluate this knowledge. We developed a reliable tool (rKR20 > .9) to assess diverse first graders' (N = 109, 45% female, Mage = 6.69 years) early fraction knowledge. We established this measure using an item chart that systematically varied items across different dimensions (i.e., continuous vs. discrete, non-symbolic vs. symbolic, equal sharing, equivalence, fraction type). Scores ranged from 23% to 91%, with a mean score of 58%. This variability suggests that some young children can engage in non-symbolic and symbolic reasoning with fractional quantities. This tool will allow us to look at the extent to which early fraction knowledge predicts later achievement and to develop training studies to promote key elements of fraction understanding.

3-H-20 Context-dependent variability in children's conceptual models of division

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Children's strategy use is variable and adaptive (Alibali & Sidney, 2015; Siegler, 1996). We examined whether the problem-solving context affects children's strategies for whole number division. Prior research (e.g., Squire & Bryant, 2002) suggested that children favor partitive division, which may interfere with later fraction division learning (e.g., Fischbein et al., 1985). We assessed N = 63 elementary-school children's conceptual models for whole number division in three contexts: using objects, story problems, and number lines. Most children displayed understanding of multiple conceptual models of division, and strategies varied by context. Story problems elicited partitive models, number lines elicited quotative models, and objects elicited both models. Finally, strategy use was

adaptive; in each context children used models that were most likely to result in accuracy. Findings imply that number lines may best afford connections between earlier-learned whole number concepts and later-learned fraction concepts (see Sidney & Thompson, 2019), supporting the integration of whole number and fraction knowledge.

3-H-21   The impact of social interaction on virtual learning of numerical knowledge in Kindergarteners

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Teachers and children have experienced disruption in their classrooms caused by the pandemic, making it challenging to continue science, technology, engineering, and mathematics (STEM) learning within a virtual environment. This study aims to understand whether incorporating social interaction into a playful, developmentally-appropriate virtual learning activity increases numerical knowledge for young children. Specifically, the study compares the effect of playing a computer number board game one-on-one with an experimenter to the effect of playing the same board game one-on-one (seemingly) with a computer on kindergarteners' numerical knowledge. Approximately 60 kindergartners from diverse cultural, linguistic, and socioeconomic backgrounds will be recruited from Hawai'i. Participants are randomly assigned to one of three conditions: Social Interaction, Computer Interaction, or Active Control (color board game), during which they meet with a researcher using Zoom to play the game together. Afterwards participants complete measures of magnitude comparison and arithmetic. Preliminary results indicate that there are no significant differences on numerical knowledge between the Social Interaction condition and the Active Control condition, t(6)=.064, p=.95 (magnitude) and t(6)=1.36, p=.22 (arithmetic), however this is likely due to the small sample size (n=8). Data collection is ongoing, and will be completed prior to the conference.

3-H-22   Childrens attributions of scientific knowledge to potential informants who vary by race and gender

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Children are sensitive to other's knowledge and social characteristics when seeking out information (e.g., Harris et al., 2018). Children as young as 5 associate intelligence with White males over other groups (Perszyk et al., 2018). The current study explored how an adult's race and gender impacts children's perception of that person's knowledge about science and their preferences for seeking out scientific information. In part 1, children ages 5-8 (N = 15) heard 8 "how" questions about a familiar biological (e.g., how birds fly) or physical phenomena (e.g., how rocks form) together with a photo of a White male, Black male, White female, or Black female. Children rated each person's knowledge about the answer to the question on a 1 to 5 scale. In part 2, children completed another 8 trials where they saw 4 faces on the screen (one from each gender/race) and chose which person knew most about the answer to a scientific question (e.g., "out of these four people, who do you think knows the most about how tornados form?"). Data collection is on-going. Preliminary findings suggest that children gave the highest knowledge ratings to White males, followed by White females and Black females, and the lowest

knowledge ratings to Black males. In part 2, children chose White males as the most knowledgeable individual in the largest proportion of trials and Black males in the smallest proportion of trials. Implications for understanding underrepresentation in science will be discussed.

3-H-23   Draw a mathematician: Understanding children's gender representation of mathematicians and its relation to math anxiety

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Mathematicians are often viewed as special, specific types of individuals and are commonly represented in the media as men. Stereotypes about who excels in math have the potential to impact children's performance as well as their career aspirations. Additionally, math anxiety, a negative reaction to math and math situations, is linked to poorer performance in math as well as lower levels of sense of belonging in math. This study elaborates on the math anxiety literature by examining the relation between math anxiety and children's gender associations of mathematicians. Fourth, sixth, and eighth-graders (N = 291; 150 girls, 141 boys) rated their math anxiety and then were asked to draw a picture of a mathematician and explain where their ideas came from. Overall, 4th graders had lower math anxiety than 6th and 8th graders and girls had higher math anxiety than boys (particularly in 8th grade). In addition, the proportion of girls who drew a female mathematician dropped steeply in 8th grade. Finally, children who expressed that a mathematician could be anyone had lower levels of math anxiety. This study sheds light on the concurrent development of math anxiety and beliefs about who is typically a mathematician. Specifically, these findings highlight that during a period of increased math anxiety, girls are less likely to associate their own gender with mathematicians.

3-H-24   "What if you were not nervous at all?": Relations between parent and child math anxiety, home activities, and parent attitudes towards play

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Engaging in playful math activities at home is known to positively relate to young children's math abilities. However, individual factors such as math anxiety, may influence how often families engage in these activities. Because math knowledge in early childhood is predictive of later achievement, it is important to understand how factors may influence children's engagement in activities that can support their early math learning. The current study examined relations between home activities, parent and child math anxiety, and parent attitudes towards play. Children (n=178, M age = 71 months, 50% male) and one of their parents (89% mothers) each completed measures of math anxiety. Parents also completed surveys of the frequency of math and play activities their child engages in at home, and attitudes towards play, including their involvement in and enjoyment of play with their child. Preliminary analyses indicate that parent and child math anxiety did not relate ($r(173)=.014$, $p=.852$). Child math anxiety negatively related to the frequency of engaging in math activities at home ($r(176)=-.157$ $p=.037$). Parent math anxiety negatively related to involvement in ($r(170)=-.155$, $p=.043$) and enjoyment of play ($r(170)=-.200$, $p=.008$). Additional analyses will further examine relations among

these factors, and results will be discussed in terms of influences on math learning in the home environment, with implications for children's math achievement.

3-H-25   Sing, act, and dance with robots: A child-robot musical theater afterschool program for STEAM education

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[1]Virginia Tech

Although "robotics for all" efforts have been initiated to emphasize a cohesive learning paradigm based on real-world applications, major challenges remain in finding diverse approaches for young learners. We designed a 13-week long afterschool program focused on child-robot musical theater, combining child-friendly humanoid and animal robots and familiar activities (acting, music, dancing, drawing) to engage children in Science, Technology, Engineering, Arts, and Math (STEAM) education. A sample of 16 children (8-10 years; 37% girls) from a Title 1 elementary school (with a high proportion of low-income students) participated in the program, and nine of them consented for research. Children completed 4 surveys to periodically report their engagement in the program in addition to pre- and post-surveys about their interest and confidence in STEAM and curiosity in robots. Children reported a high level of engagement throughout the program (Ms = 3.5 out of 4). Following the program, all children reported increased interest in STEAM. Children's confidence in STEAM (Mpre = 3.02, Mpost = 3.09; out of 4) and curiosity in robots (Mpre = 3.7, Mpost = 3.6; out of 4) were high pre- and post-program. The findings suggest that our program effectively maintained children's engagement and improved their interest in STEAM. Further research is needed to increase sample size, identify ways to enhance children's curiosity and confidence, and take into account children's demographic diversity.

3-H-26   The effect of tactile versus non-tactile counting books on children's number talk during shared book reading

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How do different types of counting books affect children's number talk during shared book reading? Preschool children (N = 285; M age = 4.39 years; 159 girls, 166 boys; 41% African American or Black, 37% White, 20% Hispanic or Latino/a, 2% not identifying with any group) participated in a pretest-intervention-posttest experiment. Children were randomly assigned to read tactile counting books, non-tactile counting books, or non-numerical storybooks in the 6-week shared book reading intervention. The total conversational utterances and numerical utterances were coded and averaged per book across the six intervention sessions. As expected, children produced more numerical utterances when reading counting books than when reading storybooks, $\emptyset$ = -27.768, SE = .653, p < .001. Contrary to our predictions, however, there was not evidence that numerical utterances differed across the tactile and non-tactile counting books, $\emptyset$ = -0.845, SE = .746, p = .258. Reported gender unexpectedly moderated the effect of counting book condition on numerical utterances, $F_{(2, 281)}$ = 5.091, p = .007, $\eta p2$ = .035. Boys' numerical utterances did not differ between tactile and non-tactile books, whereas girls produced

more numerical utterances with tactile books than with non-tactile books. Results suggest that different types of counting books may affect shared book reading behaviors in different ways for different groups of children.

K - Language

3-K-27 Children prefer novelty, do parents?

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Children prefer learning about novel over familiar objects (Mendel, 1965). Whether parents prefer to provide information about novel objects is an open question. 80 mother-child dyads completed a free play session. Mothers were given a box of objects, some familiar and some unfamiliar to children, and asked to incorporate them naturally into the play. Sessions were coded for how often mothers spontaneously provided object names and functions. After the session, children were tested for their knowledge of the names and functions of the objects. Results showed that mothers had a strong preference to provide information about the familiar objects over the novel ones. Further, children did not learn the names of unfamiliar objects, even when they were provided. Older children did learn the object functions when those were provided, however. Results suggest that, while children may prefer learning about novel objects, parents may prefer providing information about familiar ones.

3-K-28 What does it mean to learn a word, and what is the best way to do it in grade school?

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Background. Acquiring new words allows children to access, reason about, and discuss new concepts and consistent vocabulary growth is critical to maintain grade level reading (Cain et al, 2004; McKeown et al., 1983). However, the benefits of new vocabulary words are highest when children have a deep understanding of each word's meaning. Word learning from context, in which children infer the meaning of an unknown word across a multiple exposures, accounts for most vocabulary growth in school (Nagy & Herman, 1987; Sternberg, 1987) and provides deeper semantic and pragmatic knowledge than definition memorization alone (Xhang & Lu, 2015). Most research on word learning from context focuses on the written modality, and it is assumed that reading is the primary pathway to deep learning. This assumption overlooks the role auditory input plays in word learning even through adolescence (Webb & Nation, 2017), especially for the 8 million children who struggle with reading (Biancarosa & Snow, 2006). The few studies that have directly compared auditory and written word learning from stories have found auditory to be more advantageous even through 5th grade (Henderson, 2001; Maher, 1991; Suggate et al., 2013), but most of these examined surface-level, picture-to-word matching, learning. It is unknown whether one modality provides better support for deep word learning during the school years. Methods. To examine how modality influences deep and surface word learning in grade school, 121 children ages 8-15 years completed a short story adapted from creative-commons licensed material (Henderson et al., 2015; James et al., 2019). The story was presented via zoom 1 of 3 ways: written, enhanced auditory, or read-aloud auditory. Enhanced auditory included different voices for each character, sound effects, and music, similar to audiobooks or podcasts. Read-aloud auditory was without enhancements, resembling a

parent or teacher reading. Written stimuli were presented on 14 slides (4 sentences per slide) with only text. Children advanced slides at their own pace. Surface learning was assessed through 2 word-to-picture matching tasks. Deep learning was assessed based on children's definitions of the novel words. Results. A 3 (modality: enhanced auditory vs read-aloud auditory vs written) x 7 (age in years 8-14) ANOVA was performed on surface and deep learning. In both cases, there was a main effect of age, with children improving with age (all p's < 0.05) and no interactions. Both deep and surface analyses exhibited a significant main effect of modality, however, post-hoc analyses revealed distinct patterns for each. For surface learning, the written modality was significantly better than both auditory versions, which did not differ from one another. For the deep learning, the written and enhanced auditory modality were statistically the same, and both were better than the read-aloud auditory. Conclusions. These findings show that enhanced auditory learning can lead to equal levels of deep knowledge of words newly learned from narrative context, though for surface learning, written learning is better than auditory. This indicates that schools could leverage newer media such as podcasts and audiobooks to help equalize word learning for children who struggle with or are discouraged by reading. This also provides support for learning via zoom, but only when the stimuli are engaging and salient.

3-K-29 **Early bilingualism protects children from poverty: Enhanced Theory of Mind**

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Compared with monolinguals, bilingual children tend to pass theory of mind (ToM) at younger ages (Kovács, 2009; Schroeder, 2018), yet children in poverty tend to pass ToM tasks at older ages (Baker et al., 2021). We are interested in if early bilingualism plays a buffering role against the negative effects of poverty on children's ToM and whether Executive Function (EF) explains the enhanced ToM performance in impoverished bilingual children. Twenty-three English-speaking monolinguals (Mage = 48.78 months) and 21 English-Spanish balanced bilingual children (Mage = 52.67 months) from low-income families completed Wellman and Liu's (2004) five-task ToM battery and three online standardized EF tasks focusing on inhibition control, working memory, and cognitive flexibility. Language proficiencies were assessed by standardized web-based language assessment. Results showed that after controlling for age, income-to-needs ratio, and English proficiency, balanced bilingual children had significantly better ToM competence than monolingual children, $F(1, 39) = 6.084$, $p = .018$, partial $\eta^2 = .135$. However, mediation analysis indicated that this was not explained by their EF performance, 95% CI [-.318, .081]. Implications and limitations will be discussed.

3-K-30 **Building semantic networks through play supports early vocabulary**

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By age 2, children exhibit rich semantic structure in their developing vocabularies, with words that are similar in meaning organized into dense networks and neighborhoods (Hills et al., 2009; Peters & Borovsky, 2019). How might toddlers' and caregivers' behavior during play help develop this rich semantic structure? Toddlers may interact with semantically related toys; alternatively, caregivers may strategically direct their child's play to highlight unknown or distinctive concepts. In this study, we

measured whether 24-month-old toddlers' and their caregivers' propensity to interact with semantically related items associated with the toddlers' semantic network vocabulary structure. Caregiver-child dyads (N=55) were recorded playing with a standard set of semantically related and unrelated toys. Preliminary analyses suggest that toddlers with vocabulary networks characterized by greater semantic distances between words (i.e., higher mean path length) experienced greater caregiver-led and child-led interactions with semantically related toys (B=0.07, t(45)=3.24, p=0.002), even after controlling for vocabulary size. These data suggest caregivers and children strategically build on children's own knowledge structures and seek to highlight semantic connections in the child's own environment, particularly when vocabulary knowledge is less efficiently connected. Our findings support that children acquire semantic structure through responsive interactions with their environment.

3-K-31   Children's social judgments of others on the basis of dialect
Madison Myers-Burg[1], Douglas Behrend[1]
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Recent research suggests that young children prefer speakers who use familiar dialect vocabulary. The current study investigated young children's attitudes toward speakers of familiar and unfamiliar dialects. Participants viewed an animated video featuring two children. One child used American dialect labels for items displayed, and the other child used British dialect labels. Participants indicated which child they would rather play a game with (social preference), which child they would rather ask if they didn't know the name of a novel object (selective trust), and rated each child on a three-point scale in domains of likability, niceness, intelligence, and helpfulness. Participants demonstrated social preference (p<.001) and selective trust (p<.001) for American dialect users over British dialect users. Participants rated American dialect users more favorably than British users in domains of likability (p<.001), intelligence (p<.001) and helpfulness (p<.001). Interestingly, participant rating did not differ for niceness (p=.3). Participants rated American dialect users more favorably than neutral in domains of likability, niceness and intelligence (p<.001); however, participants also rated British dialect users more favorably than neutral in domains of likability, niceness, and intelligence (0<.001), but not helpfulness (p=.09). This evidence suggests that a halo effect may motivate preference for familiar dialect.

3-K-32   Gesture acts as compensatory mechanism during narrative retell in former Late Talkers
Murielle Standley[1], Miriam Novack[1], Philip Curtis[1], Magda Slowakiewicz[1], Abigail Holthaus[1], Adriana Weisleder[1]
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Narrative skills are an important component of language development. Additionally, the gestures children use during storytelling have been linked to the structure of their narratives. Specifically, the use of character-viewpoint gestures predicts better-structured narratives in typically developing children. However, this has not yet been explored in children who started out as language delayed (i.e., Late Talkers). Previous studies show that, at age 2, Late Talkers (LT) rely more on gesture than their typically developing peers, but what happens as those LTs grow up? The current study investigates gesture use during a wordless cartoon narrative retell task in former Late Talkers (fLT) and Typical Talkers (TT) at age

4. We hypothesize that gesture will serve as a compensatory mechanism to support verbal language production in fLTs. Preliminary data (n=10, fLT n=5; TT n=5) show that fLTs gesture 22% more than TTs (MfLT=11 gestures, SD=8.37; MTT=7 gestures, SD=3.67), but fLTs' gestures are less likely to assume character-viewpoint (32%) than their TT counterparts (41%). These findings suggest that gesture continues to be a compensatory mechanism in language production for former Late Talkers but may also reflect differences in narrative construction. Ongoing analyses of current and additional participants (expected n=30), to be completed by April 2022, will further investigate gesture use and type, as well as the complexity of the narrative in the speech modality.

3-K-33   **Q&A on Zoom for preschoolers: The impact of on-screen partner's questions on preschoolers' word learning and memory of content from shared book reading over video chat**

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[1]Virginia Tech

During the pandemic, video chat has been a vital educational tool for all, including young children (Dore et al., 2021). Although preschoolers have been shown to benefit from reading over video chat with an on-screen partner (Gaudreau et al., 2020), what type of experience would maximize its instructional impact over time remains to be tested. In this study, we examined whether on-screen partner's questions (compared to statements) during shared book reading would improve preschoolers' novel word learning and memory of the content over two reading phases. The preliminary analyses were based on 20% of the final sample: 16 children (3-5 years; 37.5% female) participated in a 30-min Zoom session where an on-screen adult read a storybook two times. The book included 5 novel objects and 5 hiding locations. Children were randomly assigned to read the book with either questions (n = 8) or statements (n = 8). For both groups, each reading phase was followed by a word learning test and a location memory test. There was no difference between the two reading phases in the test scores; thus, the scores were combined. Children's word learning performance was higher in the question group than the statement group, t = -2.57, p = .023. However, location memory performance did not differ between the two groups, t = -0.42, p = .680. The results suggest that asking questions can be an effective tool for teachers to support preschoolers' word learning in an online learning environment.

3-K-34   **The development of lexical inhibition in written word recognition: Insight from a new superimposed words paradigm**

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When recognizing a word, words that partially match the input are activated and compete for recognition. Thus, listeners and readers must manage competition. This requires lexical inhibition: words actively suppressing each other. In spoken-word recognition there is evidence for inhibition in adults, but weaker inhibition in younger and disordered populations. Less is known about lexical inhibition in written-word recognition, as tasks like masked priming are difficult to use with emerging readers. We developed a new paradigm that amplifies activation for a competitor to observe how it affects recognition. Written targets (in red) were overlaid on a simultaneously presented competing word (in blue). If the competing word is similar to the target, this should slow recognition. Two groups of children

(7-8 y/o: n=44; 11-12 y/o: n=55 11-12 y/o) completed this task as part of the Growing Words Project. Competing stimuli included the target word (e.g., pot, overlaid on pot), competing words (pop, to assess inhibition) and control non-words (pof). Participants selected a picture of the target from four images as eye-movements were monitored. Results show developmental changes, with more evidence of inhibition for older children than younger children (p<.05). These results differ from typical results in spoken-word recognition, as here inhibition impacted asymptotic levels of looking, whereas in spoken language the locus of the effect is in the timing of looks.

3-K-35   A preliminary investigation of perspective taking in children who stutter

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Childhood stuttering is a neurodevelopmental communication difference that originates in early childhood during a period of significant speech, language, and social cognitive development (2-6 years). Previous research suggests young children who stutter report negative communication attitudes and also experience negative reactions to their stuttering from parents and peers. Current attitudinal assessments for children who stutter often ask children about how others' perceive their communication. This preliminary investigation sought to determine when children who stutter (N = 44, ages 2-10 years, mean age = 6.32 years) develop perspective taking, or the ability to make inferences about others' thoughts and beliefs, though a behavioral false belief task (Baron Cohen, 1985). Results provide the first account of when children who stutter acquire perspective taking and how this skill may uniquely influence self-reported attitudes toward stuttering and communication as evaluated by speech-language pathologists. Specifically, older age in years significantly predicted improved odds of earning a higher score on false belief tasks, χ^2 (2) = 26.43, p < .01. Future analyses will consider false belief performance as it relates to a child's self-reported communication attitude.

3-K-36   Language complexity shapes stereotypes about competence

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The U.S. has seen a decline in overt expressions of racial prejudice over the past few decades. However, subtle racial attitudes--such as stereotypes--persist. Past research suggests that even young children endorse racial stereotypes about competence. Given social norms against explicitly vocalizing prejudice, it is unlikely that children learn these stereotypes exclusively from racist statements made by adults (e.g., "Asians are smart"). We investigate how stereotypes about competence develop, focusing on linguistic interactions as a candidate mechanism. Specifically, we ask whether children infer that a group who is spoken to with simple speech is not smart. Participants are presented with a storybook in which a protagonist repeatedly addresses members of 2 novel social groups. One group consistently receives low complexity (LC) speech, and the other group consistently receives high complexity (HC) speech. We hypothesize that participants are more likely to infer that the LC group is less competent than the HC group. While data collection is ongoing, preliminary results trend toward our hypotheses. Children (ages 5-9; N=16) selected a HC character as being smart in 54% of the trials. This inference was strongest in older children: 9-year-olds (n=7) selected a HC character as being smart in 58% of the trials. Adults (N=5)

selected the HC character as being smart in 100% of trials. This suggest that subtle variations in how we speak may shape stereotypes about competence.

3-K-37   The relationship between speaking rate and executive function in young children
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Children's speaking rate tends to increase with age, as they become more efficient in cognitive and linguistic processing. However, the role of executive function (EF) in the development of speaking rate and how the relationship between the two might interact with language remain unclear. Mixed results have been reported on the association between speaking rate and working memory with the assessment of speaking rate arguably being contaminated by the memory load in the task. The direct relationship between speaking rate and two other EF components, inhibitory control and cognitive flexibility, has yet to be examined in the literature. The current study aims to explore the relationship between speaking rate and EF in young children and to explore whether the relationship between their speech and language development might be mediated by their EF performance. Thirty-three 3- to 5-year-old children were administered two working memory tasks, one inhibitory control task, one cognitive flexibility task, and three speaking tasks. The three speaking tasks for assessing speaking rate varied in the amount of cognitive demands as children were required to perform syllable repetition, sentence repetition, and sentence modeling. The interrelationships between different EF components, speaking rate of various speaking tasks, and language ability as well as the mediation effect of each EF component on the relationship between speaking rate and language ability are assessed.

L - Learning

3-L-39   Older but not younger, children adapt their decisions about which game to practice more to maximize test performance.
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This study investigates whether 4- to 7-year-old children tailor their learning choices, focusing on boosting their strengths versus compensating their weaknesses, depending on the task characteristics, to maximize test performance. Children are familiarized with a very easy and a very difficult guessing game. Children can then choose which game they want to practice before entering the test phase. In a within-subjects design, we manipulate whether children are told they can choose which game to be tested on (choice condition) or whether the computer will select the game they will be tested on (no-choice condition). Data collection is still ongoing, but preliminary results (n=106) suggest that while younger children decided to practice the easy game irrespective of condition, 7-year-olds adapt their training choices: They practiced the easy game in the choice condition to boost their strengths and ensure the maximum final score, but the difficult game in the no-choice condition, to compensate their weaknesses and maximize the average expected final score. Interestingly, we also found that most of the 6- and 7-year-olds who decided to practice the difficult (i.e., more exciting) game in the choice condition nevertheless chose to get tested on the easy (i.e., boring) game and obtained the maximum score. In this sense, their learning choices reveal a sophisticated awareness of their strengths and

weaknesses, allowing them to enjoy the game more while ensuring maximum performance. We will further explore these patterns in a series of follow-up studies.

3-L-40   Exploring patterns of parents' number talk engagement and preschoolers math skills

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One dominant source of variability in children's early math skills is the extent to which parents and children engage in conversations about numbers (i.e., number talk (NT)). However, NT is not a unitary construct and positive relations with children's math skills are not consistent depending on how NT is operationalized, e.g., number statements vs. questions, basic (e.g., counting) vs. advanced (e.g., cardinality or arithmetic) NT, small vs. large (numerals > 4) NT. The present study used cluster analysis to examine patterns of parent NT and children's math skills. Parent-child dyads (n = 123; Child age: M = 4.40 years, SD = 3.60 months) engaged in play with grocery store toys. Preliminary analyses revealed that none of the parent NT measures independently related to children's math skills. A k-means cluster analysis, using the proportion of parents' number Qs, large NT, and advanced NT, revealed three groups of parents who provided consistently low NT overall (n = 63), greater proportions of large than advanced NT (n = 37), and greater proportions of advanced NT compared to large NT and Qs (n = 23). These clusters differed by children's standardized math scores, $(F(1, 3747.12) = 4.91, p = .03)$. Parents who used more advanced NT had children with higher scores on average. Thus, parents' relative allocation of different forms of NT, not each type of talk by itself, may matter for children's engagement in number-related conversations and their developing math skills.

3-L-41   Museum practices that support children's engineering learning

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Our work focuses on children's learning through hands-on activities and social interaction (Piaget, 1965; Vygotsky, 1970) in the context of a tinkering exhibit at a children's museum. Our goal is to investigate how museum practices contribute to family interactions that promote children's long term engineering learning and success. Fifty families with children between ages 6-9 years old (M age = 7.02) were observed in the tinkering exhibit. All families were invited to make something that rolls and received a brief orientation from a museum staff member conveying three engineering "principles" to make their creations roll. We found that half of the families referred to the orientation (N = 25) and half did not (N=25) while tinkering. Moreover, families who referred to the orientation also talked more about testing (M = 22.75) compared to families who did not refer to the orientation (M= 14, F = 5.27, p < .05). The results of this study point to ways in which museum practices can promote engineering learning opportunities for children.

3-L-42   The interactive effect of working memory and spatial anxiety on spatial skills changes with children's age

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Spatial skills are essential for math learning and can be influenced by both cognitive and emotional factors. In prior work, higher mental transformation skill was related to lower spatial anxiety among girls with higher verbal working memory (VWM) (Ramirez et al., 2012). Researchers theorized that high-VWM girls' VWM-intensive strategies were disrupted by anxiety-induced verbal ruminations. However, a recent meta-analysis showed that anxiety impairs VWM and visuospatial working memory (VSWM) to a similar degree, suggesting anxiety has a domain-general effect on attentional control (Moran, 2016). The current study examined whether VSWM interacts with spatial anxiety to predict spatial skills. Moreover, as VSWM and spatial skills are still developing during elementary school, we investigated how this interaction changes with age. Children (n=402) in first to fourth grade were tested. We found a significant three-way interaction of grade, VSWM, and spatial anxiety on mental transformation skills. Specifically, among 4th-graders (but not younger students), higher spatial anxiety was related to lower spatial skills for high-VSWM students. Our finding suggested that the interaction effects between working memory and spatial anxiety on spatial skills extend beyond VWM to VSWM, and become more pronounced as children's age increases.

3-L-43   Fraction sense intervention improves number line estimation skills in students with diagnosed learning disabilities
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This pilot trial examines effects of an evidence-informed fraction sense intervention on sixth graders with diagnosed learning disabilities in math (MLD). The work is in preparation for a larger randomized efficacy study. Students' fraction knowledge was measured with a pretest. They then underwent a series of lessons in a typical classroom setting in which they learned about fractions using partitioning into portions, number lines, measurement, and arithmetic. The intervention was carried out by the classroom teacher rather than a researcher. This poster specifically addresses data on a fraction number line estimation (FNLE) task. Fraction magnitude understanding predicts algebra knowledge and thus is a key indicator of fraction understanding. Students (N=9) completed 27 trials estimating the position of fractions on a number line from 0 to 1 and from 0 to 2. Accuracy on the task was calculated using Percent Average Error (PAE). Students' PAE decreased significantly from pretest to delayed posttest (F=9.424, p<.01, $\eta p2$=.541) Data were compared to the FNLE performance of a typically achieving sample (N=401) (Resnick et al., 2016). Looking at individual performance (Table 1), the MLD students varied in skill level at all time points, but most of them improved beyond their typically-achieving peers by the delayed posttest. Individual differences on fraction arithmetic also will be examined relative to fraction understanding.

3-L-44   What is Coronavirus? Content analysis of children's books about COVID-19 in Turkey and the U.S.
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Parents and teachers often use picture books to convey information to children (Shtulman et al., 2020; Kelemen et al., 2014). These books reflect the values and ideas of the culture in which they were created and provide a crucial socialization context (Lee et al., 2014). This study analyzed storybooks about COVID-19 intended for 3- to 12-year olds published in the first year of the pandemic (2020-2021) in two cultures (US and Turkey). We examined books (N = 25 US/ N = 17 Turkey) published in the native language of the country that were found on popular bookselling websites. Books published in Turkey were more likely than books in the US to use directives and recommendations when presenting Covid-19 related information. Books in the US were more likely to provide explanations about the virus. Books in the US presented information about precautions to take (26.2%), the Covid-19 virus (23.4%), and the expression of the children?s emotions during the pandemic (19.7%). Books in Turkey presented hygiene-related information (11%), the Covid-19 virus (14.4%), and used anthropomorphic presentations (22.9%). We highlight similarities and differences in the content and communication styles of the books in the two cultures. We discuss these findings in terms of implications for using these books as socialization tools that parents and teachers can use to help their children better understand the Covid-19 pandemic.

3-L-45 **Comparing learning capacity across species and age to identify origins of human uniqueness**

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A core unanswered question in human development is how human learning differs from that of other primate species. Previous research has hypothesized qualitative differences in learning mechanisms between species (e.g., Hauser, M. D., Chomsky, N., Fitch, W. T., 2002; Ferrigno, S., Huang, Y., & Cantlon, J. F., 2021). However, few studies have directly compared their basic learning capacities. An important factor in successful learning is the capacity to sustain a cognitive process, including attention and working memory required for the task. Here we test human children and non-human primates on a basic match-to-sample task to compare the extent to which lapse rate, quantifying inability to sustain a task, varies across species and age. We used Bayesian modeling to test whether accounting for lapse rates significantly improves estimates of subjects' learning curves beyond standard logistic models, which we found to be the case for most subjects (95% credible interval for lapse = -1.619, -1.434; -1.875, -1.564; -1.88, -1.571; -1.054, -0.657). This indicates that general processing capacity (lapse) critically should be accounted for in understanding learning trajectories. We then compare lapse rates and learning curves between primate species and age groups (3 - to 6-year-old human children) to identify key similarities and differences across populations. The data advance our understanding of the variability in capacity that gives rise to uniquely human cognition.

3-L-46 **Explaining and exploring the dynamics of parent-child interaction and children's causal reasoning at a children's museum**

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Our aim was to investigate how the timing of parents' explanations at a museum exhibit relate to children's exploration during their play. Parent-child dyads with 3- to 6-year-olds interacted in open-ended play at an exhibit focused on the properties of airflow, then children completed causal reasoning tasks related to the exhibit. Play was coded for instances of parents' explanatory utterances and both parents' and children's exploratory behaviors. Overall, children's systematic exploration, not parents' exploration or explanations, related to their scores on the causal reasoning tasks. To examine the temporal effects of parental explanation on children's exploration, we constructed models that predicted children's exploratory behaviors with parents explaining before, during, and after children's exploring. The model that best fit these data found that parents' explanations increased the likelihood of children's exploration in the following interval (compared to when parents did not generate a causal explanation). These results replicate and extend work by Callanan et al. (2020) who found that it is only when we closely examine the temporal relations among exploration and explanation that we find a link between parents' causal explanations and children's causal reasoning.

3-L-47   Worth the wait: the role of cognitive and physical effort in shaping children's value judgements, preferences, and behavior

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Despite the importance of early persistence in shaping children's learning, research has yet to examine how children first come to value their efforts, and how their previous efforts shape their future behavior. Here we examined the role of effort type (physical vs. cognitive) and intensity (high vs. low effort) in shaping children's preferences, valuation judgements, and behavior. In this between-subjects study, 5- to 7-year-olds (N = 85 tested, target N = 128) were randomly assigned to conditions (high physical effort, low physical effort, high cognitive effort, low cognitive effort). Children completed a series of tasks, that varied in type (physical vs. cognitive) and intensity (high vs. low effort required), to construct a toy. Multiple regression models tested the effect of effort type and intensity on children's evaluations, preferences, and behavior surrounding the toy they built. There was no effect of condition on children's subjective ratings (i.e., preference or value assessments of their toys, all p's > .05), however, we did detect an effect of effort type on children's behavior - children who exerted cognitive effort to build their toy were significantly more likely to wait to watch a video featuring their toy compared to children who exerted physical effort (120 seconds vs. 90s, b = -34.61, p = .05), regardless of effort intensity (high vs. low). See Fig 1. These findings provide new insights into how children's previous efforts impact their future behavior.

M - Memory

3-M-48   The emergence of future-oriented cognition in toddlerhood

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The preregistered study investigated the emergence of future-oriented cognition (FOC) in toddlerhood as well as related cognitive (i.e., self-regulation, self-understanding, memory, language) and social abilities (i.e., daily talk). Parents of 2- to 3-year-olds (N = 132; 67 girls; Mage = 34.92 months, SD = 7.06) completed the Children´s Future Thinking Questionnaire (CFTQ) to assess their child´s FOC and measures

of executive function, self-understanding, episodic memory, expressive vocabulary, parent-child future talk, child´s temporal word use (e.g., tomorrow), and child´s use of future metaphors (e.g., sleeps for days). Results showed that while 2-year-olds did engage in future thinking in some domains (i.e., saving, episodic foresight, and delay of gratification), they had more missing data than parents of 3-year-olds, especially in the domains of planning and prospective memory. Further, there was a positive correlation between age (in months) and FOC, suggesting that older children tend to have higher scores on the CFTQ. A regression analysis showed that only episodic memory and children´s use of future metaphors were significant independent predictors of 2- and 3-year-olds´ FOC. The interactions between age (in months) and predictors were not significant. Episodic memory and children's daily future talk may play a fundamental role in the emergence of FOC in young children and the results are interpreted with reference to the constructive episodic simulation hypothesis.

3-M-49   The unique contribution of episodic memory on community adaptive behavior skills in young adults with Down syndrome

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Community living skills support independence and social inclusion, affecting quality of life. Little is known about the underlying factors supporting the development of these skills among adults with Down syndrome (DS). For this analysis, we hypothesized episodic memory and community experience to be underlying factors. Participants were 23 individuals with DS from 17 to 29 years old. Participants' primary caregivers completed a questionnaire on community adaptive behaviour and on community participation. Participants completed two measures of episodic memory. Memory task scores were converted to a weighted composite score. Episodic memory, r=.552, p=.012, and community experience, r=.436, p=.048, significantly correlated with community living skills. We ran a simple multiple regression of community living skills on community experience and episodic memory. The overall model was significant, R^2=.426, F(2,15)=5.564, p=0.016. Episodic memory uniquely explained 23.6% of the variance, p=.025. Community experience uniquely explained 12.1% of the variance, p=.096. As an exploratory analysis, we divided community adaptive skills by topic and found episodic memory positively correlated with 6 of 17 topics (ps<.05). Episodic memory and community experience may be important to community living skills in young adults with DS. Alone, memory correlated with one third of community topics. Understanding the link between memory and community skills could help promote independence in DS.

O - Miscellaneous

3-O-50   Embodied learning of fractions in 4th-grade classrooms

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Gestures and embodied action can scaffold transitions between concrete experiences and mental representations of mathematical knowledge. The purpose of this exploratory study is to catalogue in-classroom prompts that encourage students to express their mathematical thinking with embodied action, thus supporting their development of mathematical knowledge. We observed video recordings of fraction comparison lessons from eight 4th-grade classrooms from across the United Sates were

observed to locate and describe evidence of student gestures and embodied mathematical actions. We then backtracked to identify and describe what prompted these student behaviors. We found that 77% of observed gestures were prompted by teachers, 21% were self-prompted, and 2% were peer-prompted. Next, we will examine the relationship between prompt type and gesture type and function. These data suggest that teachers can cue students to produce gestures. By better understanding the nature of these gesture prompts we expect to provide insight on effectively building learning spaces that encourage embodied representation of mathematical thinking.

3-O-51   Parents' stimulation and its association with cognitive abilities, social communication, attentional control, and executive functioning of children in rural areas
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As an environmental factor that promotes cognitive development during early childhood, parents' stimulation of development can be related to multiple cognitive outcomes of young children. This study examined the indirect relationship between parents' stimulation of children's development at 15 months and children's executive functioning (EF) at 36 months. A model including pathways from parents' stimulation (i.e., the degree to which parents tried to foster children's development) to EF through children's cognitive abilities, social communication, and attentional control was tested. The data used in this study were collected by the Family Life Project in rural areas of the United States. There were 1,100 children included in the secondary data analysis. Structural equation modeling was used to test the hypothesized model. The fit indices suggested a good model fit, $\chi 2(39)=38.36$, $p=.50$, CFI=1.00, TLI=1.00, and RMSEA=.00. Parents' stimulation at 15 months was positively predictive of children's EF at 36 months through children's cognitive abilities at 15 months, social communication at 15 months, and attentional control at 24 months. Accordingly, parents' stimulation in the second year of children's lives was the precursor of children's EF skills by the end of the third year. A mechanism including children's cognitive abilities, social communication, and attentional control can be considered to explain how parents' stimulation was helpful for children's EF skills.

P - Morality

3-P-52   Young children's considerations of contribution and effort for reward distribution
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Researchers have suggested that by age 6, children distribute rewards based on merit, or equity, rather than equality. Two common determinants of merit are how much one has contributed to a task and the amount of effort one has put in (Kanngiesser & Warneken, 2012; Hamman et al., 2014). In the current study, 6- to 8-year-old children were shown a series of vignettes manipulating characters' contribution and effort to a joint task and were asked how rewards should be distributed. Preliminary analyses suggest that most children believe that the individual who produced more output deserves more rewards, $X^2(4, N = 69) = 4.64$, $p = .327$. However, when effort is manipulated in which one character is at a disadvantage and must work harder to make the same contribution, less than half the children distribute more rewards to this individual, although there is an increasing trend with age, $X^2(4, N = 69) = 8.65$, $p = .07$. When both effort and outcome are manipulated, in which a disadvantaged individual who

must work harder produces less than their advantaged counterpart, most children fault the disadvantaged individual, as most of the children across the age span choose to distribute more rewards to the advantaged individual who contributed more to the joint task, $X^2(4, N = 69) = 1.94, p = .747$. While this study helps us better understand the parameters of equitable behavior, it also has implications for children's understanding of social disparities beyond reward allocation.

3-P-53   Children's and adults' reasoning about science resource inequalities between gender groups

Riley Sims[1], Amanda Burkholder[1], Melanie Killen[1]
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How do children and young adults reason about effort and advantaged status regarding gender-related science resource inequalities? We presented vignettes to children (5-6 years) and 9-11 years) and young adults (N = 144) depicting an inequality of science supplies between groups of boys and girls, varying two factors: 1) high or low effort at science, and 2) advantaged or disadvantaged amount of science materials. Results revealed that participants who used moral reasoning negatively evaluated and rectified the resource inequalities, whereas participants who used group-focused reasoning positively evaluated and perpetuated the inequalities. Participants who endorsed the inequality when the high effort group was advantaged used merit reasoning significantly more than equality and group-focused reasoning (ps < .05). Age and gender-related differences will be discussed. Together, these results reveal that both children and young adults shift not only between moral and group-related considerations, but also vary in their priorities when merit is made salient in inequality contexts.

3-P-54   Mean or mad? Children's trait inference from behaviour and facial expression

Denise Arefhaghi[1], Rebekah Gelpi[1], Jessica Sommerville[1]
[1]University of Toronto

Young children readily use information obtained from trait labels (e.g. "mean") to make predictions about other people's behaviour, but generalize less than adults when observing behaviour alone (e.g. shoving someone). In Studies 1 and 2, we show that 6-8-year-old children (N = 48) are capable of generalizing about characters' future moral violations based on earlier actions (z = -2.88, p = .004), but they predominantly rely on the facial expressions of a character, over and above their past behaviour, when making predictions about future behaviour. In contrast, adults (N = 42) showed a greater tendency to rely on the character's earlier behaviour, t(40.1) = -3.03, p = .004). Furthermore, adults' generalizations were mediated by trait inferences (z = -4.51, p < .001). We seek to determine whether children's performance differs from adults because they rely on in-the-moment cues--such as emotional states suggested by a facial expression--more heavily than adults, or because they use different criteria to infer traits and consider facial expressions more diagnostic than their previous behaviour. Study 3 will distinguish these possibilities by investigating the extent to which children's trait inference is related to a character's facial expressions and past behaviour, and how such inferences are related to their predictions about a character's future actions.

3-P-55   **Clean up with mom or keep building blocks? Young children's and parents' judgments about helping at home**

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Households provide a crucial context for the development of children's prosocial evaluations and actions. By preschool age, children form judgments about when to help others. Yet, preschoolers still struggle to balance one interest against another, such as the interests of the helper against the interests of the recipient, and parents may influence this development in children's prosocial reasoning. This study uses Zoom interviews with preschoolers (3-6 years old) about hypothetical vignettes, surveys with parents, and structured conversations between parents and children to study the development of prosocial evaluations. Though data collection and analysis are ongoing, analyses of 19 parent-child dyads' responses to hypothetical vignettes revealed that heightened recipient interest in receiving help made children more likely to judge that the protagonist should help, while heightened protagonist interest in helping made parents more likely to judge that the protagonist should help. Further, heightened protagonist interest in a non-helping activity led children to view helping as obligatory; when combined with heightened recipient interest in receiving help, the same was found with parents. Parent-child conversations are still being analyzed. The study supports the view that children's early judgments about prosocial acts are responsive to recipient and protagonist interest and will advance our knowledge of how parents contribute to the development of such judgments.

R – Numerical & spatial cognition

3-R-56   **Predicting wayfinding performance using perspective-taking abilities in four- to nine-year-old children**

Daria Lasc[1], Arielle Hershkovich[1], Sarah Shah[1], Amy Adickes[1], Christopher Simmen[1], Sonia Conde[1], Nima Patel[1], Julia Hauss[1], Hafsa Abid[1], Rachel Freeman[1], Kaitlynn Bohr[1], Jessica Charles[1], Nardin Yacoub[1], Marya Nemeh[1], Rachelle Gorczynski[1], Stefan Zivanovi
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Wayfinding, or spatial navigation, refers to the use of landmarks and spatial orientation to navigate oneself through an environment. Perspective-taking involves shifting one's imagined point of view. Previous adult research has indicated that perspective-taking abilities may be utilized to predict performance on some wayfinding tasks, specifically those tasks involving egocentric transformations. However, little research in this area has been done with children. In this study, 125 children (between four and nine years old) completed a perspective-taking task (i.e. Three Mountains task) and a wayfinding task (i.e. route-learning task where wayfinding errors and landmark recall were recorded). Even after partialling out mental age (measured by Raven's Progressive Matrices), significant correlations were found between perspective-taking abilities and all indices of wayfinding performance. This finding suggests that both tasks required egocentric transformation abilities and it supports the continuity that perspective-taking abilities may help support wayfinding that requires egocentric representations.

3-R-57   **Investigating 3- to 9-month-old infants' processing of abstract numerical information**

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Previous research demonstrated that newborn infants can match the number of sounds they hear to the number of shapes they see on a screen (Izard et al., 2009). We attempt to replicate this finding in 3- to 9-month-old infants. In two experiments, we showed infants (N =207) two arrays of brightly colored smiley faces on each side of the screen while playing a stream of repeated syllables. Critically, one side of the screen shows the same number of faces as the number of syllables whereas the other side shows either a smaller or larger quantity (e.g., 5 vs. 10).We found that infants overall showed no significant preference for the matching array; but rather, they looked longer at the larger numerosity regardless of how many syllables they heard. Experiment 2 tested whether familiarizing infants to redundant mapping between visual and auditory numerical information facilitates their numerical mapping and found the same results as Experiment 1. Surprisingly, we found little evidence of developmental change in our sample. Overall, our findings replicate previous results on infants' preference for visually complex arrays, but not infants' mapping of abstract numerical information across sensory modalities.

T - Prosocial behavior

3-T-58   **The development of intergroup cooperation: Shared preferences overcome in-group bias in children's collaborative partner choice**

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While cooperation is a hallmark of human societies, the benefits of cooperation are not always extended to those outside the group. Classic research suggest that collaboration may reduce in-group bias leading to cooperation across group bounds. Yet for collaboration to impart these benefits children must choose to enter collaborative relationships with peers from outside their group. The goal of this project is to understand how both group and interpersonal affiliation influence children's choice of collaborative partners. In Study 1, we assigned children (4-9 years, n=120) to either a group (minimal group) or an interpersonal (shared preferences) condition and presented them with a choice to play a collaborative game with either an affiliated (in-group or same preference) or unaffiliated (out-group or different preference) peer. We found that children preferred to collaborate with affiliated peers, but this preference was stronger in the interpersonal condition (LRT: $\chi^2(1) = 14.13$, $p < 0.001$). In Study 2, children (4-9 years of age, n=62) were simultaneously presented with group and interpersonal affiliation cues that conflicted. Participants chose between an in-group peer with different preferences or an out-group with same preferences. Children preferred to collaborate with the out-group/same preference peers ($p < 0.001$). These findings reveal that interpersonal affiliation can overcome in-group bias in children's collaborative partner choice.

3-T-59   **The development of epistemic partisanship and its relation to intellectual humility**

Natalie Hutchins[1], Andrei Cimpian[1]
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One of the most salient features of the current political climate in the US is its intense partisanship, which undermines the possibility of productive compromise and promotes gridlock. One contributor to gridlock may be what we call epistemic partisanship: the tendency to view and learn about the world in

a way that favors one's ingroup's values and norms. Here, we examined the development of epistemic partisanship in a study with 5- to 7-year-olds (N = 97). Children were assigned to a minimal ingroup and were asked to decide whether a series of opposing claims by the ingroup vs. the outgroup were accurate. Relative to a control condition involving no groups, children were more likely to endorse the ingroup's claims, even when they went against perceptual evidence. This partisan tendency increased with age and was mitigated by children's intellectual humility (assessed with a new child-friendly self-report scale created for this purpose). Study 2 (ongoing) explores the boundaries of epistemic partisanship and its relation to parents' political attitudes (e.g., right-wing authoritarianism). For example, would children show less epistemic partisanship if they received extra incentives for endorsing accurate claims? Would they show more epistemic partisanship if their parents scored higher in right-wing authoritarianism?

3-T-60   Children's prosocial sharing decisions: Influence of internalizing behaviors and cognitive empathy

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Prosociality in children is linked to adaptive outcomes across the life span. Research on the association between children's behavioral characteristics, including internalizing and externalizing behaviors and prosociality, has produced mixed findings. This study investigated how children's behavioral characteristics and empathy influence their sharing decision-making. Thirty-two children (18 girls; Mage = 6.8 yrs.; 5.1-8.8) completed a one-shot dictator game allocating 4 stickers to self and an anonymous child (see Fig. 1). The ratio of stickers shared to other to the total number of stickers represented the ratio of prosocial decisions. Mothers reported children's behavioral and emotional problems (CBCL) and cognitive and affective empathy (Griffith Empathy Measure). Children allocated stickers more to self (M = .30, p <.001), however, 7- to 8-year-olds (n = 13; Mratio = .38) were more likely to share with others than 5- to 6-year-olds (n = 17; Mratio = .24). Multiple regression revealed that children's age (p=.005), internalizing behaviors (p=.005), and cognitive empathy (p=.028) predicted a higher rate of prosocial decisions (R2=.562, p < .001; see Fig. 2). These results suggest that as children age, gain higher cognitive empathic understanding, and exhibit internalizing behaviors (non-clinical level), they are more likely to act prosocially. Findings suggest that prosocial behaviors may act as a coping strategy in children displaying more internalizing behaviors.

U - Reasoning

3-U-61   The role of meta-representation in children's development of recursive theory of mind and mental time travel

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The developmental transition children undergo around age four when they come to master verbal false belief (FB) tasks is considered to mark the onset of a meta-representational Theory of Mind (Perner, 1991). The present study aims to elucidate the development of meta-representation more generally and to test claims that growing meta-representation underlies mental time-travel capacities (Redshaw & Suddendorf, 2020). To this end, we compare 3- to 8-year-old children's (N=120) developing meta-

representation in recursive Theory of Mind with their recursive mental time travel abilities on three levels of meta-representational embedding. Theory of Mind was operationalized as first-, second-, and third-order FB understanding and mental time travel as an understanding of future possibilities (first order), counterfactual thinking (second order) and anticipated counterfactual thinking (third order mental time travel).Data collection for the preregistered online study (https://aspredicted.org/gk6ai.pdf) is ongoing (n=102 of N=120 children tested) but will be completed by April, 2022. The results will be discussed with regard to their implications for thinking about the scope of meta-representation in cognitive development more generally (Carey et al., 2020).

3-U-62   Children's understanding of involuntary behaviors as a mechanism for inferring deception based on nonverbal cues

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Past research has shown that children under 6 years of age do not draw inferences about deception based on inconsistencies in verbal and nonverbal testimony. Instead, preschool aged children systematically trust an adult's verbal testimony despite nonverbal leakage that suggests the speaker is lying (Ghossainy, Al Shawaf, & Woolley, 2021). By 6, however, children's decisions of trust change dramatically in that they detect the inconsistencies in verbal and nonverbal testimonies and they privilege the nonverbal inputs as being more indicative of the truth. Past studies have shown no association between theory of mind and executive functions on children's reasoning and decision making. In the current study, children between 4 and 6 years perform a search task based on verbal and nonverbal input from an adult informant, as well as a classic hand-drawing task. Planned analyses will test the hypothesis that children's understanding of involuntary actions is one mechanism that drives their ability to infer deception based on inconsistencies in verbal and nonverbal cues. Data from 50 children have been collected so far and is ongoing.

V - Self

3-V-63   Effects of personal pronouns on children's numerical problem solving

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Personal pronouns such as 'you' can be used to elicit self-referencing, whereby information is processed with reference to self rather than other people or contexts. Self-referencing is associated with robust attentional biases like attention capture and increased attentional resource availability, which may have implications for numerical processing. Previous research suggests that performance on numerical problems (e.g., "Tom has 3 balls. Bob has 2 more (less) balls than Tom. How many balls does Bob have?") can be improved when one character in the problem is replaced with the pronoun 'you' (D'Ailly et al., 1997). However, evidence for this effect is limited, and is complicated by confounds between problem difficulty and position of the self-pronoun in the extant research. Further, there has not been a test of the most parsimonious explanation: that self-pronouns reduce the working memory load of the problem simply by reducing the list of new characters to be tracked. To address these issues, we conducted two experiments in which school children solved numerical word problems, half of which included the self-pronoun 'you'. In Exp 1, children aged 7-11 years (N = 96) were asked to complete

addition or subtraction problems in which the self-pronoun was positioned either first or not first in the problem. Children were required to track either multiple characters (e.g., "you have 3 balls. Bob has 2 more...") or one character but multiple objects (e.g., "you have 3 balls and 2 bats...") to solve the problem. Accuracy data showed a reliable advantage for problems that included the self-pronoun, and children were also faster to solve these problems when they involved addition, although were slower when the question involved the more difficult subtraction operation. The position of the self-pronoun had no impact on performance, and the effect of self was consistent regardless of whether the problem included multiple characters or only one. This suggests that self-pronouns have a facilitative effect on problem solving regardless of whether or not there is a list of characters to hold in working memory. To explore the effects of difficulty further, in Exp 2, 9-11-year-old children (N = 144) were asked to solve addition and subtraction problems that were either low or high in difficulty, half of which included a self-pronoun. As in Exp. 1, accuracy was significantly higher when a self-pronoun was included in the problem, although this effect was greater in the most difficult questions. Response time data showed that self-referent questions were answered more quickly than problems without a self-pronoun regardless of difficulty. Together, these findings suggest that self-pronouns have a reliable enhancing effect on children's numerical problem-solving. The effect of self-pronouns on accuracy is greatest when the difficulty of the problems is highest, although the effect on response time is more complicated. These data suggest that incorporating self-pronouns in children's numerical problems would be good practice in schools, reducing some of the processing or load barriers children may experience when learning to solve these problems.

3-V-65   Who is motivating? Students evaluate encouragement based on speaker's knowledge

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Parents and teachers often encourage students (e.g., "You can do it!") when they encounter challenges, but these messages are not always effective. Whose encouragement motivates students the most, and why? Here we tested the hypothesis that students would be more likely to seek out and be motivated by encouragement from people who both know more about the domain (e.g., knowledge about course materials) and know about students' abilities (e.g., knowledge about their math abilities). In a large-scale, preregistered survey (through the Character Lab Research Network; n=288 middle schoolers, n=425 high schoolers), we find that middle and high school students are most likely to seek out and be motivated by encouragement from someone with both domain and ability knowledge, rather than one or the other. This effect emerged both when reasoning about hypothetical classmates (Study 1a) and real people in their lives (Study 1b). Moreover, we find that confidence in others' performance estimates may underlie this effect (Study 1c). Collectively, this work suggests that students do not find all encouragement equally motivating; rather, they interpret encouragement in light of the speaker's mental states. Ongoing work is formalizing this process in a computational model of students' evaluations of encouragement, and experimentally testing our hypothesis with behavioral measures of challenge-seeking and persistence.

3-V-66   Exploring developmental changes in children's social-cognitive imaginations, emerging self-concept, and their motivations to learn.

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Recent studies have documented developmental changes in children's social imaginations via their beliefs about action possibility. While preschoolers believe that it is not possible to act against social and psychological constraints, older children imagine ways in which one can (Kushnir et al, 2015; Zhao et al, 2021; Chernyak et al, 2013, 2019; Shtulman & Phillips, 2018). In this study, we explore whether similar developmental changes are found in the domain of achievement. Using self-reflective vignettes, we asked 4 to 9-year-old children (N=121, Mean=6.9 years, SD=1.75, Range=4.0 to 9.8) about whether it would be possible for them to do hard things in several achievement domains (math, reading, puzzles). Results showed that older children were more likely to say it was possible to do these difficult things than younger children (r=.40, p<.001). Controlling for age, children's beliefs about the possibility of doing hard things were related to their beliefs about the possibility of overcoming psychological constraints (r=.33, p=.002). Finally, children's beliefs about the possibility of doing hard things also related to their mastery orientation as measured by a single-item puzzle choice task adapted from Elliot and Dweck, 1988 (r=0.2, p=.03). These data suggest intriguing links between children's developing social imaginations, their emerging self-concept, and their motivation to learn. The nature of this connection remains a question for future research.

W – Social categories and groups

3-W-67   Parent authoritarianism and children's beliefs
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Trait labels help guide our interactions with people. However, first impressions can be misleading, and behavior is complex. The current studies explore how children respond to people who behave in a trait-inconsistent manner. In Studies 1 and 2, children (n=50) were presented with a character labeled as mean or nice respectively. They then heard that the character behaved in a trait-inconsistent manner. After each behavior, participants were asked to make a trait attribution. We found individual differences in children's responses. Approximately half the children (n=22) maintained the experimenter's trait label, and the remaining children (n=23) changed the trait label. Due to the unexpected individual differences in these data, we contacted participants' parents (n=32) to evaluate whether parent authoritarianism influenced children's deference. We found that parent's authoritarianism predicted children's maintenance of the mean label, F(1,17)=9.25, p=.008, R2=.36, but not maintenance of the nice label, F(1,17)=0.20, p=.664, R2=.018. Children with more authoritarian parents maintained that individuals were mean, even when they heard that they behaved nicely, while children with less authoritarian parents were more likely to revise their beliefs so that their trait attributions matched a character's behavior. We propose that threat indicators, such as being labeled as mean by an authority figure, are treated as informative and stable by the children of authoritarian parents.

3-W-68   Parent and self-socialization of gender attitudes in young children
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Using a large preregistered study (total N = 689), we investigate how parent socialization and self-socialization shape children's gender intergroup attitudes and behaviors in a sample of Asian, Black, Latinx, White, and Multiracial children from five geographical regions across the U.S.. Regarding parent socialization, we find that the more parents talk to their children about gender equality and gender discrimination, the more their children liked other kids with different genders than their own (ß = .213, p = .043). We also find that for kids living in heterosexual two-parent families (N = 427), the more housework women do in comparison to men, the greater their children's awareness of men's higher social status than women's (ß = .169, p = .038). Additionally, we find that children with higher levels of self-socialization (that is, those who paid more attention to and expressed more interest in learning about gender), liked kids of different genders less (ß= -.208, p = .013), and are more likely to allocate resources to children of their same gender over children of other genders (ß = .273, p < .001). Also, boys higher in self-socialization showed greater awareness of the gender status hierarchy compared to boys lower in self-socialization (ß = -.543, p < .001). In sum, we find that both self- and parent socialization processes play a role in shaping children's gender attitudes as they navigate their social worlds.

3-W-69   Considering immigration disrupts children's essentialist beliefs about nationality
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Children think of nationality as a core part of identity: previous research finds that children are more likely to expect people of the same nationality to share preferences than people of the same gender (Hussak & Cimpian, 2019). Inductive potential tasks such as these are generally used to indicate essentialist beliefs about a social category. However, do children truly believe that where someone is born defines them in important (and unchanging) ways? Here, we replicate the previous study, but include targets who are immigrants (current N = 92 four- to eleven-year-olds). Replicating the past work, when reasoning about non-immigrants, children were more likely to generalize preferences based on shared nationality than shared gender, t(184) = -14.03, p < .001. When considering immigrants, however, children's responses were more mixed. Children relied on gender when the gender-match also lived in the same country that the immigrant target moved to, t(180) = 3.44, p < .001. But, children were at chance when having to choose between a gender-match who lived immigrant's birth country compared to a non-gender match living in the current country, t(185) = -1.78, p > .05. Thus, rather than essentializing nationality, children may care more about where one lives than where they were born when generalizing preferences. These findings may suggest that children expect immigrants to assimilate to and adopt the preferences of their new culture.

3-W-70   Young children's racialized expectations of police encounters with peers
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Biased policing disproportionally impacts the Black community. Although adolescent awareness of this fact is well-documented, no empirical work has assessed young children's awareness. Young children are skilled at integrating information to make inferences about others, thus it's possible that even young children are attuned to the increased risk Black and biracial Black/White people incur when encountering the police. This study investigates whether children hold different expectations about how White, Black, and biracial peers would interact with a police officer during a time of need, and how those expectations are shaped by the child's own racial identity and racial and legal socialization. In an ongoing study, 5- to 12-year-old Black, White, and biracial children (expected N~ 216) are told a story where a Black, White, or biracial peer could use assistance, and will be asked whether that peer will solicit assistance from a White male officer. We predict that participants will expect White, as compared to Black and biracial, peers, to be more likely to solicit assistance from a police officer, and that this pattern will be strongest among Black and biracial participants and will strengthen with age. Results expand our understanding of children's racialized expectations, provide information to guide parents in teaching their children how to safely interact with the police, and inform policy and practices in Departments of Public Safety and Police Departments.

3-W-71   Children's considerations of wealth status in perceiving others' physical and psychological pain

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How do children perceive others' pain? Here, we investigate how an individual's wealth status influences children's perception of physical and psychological pain. Studies 1 and 2 showed 4- to 9-year-old American (N = 106) and Chinese participants (N = 118) four pairs of children, one after another. One child possessed a low-quality item and the other possessed a high-quality item. In each trial, participants were presented with a scenario in which both children experienced a physically harmful event (e.g., hitting their head) and were then asked to choose who felt worse. Study 3 (N = 113) was identical, except that participants were shown adult characters and asked to choose one of them to receive limited healthcare resources. With age, children became increasingly likely to choose the poorer individuals as experiencing more physical pain and as a result, they were also more likely to offer healthcare resources to them. Study 4 (N = 124) adopted a similar paradigm to examine whether children use wealth status in their perception of psychological pain and their mental resource allocation, which revealed similar developmental trends. Overall, the four studies provide consistent evidence demonstrating that the association between wealth status and pain perception emerges in early childhood, and guides children's resource allocation decisions.

3-W-72   Children's evaluations of others' gendered preferences

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The purpose of this study was to examine factors that impact children's evaluations of others based on their gendered preferences. Children ages 5 to 7 years (N = 99) were shown pictures of boys and girls who were described as liking either stereotypical masculine (e.g., Spiderman costume) or feminine (e.g.,

princess costume) toys. First, they were asked to rate how much they liked each child, then they indicated whether it was okay for the child to play with the toys they liked. Participants preferred boys who liked stereotypical masculine toys to boys who liked stereotypical feminine toys (t(197) = 2.38, p<.018); however, they did not indicate a difference in preference for girls who liked stereotypical feminine vs. masculine toys, p = .056. On subsequent trials, participants indicated that it was more acceptable when boys played with masculine (vs. feminine) stereotyped toys (t(197) = 6.20, p<.001) and when girls played with feminine (vs. masculine) stereotyped toys (t(197) = 5.30, p<.001). Taken together, these findings show that children evaluate girls, and especially boys, differently depending on their gendered interests, with gender stereotypical behavior resulting in more positive evaluations than counterstereotypical behavior.

X – Social cognition & social learning

3-X-73 Parent-child interaction during a home-based STEM activity relates to children's behaviors: The case of handwashing

David Sobel[1], Laura Stricker[1]
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We developed an activity about the effects of soap during handwashing, using everyday household objects. Parents and children (N=78) were guided through this activity in their home. We were interested in how the ways parents and children interacted during their participation related to children's use of soap during subsequent handwashing. We coded who set goals for the interaction during the activity, because previous research has shown that such goal setting relates to children's engagement. Parents then reported cases in which they observed children's handwashing. When we considered the proportion of times children used soap without prompting during handwashing, there were differences among the parent-child interaction styles. Parents who were more goal setting had children use soap less frequently than other children, B = 0.19, SE = 0.09, 95% CI [0.01, 0.36], Wald Chi-squared(1) = 4.29, p = .04. Like investigations of parent-child interaction in museum settings, the more goal-directed parents were during the activity, the less engaged children might have been, which related to their internalization of the activity to their spontaneous behavior. Age and cognitive measures (working memory, theory of mind, and knowledge of disease transmission) did not relate to children's soap use.

3-X-74 Effects of COVID-19 pandemic social isolation on children's Theory of Mind development

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Theory of Mind (ToM) development may be influenced by children's social interactions with peers, such as siblings or school classmates (McAlister & Peterson, 2012; Peterson et al., 2016). During the COVID-19 pandemic, social isolation measures and shutdown of daycares and schools starting in March 2020 in the United States have offered a unique opportunity to investigate how disruptions in children's typical social interactions with non-family peers might affect ToM development. In this study, 33 children ages 3;2-7;8 (M=5;3) participated in 4 standard ToM tasks (knowledge access, diverse beliefs, false belief, and real-apparent emotion), conducted online in summer 2021. Parents completed a questionnaire about

their children's peer social interactions before and after March 2020. The average length of interruption to school or daycare attendance was 49 weeks (SD=26.1) and the average number of social interactions with peers outside of school per month decreased from 3.9 (SD=2.4) to 2.4 (SD=2.6). We found no relationship between children's ToM task performance and the time that children spent out of school or daycare (β=-.0007, SE=.003, p=.8), or the number of peer social interactions per month (β=-.02,SE=.02,p=.2). Age was the only significant predictor of ToM task performance (β=.13, SE=.41, p<.01). This suggests that social interactions with peers outside the home might not play a major role in children's basic ToM development, at least as measured by standard ToM tasks.

3-X-75 How do mothers and fathers socialize safety values in sons and daughters?

Elizabeth O'Neal[1], Megan Noonan[1], Hanxi Tang[1], Jodie Plumert[1]
[1]University of Iowa

Parents play an important role in the socialization of children's safety values. Thus far, much of the focus has been on mother-child interactions about safety. Therefore, little is known about fathers' approach to this task. One-hundred and four parent-child dyads, with 8- to 10- year-old children (56 males, 54 fathers), jointly discussed and rated the safety of photographs depicting a child engaged in various physical activities (e.g., skateboarding) using a 4-point Likert scale. Conversation coding examined how the interaction unfolded and the reasoning used to support safety ratings, with an emphasis on disagreements and references to dangerous and non-dangerous features and potential outcomes of the activities. Disagreements were more likely with mother-son than with father-son pairs. Mothers were also more likely to resolve disagreements with sons in their own favor than were fathers. Overall, fathers were more likely to reference non-dangerous potential future outcomes of the activities than were mothers. Additionally, fathers were more likely to point out non-dangerous features of the activity with daughters than with sons. Disagreements serve as a useful mechanism in parents' efforts to socialize safety values, yet fathers did not engage in disagreements as often as mothers. Furthermore, by making more references to the non-dangerous aspects of potentially risky activities, fathers may be underplaying riskiness relative to mothers, particularly among daughters.

3-X-76 Still face in dogs

Molly Byrne[1], Kayla Sawyer[1], Angie Johnston[1]
[1]Boston College

Dogs are able to cooperate in reciprocal exchange with humans, but little is known about the extent of these abilities, and their origin. The Still Face paradigm provides a simple and subtle test of the extent that babies are participants in mutually regulated social exchange. Specifically, babies reply to a sudden non-reciprocal facial expression (i.e., the Still Face) with a decrease in affect and increase in re-engagement and distress behaviors (Tronick 1978). We directly adapted this method to test whether dogs are able to pick up on this change in social interaction. In our pilot study, each dog (N=20) was tested at home via Zoom, with their owner as the "parent" role. The owner would talk to the dog, then abruptly switch to a still, neutral face, maintaining eye contact. We found that dogs showed a significant decrease in the amount of eye contact in the still face portion, mimicking the results found in babies (t(19)=5.5, p <.001). We are now in the process of scaling up our study (N=60), including one condition

of continuous calm physical contact, and one condition that is a direct replication of the initial study, in which there is no physical contact. The results will tell us whether dogs are capable of perceiving these small changes in human affect, and if they are responding with a similar expectation of mutual regulation as human infants. This will reveal whether this Still Face effect is unique to humans or shared across other social species.

3-X-77   Another test of the stability of theory of mind from infancy to preschool

Diane Poulin-Dubois[1], Elizabeth Goldman[1], Alexandra Meltzer[1], Elaine Psaradellis[2]
[1]Concordia University, [2]Queens University

It has been suggested that infants possess a mature theory of mind (ToM). If so, conceptual stability should be expected from infancy to childhood. Some studies have reported such stability, particularly between an implicit form of false belief and later ToM abilities. Others have found no such link. This longitudinal study tested the stability of infants' performance on two implicit ToM tasks and later ToM abilities. At 18 months of age, 31 infants were administered an interactive false belief task and a knowledge inference task. Explicit ToM was measured at 4 years of age with the Wellman and Liu (2004) ToM scale and a parental questionnaire (CSUS). None of the cross-wave correlations reached statistical significance. These results challenge the conclusion that explicit false belief reasoning develops out of a precocious form of belief processing. The methodological challenges of testing implicit theory of mind in infancy will be discussed.

Z – Undergraduate poster

3-Z-78   Age-related changes in equitable resource collection and relations to resource distribution

Mary Rose Yockel[1], David Sobel[1]
[1]Brown University

By age 7, children rectify inequities in their distribution of resources over just making equal distributions. The present study considered how children made similar inferences about resource collection. Study 1 presented 3- to 8-year-olds (n=130) with characters with different amounts of resources participating in a collective project. They were asked how a teacher should fairly collect resources by contrasting whether the teacher took the same amount of resources from each individual (leaving an inequity) or left each individual with the same amount of resources (unequal taking with an equitable outcome). By age 6, children showed a preference for equitable collection. Study 2 contrasted equitable collection and distribution in 5- to 7-year-olds (n=77). Children showed a stronger preference for equity in their collection than distribution. This effect was driven by the older children in the sample. The mechanisms for equitable resource collection might be available to children earlier than for distribution.

3-Z-79   Teachers' scientific questions differ by child gender in preschool classrooms

Yuhan Wang[1], Sona Kumar[2], Amanda Haber[2], Kathleen Corriveau[2]
[1]Beijing Normal University, [2]Boston University

From childhood, girls and boys receive social messages that may contribute to their knowledge and beliefs about STEM. Specifically, it has been found that adults are more likely to provide high-quality explanations to boys' science questions compared to girls'. In the current study, we examined how teachers' scientific questions vary by child gender in an inquiry-based preschool classroom. We explored at how often teachers directed causal questions (e.g. "why do leaves change color?") and fact-based questions (e.g. "where do hermit crabs live?") to boys and girls. Our results indicate that teachers overwhelmingly direct more causal questions (81% vs. 19%, z = -5.82, p < .001) and more fact-based questions (71% vs. 29%, z = -9.02, p < .001) to boys compared with girls. These results highlight one way in which girls receive different messages from boys as early as preschool, which potentially contributes to differences in boys' and girls' scientific knowledge and motivation in learning science.

3-Z-80   Behavior, not appearance, drives 4- and 5-year-olds' inferences about trustworthiness

Natalie Hobbs[1], Carolyn Palmquist[1]
[1]Amherst College

Children predict others' future behavior from their facial features (Charlesworth et al., 2019). It is unclear how facial features and behaviors interact to affect predictions. Twenty-one 4- and 5-year-olds made predictions about puppets' competence and trustworthiness. Appearance sometimes matched behavior (e.g., competent appearance, knowledgeable behavior), on other trials, appearance did not match behavior (e.g., competent appearance, ignorant behavior). Children made inferences on trustworthy trials, not competent ones; prosocial behavior drove those inferences. When appearance matched prosocial behavior (trustworthy, nice), children inferred niceness 90% of the time; when appearance did not match prosocial behavior (untrustworthy, nice), children still inferred niceness 82.5% of the time. These frequencies were significantly greater than chance (χ2s > 9.4, ps < 0.003), but not different from one another (χ2 = 0.0.95, p = 0.33). When appearance did not match antisocial behavior (trustworthy, mean), children inferred niceness 37.5% of the time; when appearance matched antisocial behavior (untrustworthy, mean), children inferred niceness 38.5% of the time. These frequencies did not differ from chance (χ2s < 1.27, ps > 0.25), or from one another (χ2 = 0.008, p = 0.929). Therefore, behavior, not appearance, drives children's inferences, particularly when inferences are based on prosocial behavior.

3-Z-81   What does it mean? The role of social contingency in word learning through digital media

Natalie Freitag[1], Kelsey Notestein[1], Grace Witecha[1], Megan Lorenz[1], Sarah Kucker[2]
[1]Augustana College, [2]Oklahoma State University

Previous research suggests that toddlers learn words better when parents are socially contingent (SC), or responsive and reliable during live interactions. The present study investigated the impact of SC parents on word learning when co-viewing a pre-recorded video. Forty-five 2-to-2.5-year-old children watched a video that taught them four novel word-object pairs. Half of participants watched with an SC parent, while the other half watched quietly (non-SC). After the video, children were tested on their retention of the words. Parents also completed demographic and language questionnaires. Children in the SC condition repeated words during viewing more often than children in the non-SC condition.

Overall performance on the test trials between the SC and non-SC conditions was not significantly different. However, children learned at levels significantly above chance (Figure 1). Collectively, these results suggest that SC support may not benefit children's word learning when viewing a pre-recorded video.

3-Z-82 **The apple doesn't fall far from the tree: Parental hostile attribution bias predicts preschoolers' social decision making**

Sylvia Lanni[1], Carolyn Palmquist[1]
[1]Amherst College

Caregivers model hostile attribution bias (HAB) for their children (Godleski & Ostrov, 2020). Nonetheless, little is known about how this modeling manifests itself in children's everyday social decisions. Here, 32 4- and 5-year-olds completed an HAB measure and a standard selective trust task. Their caregivers completed an HAB questionnaire (Coccaro et al., 2009) and reported on their children's traits (Goodman, 1997). We replicated Godleski and Ostrov's (2020) association between parent and child HAB, r(32)=0.411, p=0.027. Parent HAB also directly predicted child behavior. Parents' benign trust (less HAB) was positively correlated with children's choice of a previously unfamiliar informant, over a previously inaccurate one, on a sharing task, r(32)=0.38, p=0.038. Finally, parent HAB influenced children's reasoning about the inaccurate informant. Interestingly, children whose parents reported higher negative emotional responses in the HAB questionnaire were more likely to state that the inaccurate informant, who provided the children with false information, was making a mistake rather than being purposefully tricky, b=-4.54, p=0.028. Taken together, these results argue that although child HAB may not directly predict children's trust decisions or interpretations of inaccuracy, parent HAB independently predicts children's social decision making.

3-Z-83 **The effects of mindfulness meditation training on children with trauma**

Brittany Addison[1], Christine Ziemer[1]
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While there is a fair amount of research on the effects of mindfulness meditation on children and adults, there is not nearly as much research regarding how a mindfulness meditation practice may benefit children who have experienced trauma. In this investigation a four-week intervention period of mindfulness mediation training was utilized in a group foster home setting in order to determine the effects of mindfulness meditation on children who have experienced trauma. The practice consisted of meditation and breathing techniques to induce a sense of mindfulness. These sessions were conducted through a curated playlist on YouTube and practiced in a classroom setting. Children completed pre- and post-test questionnaires measuring mindfulness, emotion-regulation, anxiety, depression, and stress. We hypothesize that as children increase in their mindfulness skills emotion-regulation will increase and anxiety, depression, and stress will decrease. We expect this effect may be especially noticeable for children who have experienced high levels of trauma.

3-Z-84   **Training "close" and "far" during shared book reading**

Summer Hall[1], Kayla Dillon[2], Megan Lorenz[1]
[1]Augustana College, [2]University of Wisconsin Madison

This investigation examined whether children can learn relational spatial prepositions from a storybook during shared reading. Twenty-four 24-to-30-month-old children were read a storybook daily for two weeks that targeted either the words "close/far" (training condition) or "red/blue" (control condition). Children's comprehension of spatial terms (close/far) and color terms (red/blue) were tested both before and after the two week reading period. Parents also completed measures of children's general and relational vocabularies prior to pre-test. On spatial term trials, children's pretest and posttest performance in the training condition did not differ significantly from chance, from one another, nor from the control condition (Figure 1). However, on color term trials, children in both conditions successfully identified color words at levels significantly greater than chance at pretest and posttest. Finally, parental report measures of vocabulary were not predictive of posttest performance for color or spatial terms. Collectively, these results suggest that storybook exposure to these words did not enhance learning in 24-to-30-month-olds.

3-Z-85   **Verb learning in Japanese and English: Importance of similarity and comparisons**

Akari Notsu[1], Marissa Young[2], Victoria Bell[2], Jane Childers[2], Mutsumi Imai[1]
[1]Keio University, [2]Trinity University

Prior studies have shown that children younger than five years can have difficulty extending new verbs in English, Japanese, and Chinese (Imai et al., 2005; 2008). This new study utilizes the same stimuli with additional comparison trials in the learning phase for each verb, and an additional test trial type. In Study 1, 2½-, 3½- and 4½-year-old Japanese-speaking (n=180) children learned four novel verbs in a similar first (similar then varied events) or a varied condition (all varied events). Univariate ANOVA shows main effects of Age, Condition, and AgexCondition (ps< .05). Study 2: same aged English-speaking children (n=63 to date) shown the same stimuli did not differ by condition, but were more successful when test events included new objects (p=.01), and at each age group, were able to extend at test (ps< .02). Overall, these results show the importance of multiple comparison events in facilitating children's verb learning.

3-Z-86   **Individual differences in cognitive resources predict math learning: Working memory helps, but strategy variability hurts**

Samantha Macksey[1]
[1]Northeastern Illinois University

Children often produce multiple inconsistent problem solving strategies prior to growth in math understanding. Such strategy variability is thought to reflect openness to strategy and concept learning. However, how strategy variability interacts with other cognitive individual differences is poorly understood. We examined the roles of strategy variability and working memory capacity (WMC) on children's mathematical equivalence learning. Children aged 7-11 years (N = 163) completed a pretest-instruction-posttest protocol over Zoom. Children solved mathematical equivalence problems (e.g., 3 + 4

+ 5 = _ + 5) before and after watching video lessons. We additionally measured children's WMC and strategy variability at pretest (i.e., number of unique incorrect strategies). Strategy variability was a negative predictor of learning, whereas WMC was a strong positive predictor of learning. Strategy variability and WMC did not interact. These findings further our understanding of how cognitive factors influence how instructional input benefits children's learning.

3-Z-87 **Correlates of hope in children and adolescents**

Kelly Drogan[1], Jennifer Van Reet[1]
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Hope is a cognitive construct theoretically defined as the combination of believing that one can achieve goals (agency) and recognizing and organizing the necessary steps to reach a goal (pathways) (Snyder, 2002). Hope is correlated with positive outcomes in adults, but is understudied in children. The current study explored correlations between hope, coping strategies and perceived social support through a developmental lens using online surveys. Participants consisted of 8-12 year old children (n = 26) and undergraduate college students (n = 34). Results show that hope and adaptive coping were significantly positively correlated for both children and adolescents; however, social support and hope were only significantly correlated for adolescents. Social support and coping via self-reliance were significantly positively correlated in the adolescent sample, and social support and adaptive coping were significantly positively correlated in children. There was no significant difference in total hopefulness between children and adolescents. This research suggests that encouraging healthy coping strategies might promote hopefulness in children.

3-Z-88 **"Me, myself, and I:" An analysis of underrepresented students' perspectives on their postsecondary trajectories**

Aarushi Rohila[1], Rebecca Adler[1], Bethany Rittle-Johnson[1]
[1]*Vanderbilt University*

Many students of color and those from low-income families are struggling to work on a path towards higher education and careers. These students may have fewer social networks, which may lead to a less informed plan for life after high school and a consequential lack of representation in college and the workplace (Missaghian, 2021). We reported on 67 focus groups with predominantly Black high schoolers (n = 251) experiencing low income and economic marginalization, analyzing how they learned about potential career paths after high school and possible barriers that may obstruct their desired paths. Overall, we found that many students were missing adequate support; almost 57% of groups had at least one student indicate that they learned about postsecondary paths on their own. Although 85% of groups had at least one student approach family for support, reported exposure to concrete postsecondary information was significantly lower (60%). When factoring for school diversity, groups from segregated high schools received concrete college and career exposure significantly more from within school than from their families compared to students at racially balanced high schools. The results also revealed that most groups identified individual barriers which they believed could hinder their goals, including stress and lack of motivation. We suggest the implementation of interventions to improve school-family communication and collaboration to better support underrepresented students.

3-Z-89 **Exploring context-specific variation in parent's and children's higher-order thinking talk**

Alyssa Guillu[1], Ran Wei, Joseph Blatt[2], Meredith Rowe[2]
[1]University of Chicago, [2]Harvard Graduate School of Education

Higher-order thinking talk (HOTT), talk about and with relations, has been shown to support children's higher-order thinking skills (Frausel et. al, 2021). Although prior research suggests that conversational context and parental factors relate to HOTT onset among children (Frausel et. al, 2020, 2021), we have a limited understanding of factors explaining individual differences in <I>parent's HOTT. To address this gap, the current study examined parents' and preschoolers' use of HOTT during object-oriented pretend play and narrative episodes on three dimensions: content (inferences, comparisons, abstractions, hierarchies, and routines/preferences), complexity (surface HOTT in which relations are easily perceivable versus structure HOTT in which relations are abstract), and speech act (questions eliciting HOTT versus statements providing higher-order information). 75 mid- to lower-SES families in the Northeastern US were videotaped playing with a pizza toy and discussing past and future events. Findings indicate that HOTT during pretend play and narratives differed in frequency, density, and composition. During narratives, parents and children produced more and denser HOTT. Narratives also tended to elicit more HOTT questions from parents and HOTT statements from children, whereas pretend play uniquely prompted inferences and hierarchical HOTT. These findings underscore the context-specific HOTT benefits that could be leveraged by families.

3-Z-90 **The relation between verbal intelligence and creative potential in early childhood**

Sophie Richardson[1], Julie Vaisarova[1], Stephanie Carlson[1]
[1]University of Minnesota

Creativity tasks in developmental psychology research tend to rely on verbal ability to communicate ideas. These verbal demands might make it difficult for a child to receive accurate creativity scores because of the unclear relation between verbal intelligence and creativity. This study aims to investigate the relation between verbal intelligence and creative potential. Typically developing 4- and 6-year old children (N = 84; 86.9% White and Non-Hispanic) completed the Draw a Pretend Person creativity task and the Stanford-Binet Routing Subtests for verbal and nonverbal intelligence. Transcripts of the creativity task were analyzed for the number of nouns, verbs, and adjectives used, as well as mean length of utterance (MLU). Results indicated that, above and beyond nonverbal intelligence, both noun total (B = 0.346, p <0.01) and verb total (B = 0.325, p <0.01) were linearly associated with higher creativity ratings; however verbal intelligence and MLU were not. There was no evidence of a weaker relation between creative potential and verbal intelligence as the child's verbal ability reached a threshold (p = 0.636). These results suggest that children are able to better express creativity if they have a larger vocabulary, but it is unclear if vocabulary bolsters creative ability or if creativity encourages vocabulary growth. Future research should investigate the nature of this relation in a more diverse population to understand causal directionality.

3-Z-91   Parental involvement in new and novel word learning and comprehension

Madison Dill[1], Sarah Kucker[1]
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Research suggests that the degree to which parents are involved in their child's life, including how much they read together and how much time is spent in play, positively correlates with children's vocabulary, even after controlling for demographic characteristics and socioeconomic status. However, less work has looked at engagement's impact on confidence in word learning. This is the aim here. Phase one explored the relationship between general parental involvement and a child's accuracy and confidence in known and novel word learning. Children were given a referent selection task and asked to identify an item by name; their initial and final choices were recorded as a measure of initial confidence and final accuracy. There was a significant correlation between involvement and the child's performance on known referent selection, $r(87)=.294$, $p=.006$ and vocabulary percentile, $r(88)=.478$, $p<.001$. This was primarily driven by reading interactions. These results suggest reading with your child has a significant effect on your child's ability to recognize known words but not in recognizing new words. However, other interactions (eating, drawing, doing puzzles together) do not have an effect on a child's ability to recall new or familiar words. Phase two is in progress and will focus on the relationship between the child's vocabulary and the child's engagement when reading with their parents.

3-Z-92   "Because it's a little bit more my language": Metalinguistic explanations for language-based biases in young monolingual and bilingual children

Isabella Iven[1], Catherine Walsh[1], Aylin Fernandez[1], Aleyda Arreola[1], Jennifer Clegg[1], Amy Weimer[1], Katherine Warnell[1]
[1]Texas State University

Although extensive research has examined language and accent biases in young monolingual children, comparatively less work has studied bilingual children or the extent to which children are explicitly aware that language could be the origin of their biases. In the present study, English monolingual (n=68) and Spanish-English bilingual children (n=34) aged 4-7 years listened to pairs of puppets who displayed different language pairings. These pairings contrasted native-accented English, Spanish-accented English, native-accented Spanish, and native-accented Spanish-English bilingual speakers. For each pair, children were asked who they would rather befriend and why. We coded children's responses to the why question, focusing on the frequency of metalinguistic explanations (i.e., responses that mentioned language or accent). Older children were significantly more likely to use metalinguistic explanations. Follow-up analyses indicated the age effect was driven by monolingual children increasing their percentage of metalinguistic explanations (mean of 4-5y = 5.28% vs. mean of 6-7y = 20.68%, p = .03). Spanish-English bilingual children did not show this age-related increase (mean of 4-5y = 11.83% vs. mean of 6-7y = 13.69%, p = .834). We will discuss the implications of metalinguistic awareness for the development of language-based social biases.

3-Z-93   The roles of overconfidence, overclaiming, and cognitive reflection in children's beliefs in animal myths

Candice Ma[1], Jenny Nissel[1], Jacqueline Woolley[1]
[1]University of Texas

In addition to conveying scientific facts to their children, parents often engage in the odd phenomenon of relaying pseudoscientific facts or myths, such as that swallowing a watermelon seed makes a watermelon plant grow in one's stomach. The present study explores children's beliefs in common myths about animals (e.g., that chocolate milk comes from brown cows). We assessed 61 7- to 10-year-olds' endorsement of 8 animal myths and examined various individual difference factors that might affect belief: (1) overconfidence and overclaiming, which have been shown to be related to adult beliefs in vaccine myths, (2) cognitive reflection, which is related to children's identification of true scientific statements, and (3) three exploratory variables--interest, familiarity, and parent promotion. Myth endorsement ranged from 8-76%. Overconfidence, overclaiming, and cognitive reflection did not affect belief. However, children with greater interest in animals were less likely to endorse the myths. In addition, children were more likely to endorse familiar myths and those that their parents promoted. Findings suggest that interest, familiarity, and parent testimony play a role in children's beliefs in common animal myths.

3-Z-94   Children's evaluations of intentions regarding novel public-health measures

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With the introduction of new norms during the COVID-19 pandemic, there are unprecedented questions on how children evaluate people who do not follow protective behaviors. This study explored how children evaluate intentional and accidental violations of protective behaviors that might hurt other individuals. Since children might have preconceived notions surrounding COVID-19, we presented children with stories about aliens who have to make choices about behaviors such as wearing heavy caps to cover spikes on their bodies that might otherwise hurt other aliens, mirroring the inherent dilemma in covid-related protective measures such as mask-wearing. In a study with a 2x2 within-subject design, N = 60 children at ages 5-10 years were asked to evaluate different aliens. We manipulated the intention of the alien (accidental vs. intentional) and the severity (low vs high) of harm caused after not engaging in the protective behavior. Our regression analyses showed that in high harm situations children across all ages rated intentional norm-violators as more wrong compared to low severity situations, $X2 (1) = 10.23$, $p = 0.001$. Children also viewed the aliens as worse friends when they were intentional, $X2 (2) = 59.31$, $p < .001$, and could cause high harm, $X2 (2) = 7.92$, $p = 0.02$. These findings provide insight into how children reason about public health behaviors, making more negative attributions to individuals who intentionally fail to protect others from harm.

3-Z-95   Playful virtual microsystems: Triadic play interactions between pandemic-era babies, parents and their grandparents

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Pandemic-era families used video chat to connect during COVID-19, but video chat is a cognitively challenging medium for young children, and families must adapt play to virtual settings. Sensitive co-viewers can support successful social interactions and digital play via video chat (Barr, 2020). Family video chats therefore provide a unique context to examine children's interactions with on-screen partners in a "virtual microsystem." We conducted a naturalistic study and recorded 3 video chats from 50 families with babies (mean age=11.6 months, range: 6-25 months). We used observational coding to describe and quantify playful activities (e.g., imitating, singing, pretense). We asked how parents and grandparents initiated and supported infants' play, and examined spontaneous play activities. Figure 1 shows the play types observed. Grandparents initiated the most bids (49%), and children initiated the next most often (33%), whereas bids by parents (14%) and siblings (3%) were less common. Play bids were typically directed to infants (57%) or grandparents (41%), and parents took an active role in scaffolding the play interactions (75%). Coding is currently ongoing for infant attention. This study shows that video chat can provide high-quality interactions for families at a distance. The results inform our understanding of infant play in a digital era, and has practical applications for caregivers to support positive interactions via video chat.

3-Z-96 How do cognitive and social factors contribute to math learning?

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U.S. elementary students have poor understanding of the equal sign. This study examined the roles of children's working memory capacity (WMC) and socioeconomic status (SES) in children's learning from a lesson on mathematical equivalence. Second to fifth graders (N = 162, Mean Age = 9 years, 2 months) completed a pretest-instruction-posttest study via Zoom. Children's mathematical equivalence understanding was measured before and after instruction. We also measured WMC and children's SES (using a composite score of school free lunch and parent education). Children's WMC and SES were positive predictors of mathematical equivalence understanding prior to instruction. However, only WMC predicted children's learning from instruction. Importantly, WMC and SES did not correlate, nor did they interact to predict learning. These findings suggest that WMC is a more critical factor for math learning than SES. These results further highlight that cognitive resources, not environmental resources, are what is critical for math learning.

3-Z-97 Being me in times of change: The underlying resilience of children through the COVID-19 pandemic

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A majority of pandemic research on children focuses on third-party perspectives from people such as teachers and parents (Chakraborty, 2021; Sprang and Silman, 2013) and on negative effects of illness, isolation and school closures (Haleemunnissa et al., 2020; Lewis, 2021). Fewer studies have asked children about how they conceptualize their experience in lockdown, and even fewer look for evidence that children might have positive experiences to share. To address this gap, we conducted a structured

interview at two timepoints with 7- to 11-year-olds (N=28, mean age=9.27, Range= 7.13-11.62, 20 returned for time 2) beginning fall 2020. We asked children how they were spending their time, how they felt about family, school, and friends, and lessons they learned about themselves. Results showed children's feelings about lockdown were surprisingly positive: 60.5% (29/48) referred to being able to overcome the challenges of virtual school, 54% (26/48) talked about meaningful connections with family. Finally, though unprompted, 35% (17/48) of children mentioned finding new ways to use technology as a facilitator of social connection. The general pattern held across both time points, though we found mixed attitudes towards school by time 2. Children's responses reveal a balanced understanding of their social lives and an ability to adapt to this challenging year. Though preliminary, this study underscores the importance of asking children directly about their pandemic experience.

3-Z-98   **The impact of COVID-19 on children's play**
Jessica Kardasz[1], Dominique White[1], Cara DiYanni[1]
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We explored the impact of COVID-19 on play. In October 2020, we sent an initial survey to 67 parents of 79 3- to 10-year-olds, and interviewed 37 of those children. Results revealed that children's outdoor play increased in frequency from before the pandemic to the time spent in quarantine, and remained significantly more common in the fall months following quarantine. Similarly, the amount of unstructured, free play that children engaged in increased during quarantine, and stayed significantly elevated afterward. Finally, screen time levels skyrocketed during quarantine, and continued to be greater in the fall months than pre-pandemic. In July 2021, we sent out a follow-up survey and received responses from 61 parents of 101 2- to 12-year-olds. We found that while outdoor play had generally leveled off and returned to pre-pandemic levels, most parents reported that levels of unstructured play continued to be higher than before, and screen time also remained at higher levels than pre-pandemic. Most parents recognized that the pandemic continued to impact their children's play, both directly and indirectly, even 16 months after quarantine was first initiated. The findings from each of these surveys has implications for both parents and teachers in terms of assessing the impact of COVID-19 - both short-term and long-term - on the health and well-being of their children.

3-Z-99   **Children's use of math elicitations supports their own math learning**
Kalina McNeil[1], Alex Silver[1], Melissa Libertus[1]
[1]University of Pittsburgh

Math is used every day when shopping or telling time. Math abilities are related to outcomes including better health, greater chance of full-time employment, and higher income (Agarwal & Mazumder, 2013; Currie & Thomas, 2001; Reyna & Brainerd, 2007). Individual differences in math are present as early as the beginning of kindergarten (Jordan et al., 2006). Parents can support their children's early math learning through encouraging conversations about math (Levine et al., 2010). No work has looked at how children spontaneously discuss math without parent prompting, which may be a key information-seeking technique that helps children shape their own math learning. We examined children's math elicitations (questions and prompts used to evoke a math response) during natural free play in both lab and home settings in 119 parent-child dyads (62 boys; M age=3.9yrs). We focused on cases where

parents were not previously discussing math, but children elicited math content relevant to the ongoing conversation. Children who used more math elicitations had larger growth in math skills over 6 months, even controlling for their overall elicitations and baseline math performance, $\beta=0.35$, $p=.001$, suggesting that children who take what their parents are saying and make it math-related may promote their own math learning. This stresses the importance of considering how children directly shape the home environment in addition to thinking about parents' influences on children's learning.

3-Z-100   **Impacts of gender stereotypes, storybooks, and socioeconomic status on children's development**

Madeline Hulsing[1], Sarah Ziehme[1], Sarah Kucker[1]
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Children's development is driven by multiple factors, including the parents' gender stereotypes and their children's toys and books as well as socioeconomic status (SES). Previous research suggests that a parent's perception of gender roles impacts their communication and interactions with their child. Individuals with children who hold stronger gender stereotypes may provide more toys/books reflecting those stereotypes (e.g. more dolls for girls, more cars for boys), instilling gender stereotypes in the children, creating a cyclic effect. The current study investigates this idea through a parent report survey and lab-based interactions. Additionally, the work here explores how differences in toys/books correlates with vocabulary differences and how parents' socioeconomic status and the means by which they acquire books correlates with present book themes. There was a marginal positive correlation between parent education and books that focused on the theme of taking a stand, $r(28)=.295$, $p=.13$, and a positive correlation between percentage of books that are bought new and prominence of hard work as a theme, $r(28)=.337$, $p=.08$. Stereotype results are in progress. Overall, the results show that book content/themes may be influenced by SES, which may have implications for children's education and socialization.

3-Z-101   **Bilingualism, what is it good for? Children's math learning**

Jan Rodriguez - Cruz[1], Jackelyn Castaneda[1], Samantha Macksey[1], Michele Villacres[1], Kayla Nuszen[1], R. B. Church[1], Andrew Young[1]
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Whether bilinguals have specific cognitive advantages over monolinguals is one of the more controversial issues in cognitive and developmental psychology. Few prior studies directly considered differences between bilingual and monolingual children's math learning. In the current study we investigate the interaction between bilingualism and children's math learning. Second to fifth graders (N Monolingual = 92; N Bilingual = 66) participated in a pretest-instruction-posttest experiment over Zoom. We measured children's correct solutions on math equivalence problems (e.g., 3 + 4 + 5 = _ + 5) before and after watching a video lesson. Focusing on children with poor pretest performance (<2 correct out of 12; N Monolingual = 72; N Bilingual = 57) our results show that bilinguals benefited from instruction significantly more than monolinguals. These data further our understanding of specific cognitive advantages that are associated with bilingual experience during childhood.

3-Z-102   **Why do you like to (not) share? Exploring how egocentric reasoning and object value relate to children's motivations to share.**

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Sharing is often depicted as a prosocial act wherein children share to be kind to others. But, sharing is often more complicated. In structured interviews, we asked 4- to 10-year-olds (N=22) about their motives for sharing different kinds of possessions (fun/special). Using a series of regressions, we examined children's decisions about, and explanations for, sharing. We found that egocentric reasons for sharing (e.g., "because it's more fun for me") increased with age (p=.028), but prosocial reasons did not (p=.32). The reported type of object (fun/special) did not influence children's reasoning; however, coding of their explanations revealed that the unique nature of the possession (e.g., whether it was a favorite or had a special history) was mentioned more often as a reason for not sharing possessions with others than otherwise (p=.030). These findings have implications for understanding children's evolving theories of sharing.

3-Z-103   **Setting preschool children up for success: Early math assessments predict global math achievement**

Maya Quale[1], Joseph Boateng[1], Mackenzie Henry[1], Marissa Brown[1], Mary Fuhs[1]
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This study aims to answer the question: Which specific math and executive function (EF) skills predict global math achievement among children from underserved populations? Children ages 3-5 from preschools and childcare centers in the midwestern United States were assessed on EF and early math skills, using he Minnesota Executive Function Scale (Carlson & Zelazo, 2014), Woodcock Johnson picture vocab and number sense tests (Woodcock et al., 2014), the flexible attention to magnitude (FAM) assessment (Fuhs et al., 2020), a subitizing assessment, number line estimation, and a proportional reasoning task (N= 61). Correlation results indicated that age, FAM, and number line estimation had the strongest relationship with children's global math achievement, meaning that these skills could potentially be targets for intervention in early instruction. These results are especially important given that this study was conducted with an underrepresented population in the math cognition literature, children from primarily low-income homes who were predominantly Black or African-American.

3-Z-104   **Exploring the nature of children's number and letter reversals**

Jordan Hassani[1], Sabine Doebel[1]
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Children often write letters and digits backwards during literacy acquisition. Intriguingly, characters that are perceived as oriented to the left (e.g., <3>) are reversed more often than characters that are perceived as oriented to the right (e.g., <c>) (Treiman & Kessler, 2011). We explored this phenomenon by assessing 67 4- to 6-year-old children's reversals in three formats: writing, recognition, and parent report. The measures were correlated, and on the writing and parent report measures, children

reversed left-facing characters more than right-facing ones, p<.01. Parents underestimated left-to-right reversals, and overestimated right-to-left ones, relative to what children wrote. On the recognition and writing tasks, the most frequently reversed characters were left-facing, but some left-facing characters were not reversed much (e.g., <2>, <3>), suggesting a role for familiarity. Across tasks, reading-but not writing-experience predicted reversals. Findings are discussed in relation to competing theories about the nature of children's reversals.

3-Z-105   **How a mother's question-use scaffolds their child's syntactic development**

Grace Buckalew[1], Alexus Ramirez[1], Julie Schneider[2]
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A mother's question-asking behavior greatly affects the vocabulary development of their child (Luo et al., 2022). One important aspect of mother question-asking is the use of Wh- questions, which elicits utterances from the child and supports vocabulary development (Rowe et al., 2016). Despite Wh-questions eliciting more complex responses from children, it remains unknown how these questions relate to syntactic development. To address this gap, 34 parent-child dyads participated in a 15-minute play session similar to the Hirsh-Pasek et al. (2015) three-box-task. The Diagnostic Evaluation of Language Variation (DELV) assessment was used to measure syntactic competence in children. Using SALT, we first coded for Wh- questions (e.g. who, what, etc.) and later determined if those questions fell into three categories: information seeking, pedagogical, or Y/N and rhetorical questions. When controlling for total parent utterances, we found that mothers asked more rhetorical questions overall (F(2,95)=80.3, p < 0.001); however, when asking Wh- questions, they were predominantly information-seeking (F(2,638) = 30.6, p < 0.001). This is important, as the use of information seeking Wh- questions positively predicted children's syntactic knowledge (b = 2.08, p = 0.03). Taken together, maternal use of Wh- questions aids syntactic development, likely because they require a more syntactically complex response on the child's behalf.

3-Z-106   **Do preschoolers engage in rational non-reconsideration?**

Sofia Serafina Riskin[1], Junyi Chu[1], Laura Schulz[1]
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Although children often minimize costs and maximize rewards when selecting actions, ultimately a good plan is one that can achieve our goals. We ask if children willingly take costly actions to achieve already chosen goals and disregard equally valuable but less costly alternatives. In this ongoing Zoom study, four-to-six-year-olds copied drawings to help one of two characters. On Joint trials, children saw both goal+drawing pairs before choosing who to help. On Goals First trials, children chose who to help before learning their chosen goal is more effortful. Experiment 1 (between-subjects, n=24 of 60 pre-registered) finds that children copy the harder drawing more often on Goals First trials (M=3.17 of 4 trials) than on Joint trials (M=1.33; t(22)=4, p<.001). We obtain similar results in adults (n=56; p<.001). In Experiment 2 we control for a bias to perseverate on Goals First trials by additionally telling children their adopted character has already received help (i.e., Goal Devalued trials). In pilot data (n=9, within-subjects), children switch on Devalued trials but not Goals First trials (p=.02). In summary, children preferentially maintain adopted goals given updated cost information (Goals First trials) despite otherwise minimizing

effort (Joint trials) and having no difficulty reconsidering goals that have lost value (Goals Devalued trials). The results raise new questions about the nature of resolve and how goals and costs are weighted in decision making.

3-Z-107   **How contextual clues during STEM-based exploration impact caregiver-child dialogue?**

Lauren Ezell[1], Sarah Kucker[1]
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Learning is often aided by caregiver-child dialogue. Different contexts facilitate that dialogue in different ways. Prior work suggests that signage changes caregiver-child communication (Ridge et al., 2015; Williard et al., 2019). Less work has explored how different amounts of signage impact interactions or how this dialogue translates to the home. These are the goals of the current study. In study 1, 178 families were observed as they interacted with museum exhibits that varied in the amount of signage present - no signs, minimal directive signs, or text heavy signs. Multiple types of speech were measured for caregivers and children. The amount of talk was highest when exhibits included some level of signage, $F(2, 174)=14.52$, $p<.001$. In addition, the longest interactions occur with minimal sign amounts, with caregivers doing most of the talking, $F(1,2)=104.29$, $p<.001$. For study 2, children will be sent a learning kit containing different building blocks, along with cards containing building directions. Kits have one of three conditions: vague directions, minimal directions, or specific directions. Interactions will be observed via Zoom and coded as in study 1. We hypothesize the amount of caregiver-child talk will be highest when there is some direction. We also hypothesize more detailed kits will lead to higher quality talk. Taken together, these studies contribute to understanding what role contextual cues have on the quantity and quality of caregiver-child interactions.

3-Z-108   **Emotion responses following failed goals**

Isabel Herrera Guevara[1], Alexis Smith-Flores[1], Lindsey Powell[1]
[1]UC San Diego

At 10 months infants expect happiness rather than sadness to follow successful goals, but show no expectations about failed goals (Skerry & Spelke, 2014). Here we explore whether infants' expectations about emotional consequences of goal outcomes vary by social context and age. In Experiment 1, infants (N=30) saw events in which one actor failed a goal in one block and a second actor completed a goal in another. An observer, affiliated with the actor, responded to this outcome by emoting positively or negatively. Infants' looking to the negative outcome compared to the positive outcome was significantly greater than chance in the completed block, $t(29)=3.66$, $p=.001$, but looking to the negative outcome during the failed block was not significant, $t(29)=0.93$, $p=.359$(Fig1). Infants expect happiness to follow an affiliate's completed goal, but it remains unclear how infants are reasoning about failed goals. Experiment 2 replicated Skerry & Spelke's (2014) original study with 17-month olds (N=28). Infants saw the same events as in Experiment 1 except that there was no observer and the actor emoted to their own goal outcome. Infants' looking to the negative outcome in the complete block was significant, $t(28)=3.502$, $p=.002$, whereas infants' looking in the failed block was not different from chance,

t(28)=1.919, p=.066(Fig1). These results suggest that reasoning about failed goals comes online much later in development than reasoning about complete goals.

3-Z-109   **A naturalistic analysis of parent-child 'know' and 'think' questions in early childhood**

Rebecca Ruger[1]
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Know, unlike think, presupposes the factuality of its complement. Could distinctive pragmatic and syntactic profiles cue word learners to the different presuppositions? Parents' child-directed ("Do you") questions containing know (N=327) or think (N=593) in the main clause and at least a verb in the second clause were accessed from the longitudinal corpus data (MacWhinney, 2000) of five English-speaking parent-child (ages 2 ½ to 3 ½) dyads.Think questions often sought children's answers about possibilities: modal auxiliaries were more common in the embedded clauses of think (43.51%) compared to know (18.04%) questions (e.g.,"What do you think we should do today?"), p<.001. Children's ("Do you") think biclausal questions were infrequent at this age (N=21; 33.33% with a modal auxiliary in the embedded clause). They asked about five times as many ("Do you") know biclausal questions (N=99) and (N=11; 11.11%) had a modal auxiliary. Parents also tended to use a wh-complementizer with a null complement (e.g., "Do you know what?" or "What do you think?). They were more likely to follow-up know (N=124 ; 55.65%) versus think (N=76; 14.47%) null complement questions with an 'answer' (i.e., declarative utterance in the following line), p< .001. Future research should examine the generalizability of these findings and whether the different uses and syntactic profiles encourage children to associate think more than know with questions seeking answers that have a degree of uncertainty.

3-Z-110   **Four-year-old children fail to identify teacher-led analogies in mathematics**

Nicholas Kendall[1], Marie Amalric[1], Elizabeth Spelke[1]
[1]*Harvard University*

As children begin formal education, teachers commonly use analogies to help them grasp new concepts, especially in mathematics. This bears on the observation that even young children spontaneously produce analogies as they explore the world, which is seen in common games like "the floor is lava" or playing "house" on the playground. But in educational contexts, are children also able to productively use analogies when they are generated by someone else? In this study, we investigated 4-year-old children's ability to recognize and utilize analogies to solve a formal problem that is new to them. Children were presented with pairs of analogous situations posing the same math problem. The solution of the first situation was systematically explained before the second situation was introduced. Children were then asked to use their knowledge of the first situation to solve the second situation and identify how both situations related to one another. The results of our study challenge the idea that preschoolers are able to spontaneously use analogies produced by someone else, as children most often failed to identify the intended similarities between two parallel situations. While our results do not imply that analogies should be avoided in educational settings, they suggest that when used, analogies should be made fully explicit.

3-Z-111   **The universality of the gender brilliance stereotype and its negative impact on children's motivation**

Seowoo Kim[1], Lin Bian[2], Kyong-sun Jin[1]
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Recent research indicates that U.S. children in early elementary school years associate intellectual ability with men rather than women (Bian et al., 2017). In line with this "brilliance = men" gender stereotype, 6-year-old American girls are less interested in games said to be for "really, really smart children" than boys. Our research examined whether children's gender brilliance stereotype and the negative impact of this stereotype on children's motivation is cross-culturally consensual. Adapting Bian et al. (2017), we tested whether 5- to 7-year Korean children, raised in a racially homogenous culture, apply this gender stereotype when making judgments of Asian (Study 1, N = 96) and White (Study 2, N = 96) people's intelligence. Around the age of 7, Korean children were more likely to choose Asian men as being smart than Asian women, and they extended this belief when making inferences about White people's intelligence. Study 3 (N = 80) presented 6- to 7-year-old Korean children with two novel games, one said to be for "children who are really, really smart" and the other for "children who try really, really hard." 7-year-old girls, but not 6-year-old girls, were less interested than boys in the "smart" game, while both boys and girls at all ages showed similar interest to the "hardworking" game. These results support the universality of the gender stereotype about intellectual talents and its negative impact on girls' interests in intellectually challenging activities.

Poster Session 4

A – Action

4-A-1   **Early tool use: Chopstick use by young Chinese children**

Giselle Yao[1], Caroline Mayberry[1], Katarina Patton[1], Brooke Rovner[1], Isabella Trachtenberg[1], Jeffrey Lockman[1]
[1]Tulane University

Eating with utensils is an early developing form of tool use. Eating involves coordinating spatial and motor abilities to transport food, and is shaped by social and cultural contexts. Yet little is known about how children learn to eat with chopsticks, despite their use by over 20% of the world's population. Here, we investigate how Chinese children learn to use chopsticks. We videoed 49 children (age=21-78 months; 31 girls) during mealtimes in Guiyang, China. Children correctly aligned chopsticks in 1739 out of 1860 total self-feeding events. The number of self-feeding (p<.001) and independent-feeding (self-feeding, but without caregiver involvement; p<.001) events increased with age; use of bare hands or leaning over to eat directly from a personal bowl decreased with age (p=.009). Additionally, children dropped food less from chopsticks as they became older (p<.001). Together, our findings provide new information about how young children become skilled in chopstick use.

4-A-2   **How do children ascribe intentional action in a moral dilemma?**

Isa Garbisch[1], Britta Schünemann[1], Marina Proft[1], Hannes Rakoczy[1]
[1]University of Göttingen

Making sense of other's actions is fundamental to our social lives. Intentional actions, however, can be subjective. Subjective in the sense that a person does many things simultaneously but the intentionality of those actions depends on the description under which she acts. In preregistered studies (N=116, 8-to-10-year-olds, N=222 adults) we asked how foreseen harmful actions were evaluated regarding their intentionality and responsibility. We derived statements depicting intentional acting in so called "act trees" and developed response patterns indicative for particular act trees. Results suggested that subjects represented the harmful act as an unintended side-effect of the agent's intentional acting. By manipulating the agent's motive in additional conditions, we tested underlying presuppositions. In ambiguous situations (no motive) subjects rated the agent's intentionality and responsibility as when she explicitly stated her good intentions. Children rated the moral permission lower than adults. Our methods provide promising new ways to investigate children's intentionality ascriptions.

4-A-3   Foundations of literacy: An eye tracking study of letter copying

Caroline Mayberry[1], Riana Gaudet[1], Jeffrey Lockman[1]
[1]Tulane University

In the current study, we used head-mounted eye-tracking to focus on the process of handwriting, and investigated how young children attempt to coordinate eye and hand as they copy all the letters of the alphabet. Thirty-four participants (17 female) between the ages of 4-5 years wore a head-mounted eye-tracker while copying each lowercase letter of the alphabet in randomized order. The number of repeated fixations to each letter while copying was coded to measure handwriting automaticity. Pencil lifts were coded to measure interruptions to handwriting fluency. These visual and manual indicators of handwriting ability were linked to one another ($r = 0.67$, $p < 0.01$). Handwriting difficulties were related to both visual ($r = -0.45$, $p < 0.05$) and manual ($r = -0.47$, $p < 0.05$) behaviors. Additional analyses will explore the relative difficulty of different letters and the effects of school experience on letter copying skills.

B - Attention

4-B-4   Mom, I am bored!: A mixed methods exploration into boredom in early childhood and links to self-regulation

Alana Anderson[1], Sammy Perone[1]
[1]Washington State University

Introduction: Early childhood is marked by rapid changes in children's ability to regulate thoughts and emotions. Strong self-regulation in early childhood has been linked to better education, health, and well-being in adulthood (Moffitt et al., 2011; Richmond-Rakerd et al., 2021). The frequency with which children experience boredom may be an indicator of individual differences in self-regulation during early childhood. Boredom is a negative emotion associated with mundane or meaningless tasks or situations. Adults who frequently suffer from boredom have poorer self-regulation and are more likely to experience mental health problems (e.g., depression or anxiety) and use more substances (Mercer-Lynn et al., 2011, 2014). The goal of this study is to investigate links between self-regulation and boredom in early childhood and to uncover strategies children use to cope with boredom. Methods: Ninety-seven parents of 4- to -6-year-old children (mage = 4.91 yrs) rated the frequency with which their child experienced boredom. They also reported on their child's emotional regulatory capacity measured as

effortful control (CBQ; Putnam & Rothbart, 2006) and their child's sustained attention using the attentional perseverance scale (Rowe & Plomin, 1977). A brief interview was conducted in which parents described their child's experience of boredom. Interviews were coded for the child's social strategies (e.g., social play), behavioral strategies (e.g., switching activities), attentional deployment (e.g., distraction), and cognitive reappraisal (e.g., reframing an activity). Results: Children who more frequently experienced boredom had lower ratings of sustained attention, r = -.28, (all ps < .05) and lower effortful control, r = -.20. This indicates children who experienced boredom more also struggle to control their attention and regulate their emotions. Ninety-nine percent of children used social strategies such as asking a parent to play with them or starting fights with siblings. Most children (90.1%) also used behavioral strategies to cope with boredom, such as finding a book to read. Parents who rated their child as more prone to boredom also reported more social strategies, r = .29, and fewer behavioral strategies, r = -.25. Parents frequently described individual differences in their child's experience of boredom compared to siblings, and developmental differences in their child's ability to cope with boredom during early childhood. Conclusions: This study is the first investigation of boredom in early childhood. Our results linking emotion regulation capacity and sustained attention with the frequency of boredom in early childhood resemble associations found in adulthood. Understanding the conditions under which children experience boredom will provide insight for teachers and parents to help children effectively cope with boredom. The effectiveness of the strategies children use to regulate a state of boredom and relations to cognitive and emotion regulatory abilities will also be discussed.

4-B-5   "Paying Attention Gets Twice the Result with Half the Effort": Teacher's perception of children's attention in Chinese kindergarten classrooms

Zoe Mao[1], Jennie Grammer[1]
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Attentional skills are a key component of children's ability to engage in cognitive control, which has important implications for school readiness and later academic success. Early childhood educators play an important role in the development of cognitive control, and early school experiences are thought to contribute to the emergence and refinement of these skills. However, we know relatively little about teacher's understanding of children's cognitive skills - including attention - in the classroom setting, or what they do to support their development. In this qualitative investigation, kindergarten teachers of five- to six-year-olds in public schools in Shanghai, China were interviewed about their perceptions of and instructional practices related to children's attention, and their classrooms were observed. Qualitative analysis highlighted teachers' understanding of the attentional skills, their attributions of children's attention/inattention in class, and teachers' behaviors supportive of children's attention. Interviews revealed that the teachers had a nuanced understanding of attention, and they saw themselves as creators and modifiers of the classroom context as well as knowers of and responders to students' needs. In addition to these findings, we report on observations of teachers' efforts to actively support children's attention development in their kindergarten classrooms.

4-B-6   Differential eye gaze cue processing in autism spectrum disorder

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While previous research has explored the extent to which eyes are used to guide attention in people with Autism Spectrum Disorder (ASD), it is nonetheless unclear how eyes can direct attention when stimuli are presented centrally and peripherally. The present research evaluated the ability of eye gaze as a social cue to orient attention in adults with ASD. It looked at endogenous and exogenous cueing and evaluated differential effects. Participants responded via keyboard press and were required to detect a target that was congruently or incongruently cued by the direction of the eyes presented in a schematic face. Faces were presented either centrally or peripherally using five different stimulus onset asynchronies (SOAs). In the central condition, eye gaze shifted to the right or left, while in the peripheral condition the pupils appeared either in the right or left face. Reaction time (RT) and accuracy were compared between subjects with ASD and without ASD. Results thus far indicate faster RTs for central cueing at all SOAs tested, with an interaction between face condition, SOA, and ASD diagnosis (all p<.05). Findings will be discussed in relation to current theories suggesting differences in how people with autism differentially process eye gaze and symbolic cues.

4-B-7   Proactive interference from LTM hinders retrieval from visual working memory in 3-year-olds

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Proactive interference (PI) occurs when memories that were learned previously compete with currently relevant information (Keppel & Underwood, 1962; Kane & Engle, 2000). Despite extensive literature investigating the effect in adults, little work has been done in young children (Kail, 2002). In two pre-registered experiments (https://osf.io/3eg6h, https://osf.io/cjukf), we used a Delayed Match Retrieval paradigm (Kaldy, Guillory & Blaser, 2016) to investigate the effect of PI on visual working memory in 30-42-month-old toddlers (see figure 1). Experiment 1 measured the magnitude of the PI effect using a blocked design. Performance was significantly higher in the No_PI (M=76.6%, SD=15.8) than in the PI condition (M=62.8%, SD=16.0) (paired t-test, t(35)=5.231, p < 0.00001, see Figure 2). Experiment 2 sought to identify the source of PI: whether PI is coming from lingering information from the previous trial in WM, or from the reactivation of information in long(er) term memory. Preliminary results from Experiment 2 reveal a similar trend: No_PI (M=77.8%, SD=20.51), PI (M=66.62%, SD=12.7, t(15)=1.97, p=0.057, see Figure 2). This is the first time the effect of PI on memory retrieval has been quantified in children under 4 years of age.

D – Computational approaches

4-D-8   How child-directed input affects the acquisition of semantic categories: A recurrent neural network model

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Prior work has demonstrated that distributional dependencies between lexical units in language input can be used to detect word clusters that broadly conform to the categories of the adult language (Cartwright & Brent, 1997; Elman, 1990; Mintz et al., 2002, Redington et al., 1998). However, most distributional models of grammatical and semantic category learning collapse language input to children across different age groups, which makes such models nearly impossible to study from a developmental

perspective. It is well known that children's language input is initially much more limited in scope, and only gradually diversifies into its adult form. For example, Huebner & Willits (2021) showed that the distributional statistics in the input to younger children better signal the presence of the noun category compared to the statistics of speech to older children (1-3 vs. 3-6 years of age). Findings such as these suggest that current distributional models of lexical category acquisition are missing an important dimension, namely developmental time. In order for insights from modeling studies to be relevant to child language acquisition, we require models that learn under more realistic, developmentally plausible conditions. In this research, we asked whether training a model on language input in the order that children actually experience it can reveal novel insights concerning potential similarities between learning in children and neural networks. In particular, we focused on the acquisition of lexical semantic category knowledge in the RNN trained on the next-word prediction task. First, we examined the RNN under carefully controlled artificial conditions, and found that successful lexical semantic acquisition is highly sensitive to subtle statistical properties of the training data. We found that lexical semantic representations were impoverished when trained on input with redundant cues - distributional signals that provide identical information about an upcoming word in a sentence. The difference between successful and unsuccessful acquisition depended not only on how much information is in the data, but how it is realized. Second, we used the results of our artificial language learning simulations to develop a theoretical framework for better understanding how and when next-word prediction can produce rich lexical semantic representations. Our theory, based on entropy-maximization and anchoring (Cameron-Faulkner et al., 2003), predicts that the RNN would develop richer lexical semantic representations by avoiding redundant semantic information during the earliest stages of training. We tested this prediction by training the RNN incrementally on child-directed language that has been ordered by the age of the target child, taking advantage of the fact that there is less redundancy in speech to younger as opposed to older children. When first trained on input with less redundant information (input to younger children), the RNN learned richer lexical semantic representations compared to an RNN first trained on input with more redundant information (input to older children). Our work demonstrates that incorporating developmental time can update the way we think about learning in computational models, and opens the doors for researchers to test novel predictions concerning the similarities and differences between learning in children and artificial systems.

4-D-9   People's use of numerical versus proportional comparison strategies across development

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Infants can make probabilistic inferences from proportional information, yet older children and adults demonstrate systematic difficulty comparing proportions. For example, when comparing two probabilistic game spinners, 6-year-olds can correctly judge which has a higher probability of resulting in red when the spinners are undivided (i.e., one red piece and one blue piece), but are more often incorrect when the spinners are divided (e.g., 3/5 has 3 red pieces and 2 blue pieces; Hurst & Cordes, 2018). This behavioral pattern is often attributed to numerical interference during proportional reasoning with discrete quantities. Here, we reanalyze data from Park, Viegut, & Matthews (2020) and Hurst & Cordes (2018) using a novel Bayesian model-based approach to test the hypothesis that people use the approximate number system (ANS) to make numerator-based comparisons when proportions

are based upon large discrete numbers but use a holistic proportion comparison when proportions are based on continuous area. In preliminary analyses, we find that all samples - from preschoolers to adults - are more likely to use an ANS numerator comparison than a holistic proportion comparison for proportions of dots but are more likely to use a holistic proportion comparison for ratios of lines or proportions in circular pie charts. Moreover, the reliance on a holistic proportion strategy increased across the age groups tested.

4-D-10   A formal approach to dissociating triggers of children's curiosity
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Curiosity motivates us to explore, and therefore motivates learning. However, not all exploration leads to learning. To maximize successful exploration, it would be ideal to selectively experience curiosity when learning is most likely. Indeed, children explore when they are surprised (Stahl & Feigenson, 2015) or uncertain (Schulz & Bonawitz, 2007)--and these states could signal that learning is likely. However, surprise, uncertainty, and expected learning can be disentangled (Liquin et al., 2020). In the present research, we disentangle these possible triggers of curiosity, and we test which triggers predict children's and adults' curiosity. 55 adults and 55 5- to 9-year-olds completed a reinforcement learning task, in which the source of each reward was unknown. On each trial, participants rated curiosity about the reward's source on a 4-point scale. We used a Bayesian model to quantify trial-by-trial surprise, global uncertainty (about the learning goal for the entire task), global expected learning, and local uncertainty/expected learning (about the learning goal for the specific trial). In adults, only global expected learning and local uncertainty/expected learning explained unique variance in curiosity. In children, all four cues explained unique variance in curiosity. Taken together, these results provide evidence for a developmental shift in the triggers of curiosity, from tracking multiple cues in childhood to selectively tracking expected learning in adulthood.

4-D-11   Children, adults, and machines use the geometric centroids of objects to judge physical stability
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Despite much research on humans' intuitive physics, we know little about the perceptual mechanisms that support such reasoning. Here we tested whether the geometric centroid of an object, also known as the center of mass (CoM), forms the basis for judgments of physical stability. Humans' sensitivity to the CoM is well documented and we hypothesized it would play a unique role in stability judgments. Across three experiments, we found that the point of subjective equality for an object's tipping point scaled according to the CoM, not other object features, in both 6-year-olds and adults. Using computer simulations, we confirmed CoM specificity in stability judgments. Random forest classifiers (5-fold cross-validation), which were trained on a combination of object features (height, base area, radius, CoM) and tasked with predicting object stability, showed the highest accuracy when the CoM was used for classification. Altogether, these findings suggest that from early in development, judgments of physical stability are rooted in specific perceptual information about objects' geometric centroids.

4-D-12   **The foundation and design of an interpretable transformer knowledge tracing model**

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Knowledge Tracing (KT), a component of Intelligent Tutoring Systems (ITS) that traces individualized students' learning patterns, has evolved through the progress of artificial intelligence technology. Though the transformer can outperform other neural networks by over 10% when employed on KT models (e.g. Pu et al., 2020), it lacks interpretability and impedes the analysis of students' cognitive processes and an empirical evaluation of the model. As a review of previous works (Table 1) regarding the interpretation of transformer knowledge-tracing (KT) models, this study presents an Interpretable Transformer Knowledge Tracing (ITKT) model along with its input format. This model makes use of matrix-sequences instead of key-value pairs as the input, where each matrix contains selected features, such as the required skill, and number of hints of each questions-answering activity. Moreover, latent variables of the model will be revealed for correlation analysis. As the input and correlation values of the input are multi-degree, the ITKT model is self-explanatory. Preliminary results revealed that the ITKT can outperform the TKT model's accuracy over several public datasets. We believe that ITKT will also lead to the enhancement of predicting accuracy due to its similar structural improvement from DKT to DKT+. Additional insights into the design of the model and its results will be presented at the conference.

4-D-113   **Contextual modulation of parent-child conversation: Semantic network connectivity and children's vocabulary development**

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Language comprehension requires not only that children have broad vocabularies (breadth), but also that those words stimulate rich, interconnected networks of conceptual knowledge (depth). Within psycholinguistics, network science has been widely applied to human semantic knowledge. Yet, how the semantic network structure is modulated by the type of nonlinguistic context needs further attention. The current study investigates if the structure of words' connectivity in parent-child conversation varies by activity setting (book reading, toy play, mealtime); and if early word learning relates to semantically contingent conversation within each activity setting. We use the Home-School Study of Language and Literacy Development Corpus (Dickinson & Tabors, 2001) from CHILDES (MacWhinney, 2014), and the analyses are based on the subset of 62 children. In comparison to toy play and mealtime, the semantic networks in book reading possess a small-world structure with highly clustered neighborhoods and this semantically contingent conversation relates to children's vocabulary development.

E – Conceptual development

4-E-13   **I dunno - I guess - I mean whatever: Children form a many-to-many pragmatic mapping of shrug gestures between early and late childhood**

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Children begin using communicative gestures between 8 and 12 months of age, before they speak their first words (Bates, 1976), and early production of co-speech gestures can precede, predict and facilitate early milestones in language development (Iverson & Goldin-Meadow, 2005). Though non-referential co-speech gestures (e.g., beats, palm-ups) serve critical pragmatic functions in everyday conversation (Harris et al., 2017; Vilà-Giménez & Prieto, 2021), developmental research has primarily focused on the role of referential gestures (e.g., points, iconics) in lexical and syntactic development. Because non-referential gestures evolve from being used largely as emblematic stand-ins (e.g., "don't know" shrug) to negotiating interaction itself, they provide unique insight into children's pragmatic development. We ask how children's earliest interactive gesture forms develop from lexical to pragmatic functions by focusing on the early-acquired shrug gesture. We propose that children initially produce a shrug emblem with prototypical form and function that develops into shrugs' characteristic many-to-many form-function mapping in late childhood, parallel to the extended developmental trajectory of verbal epistemic expressions like modals (Leahy & Carey, 2020). Given the lack of supporting contextual information in speech, young children's gesture-only acts may more often use a prototypical form and meaning than co-speech shrugs. We examined forms and functions of children's shrugs using a longitudinal corpus of spontaneous interaction from 18 American English-speaking caregiver-child dyads across 12 home visits between 14 and 58 months ("early childhood") and 2 visits between 11 and 13 years ("late childhood"). Using a conversation analysis inspired annotation scheme, we compared shrugs produced with and without speech. Our findings support these hypotheses. Up to 58 months, children were significantly more likely to use a prototypical form (shoulder raise and/or complete palm-up) and prototypical function (ignorance) for shrugs produced without speech than for co-speech shrugs (form: $\chi2=37.28$, p<.0001; function: $\chi2=108.37$, p< .0001). Further, a mixed-effects logistic regression of function (prototypical vs. not) predicted by form (prototypical vs. not), speech co-presence (present vs. not), and age (months) showed that prototypical function was significantly more likely with prototypical form (b=0.95, SE=0.38, p=0.01) and significantly less likely with co-produced speech (b=-2.55, SE=0.36, p<.0001). There was no significant effect of age in early childhood. Between ages 11 and 13 years old the same children remained significantly more likely to use a prototypical function for shrugs produced without speech ($\chi2=12.20$, p<.0001). However, older children were no more likely to use prototypical form with or without speech, and prototypical form did not predict function, supporting the late childhood emergence of a many-to-many form-function mapping. In sum, children build a many-to-many form-function mapping across a lengthy trajectory of pragmatic development extending into early adolescence, with this gestural epistemic indicator mirroring the prolonged development of verbal epistemic expressions. As children develop more sophisticated conversational and pragmatic resources, their shrug gestures are more contextualized and less emblematic, supporting a fundamentally multimodal framework for the acquisition of discourse pragmatics.

4-E-14   Children draw on a concept's central form to understand ambiguous sentences

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One of the most distinctive components of human cognition is our capacity to combine concepts together (Chomsky, 1957; Fodor, 1975; Pinker, 1994). Yet even the simplest of combinations produces a structure that is ambiguous with respect to its precise meaning. Consider a sentence like "The café is efficient." The human mind represents a vast number of properties as true of cafés--generic properties

like having electricity, wifi, music, outdoor seating, windows and restrooms. But to which of these properties does "efficient" apply? The present research investigates a conceptual bias which might help children navigate this hypothesis space. Specifically, we ask whether children interpret sentences in terms of properties represented via the central form of a concept. The central form represents a subset of a concept's properties in a privileged manner (e.g., representing serving hot drinks for the concept café, called a form property). Form properties--in contrast to "merely" generic properties (e.g., having wifi for a café)--are understood (i) normatively (e.g., cafés should serve hot drinks), (ii) as stably present in the kind (e.g. cafés will always serve hot drinks), and (iii) as licensing formal explanations (e.g., cafés serve hot drinks, because they are cafés) (e.g., Haward, 2020; Prasada and Dillingham, 2006). Prior research suggests that adults are biased to interpret sentences such as "The café is efficient" in terms of form properties rather than generic properties: e.g., such that the café's serving of hot drinks is efficient (as opposed to its wifi; Haward, in prep). The present studies investigated whether this bias may be present early in language acquisition, facilitating children's interpretation of sentences. Preschoolers (n=90, M=5.58 years, SD=.85) were introduced to a character named Ali Alien, who had recently arrived on Earth. On each trial, children heard Ali produce an ambiguous sentence about an instance of a kind (e.g., "The park is big"; Fig. 1). Two characters, Sarah and Tim, also heard this sentence, and each made a guess about what Ali was saying. One of them guessed an interpretation that involved a form property (e.g., "The park's grass field is big") while the other guessed an interpretation that involved a generic property (e.g., "The park's bathroom is big"). The child was then asked which character made the best guess. Pretest indicated that both properties license a true generic. On posttest, the child was asked to accept or reject a formal explanation for each property (e.g., "The park has a bathroom because it's a park"). Strikingly, children interpreted sentences in terms of form properties (62%) more than generic properties (38%; p<.001), including by age four (n=30; 66% vs 34%; p<.001). They also accepted more formal explanations for form properties (81%) than generic properties (50%, p<.001), confirming they represented the form properties as distinct from the generic properties. Given the early emergence of this bias, we propose that it is likely crucial to language learning, and maybe even the reason that concepts have a central form. As young children begin to acquire rich generic knowledge about thousands of kinds, and as they construct sentences of increasing complexity, a simple, early-emerging bias to interpret sentences in terms of form properties--which will yield the right solution most of the time--would be of particular benefit to a computational system seeking to minimize costs.

4-E-15   A milestone in the development of verbal reference: learning words for unseen objects
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Learning about perceptually unavailable objects or events from language requires a referential link between words and mental representations. When and how does this link emerge? We leveraged 15-month-olds' (N=75) sensitivity to semantic priming to address these questions. An actor first named three familiar visible objects and then labeled a non-visible object. In the Priming condition all familiar objects were from the same semantic neighborhood (e.g., fruits). During test, infants saw a novel object from the same neighborhood and a semantically distant object and heard the newly learned word. In the No Priming condition familiar objects were semantically distant from each other. In the Switch Word condition an unfamiliar novel word was used during test. Only in the Priming condition, did infants

prefer to look to items in the same semantic neighborhood. These results establish the earliest evidence of infants forming a mental representation of an unseen object based on language.

4-E-16   Children's representations of coincidences

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The idea of coincidences intrigues us. We share our experiences of coincidence with others, and spend time pondering their meaning. Although coincidence representations have been explored in adults, little is known of their development. Here we explored coincidence representations in adults and 5- to 10-year old children. Participants read stories describing co-occurring events (e.g., children discovering they all had the exact same lunch at school), and then answered a series of questions. In Expt. 1, we found that adults were highly sensitive to the presence of possible explanations for the co-occurring events. They were significantly less likely to judge events as coincidental when potential explanations were available, even when explanations were not explicitly linked to the events. Further, their ratings were modulated by the number of co-occurrences, yielding an inverted U-shaped pattern. Coincidence ratings increased with the number of co-occurring events, but declined again when the number of co-occurrences grew suspiciously large. In Expt. 2, we found that children also represented coincidences: like adults, their coincidence judgments were sensitive to the presence/ absence of potential explanations. However, only older children's ratings were sensitive to the number of co-occurrences. In sum, our research suggests that young children already have a basic understanding of coincidences; this understanding undergoes further development during the school-age years.

4-E-17   Surface-to-structure shifts in rational number categories

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As learners develop expertise, they undergo a surface-to-structure shift in attention (e.g., Chi et al., 1981), a shift in reasoning about problems based on surface-level features (e.g., numbers in a problem) to structure features (e.g., relations in a problem). In math, Sidney and Alibali (2015; Sidney, 2016) used a sorting task to show that from 5th grade to adulthood, learners shift from thinking about fractions and whole numbers as separate categories to an integrated system. This study seeks to replicate these findings in a larger sample of existing data (n = 372). Furthermore, we explore a possible role of math anxiety (Ashcraft, 2002) in the development of math expertise in a subset of adults (n = 59). We hypothesize that adults with higher levels of math anxiety focus on surface-level features of problems, and fail to treat fractions and whole numbers as an integrated system.

4-E-18   Learning words from context: Development in abilities to learn word meaning from simple regularities of word use in language

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From early in development we use linguistic context to learn new words. However, which cues to word meaning we can extract from context may change across development. Here we investigated the development of abilities to extract word meaning from two types of regularities of word use: regularity with which words co-occur (e.g., juicy-apple) and regularity with which words share patters of co-occurrence (e.g., apple and melon both co-occur with juicy). Across two paradigms (sentence listening and cued recall) we presented participants (4-5-year-olds; 6-7-year-olds and adults) with input in which novel and familiar words co-occurred in accordance with these regularities. At test participants' understanding of novel words was assessed. While all age groups learned from word co-occurrence, ability to implicitly learn from shared patterns of co-occurrence seems to emerge only around the age of seven. We discuss the different mechanisms of co-occurrence-based learning with a goal to shed light on potential ways to support word learning from context early in development.

4-E-19   The development of temporal effects on the perceived strength of ownership claims
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To navigate the social world, children must acquire an understanding of different forms of ownership. Most prior research has focused on categorical and exclusive forms of ownership, but less is known about situations where ownership claims are non-exclusive and may vary by strength. Across 2 studies (N=126), we investigated the role of temporal cues in the perceived strength of claims over resources. Specifically, we examined whether time spent using a resource and time since its abandonment were salient cues in deciding whether a resource is available for use. Four- to 7-year olds and adults observed two characters approach identical resources. Time of use and time abandoned were varied across conditions, then participants were prompted to choose which resource to approach. Older children and adults chose the target resources more often than chance, and the time since abandonment served as a stronger cue. These studies combined lay a foundation for research on non-exclusive forms of ownership and suggest a representational structure for claims that is distinct from categorical forms of ownership, for example, an analog system for claim strength that increases with time of usage and gradually diminishes after abandonment.

4-E-20   The influence of culture and development on the understanding of illness: A comparison of Chinese and American children and adults
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The present study examined Chinese and American children's and adults' understanding of illness causation. Children ages 4-10 and adults from China and the US were asked open-ended questions about what makes people sick and why and were also presented with vignettes in which a character is sick an asked which of two possible causes of illness is correct or if they both could be right. The possible explanations of illness presented in the vignettes included psychogenic, biological, immanent justice, and vitalism. The results indicate that (1) participants in both countries prioritize the causes of illness in the same order: biological, vitalistic, psychogenic and immanent justice, (2) Chinese participants preferred vitalism significantly more than American participants (4) older participants preferred

biological explanations, and (4) older Chinese children gave more coexistence responses than younger children. Overall, both culture and age impact the understanding of the causes of illness.

4-E-21   Building blocks of recursive pattern processing in human children and adults

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Humans are adept at processing abstract patterns. Active generation of recursive sequences is often argued to be a key behavioral marker of rich, algorithmic cognition but the precise cognitive mechanisms underlying recursive sequence generation remain mysterious. Recursive center-embedded sequences are considered to be hallmarks of uniquely human context-free grammars that cannot be generated using simple means like finite-state automata. Here, we investigate three potential building blocks of recursive pattern processing: hierarchical reasoning, ordinal reasoning, and associative chaining. Our Bayesian mixture model quantifies the extent to which these three cognitive mechanisms complement or compete with each other in the context of a recursive center-embedded sequence generation task in human children and adults across one and two levels of embedding. We also probe the role of underlying perceptual or semantic relational structure in recursive rule learning. The presence of relational structure (either perceptual or semantic) facilitates the preferential generation of recursive center-embedded sequences via hierarchical reasoning. In the absence of relational structure, the use of ordinal reasoning predominates. Notably, a small number of subjects generate recursive center-embedded sequences even in the absence of underlying relational structure. Overall, our observations point to a potential domain-general capacity for recursive pattern processing in humans.

4-E-22   Uncovering childrens' category representations

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Representing the world in terms of categories allows us to abstract from the many ways experiences differ and focus on their generalizable features. For example, because apples vary in color and size, a persimmon might at first look fairly similar. Learning about the category of apples, though, produces an internal representation that groups apples together, and renders other fruits less likely category members. Since category membership is a gradual notion, these representations can be thought of as probability distributions. However, directly accessing these distributions is challenging, and, as a result, most experiments only probe the categorization of a small set of items by asking for the item's category features, or determining their similarity to other items. Here, we present a method that is based on a statistical procedure (MCMC) that allows us to directly produce exemplars from childrens' categories without pre-specifying test items. Instead, the method adaptively selects which stimuli to present, allowing us to focus on the most informative items. We use this method to uncover age-dependent differences in category organization of fruits in a pre-registered online experiment. Contrasting 5-year-olds (n=40), 7-year-olds (n=60), and adults (n=131), our preliminary results suggest that the groups differ in how they weigh color and shape features to establish fruit categories. We discuss these results in the context of color and shape biases throughout development.

4-E-23   **Multimodal representational affordances within concreteness fading foster cognitive flexibility in STEM's geometry**

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Advances in science and technology from a Fourth Industrial Revolution (Schwab, 2017) have generated life altering change in the economic and employment lives of our young professionals, in the social lives of our families, and in the educational lives of our children. To prepare students for a rapidly changing 21st Century global Knowledge Economy (OECD, 2015), it is imperative to develop cognitive flexibility in academic domains (Bransford, Brown, & Cocking, 2000). This study examines how the affordances from multimodal representations within a Concreteness Fading (Fyfe & Nathan, 2017) learning intervention foster cognitive flexibility when learning formal mathematical proof in STEM's geometry. Materials included Enactive representations, object-shapes for manipulating spatial-evidenced proof; Iconic representations, picture-shapes for drawing Euclidean-evidenced proof; Symbolic representations, symbol-numbers for writing formula-evidenced proof. Experimental design featured post-secondary non-math majors (N=8, male=2, female=6) randomly assigned to four conditions: enactive-iconic-symbolic (n=2), enactive-symbolic (n=2), iconic-symbolic (n=2), symbolic (n=2). Think-aloud protocol analysis reveals participants who reached a perceived impasse with initial proof, demonstrated cognitive flexibility by resourcefully employing alternative spatial-based and perceptual-based proofs learned from the intervention.

4-E-24   **Infants' understanding of agents' instrumental actions in grid-world environments**

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Infants succeed in recognizing an agent's instrumental actions to a higher-order goal (e.g., Sommerville and Woodward, 2005). Current machine-learning models fail to reason about others even as human infants do (Gandhi et al., 2021), but parallel tests of infants and machines can inform our understanding of human and artificial intelligence. We presented 18 infants with a test of machine commonsense reasoning about agents at 11 and 15 months in a Zoom experiment. Infants watched videos of a simple grid-world environment (Fig. 1) in which an agent uses a key to retrieve a blocked object. At test, the object is no longer blocked, so infants should be surprised if the agent goes to the key instead of the object. At neither time point did infants look longer to this unexpected outcome (11 months: $t(17)=.77$, $p=.649$; 15 months: $t(17)=.27$, $p=.794$). However, a simple slopes analysis revealed that infants' looking to the unexpected outcome at 15 months was predicted by their looking to the unexpected ($t(32)=.20$, $p=.056$), but not expected ($t(32)=.05$, $p=.713$), outcome at 11 months. Minimal cues to agency, simple visuals, and the navigational context may have affected infants' group-wise agency reasoning, but individual differences suggest that the effect of these cues may be overcome by a kind of "background training" that computational models typically receive. Such training might allow infants to learn what elements in these minimal displays are instantiating the properties of agents.

4-F-25 **Toddler's time allocation in two cultures**

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Infants can acquire information about their environment during interactions with other people, by observing people who are not interacting with them, and during independent exploration of the environment. The extent to which infants have opportunities in these contexts is thought to vary by culturally mediated caregiver goals (e.g., Lancy, 2016) which may, in turn, relate to caregivers' experiences in formal schooling contexts (e.g,. Rogoff et al., 1993) and could affect who is responsible for caregiving (other children or adults, e.g., Tapia-Uribe et al., 1993). The goal of this study is to provide a quantitative and comparative assessment of toddler's allocation of time in two cultural communities (US, Yucatec Maya), and to consider what factors relate to individual differences in time allocation. 65 families (36 Maya and 29 US) with an infant between 15 and 23 months participated (mean age: 18.9 months; 28 females). Families were recorded for one hour in natural interaction in their home. Videos were coded for the duration of infant's activities as defined by three mutually exclusive categories (see figure 1): Interaction (others were interacting with the infant), Opportunity Alone (the infant was in the presence of others but not interacting with them), or Time Alone (the infant was completely alone) as well as who was present (adults or other children) during each bout where other people were present. In addition, the category of "Opportunity Alone" was further coded to assess infants' visual eye gaze to social partners. Data was collected on demographic information including infant gender, years of maternal schooling, and whether or not the infant had older siblings. Results showed that the relative frequencies of learning opportunities varied by culture: US infants spent most time engaged in interaction with others while Maya infants spent most time in the combined contexts of opportunity alone and time alone (figure 2). When others were present, these others were most often adults in the US sample, and most often children in the Maya sample (figure 3). Finally, while Maya children had more overall opportunities to observe the actions of others who were not engaging with them, Mayan and US children allocated attention to non-interactive social actors in very similar ways (figure 4). We next investigated the relationship between maternal education, caregiving, and children's time allocation by fitting Bayesian models with logistic link functions on the proportion of time that infants spent in interaction with others and on the proportion of time the spent in the company of children (See tables 1- 2). Results showed that, in the Maya community, infants of more educated mothers were less likely to be left in the company of other children alone as compared to children with less educated mothers. Infants of more educated mothers were also less likely to be engaged in interaction (when others were present) than children with less educated mothers (Figure 5). Together these results suggest that, in the Maya community, maternal education may shift who is responsible for the primary caregiving of infants (from other children to adults), and could, in turn, shift the learning contexts that children are typically a part of by reducing the amount of time children spend in interactive contexts.

4-F-26 **Parental support of preschoolers' math learning in the Chinese context**

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Chinese students' advantage in mathematics is evident as early as preschool, where they demonstrate superior math understanding than their Western peers. However, little is known about the reasons for this advantage. The present study seeks to fill this gap by examining how Chinese parents support the two building blocks of math fluency: number knowledge and spatial thinking. A sample of 90 Chinese children, aged 4 and 5 years, and their primary caregivers participated in this study. Parental support--as measured by parental math-related beliefs, frequency of home activities, and use of math talk--and its role in children's numeracy and spatial skills were examined. The results show that parents with higher expectations of their children's numeracy abilities were more likely to engage in direct numeracy activities, in turn predicting children's number knowledge (Figure 1.1). In contrast, parents who were more knowledgeable about mathematical development engaged in general STEM activities more frequently, which, in turn, predicted children's spatial skills (Figure 1.2). Furthermore, parents of the 5-year-olds more actively supported their children's math learning via frequent and diverse talk about numbers compared to parents of the 4-year-olds (Table 1). These findings portray a picture of Chinese parents' role in their children's acquisition of early math skills and of variation within the Chinese context. Future work is examining the same measures in an American sample.

4-F-27 Navigating the explore-exploit dilemma: A cross-cultural examination of 3-6 year olds' own behavioral strategies and enforcement of strategies onto others

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Growing evidence suggests that young children choose to explore when faced with a tradeoff between exploring and exploiting their environment. However, existing research has (1) lacked cultural diversity, leaving open questions about the universality of these claims, and (2) has yet to test whether children are not only highly exploratory themselves, but also enforce exploratory behavior onto others. Here we examine U.S. and Turkish children's enforcement of exploratory decisions on a character navigating the explore-exploit dilemma. 3- to 6-year-olds (N = 120 tested, target N = 264) watched a video of a character searching for rewards in environments of varying reward distributions and were asked whether they should "stay" in one environment or "go" to a new one. Across cultures, children were more likely to enforce "go" behaviors (M= 1.65 go utterances produced) compared to "stay" behaviors (M= 0.70 stay utterances produced, t(117) = 9.02, p < .0001). U.S children were more likely to enforce "go" behaviors (M = 1.86 utterances) than Turkish children (M = 1.40, p = .002); children did not differ in their enforcement of "stay" behaviors. In the full sample, we will examine children's enforcement of exploratory behaviors in relation to contextual factors (i.e., environment resource distribution) and individual differences (e.g., children's own behavior in an explore-exploit task, executive functioning abilities, and caregiver socialization practices surrounding curiosity).

G - Diversity

4-G-28 Early environments and exploration in the preschool years

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A key way in which children learn is by playing and exploring the world around them. Many factors may shape the ways in which children explore, including potential information gain (Schulz & Bonawitz, 2007; Sim et al., 2015), prior success on unrelated tasks (Doan et al., 2020), and how information is presented and framed by other people (Bonawitz & Shafto et al., 2011; Gweon et al., 2014; Yu et al., 2018). At the group level, then, exploratory play may be influenced by various elements in children's internal and external environments. Less clear, however, is how exploratory play may systematically differ across individual children. Here, we investigate how patterns in children's exploratory learning are related to age and home socioeconomic status (SES) in early childhood. We have an abundance of exploratory play data already collected within our lab, and our participants come from the highly socioeconomically diverse area around Newark NJ, making us uniquely situated to be able to get at this question. We compile data from several experiments already run in our lab, and perform correlational analyses, in an attempt to preliminarily characterize these relationships. Data for this analysis were pooled and normalized from four past experiments conducted within our lab between November of 2014 through April of 2019; these included a total of N=278 children (M(age)=56 months, 149 girls). All four experiments used novel toy exploration tasks in which children were presented with a unique toy that had several non-obvious functions. Three of the four experiments also included a pedagogical demonstration, which involved an experimenter calling the child's attention to a specific feature of the toy. Children's subsequent play with the toy was recorded and coded from videos, including the amount of time children played, the number of additional functions they discovered and how they focused on them, and the number of unique actions they performed on the toy. We also had data on children's age and familial SES (inferred from the median income in the child's home zip code). We correlated age and SES with the measures of play coded for these studies. Correcting for family-wise error, we found three key results. First, age was positively and significantly related to the total number of unique actions performed (r(270)=0.171, p=0.005). Thus, children's play tended to become more variable with age. Second, children from lower SES areas tended to perform more unique actions throughout the course of their play, (r(178)=0-.218, p=0.003) and focused a marginally smaller proportion of their play on the function demonstrated by the experimenter (r(173)=0.190, p=0.012). Finally, within children from lower SES areas, the proportion of time spent playing with the demonstration traded off with overall variability (r(110)=-0.248, p=0.008) and length of play (r(111)=-0.240, p=0.010). In contrast, we did not find similar trade-offs in children from higher SES areas (ps>0.59). Thus, while children from lower SES areas may play more variably in general, their tendency to focus on pedagogically cued features may also be associated with shorter length and less variability of play, whereas higher SES children's tendency to focus on demonstrated features is not related to these other features of their play. Together, this work lays critical groundwork for understanding early active learning across diverse developmental contexts.

4-G-29   Mothers', fathers', and toddlers' code-switching in dual language homes: Relation to children's expressive vocabulary

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Using a sample (N=18) of primarily Hispanic mothers and fathers and their two-year-old children, we examined parent and child English-Spanish code-switching (CS) during a 19-minute play session. Parents' inter-sentential CS was measured using the insertion (i.e., Matrix Language) and the alternation approaches and their intra-sentential CS was measured as one-word and multiple-word switches using

the insertion approach (Bali et al., 2015; Halpin & Melzi, 2021; Yow et al., 2018). We also measured CS between parent and child. Parents code-switched between utterances quite often (14-30% of utterances). Paired samples t-tests showed that parents used inter-sentential CS significantly more often than intra-sentential CS (Table 1). Children were significantly more likely than parents to initiate CS (t=4.82, p<.01 with mothers; t=3.03, p<.05 with fathers). Mothers who used more inter-sentential CS, measured by the insertion approach, had children with smaller expressive vocabulary (r=-.90, p<.01). Future analyses will examine the correlates of parent CS and the functionality of CS between parent and child.

4-G-30   Children's and adults' concepts of skin color inheritance

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Prior research has addressed the categorization of individuals born to parents of different races. Less is known about children's and adults' understanding of how human offspring inherit color from parents of diverging skin colors. American adults use similar strategies to categorize multiracial individuals and to categorize fluids that originate from the mixing of other fluids (Noyes & Keil, 2018). The present study compared children's (N = 354; 4-10) predictions about the possible skin color of a multiracial baby to their predictions about the possible outcomes of mixing paint colors. Children indicated whether each of nine human skin colors were possible for a multiracial baby and whether each of eight paint colors were possible outcomes of mixing two paint colors. By 5 years, children understand that human skin color, unlike mixed paint, is stochastic, resulting in a wide range of possible outcomes. However, children's understanding of skin color inheritance is still developing as their use of language analogous to fluids, but not language analogous to genetics, increased with age. Data collection with adults is ongoing and will complement these findings by assessing the beliefs that underlie American adults' reasoning about skin color inheritance. If children and adults rely on analogy to fluids to understand skin color inheritance, this could have important implications for how lay theories about race can impact one's reasoning about biological processes.

H - Education

4-H-31   Exploring the development of preschoolers scientific questions in an inquiry-based learning classroom

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From an early age, children construct their own knowledge in a multitude of ways. One integral strategy they employ is asking questions to adult learning partners, such as caregivers and teachers. Children's question-asking develops throughout the preschool years as they begin to ask more sophisticated causal (e.g., why and how) questions that demand more complex responses from adults and may play a critical role in supporting children's early science learning (Chouinard et al., 2007, Corriveau & Kurkul, 2014; Harris et al., 2018). To date, research on how children's early question-asking develops focuses primarily on group differences in parent-child interactions. Here, we examine teacher-child interactions to explore how preschoolers' scientific questions develop longitudinally in a classroom setting. We explored these interactions in a naturalistic, preschool classroom, with a particular focus on 5 individual children as they

engaged in a month-long extended scientific inquiry unit in an inquiry-based learning classroom. In an inquiry-based model, children can help actively construct their own knowledge through asking questions and experimenting (Edson, 2013). We hypothesized that children would ask a large number of information-seeking (causal, e.g., "how" and "why; fact-based, e.g., "where" and "what") questions. We were particularly interested in investigating longitudinal differences between the children in how they engaged in the inquiry through the questions they produced. We collected videos (N = 18; approx.14 hours) throughout a month-long inquiry unit on forces and motion. The videos were transcribed in CLAN-CHILDES software at the utterance level (7,956 total utterances) for the teacher and 5 individual children. Utterances were coded for delivery (question or statement) and content (e.g., fact-based, causal, scaffolding). The majority of utterances were statements (78.6%) and spoken by the teacher (73.4%). Children varied in their amount of talk (range: 0.8% to 8.8% of total utterances). With the exception of one child who spoke the least overall (0.8% of total utterances; 20% questions), children produced similar proportions of questions (range: 9.9% to 11.7%) and statements (range: 88.8% to 90.1%). Of their questions, most were information-seeking (64.6%); and this is consistent with children individually (range: 58% to 83.3% information-seeking questions), apart from one child who spoke the second-least overall (1.8 of total utterances; 31.2% information-seeking questions). Taken together, these findings provide insight into individual differences in children's questions during a month-long scientific inquiry. Although there was variability in overall talk, children produced a similar proportion of questions (primarily information-seeking questions) and statements. Subsequently, it does not seem that simply speaking more leads to more questions. Children primarily asked information-seeking questions, suggesting that when given the chance, children ask questions to construct their own scientific knowledge. Further analyses will continue to examine the content of children's and teacher's questions, as well as the longitudinal development of these questions throughout the inquiry unit. By examining the naturalistic development of children's scientific questions in the classroom, we hope to add to the literature on the development of children's question-asking and inform the role of questions in early science learning.

4-H-32   Subdomain-specific relations between home math activities and 4-year-old children's math skills
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Studies investigating relations between home math activities and child math skills have rarely explored the alignment between the specific skills these activities foster and children's math performance in these skills. The present study examined specific relations between math subdomains in home activities and children's skills (e.g., home counting/cardinality activities related to children's counting/cardinality skills). Participants were 78 mostly middle-income, White parents and their four-year-old children (M age = 53.19 months; 45% girls). Parents completed a 24-item survey about their frequency of home activities in five math subdomains: counting/cardinality, set comparison, number identification, adding/subtracting, and patterning. Children's math skills in these subdomains were assessed with the Preschool Early Numeracy Scale (PENS) and the Early Patterning Assessment. Specific relations were observed in set comparison, adding/subtracting, and patterning, such that higher frequency of home activities in these subdomains related to higher child math skills in each area. No relations were found in counting/cardinality and number identification. Overall home math activities averaged across the five

math subdomains positively related to children's overall math skills. Findings highlight the importance of engagement in specific math activities in the home environment for child math development.

4-H-33   **How does parent-child conversation during a scientific storybook reading impact children's mindset beliefs and persistence?**

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From an early age, parent-child scientific conversations may send messages about the importance of hard work in STEM. We explored how parent-child discourse during a scientific storybook about success impacts preschoolers' mindset beliefs and persistence. Parent-child dyads (N = 74; mage= 58.4 months, 34 female) were assigned to one of two storybook conditions about Marie Curie: Achievement (highlights success without any mention of failure) or Effort (emphasizes challenges on the path to achieving success). After the storybook, children were asked mindset beliefs and effort questions, and presented with an impossible task. Analyses indicate that children in the Effort Condition were more likely to endorse a growth mindset (B = 0.23, p < .10), attribute a scientist's award to hard work (B = 0.29, p = .04) and persist longer on the impossible task than children in Achievement Condition (63.13 vs. 38.1 seconds; B = 32.92, p = .01). This work highlights how parent-child scientific discourse impacts children's mindset and effort beliefs in science.

4-H-34   **Investigating the numerical cognitive development of rural Chinese preschoolers living in poverty**

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Prior studies suggested an age-associated number learning trajectory (e.g., Clements and Sarama, 2017) and a robust association between the inhibitory control and early math achievement (e.g., Blair and Razza, 2007). Yet, few studies have examined children with low SES in poverty-stricken areas. This cross-sectional study fills this gap by explicitly measuring and analyzing 778 children aged 3 to 5 from households with annual family income below $500 in Wenshan, China, using East Asia-Pacific Early Child Development Scales and Head Toes Knees Shoulders scores. Results from statistical tests find that a) there is a significant difference in numeracy scores across age groups, with a greater difference observed between age 4 and 5 than between age 3 and 4; b) there was no significant difference in the numeracy scores between genders; c) after controlling for age, there is a positive correlation between children's early numeracy scores and their inhibitory control scores. These findings demonstrate that rural Chinese children's early numeracy knowledge is associated with inhibitory control skills and can vary vastly depending on age. Specifically, as children grow, their skill levels increase in number sense, counting physical objects, counting numbers, but not in basic arithmetics. This non-WEIRD study is significant for understanding the numerical cognitive development of rural Chinese children living in poverty and can inform relevant policy-making.

4-H-35   **Underlying mechanisms of benefits of varying worked example types on algebra learning**

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Prior research highlights a positive effect of incorrect worked examples on mathematics learning. Yet the underlying mechanisms are unclear. We examine potential mechanisms of improvements in algebra learning by example type. In a pretest-experimental manipulation-posttest study, students worked with one of three types of worked example materials or a problem-solving control. Example conditions varied by correctness and explanation type. We analyze students' problem-solving errors and explanations provided in the three example conditions. These data operationalize three potential mechanisms: a reduction of misconceptions (i.e., fewer targeted conceptual errors), a weakening of incorrect knowledge (i.e., fewer errors overall), and increases in principled algebra knowledge (i.e., explanations focusing on principles underlying procedures). A series of mediation analyses reveal each of these as important mechanisms of different effects. A reduction of misconceptions explains greater benefits of all three example conditions, compared to the control, on an algebra concepts posttest. A weakening of incorrect knowledge explains greater benefits of incorrect examples in particular, compared to the control, on an algebra procedures posttest. More principled explanations of procedures explains the benefits of incorrect examples on post-conceptual scores compared to the correct examples condition. These findings help explain why prior work yields varying effects by example type.

4-H-36   **Measuring Preschoolers' and Kindergarteners' understanding of different types of patterns**

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One important, but often overlooked, skill related to early math development is patterning (Zippert et al., 2020). However, there is not an established, commonly used measure of early patterning skills (Rittle-Johnson et al., 2013). The current study advanced the development of a short, easy-to-administer, teacher- and researcher-friendly patterning instrument that reliably assesses the repeating (e.g., ABAB) and growing (e.g., change by 1) patterning knowledge of both preschool and kindergarten students. Furthermore, the study aimed to provide evidence for the reliability of the assessment when administered virtually. Children (n = 96) were assessed in Fall 2020. Participants were between the ages of 4 and 6 (M = 5.1 years, SD = .65 years), 51% of participants were girls, 88% identified as White, 94% spoke only English in the home, and 3% received financial assistance to attend school. Children's repeating and growing patterning knowledge were positively correlated, $r(95) = .40$, $p < .001$, and children were significantly better at completing repeating patterns compared to growing patterns, $t(85) = 11.41$, $p < .001$. Additionally, when administered virtually, the assessment reliably measured children's overall and repeating patterning knowledge in our predominantly White, middle-class sample; however, the growing subscale was not a reliable measure. Future work will look to administer the assessment to a more diverse sample and revise the growing subscale to improve reliability.

4-H-37   A meta-analysis of the worked examples effect on mathematics performance

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The current meta-analysis quantifies the average effect of worked examples on mathematics performance from elementary grades to postsecondary settings and explores moderators of this effect. Though thousands of worked examples studies have been conducted to date, a corresponding meta-analysis has yet to be published. Exclusionary coding was conducted on 7499 abstracts from published and grey literature to yield a sample of 40 articles reporting on 49 studies and 185 effect sizes. Using robust variance estimation (RVE) to account for clustered effect sizes, the average effect size was moderate at $g = 0.43$, $p = .03$. Moderators assessed included the type of worked example, administration format, grade/school level of participants, and content area/topic covered. No moderators significantly varied the effect of worked examples. These findings suggest that the worked examples effect is robust to alterations in example and administration type and effective across a range of grades and content areas within mathematics.

4-H-38   Children's explanations for ability grouping arrangements

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From the start of formal schooling, children are exposed to achievement cues in the classroom. One salient source of such information in elementary school is within-class ability grouping--the instructional practice of separating children by ability for small-group instruction. Despite the ubiquity of within-class ability grouping practices, children are seldom told why they and their peers are assigned to their respective groups and what their group placements mean for their ability to learn and succeed in school. Instead, children are left to make sense of this practice on their own. In the present work, we examine elementary school-aged children's explanations for ability group assignments. We focus on explanations because the ways in which students explain their early experiences in the classroom set the stage for their later sense of adjustment and belonging in school. Results from a study with 98 6- to 11-year-old children indicated that children attribute ability-group placements to internal causes--and, more precisely, unstable, internal causes. Children's explanatory preferences likely reflect a general cognitive tendency to appeal to internal causes and an elementary-school ethos that emphasizes the importance of effort and hard work. In ongoing work, we examine whether children's attributions relate to (a) their own motivation and (b) their attitudes toward students in low-ability groups.

4-H-40   Academic and behavioral outcomes of Montessori education: a meta-analysis

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School is an important venue for cognitive development. Although the vast majority of children attend conventional schools, which historically have used a teacher-text-centered model, some children attend alternative, child-centered schools. The most prevalent alternative model is Montessori education. Studies of the outcomes of Montessori education often have small ns, and therefore a meta-analysis is

important to determine its effects. We prepared a Campbell Collaborative review comparing Montessori with traditional education. From 2,012 articles yielded by a broad search, we culled 32 that met criteria including showing evidence of baseline equivalence, and contributing at least one finding with sufficient data to compute an effect size and variance. Using a robust-variance estimate procedure, Hedge's g effect sizes for academic outcomes ranged from 0.26 for general academic ability to 0.05 for social studies, and for nonacademic outcomes ranged from 0.41 for students' inner experience of school to 0.23 for social skills. For most outcomes, moderate to high quality evidence indicated that Montessori yields better academic and nonacademic results than traditional education.

4-H-42   Precursory knowledge of commutative multiplication relies on geometric representations

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One way children learn large numbers is by understanding that they are composed of smaller numbers. And realizing that each number is unique even if it can be composed in different ways is essential to develop comprehensive numerical skills. For example, adults know that both buying 2 bags of 4 apples and 4 bags of 2 apples will result in buying 8 apples. But before mastering multiplication, most school-age children do not spontaneously perceive this result. Does that mean that, contrary to addition, children do not possess precursory knowledge of the commutative principle of multiplication? To address this question, we asked 5-year-old children to judge whether two characters got a fair or an unfair share of apples in various situations probing commutative multiplication and addition, and mere identity. To investigate the preferential underlying representations, the groups of apples were displayed with and without geometric cues of symmetry, as well as with and without verbal descriptions. We found that additive commutativity is generally more accurately perceived than multiplicative commutativity, and that verbal descriptions were not helpful. Perhaps more importantly, we found that even before children learn formal arithmetic in schools, they do possess early intuitions of commutative multiplication as long as the symmetry intrinsically contained in commutativity is clearly apparent. Our results may provide useful insights on how to best introduce commutativity at school.

I – Face perception

4-I-43   Development of infants' attention to speakers of their native language in static and dynamic scenes

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Within the first year of life, infants begin to construct social categories based on language and race. Three- to five-month-old infants look longer at same-race people and speakers of their native language when paired against people from an unfamiliar racial or linguistic group. In the case of race, this pattern of visual preference is reversed by 9 months of age, but it is unclear why. With race, differences in attention may be confounded by not only emerging social biases but also developments in perceptual and face processing. With language, no study to our knowledge has traced such developmental changes at this age range. Thus, investigating infants' visual preferences based on a person's language provides an opportunity to examine developmental changes in visual attention unconfounded by face processing

and to directly test the relation between infants' visual attention and social expectations. Further, past studies have generalized from static stimuli (i.e., faces), but people are intentional agents who are constantly performing actions. How are infants distributing their attention in such dynamic situations? Will visual preferences found with face stimuli also be manifested in such dynamic situations? Here, we presented 32 5-month-old and 32 9-month-old monolingual English only hearing infants with people who spoke their native language (English) or a foreign language (French) in a static (pictures of faces) or action condition (videos of speakers acting on toys). The study was conducted on Lookit and conditions were presented in a random order in a within-subjects design. The side, language, and order of presentation of each speaker was counterbalanced; bilingual speakers were used as stimuli. Infants' gaze was coded offline by two coders blind to the study conditions and hypotheses. Averaged looking times of 9-month-olds revealed no visual preference for either speaker during the static condition (t = -1.03, p = 0.31), but infants looked longer to the native over foreign language speaker during the most critical period of the action, namely, when the speakers were reaching and grasping the toy (t = 2.27, p = 0.03). Thus, 9-month-old infants showed no language-based visual preferences when presented with static faces (in line with what has been found with race), but they looked longer at the speakers of their native language when the speakers were performing a potentially relevant action. These results are in line with theoretical accounts that describe infants as active learners and suggest that infants use language group membership to monitor their attention towards culturally relevant informants. We are currently analyzing the data of the 5-month-old infants and the data of another group of 32 9-month-old infants with the aim of replicating these results. This study was pre-registered and can be found at OSF (Anonymous link of Study 1: https://osf.io/8mqkr/?view_only=ab71229ea6e044bd99d00806d0064ae9; Anonymous link of Study 2: https://osf.io/qjxv8/?view_only=15f7c3af20a14e2e951c9844d2266284).

4-I-44   Children's perceptions of ambiguous interracial interactions: Behavior and size judgments

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Children's perceptions of ambiguously aggressive actions are biased by the race of the actor (Sagar & Scofield, 1980). The present research attempts to conceptually replicate and extend upon this work by examining perceptions of events and the physical size of Black and White cartoon characters, based on research showing that Black men are rated as physically larger and more threatening than White men of the same size (Wilson et al., 2017). Forty-one 9- to 13-year old White children watched cartoon clips of Black and White characters performing ambiguously aggressive acts (e.g., bumping into someone) and rated the actors and targets on various characteristics (e.g., mean, strength). Participants also rated the height and weight of a separate set of Black and White cartoon faces using visual scales. We hypothesized that participants would rate Black actors as more mean and threatening than White actors. We also hypothesized that these race differences would be mediated by a "size bias," such that Black actors would be seen as larger than White actors. We found that participants rated Black actors as stronger than White actors, but other hypotheses were not confirmed within this age range. Future research is needed to understand the relation between children's representations of actor race, physical size, and threat.

4-I-45   Infection detection in faces: Children's development of pathogen avoidance

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Adults can detect and avoid cues of sickness in faces. However, less is known about how these abilities develop. We tested whether 4- to 5-year-olds (N = 46) and 8- to 9-year-olds (N = 30) could use face photos to identify and avoid sick people when viewing pairs of sick and healthy face images. When children were asked, "Who is sick?", one-sample t tests comparing each age group's performance to chance (.50) revealed that 8- to 9-year-olds (M = .57, SD = .11), but not 4- to 5-year-olds (M = .52, SD = .13), were above chance at identifying the sick face (t(29) = 3.57, p = .001, d = .65, and t(45) = 1.04, p = .306, respectively). However, independent samples t tests did not reveal a statistically significant age group difference (t(74) = 1.71, p = .091), suggesting developmental improvements in explicit sickness recognition were likely small. On the other hand, when asked, "Who would you rather sit next to?", neither 4- to 5-year-olds (M = .48, SD = .11) nor 8- to 9-year-olds (M = .54, SD = .14) avoided people with sick faces (t(44) = 1.23, p = .226, and t(29) = 1.76, p = .088, respectively), yet the 8- to 9-year-olds outperformed the 4- to 5-year-olds (t(73) = 2.24, p = .028, d = .53), suggesting better implicit sickness avoidance with age. Our findings suggest that there may be some developmental improvements in explicit and implicit face illness recognition in childhood.

4-I-46   Perceptual signaling of an intelligence stereotype

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The orthodox view of stereotypes is that they are culturally transmitted. Here, we tested an alternative account based on perceptual transmission, whereby perceived facial dominance signals intelligence. In Experiment 1, adults (N = 55) rated computer-generated faces according to gender and various traits (e.g., dominance, attractiveness, and trustworthiness). More dominant faces were judged as smarter than less dominant faces and, crucially, dominance was the only variable that mediated the gender-intelligence link. In Experiment 2, we gave 6- to 10-year-olds (N = 68) a two-alternative forced-choice task where children judged which of two faces was smarter. Face pairs either differed in dominance, gender, or both. Children judged more dominant faces as smarter than less dominant faces. By contrast, the intelligence of male and female faces was not rated according to the stereotype of males as more intelligent. Taken together, our findings suggest a specific role for facial dominance in signaling intelligence.

J - Identity

4-J-47   Mad Scientists? Middle-school age girls have more positive attitudes towards science and scientists than boys do

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Despite progress, women are still underrepresented in STEM fields (Cimpian et al., 2020; NSF, 2017). When do attitudes, confidence, and gender stereotypes related to science form or shift? Previous studies of middle schoolers have shown that boys are more confident in their science abilities even when science grades for girls and boys are the same (Hill et al., 2017) and more likely than girls to say

that boys "should" be good at STEM (McGuire et al., 2020). We examined these domains in early adolescents. We used questionnaires to assess science attitudes and confidence in 51 middle schoolers (F=22, M=29, 11.3 to 14.3 years old [M=12.65, SD=0.65]) in Southwestern Virginia. To assess gender stereotypes about science and intelligence, children chose "the smart one" (Bian et al., 2017) and "the scientist" (Diaz et al., 2020) from gender-balanced picture arrays. COVID-19 disruptions resulted in smaller sample sizes than anticipated. Girls were more likely to choose "I like science" compared to boys' "I don't care about science" $(t(48)=-1.76, p=0.08)$. However, girls reported learning less than boys in science classes last year $(t(49)=1.88, p=0.06)$, despite no gender differences in reported grades $(t(49)=.17, p=0.42)$. Girls were more likely to say that they would like to have a scientist help teach in their classroom $(t(47.53)=-2.13, p=0.04)$, while boys were more likely to agree with "Most of my friends do poorly in science class" $(t(48)=2.01, p=0.05)$. When asked about future jobs, girls were more likely than boys to indicate science-related careers when healthcare was included as science related $(t(45)=-1.84, p=.072)$. In pairing females or males with gender-neutral descriptors, both groups displayed positive in-group biases ("Smart" $t(42)=-2.08, p=0.04$; "Scientist" $t(43)=-4.25, p=0.00$). For girls, choosing females for "Smart" descriptors was positively related to how much they reported liking science $(r=0.49, p=0.03)$, wanting a scientist to visit their classroom $(r=0.41, p=0.07)$, and learning in science last year $(r=0.40, p=0.09)$. For boys, choosing males for "Scientists" was related to boys agreeing with "I get good grades in my science classes" $(r=0.35, p=0.08)$. Overall, girls were more positive in their attitudes towards science, but lower in their confidence. Both groups displayed positive in-group biases when presented with gender-neutral descriptions of "smart people" and "scientists." This is in contrast to previous research showing positive out-group biases from girls towards boys at the end of kindergarten regarding intelligence (Bian et al., 2017), but similar to a study showing positive in-group biases towards being a "scientist" (Diaz et al., 2020). For girls, these positive in-group biases were related to a number of positive attitudes toward science, while for boys they were only related to their self-confidence.

4-J-48   Young children's context-sensitive understanding of identity
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People hold multiple identities that can be broadly categorized into two types: personal identity (individual characteristics) and social identity (group memberships). Here, we examine whether children could flexibly invoke the appropriate identity to predict an individual's actions in different social contexts. Specifically, we expected that children would predict the individual to demonstrate their social identity when outgroup members are present but to prioritize their personal identity when outgroup members are absent. Four- to 9-year-olds (N = 108) were presented with four scenarios involving two ingroup members (A1 and A2) and an outgroup individual (B1). In each scenario, A1 and B1 favored different items and an identical copy of the two items was available. A2 held a secret preference for the outgroup item. We asked children to predict which item A2 would choose when A1 is present (ingroup-present condition), B1 is present (outgroup-present condition), or when both are present (both-present condition). Four- to 5-year-olds expected A2 to prioritize her personal identity by choosing the outgroup item in all three conditions. However, older children were more likely to predict A2 to choose the ingroup item in the outgroup-present and both-present conditions than the ingroup-present condition, suggesting that they bring forth social identity in intergroup contexts. These findings indicate that a context-sensitive understanding of identity develops in early childhood.

4-J-49   Children's evaluations of gender non-conforming peers

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Do children use gender non-conformity as a basis for their social evaluations? This study presented 4 & 5 year-olds (n = 91) and 6-8-year-olds (n = 99) with gender conforming (GC) and gender non-conforming (GNC) dolls and asked them to make several evaluations including liking, similarity, affiliation, perceived popularity, academic competence, rule knowledge and resource allocation. We investigated a series of research questions: whether evaluations varied by the type of gender non-conformity, the age group and gender of child participants, the gender of the targets, and participants' own level of gender conformity and exposure to GNC people. Children exhibited an overall bias in favor of GC children over GNC children. However, patterns of specific evaluations varied by age group, child gender, and target gender. Older boys and younger girls had more negative evaluations towards GNC children and GNC boys were evaluated most negatively overall. Children's own level of GC was predictive of their traditional flexibility, but exposure to GNC people did not affect evaluations.

4-J-50   Children's perceptions of Black-White targets' identity claims

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We explore children's (N=160, 4 -11 years old) judgements about others' racial identity claims. Participants viewed nine target children who varied in their racial background (2 White parents, 2 Black parents, or one parent of each race). Targets claimed they were White, Black, or biracial, and participants decided whether the claim was "OK" or "not OK". Whereas participants across all ages and racial backgrounds found it most acceptable for monoracial targets to claim identities that matched their parentage, participants' judgments about biracial targets' claims varied based on their own background. With age, White children became more likely to say all three identity claims were equally appropriate, whereas non-White children became more likely with age to think biracial claims were the most appropriate. Future research should examine the mechanisms behind these differences based on children's own racial background, such as ingroup/outgroup delineations or effects of contact with various racial groups.

4-J-51   Trust, guidance and purpose growing up today: An exploratory analysis of how children and young people satisfy these needs and associated vulnerabilities

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This research is an exploratory approach to understand how children and young people (CYP) primarily in Britain experience issues of trust, guidance and purpose. It is designed to understand how CYP cope with lack in one or more of those areas, the extent to which they have developed skills of epistemic vigilance, and the extent to which they find those skills important. 8 experts with more than 130 years of experience working with CYP in between them were interviewed on these questions. The interviewees

came from diverse backgrounds, from psychiatry to non-profit support and teaching. The interviews were coded and analysed thematically. The findings revealed vulnerabilities in each of these areas that can expose CYP to disinformation, poor guidance and various scams. The interviewees reflected on the institutional, family, and peer-related nuances of these issues and offered solutions to mitigate risk and support epistemic vigilance.

K - Language

4-K-52   Working memory training improves children's syntactic ability but not vice versa. A randomised controlled trial.

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Cognitive transfer has proved both a subtle test of the interconnectivity of different components of the mind and a promising methodology for applied interventions. Using the cognitive transfer approach, we tested several hypotheses about the relation between syntax and working memory (WM) in development: As a result of training (1) WM improvements will transfer to improved syntactic ability (2) syntactic improvements will transfer to improved WM performance (3) improvements in WM and syntax will transfer in both directions (4) improvements in WM and syntax will transfer in neither direction. In a pre- post-test randomised control trial, 104 native Cuban Spanish-speaking children (M = 7;2) were either given syntax training (subject-verb agreement) in their first language (L1); syntax training in their second language, English (L2); working memory training (N-back) or normal instruction schedule. After six weeks, children showed cognitive transfer from working memory to syntax, but not vice versa, in support of hypothesis (1). The result was most striking in the case of their first language, where working memory training was as effective as language training in boosting syntactic performance. Our results contribute to the debate on the domain specificity of language by showing deep interaction between WM and syntax in children and, by using a randomised control design, show the causal direction is from WM to syntax. We were able to demonstrate greater 'depth' of this interaction than previous literature by employing a purely non-verbal measure of WM. We suggest that the most parsimonious mechanism by which transfer occurred is that there is a close functional mapping between the kinds of cognitive processes required to succeed in the WM task and the subject-verb agreement task. These abilities are connected in a functional hierarchy, such that training one part of the hierarchy transfers to branches close by (Carroll, 1993; Lövdén et al., 2010; Noack et al., 2009 Noack et al., 2014; Figure 1) The effect of transfer was more attenuated in the L2 group compared with L1, yet still statistically significant in both. From previous research there were strong reasons to suspect engaging with different L1/L2 stimuli might lead to different parsing strategies that could plausibly result in different transfer effects. Our results are discussed with respect to L2 speakers' greater susceptibility to similarity-based retrieval interference in part because of their greater reliance on semantic and pragmatic information when parsing (Cunnings, 2017). In summary, our findings about the directionality of the cognitive transfer using a randomised control trial points to a strong causal role for domain-general cognition in language and adds support for theories of development that see language acquisition as a process of repurposing cognition for linguistic ends (e.g., Ibbotson, 2020).

4-K-53   Does active question-asking help preschoolers learn words?

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One way that children actively gain access to new information is through asking (many) questions. Recent work from our lab has shown that in the context of an interactive activity, preschoolers spontaneously target their questions about word meanings toward content where there is potential for information gain. A crucial question is whether active learning leads to more robust learning outcomes. This study examines whether children show better performance in both immediate and delayed tests of knowledge of word meanings after they ask questions about word meanings versus when they are given information about word meanings without asking a question. Four- to six-year-old children participated in a zoom call with an experimenter. During the call, children were asked to move objects. The instructions for moving the objects included an unknown verb (e.g., "transpose the cow and the horse"). In the Active condition, children were told the definition after they asked a question about what the novel word meant. In the Direct Instruction condition, children were offered definitions for the word meanings immediately after hearing the instruction to move the object. Children's immediate production of the action (after the definition) and retention of the word meaning were tested. Retention was measured using a 2AFC task that was administered after a delay of 5 minutes. Children were shown pairs of videos depicting an action they had been asked to complete which had been linked to a novel label (e.g., careen) paired with another action they had been asked to complete which had been linked to a known label (e.g., spin) and were asked to select the video matching the target novel verb. There were no differences in children's immediate production or retention across the two study conditions. Active learning did not appear to confer the hypothesized benefit. Children showed a robust ability to complete the target action after hearing the definition: Children in the Active Condition completed the correct action on average for 4.38 of the 6 unknown words (72.9% of trials, SD=2.06), and children in the Direct Instruction Condition completed the correct action on average for 5 of the 6 unknown words (83.3% of trials, SD=1.22). However, they did not retain these meanings. They showed at chance selection of target actions in both the Active (M=3.21, SD=1.14, n=24) and Direct Instruction Conditions (M=2.88, SD=1.36, n=24). These findings are consistent with previous results showing that children are able to complete referent selection tasks with novel labels, but that they fail to retain meanings (Horst & Samuelson, 2008). Information offered about the word meaning was sparse. This leaves open the question of whether active learning may confer benefits with additional scaffolds (gesture, repetitions of labels, etc).

4-K-54   How many palabras? Codeswitching and lexical diversity in Spanish-English bilingual picture books

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Lexical diversity in children's early language environments supports vocabulary acquisition in monolingual and bilingual children (Hammer et al., 2009; Hoff, 2003). One important source of lexical diversity is the narrative text in children's picture books, which may contain vocabulary and concepts not found in spoken language (Montag et al., 2015). While new research illustrates the potential benefits of reading for early bilingual vocabulary development (Brouillard et al., 2020; Méndez et al.,

2015; Read et al., 2020; Restrepo et al., 2013), the quality of bilingual picture books has not been systematically evaluated. We present the first study to examine the quantity and quality of text in a corpus of Spanish-English picture books (N=45) widely available to bilingual families. We selected books targeted at children ages 0-9 that included both English and Spanish but were not full translations. All books were transcribed in their entirety and tagged for the use of English and Spanish using CLAN (MacWhinney, 2000). To assess quantity, we calculated the number of total words (word tokens) and the number of unique words (word types) in each language. To evaluate quality, we measured lexical diversity (type/token ratio) for each language and the mean length of utterance (MLU) for English-only and Spanish-only sentences. We also examined switching between languages both within (Mira el FIRETRUCK) and between utterances (Mira el camión. IT'S LOUD.) to understand how the languages were used together. Overall, we found that books in this sample presented primarily English text. Books contained on average only 15% Spanish word tokens and included significantly more unique words in English than in Spanish [t(44)=10.03, p <.001]. In addition, English utterances had a longer MLU [t(44)=10.78, p<.001]; the majority of Spanish utterances were only 1-2 words, suggesting greater sentence complexity in English. However, the type/token ratio was significantly higher in Spanish [t(44)=3.62, p<.001], revealing that relatively more unique words appeared in Spanish than in English (see Figure). Analyses of the most frequent words in each language suggested that function words appeared more commonly in English (e.g., the, is), while words about family appeared much more often in Spanish (e.g., abuela), providing additional evidence of differences in how the two languages were used. Finally, we found that books in our sample included frequent switching between languages. On average, 38.4% of utterances included words in both languages, and 13.18% of utterances represented a switch from the prior utterance, suggesting that switching was much more prevalent than what has been found in spoken language (e.g., Bail et al., 2015). Based on these results, we propose that bilingual books offer potentially enriching input for dual language learning, but they may be providing unequal experiences in the two languages. Future research will explore reasons for the dominance and greater complexity of English input (e.g., perhaps the books are aimed at an English-dominant audience, or intended to introduce particular concepts and vocabulary), as well as what children learn from reading bilingual books, particularly those that may provide different experience with language than what they hear on a daily basis.

4-K-55   Developmental improvements in cardinal, ordinal, and spatial language in early childhood

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Our goal was to specify the developmental trajectory of cardinal, ordinal, and spatial language comprehension and production in early childhood. Thus far, 71 preschool children were tested using cardinal (one, three, five), ordinal (first, third, fifth), and spatial (front, middle, back) labels, presented in counterbalanced order. Children viewed a row of toy cars. In the Give Me (comprehension) condition, children were asked to place the appropriate car(s) into a toy garage based on the label provided by the researcher, whereas in the Tell Me (production) condition, children were asked to produce the correct label for the car(s) specified by the researcher. Analyses revealed significant developmental improvement from ages 3 to 4 years and 4 to 5 years. Children were significantly more accurate in the Give Me condition than the Tell Me condition suggesting comprehension is easier than production.

Children were significantly more accurate on trials involving cardinal labels than those involving spatial labels and significantly more accurate with spatial labels than with ordinal labels. These findings are useful because cardinal, ordinal, and spatial language are important for academic success.

4-K-56 **The effect of memory tasks on young children's word knowledge judgment**

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Children's awareness of whether various words are novel or familiar may play an important role in their word learning. We tested whether this awareness could be increased by drawing their attention to features that distinguish novel from familiar words. Sixteen were assigned to each of three conditions (M age = 4-2; R = 3-3 to 4-11). (We plan to test four more per condition to achieve adequate power.) During a video-chat, E told the child to listen to two animals and remember the things that each said they liked. Conditions differed in what these things were: a mix of novel and familiar words (Familiarity Contrast); all familiar words (Familiars); or non-word stimuli (Control). Children's awareness of word novelty was then tested. As predicted, Control showed less awareness than either treatment condition. However, the treatment conditions did not differ. We discuss possible reasons for the unexpected positive effect of the Familiars task.

4-K-57 **The role of syntax in children's acquisition of spatial language: Verbs of direction and spatial location**

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Theories of verb learning suggest that attending to syntax when learning verbs is important, either as learners use the range of frames to deduce meaning (syntactic bootstrapping, e.g., Fisher et al., 2019) or if they align sentences using structure mapping (e.g., Imai & Childers, 2020). We tested whether children could learn two types of spatial verbs. Using Levin's (1993) verb analysis, we presented 3- and 4- year-olds (n = 37) and adults (n = 25) with two verb classes (specified direction, SD; spatial configuration, SC), and tested how well participants could judge grammaticality by having them choose one of two animated characters at test. Adults' grammaticality judgments were consistent with Levin's analysis for 6 out of the 9 verb constructions; they chose the grammatically correct option significantly above chance (binomials, $ps < .05$). In contrast, children's performance did not significantly differ from chance across all verb constructions. However, comparing the results in the experimental 'training' condition to a control condition (no training; n=15), children appear to benefit from hearing four sentences during training. When they make errors, they are consistent with a bias to prefer causative sentences, even if those sentences are ungrammatical. These results support claims that syntax plays a critical role in verb learning.

4-K-58 **The longitudinal relation between language abilities and metacognitive monitoring: Relational differences in native and non-native speakers**

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Language is a mean to think, talk and learn about higher-order processes such as metacognitive monitoring (the ability to evaluate ongoing cognitive processes). We investigated the longitudinal relation between language abilities in kindergarten and metacognitive monitoring accuracy in grade one. We analyzed data from the NEPS (National Educational Panel Study), a large-scale assessment conducted in Germany (N = 9,159). We computed a cross-lagged panel model including receptive language abilities, metacognitive monitoring, and task performance (control variable), measured in kindergarten and grade one, respectively. Cross-lagged paths revealed that language ability in kindergarten significantly predicts monitoring accuracy in grade one. However, monitoring accuracy did not predict language ability. Language abilities were measured in the instruction language, representing L1 language for native speakers and L2 language for non-native speakers. Therefore, it may be that the relational structure between language and monitoring differs between native and non-native speakers. Multigroup analyses revealed that language ability predicts monitoring accuracy for native speakers (N = 6,399) but not for non-native speakers (N = 785). However, monitoring accuracy predicted the language ability of non-native speakers but not of native speakers. Our results indicate directional differences in the relation between language and monitoring ability for native and non-native speakers.

4-K-59 Beta event-related spectral perturbations and semantic processing difficulties following institutionalized care

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Individuals raised in institutionalized care are vulnerable to language deficits. We recorded behavior and EEG while participants judged whether semantic information in a spoken word matched or mismatched an image. Auditory word meaning matched the image, was unrelated and mismatched, or was related and mismatched. Participants were Russian adolescents and adults with a history of childhood institutionalization (n = 187) or raised in biological families (n = 267). Despite behavioral and ERP effects of institutionalization, midfrontal theta (4-8 Hz; 500-1000 ms) varied with semantic conflict processing (X^2 = 18.38, p < .001) but not institutionalization history. Midfrontal low beta (12-20 Hz; 500-600 ms) had an institutionalization x task condition interaction (X^2 = 11.50, p < .01); the difference between the matched and mismatched conditions was larger for the institutionalization versus biological families group. Results indicate persistent language deficits following institutionalization and suggest that beta may be an underlying mechanism.

4-K-60 The effects of viewing perspectives on direction-giving in children

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Providing quality route directions has been established as an indicator of spatial environment knowledge (Blades and Medlicott, 1992). Previous research on adults has found that perspective may

influence wayfinding and spatial knowledge (Morales et al., 2011; Bryant & Trverskey, 1999). We examined whether different viewing perspectives would impact route direction-giving in children. Ninety children (Mage= 7.4, SDage= 2.03, 46 males, ages 4-10) participated. Children were asked to provide route directions based on a map or a video. The video showed a first-person, or route perspective, of an avatar navigating through a virtual environment. The map condition displayed a birds-eye view, or survey perspective. Landmark words reference a stimulus, "monkey" ; direction words reference the path, "left". Results showed that children produced more landmark words in the video than the map, and more direction words in the map than the video. Therefore, route directions vary as a function of viewing perspective.

4-K-61   Speaker variability impacts infants' generalization and recall of word-referent mappings

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Multiple speakers may add variability, highlighting invariant acoustic features that support encoding, recognizing, and learning from speech (Rost & McMurray, 2009). It is unknown how this variability influences infants' generalization of word-referent mappings. We tested the impact of multiple speakers on infants' learning of word-referent mappings and generalization of the mappings to a new voice immediately after training and following a week delay. Infants (19-month olds, N=30 per condition) completed a novel word-learning task in which they were taught 4 word-object pairings by a single-talker (ST) or multiple-talkers (MT, 8 speakers). At test infants had to generalize the mappings to a new voice. Infants were tested immediately following training and again after a one-week delay. A 3-factor ANOVA including condition, sex, and test (immediate and delayed) indicated a 3-way interaction, p=.03. Follow-up tests revealed that females in the MT condition generalized the mappings immediately after training, p=.01, but not after the delay, p>.05. Females in the ST condition only exhibited generalization at the delayed test, p=.049 (Fig.1). Males did not demonstrate word learning at either test, all ps>.05, regardless of condition. The data suggest that talker variability may both help and hinder word-learning; variability promotes the formation of flexible lexical representations, but the representations are not robust enough to be stored.

4-K-62   Children restrict meaning of ordinal vocabulary in numeric but not temporal contexts

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Children's understanding of numerical order is a strong predictor of mathematical achievement (Lyons et al., 2014). Prior work reveals a reverse distance effect, whereby people are better at judging the ordinality of consecutive, as opposed to non-consecutive, numbers (Hurst et al., under review; Lyons & Ansari, 2015). One explanation for these results is that children do not understand the vocabulary used to describe ordinal relationships, 'before' and 'after'. To explore this, we compared children's interpretation of 'before' and 'after' in numerical and non-numerical contexts. Five- & 6- year-olds (N=121) made ordinal judgements about a sequence of 5 numbers and 5 temporal events involving both consecutive items (e.g., "Does 5 come after 4?") and non-consecutive items (e.g., "Does 2 come before

4?"). There was a significant interaction between context and trial type F(1, 117)=59.8, p < .001. Children accepted consecutive numbers as coming 'before' or 'after' each other, M=0.76, more so than non-consecutive numbers, M=0.5, t(118)=8.25 p<.001. However, children did not differently judge consecutive, M = 0.72, and non-consecutive, M=0.69, temporal events, t(119)=1.32, p=.19. Children restrict the meaning of 'before' and 'after' to only consecutive items in a numeric context but not a temporal context, indicating that the reverse distance effect for ordinal judgements is not due to a misinterpretation of relational vocabulary in general.

4-K-63   The visual signals for learning in children's picture books

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A wealth of research demonstrates that picture books are an important tool for early language acquisition (Horst & Houston-Price, 2015). Many studies have examined the roles of the linguistic and social worlds of picture books in supporting word learning. However, much less is known about the ways the visual world of picture books supports word learning. Here we sought to explore the contributions of the visual world on learning by characterizing the referential transparency of nouns in commonly-read picture books for younger (i.e., publisher's age range between 0-5 years) and older children (3-8 years). In our study, we employed a modified version of the Human Simulation Paradigm (Gillette et al., 1999) where naïve adult participants guessed the identity of common nouns (e.g., "bag", "face", "school") from the illustrations (stripped of all the text) in which those nouns appeared. Our results revealed that illustrations were more informative for picture books geared towards younger children than picture books geared towards older children. These findings raise the possibility that how picture books support word learning might change with development. The implications of this work for the basic mechanisms of word learning and for educational and intervention contexts will be discussed.

4-K-64   Infant-directed communication: Examining the multimodal dynamics of infants' everyday interactions with caregivers

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Everyday caregiver-infant interactions are dynamic and multimodal. However, the quality and quantity of infant-directed speech (IDS) has received primary focus in much research on infants' natural interactions with caregivers. Our goal is to augment research on IDS by investigating "infant-directed communication" (IDC): the suite of communicative signals from caregivers to infants including speech, action, gesture, emotion, and touch. We asked caregivers and their 18- to 24-month-old infants to play for 10 minutes while being recorded on Zoom. Videos from 44 predominantly white, middle-class caregiver-infant dyads in the U.S. were coded for IDC using extensively detailed methods. We found that multiple, overlapping dimensions of infant-directed communication occurred throughout the entire 10-minute interaction. In fact, significantly more than half of the speech that infants heard (M = 64%, SD = 12%) was accompanied by one or more non-speech dimensions of IDC, p < .001. Further, while speech alone was not predictive of vocabulary size (p = .35), caregivers used more IDC when interacting with infants who had smaller vocabularies (p = .003). Thus, caregivers may tailor their use of IDC to their

child's abilities, perhaps in a way that enhances learning over time. Overall, our investigation of IDC provides new insights into the true richness of infants' everyday social interactions and enhances current understanding of relations between caregiver input and early learning.

4-K-66   Peas are green: testing toddlers' associations of colors with familiar objects

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Past research suggests that toddlers associate specific colors with objects (Johnson et al., 2011; Perry & Saffran, 2016); however, not all objects have prototypical colors. We created a novel task to investigate whether toddlers are sensitive to differences in these regularities across categories (e.g., most foods have prototypical colors, but vehicles do not). This study was administered via Zoom and recorded for later hand-coding of gaze behavior. Toddlers (36-48 months, n=28) saw familiar objects that were labeled. Immediately after, we assessed their accuracy in encoding objects' colors. On each trial, toddlers heard one of the familiar objects named and saw two colored squares (one matching the color of the object from familiarization). When the named objects were foods with prototypical colors (e.g., peas), toddlers' accuracy in fixating the target color was significantly greater than chance, M=.66, p<.01. When the named objects were vehicles without prototypical colors (e.g., car), toddlers' accuracy in fixating the target color was not significantly greater than chance, M=.54, p=0.22. These findings suggest that toddlers attend to color differently across semantic categories. In future work, we will use this paradigm to investigate how toddlers learn to associate colors with novel objects from different semantic categories. This research will aid in understanding how toddlers use prior knowledge (e.g., most foods have prototypical colors) to facilitate learning.

4-K-67   Children's exposure to language switching in bilingual homes across two communities

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Language switching is a key characteristic of bilingual environments. However, estimates of language switching in caregiver-child interactions vary widely across studies, perhaps due to variation in the communities tested and interaction contexts. Here, we directly compare switching across two bilingual communities to describe diversity in young bilingual's everyday language input. Data from forty 18-35-month-old toddlers from Spanish-English homes in the United States (N=20) and French-English homes in Canada (N=20) were analyzed. We recorded children at home (via Zoom) during two 10-minute play sessions, one with just their primary caregiver and another with additional household members present (e.g., other parents, siblings, nannies). While switching patterns were similar across the two communities during the first session, we found different patterns of switching with multiple speakers present. In the Spanish-English community, we found no significant difference in the number of switches-per-minute that occurred within-speakers (M=2.87, SD=2.00) or across-speakers (M=4.36, SD=3.76), p = .30. In contrast, French-English children encountered significantly fewer within-speaker (M=1.77, SD=1.02) than across-speaker switches (M=6.23, SD=4.18), p = .003. Overall, this study

provides the first direct comparison of the dynamics of switching across bilingual communities and highlights the importance of considering the nature of switching that children are exposed to.

L - Learning

4-L-68   Should the Cat in the Hat Keep Talking Like That? Evaluating levels of anthropomorphism in children's educational media

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How does anthropomorphic content in media affect children's learning? Some studies have found that anthropomorphic content in media can hurt learning because it encourages children to extend anthropomorphic properties from the media onto real-world entities (Ganea et al., 2014; Waxman et al., 2014). But other studies suggest that anthropomorphic content either has no bearing or can help with learning because this content can evoke stronger responses to the narrative and its educational elements (Bonus & Mares, 2018; Conrad et al., 2021; Ganea et al., 2011). One possible explanation for these mixed findings is that different studies have used different levels and types of anthropomorphic content. Some researchers used media that contain high degrees of anthropomorphism, depicting nonhuman animals as essentially human (e.g., the Berenstain Bears; Waxman et al., 2014), while other researchers used media that contain lesser degrees of anthropomorphism (e.g., Geerdts et al., 2016). As a first step towards addressing this disconnect, this study presents a content analysis of anthropomorphism in children's narrative educational media. Our main goal is to determine if the degree of anthropomorphism present in a piece of media is related to features that indicate its potential educational quality. Our analysis set was drawn from a previous study (Chlebuch et al, 2021), which contained 138 videos (from 33 shows) and 110 books. The media was selected if it had a narrative format, was designed to teach a topic in the natural or social sciences, and was aimed at children between the ages of 4 and 10. Forty-three books and 103 videos (from 27 shows; 58.9% of the set) were identified to have some form of anthropomorphism; this is the set that will be analyzed in greater detail for the current study. Most pieces of media in this subset are designed to teach biology (n=94, 64.4%), followed by physics (n=41, 28.1%), history (n=5, 3.4%), science process (n=4, 2.7%), and engineering (1.4%, n=2). Aside from simply identifying which pieces of media have anthropomorphism, this project examines these pieces of media in a more fine-grained way. Specifically, one group of coders will evaluate the degree of anthropomorphic content in a piece of media. They will record the types of anthropomorphized figures (e.g., animals, objects) as well as the ways that these types of figures are being anthropomorphized (e.g., have eyes, can talk). A second group of coders will evaluate the factors that comprise the potential educational quality of a given piece of media. Rooted in the quality index designed by Jordan (1996) for evaluating the educational quality of television programming, coders will rate how explicitly the educational content is stated and how interwoven the narrative component is with the intended educational content. We predict that there will be a negative relationship between the degree of anthropomorphic content and its markers of educational quality: Pieces of media containing larger degrees of anthropomorphic content will be rated as having educational content that is less explicitly stated and is less interwoven with the media's narrative content. These findings will help further clarify the role that level of anthropomorphic content in media can have on children's learning of educational material and can inform choices about how educational media is designed and produced.

4-L-69   Pre-testing as a facilitator of memory integration in children and adults

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Acquiring information from complex materials is challenging. Learning strategies help to maximize outcomes under such conditions. Pre-testing, or answering test questions prior to explicit learning, facilitates adult learning (Little & Bjork 2016, Carpenter & Toftness 2017). However, prior work focused only on direct factual recall. Whether pre-testing facilitates more complex memory processes, and whether pretesting facilitates children's learning, is unknown. To address this need, in the current work we assessed the influence of pre-testing on the complex memory process of self-derivation through memory integration in adults (Experiment 1) and 7-year-old children (Experiment 2). Self-derivation through memory integration requires a learner to combine two separate yet related episodes of new learning in order to generate novel information. For instance, a learner might learn the fact "The word dinosaur means terrifying lizard." At a later time, they learn "The first dinosaur bones were found by the Chinese." When asked, "Who found the first terrifying lizard bones?", the learner must integrate across the two separate yet related episodes to self-derive the correct answer, "The Chinese." Self-derivation through memory integration is an ecologically valid model of learning (Varga et al., 2019). Regardless of age, there is striking variability in performance: across multiple studies, performance ranges from floor to ceiling. Pre-testing is a possible means of facilitating performance, thus lessening variability in this educationally relevant learning process. In Experiment 1, 45 adults (Mage= 20.42) were exposed to 20 integrable fact pairs, half of which were pre-tested. The pre-test consisted of an open-ended question probing one of the two separate yet related facts making up each integrable sentence pair. For instance, a participant might be asked to answer the pre-test question "What does the word dinosaur mean?" before learning both members of the integrable pair (see above). In Experiment 2, 37 children (Mage= 7.23) were exposed to 14 integrable fact pairs, half of which were pre-tested. Participants in both samples also completed Woodcock-Johnson Tests of Verbal Comprehension. Preliminary data shows that, overall, adult learners were more successful at answering the integration questions on pre-tested trials t(44)= 2.94, p=.005. We did not see evidence of this same overall effect in children t(36)= .95, p= .347 (Figure 1). For both age groups we found the same pattern of correlation between verbal comprehension and learning outcomes: they were stronger for non-pretested trials (adult r= .28, child r= .56) than pre-tested (adult r= .19, child r=. 37). One possibility for these results in that both child and adult learners do not rely as much on their own knowledge (as indexed by verbal comp) when they have access to a pre-test. Adults may benefit from this type of adjustment whereas children might not. As a whole this work shows that pre-testing is an effective learning strategy for adults, not only for direct recall, but also for more complex memory processes. Preliminary data show it is not as effective for children. Further, we find preliminary evidence supporting novel insight into why pre-testing works for adults: it lessens the need for learners to rely on their own prior knowledge. Results allow for deeper understanding about developmental differences in the effectiveness of learning strategies.

4-L-70   Early scientific literacy: Foundations in causal reasoning

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Although early causal reasoning has been studied extensively, inconsistency in the tasks used to assess it has clouded our understanding of its structure, development, and relevance to broader developmental outcomes. This research attempts to bring clarity to these questions by exploring patterns of performance across several commonly utilized measures of causal reasoning, and their relation to scientific literacy, in a sample of 3-5-year-old children from diverse backgrounds (N = 153). A longitudinal confirmatory factor analysis revealed that some (counterfactual reasoning, causal learning, and causal inference), but not all (tracking cause-effect associations and resolving confounded evidence), measures of causal reasoning assess a unidimensional factor, and that this resulting factor was relatively stable across time. A cross-lagged panel model analysis revealed associations between causal reasoning and scientific literacy across each age tested. The two constructs related to each other concurrently, and each predicted the other in subsequent years. Implications for early STEM-engagement and success are discussed.

4-L-71   Developing the knowledge base: Self-generation as a tool for change

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What are the cognitive processes that support knowledge base development? For children and adults, generating information oneself leads to better memory than if the information was directly taught (Slamecka & Graf, 1978). However, less is known about whether self-generating improves memory for related information in the knowledge base, or only what has been generated. This question is critical because self-generating is most effective for learning if it offers a more general memory benefit. In this study, we examined how the knowledge base may benefit from the generative process self-derivation via memory integration (Bauer & Varga, 2017): production of novel inferences based on integration of multiple facts. We exposed college students to integrable neuroscience facts. We then prompted them to self-derive an inference based on the facts (self-derivation condition), or we directly taught them the inference and asked them to rephrase it (rephrase condition). In both conditions, successfully generating one's own information led to higher performance. Further, when self-derivation was successful, memory for both the generated inferences and the directly-taught facts was better than in the rephrase condition. This suggests that generating information oneself supports learning, furthering our understanding of how to build knowledge across development. The data also demonstrate that when one successfully engages self-derivation, it is a critical tool for effective learning.

4-L-72   The effect of goals on families' exploration during an informal STEM activity

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Exploration, actions taken to reveal information from the environment, supports children's learning from informal STEM experiences (Callanan et al., 2020). However, whether informal experiences engender exploration depends on their design. Laboratory research suggests play prompts influence exploration (Yu et al., 2018). Therefore, we examined how the specificity of provided goals influenced exploration during a parent-child informal programming activity with an app-controlled robot. Researchers delivered iPads and the robot to families' (N =74) homes. During the virtual study, children

(Mage = 7.8) and parents used an app to program the robot to complete an assigned goal - either an open-ended goal, a guided goal with some specifications, or a closed-ended goal with step-by-step instructions. Exploration was measured by the variety of codes in families' final programs. Goals influenced exploration F(2,65) = 5.613, p = .006. Families who completed the open-ended goal explored most, r(65) = -.38, p = .001. Open-ended goals may best support exploration during informal STEM activities.

4-L-73   Home sweet home: Relations between episodic and semantic memory in childhood

Sabrina Karjack[1], Chi Ngo[2], Nora Newcombe[1]
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Semantic knowledge guides adaptive behaviors through generalization; episodic memories preserve individual experiences. Some models propose that generalization occurs via linking individual yet related episodes (Kumaran et al. 2012). If so, generalization should be contingent on memory for specific instances, as observed in adults (Banino et al. 2016). However, in development, semantic memory surfaces years before episodic memory, and Ngo et al. (2021) showed generalization did not depend on episodic memory in young children. This study aims to further characterize the contingency. Children of 3-8 years watched animals find homes in distinctive environments. These events had a coarse-level regularity (e.g., mammals-town 1; birds-town 2), and a finer-grained regularity (e.g., horses-castle in town 1). We tested children's inferences about unstudied animal-place associations as well as episodic memory of the animal-place associations on continuous and categorical scales. We predict coarse-level generalization will be robust at an early age, while fine-grained generalization will show age-related change, as will episodic memory. Fine-grained but not coarse-level generalization may be contingent on episodic memories. This design will reveal age patterns in generalization and episodic memory, and characterize the generalization-episodic memory interdependence in childhood.

4-L-74   A preliminary investigation of the relationship between children's shape knowledge and mental rotation skills

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Shape knowledge and mental rotation are both components of spatial cognition, and a recent study (Casasola et al., 2020) has indicated that the two may be developmentally related. The present work investigated whether teaching 4- and 5-year-olds the definitional properties of shapes affected their mental rotation skills. Children were randomly assigned to either a shape learning condition or a control condition and were given two mental rotation assessments and two shape knowledge assessments before and after the instructional period. All testing was performed virtually over Zoom. Children 4.5-years and older in the shape condition had a marginally significant increase on mental rotation performance with non-shape stimuli. Exploratory analysis found that children's baseline mental rotation score was positively correlated with change on a shape sorting task. Results give preliminary indications that children's shape knowledge and their mental rotation ability are related and help to constrain theories of how shape knowledge is acquired and how it may affect mental rotation skills.

4-L-75   **Predictors of arithmetic fluency with integers**

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Integer arithmetic skills are important for later mathematical performance and learning. This work investigated factors associated with fluency in integer addition in children in grades 5-7 (N=62, M age=11.44 years). We examined demographic, attitudinal, and cognitive factors, including age, grade, gender, mathematics anxiety, understanding of the Additive Inverse principle (i.e., the sum of any number and its inverse is 0), and use of mathematically precise language ("negative" rather than "minus" on a related task). Older children, boys, and those who used "negative" language scored higher on the integer arithmetic fluency task (IAF; from Tsang et al., 2015), and children with higher mathematics anxiety scored lower. Understanding of the Additive Inverse principle was unrelated to IAF. A linear model including all correlated factors revealed that only math anxiety and grade level were significant predictors of IAF. Future work should further examine the implications of mathematics anxiety for integer understanding.

4-L-76   **Developmental changes in learning from robots**

Anna Baumann[1], Alexandra Meltzer[1], Elizabeth Goldman[1], Diane Poulin-Dubois[1]
[1]Concordia University, Montreal

This study examined if preschoolers aged 3 (N = 43) and 5 (N = 43) years prefer to learn words from a competent humanoid robot (NAO) or an incompetent human. The results indicated that 5-year-olds endorsed NAO's labels for unfamiliar objects significantly more than 3-year-olds (t(84) = -2.1, p = .037). Only older children selected the robot above chance. In a naïve biology task (Gottfried & Gelman, 2005) children were shown animals, artifacts, and the robot and asked what goes inside: something mechanical (e.g., gears) or biological (e.g., bones). The 3-year-olds chose the correct inside (mechanical) for NAO half the time, but most of the 5-year-olds correctly chose the mechanical inside. These results confirm the robust reliance on epistemic cues by 5 years of age in the trust paradigm. An ongoing follow-up study with 3-year-olds pitting a non-humanoid robot with a human informant will shed light on the current findings.

4-L-78   **Curiosity promotes preschoolers' learning on a causal task**

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Curiosity occurs when a child recognizes a gap in their knowledge and seeks to close that gap (Lowenstein, 1994), which often occurs through exploration (vanSchijndel et al., 2018). Children who are more curious have higher academic outcomes in kindergarten (Shah et al., 2018), likely because curiosity increases children?s motivation to learn (Author, 2018). In the current study, 43 children (4- to 6-years) completed a behavioral measure of curiosity before participating in a causal learning task where they were asked to explore several objects to learn a causal mechanism. Children were then tested on their knowledge of the causal mechanism after the task. We predicted that children?s curiosity and

exploration would predict their performance on the test. We also predicted that children who are more curious would explore more items during the task. In accordance with our hypotheses, children?s curiosity significantly predicted their performance on the causal learning test (B =0.20, t(41) = 2.48, p=.02), and exploration marginally predicted performance, B = 0.09, t(42) = 1.96, p =.06. Surprisingly, children?s curiosity did not influence the number of items they explored, B = -0.67, t(41) = -0.36, p=.72. These findings indicate that curiosity is important for learning, and that the relation between curiosity and exploration is complex in young children.

M - Memory

4-M-79   How good are adolescents' powers of observation? Predicting event memory and trustworthiness in 12-to 17-year-olds

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Adolescents are an important yet understudied age group in the field of eyewitness testimony. Potential jurors rate adolescents' cognitive capabilities as similar to adults but judge them to be less trustworthy than younger children. To investigate which factors predict event memory and trustworthiness in 12-to 17-year-old adolescents, we tested their memory for events in a video, using free recall and multiple-choice recognition. In addition, adolescents completed tasks assessing their cognitive capabilities using theory of mind, decision-making and self-perception measures, and their trustworthiness using Machiavellianism and willingness to trust measures. Adolescents were 90% correct for recall and 81% correct recognition. Recall increased with age and self-perception; older and more competent adolescents had a higher proportion correct for recall. Gender and self-perception predicted Machiavellianism. Males had higher Machiavellianism scores than females and adolescents with lower self-perception had higher Machiavellianism scores. Self-perception also predicted willingness to trust. Adolescents with lower self-perception had lower trust in others. Overall, these findings indicate that self-perception significantly predicts both recall and trustworthiness. Additionally, the findings demonstrate that adolescents have the memory capabilities to act as eyewitnesses and therefore can provide reliable testimony in court proceedings.

4-M-80   The mental timeline supports the development of temporal memory

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In early childhood, the development of memory for the temporal order of events lags behind memory for where those events occurred. A potential solution to the challenge of remembering temporal order is to engage the mental timeline, a linear projection of time onto space. Previous work suggests that adults and older children spontaneously activate the mental timeline when encoding the order of events into memory. Here, we asked whether the development of the mental timeline in early childhood supports the development of temporal memory. To answer this question, we tested for an association among individual differences in the strength and orientation of children's mental timelines and their memory for temporal order. 96 5-to-6-year-old children watched videos of a character engaging in a series of events and then answered memory questions about the order and location of the events. Children also completed an open-ended timeline construction task in which they arranged icons to

represent temporal order. We found that performance on the timeline task predicted children's memory for temporal order but not their memory for locations: children who made two linear arrangements had better temporal memory performance than children who made zero lines (t(57)=-2.2, p=0.03), but there was no difference in location memory performance (t(62)=0.36, p=0.7). Our results suggest that one reason why the mental timeline is so common across cultures is because it facilitates temporal memory.

4-M-81   Storytelling and autobiographical reminiscing in young children

Madeleine Frazier[1], Sabrina Karjack[1], Giulia Masi[1], Elliott Johnson[1], Ingrid Olson[1], Nora Newcombe[1]
[1]Temple University

Young children are enthusiastic storytellers, but their narratives tend to be disorganized. During this same age range, autobiographical memory rapidly improves. Does developing narrative skill play a key role in the development of autobiographical reminiscing? We tested this connection by showing clips of silent, unfamiliar German cartoons about a mouse (Maus) and his elephant friend to 4- to 6-year-old children (n = 50, collected but not all coded). After viewing a cartoon once, participants were instructed to narrate the story while it was replayed. We quantified a variable termed "narrative complexity" based on temporal and causal elements, as well as goal-based story structure. Separately, children reminisced about personal life events that their parents had selected. We evaluated children's reminiscences based on their production of new or repeated information, a variable termed "elaborative skill". We also measured children's verbal intelligence as a control. Our preliminary results (n = 10) confirm that both narrative complexity and elaborative skill correlate positively with age, controlling for verbal IQ. With the full dataset coded, we will report on whether children who produce more complex narratives about Maus produce more detailed personal reminiscences, independent of age and verbal intelligence.

4-M-82   14- to 19-month-old infants' memory benefit from virtual counting events

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Recent studies suggest that watching an experimenter count helps infants better remember sets of objects (Wang & Feigenson, 2019). This kind of counting input may underlie individual differences in later number knowledge (Gunderson & Levine, 2011). The current study focuses on counting objects to understand how infants represent objects and events via media: Does virtual counting help infants better remember objects on a screen? Sixty infants (M = 16.52 months, SD = 1.90, 33 males) participated in this study online. We measured infants' memory for hidden objects with a violation of expectation paradigm, comparing infants' looking time when there was a Match between the number of objects hidden and revealed (e.g., two objects hidden, two objects revealed) or a Mismatch (e.g., four objects hidden, two objects revealed). Infants watched the objects counted (Counting condition) and labeled without counting (No Counting condition) before being hidden. If virtual counting aids infants' memory for hidden objects, they should distinguish the two events in the Counting condition only. The No Counting Condition showed no event preference , t(59) = -1.61, p = .11, Cohen's d = -.21. In contrast, in the Counting Condition, infants looked significantly longer at the Mismatch Event , t(59) = 3.52, p < .001,

Cohen's d = .45. These results suggest that only the Counting Condition enhanced infants' memory, and that infants' memory for hidden objects may benefit from virtual counting.

N – Methods and statistics

4-N-83   Young children treat puppets (and dolls and pictures) like real persons

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When young children are tested on social cognition tasks using puppets or dolls, do they exhibit similar, and similarly valid, results, as when they are tested for their understanding using real persons? We tested this question empirically by conducting a meta-analysis (aggregating data across 259 separate studies and 35,189 children) on false-belief theory of mind tasks. In our data, children were often tested with puppets and dolls (more than 70% of the time) but performed essentially equivalently as when tested with real persons. This equivalence held in many countries (36), including English-speaking countries like the U.S., the U.K., and Australia, European countries like Germany, Poland, Sweden, and Portugal, non-western countries like Japan, China, Thailand, and the Philippines, plus South and Central American countries like Brazil, Argentina, Peru, and Mexico. This equivalence also held in various age groups, focally children who were 2.5 to 6 years at the time they were developing their theory of mind - young children were similarly incorrect at judging false beliefs with puppets and dolls just as with people, and older children were similarly correct.

4-N-84   The development and testing of a novel face controlled experimental tool for toddlers and young children

David Tompkins[1], Marisa Radulescu[1], Nikki Jagid[1], Max Portnoy[1], Obinna Abii[1], Brandon Man[1], Annika Voss[2], Vanessa LoBue[3], Lisa Oakes[2], Marianella Casasola[1]
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This poster outlines the testing and development of a novel experimental tool intended to add an intuitive control system to asynchronous remote experiments for young children. The tool incorporated HandsFree.js (Ramos, 2021), a publicly available face-tracking JavaScript library, to the Gorilla remote testing platform (Anwyl-Irvine, Massonniè, Flitton, Kirkham, & Evershed, 2020), and thereby allowed participants to control images on their screen by turning their face to either direction. We used the tool to test 30 children between the ages of 1 and 4 years in a simple shape matching task. Sixteen of these children received the task asynchronously with prerecorded instructions. The remaining 14 children received the task with live instructions via a remote video-conferencing platform. Children were largely unable to use the tool successfully in either group. In some cases, children did not appear to understand how to use the tool, despite completing several training trials. Children who did appear to understand the tool encountered many technical issues, likely due in part to the constraints of participants? home devices. We share several recommendations for researchers interested in developing or using remote interactive tools. First, we recommend a focus on simple and familiar gestures, such as pointing. Second, we advocate an iterative approach to developing similar tools. Third, we encourage an early consideration of the limitations of home devices.

4-N-85   Creativity is in the eye of the (adult) beholder: Rating preschoolers' responses to the alternate uses task

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Although divergent thinking (DT) tasks (in which participants generate ideas for an open-ended problem) are widely used to assess creativity, their scoring is debated. Neuroscientists studying adult creativity increasingly rate the creativity of ideas rather than relying on volume and statistical rarity. However, developmental research often uses count-based scores, making it challenging to link these bodies of work. A recent study found a negative link between 4- to 6-year-olds' executive function (EF) and the number of ideas generated in the Alternate Uses test of DT (Vaisarova & Carlson, 2021) - a pattern contrary to some research on the role of EF in adults' performance on this task. To probe whether this apparent difference is developmental or methodological, we applied a rating protocol from adult creativity research (Silvia et al., 2008) to data from this project. Ratings were reliable across three raters in Study 1 (N=103) and Study 2 (N=74), although reliability was lower with novel (ICC=.70-.74) than familiar stimuli (ICC=.84-.95). Creativity ratings were associated but not redundant with count-based scores (rs =.28-.39), and negative associations with EF became null when using ratings. Subjective ratings are an interesting addition to the developmental creativity researcher's toolbox; however, raters' reflections suggest that children's DT is not just a "mini" version of adults' DT and rating the creativity of young children's ideas involves special considerations.

P - Morality

4-P-86   Differences in information-seeking behavior about morally-relevant events in children and adults

Daniel Yonas[1], Larisa Heiphetz[1]
[1]Columbia University

Both children and adults show sensitivity to information regarding intent when making moral judgments (Young, Cushman, Hauser, & Saxe, 2007). Children and adults also spontaneously seek out information about events that violate their expectations (Legare, 2012). We extend this work in the following ways by probing children's and adults' interest in seeking information about intent in morally-relevant situations and by investigating how this desire for information may change across development. This work is important because of how in everyday life, explicit information about intent is not always available. This design allowed us to test how expectations may shape responses to different types of morally relevant actions. Young children show optimism about others and expect them to perform pro-social behaviors (Boseovski, 2010). Therefore, they may be particularly curious about why people act in unexpected ways, i.e, perform transgressions. Because optimism declines across development, older participants may find transgressions less unexpected and therefore express less curiosity about these behaviors. The current work probed this question and investigated the differences in adults' cognition (N = 192; recruited through MTurk) by comparing their responses with 80 older (7- to 9-year-old) and 80 younger (4- to 6-year-old) children. All participants learned about characters who performed either transgressions or prosocial behaviors for unclear reasons (e.g. saying something mean vs. nice about another person's drawing for unstated reasons). Participants then indicated how much they wanted to learn about why these actions occurred on a scale ranging from -2.5 (indicating a strong desire to learn about why the transgression occurred) to 2.5 (indicating a strong desire to learn about why the pro-social behavior occurred). Additionally, participants indicated their desire to attempt specific

information-seeking behaviors, such as asking actors why. We averaged responses across these items to form one measure of information-seeking and entered this composite into a 2 (transgression versus prosocial behavior) x 3 (younger child, older child, adult) mixed ANOVA with repeated measures on the first factor. We found a main effect of age: older children reported a greater desire to obtain information about moral transgressions than adults. Additionally, younger children did not significantly prefer either prosocial behaviors or moral transgressions. These results demonstrate a difference in the evaluation of moral transgressions that is not present when evaluating prosocial behaviors. This effect may not be present in younger children because they may value positive information as highly as information about expectation-violating events. Future work will address how this effect may be a function of older children and adults' expectations for transgressive events (e.g. that this effect may then appear in older children as they begin to value positive information less highly and then further reduce in adults as transgressive events become more expected).

4-P-87   What do children and adults learn from punishment? Examining laypeople's understanding of punishment's messages

James Dunlea[1], Larisa Heiphetz[1]
[1]Columbia Univeristy

Legal pundits argue that punishment is an action and a tool for social learning and communication. Yet, little work has tested what people might learn from observing punishment. Study 1 examined this topic by probing 6- to 8-year-olds' and adults' views about what punishment signals about a punished individuals' past. Subjects learned about an incarcerated target and indicated their agreement about whether he was punished for his prior bad character. Children were more likely than adults to report that people receive punishment for their bad character. Study 2 built on Study 1 by probing the role of relationships with incarcerated people in shaping children's inferences about criminal legal system (CLS) contact. Six- to 12-year-olds with incarcerated and non-incarcerated parents provided qualitative data about why they thought people encountered the CLS. Both groups inferred that CLS contact stems from internal factors (bad character, desires). Together, Studies 1-2 suggest that children use CLS contact as a signal of past immorality. Study 3 probed 6- to-8-years-olds' and adults' inferences about punishment's future-oriented messages. Subjects indicated the extent that "nice" and "mean" targets' character changes after incarceration. Children--not adults--indicated that "mean" targets became "nicer" after incarceration, suggesting that children view punishment as a signal of moral redemption. Together, this work illuminates what laypeople learn from punishment.

4-P-88   Preschooler's context dependant moral evaluations

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Unlike adults and infants, preschoolers show inconsistencies in their context specific moral-judgements (Li, Hou, Zhu & Tomasello, 2020, Li & Tomasello, 2018 and Bocian & Szarek, 2020). Our work seeks to explore when, and under which circumstances, preschoolers positively evaluate those who punish bad others. Across 4 Experiments with 3- and 4-year-olds and 1 experiment with adults, participants watched a series of animations featuring prosocial/antisocial characters being aided/thwarted by a

rewarder/punisher character. Participants then rated the acceptability of the rewarder and punisher's actions on a 5-point scale, ranging from "really bad" to "really good". This work indicates primarily non-significant patterns of context specific evaluations among preschoolers. The current study seeks to replicate Experiment 3, where 4-year-olds (but not 3-year-olds) rated helping prosocial targets as more acceptable than helping antisocial targets and hindering prosocial targets more unacceptable than hindering antisocial targets. By making minor procedural adjustments we hope to amplify our previous findings. Data collection will be completed upon presentation.

4-P-89 Should Furpees put caps on their spikes? Children's reasoning about novel public-health measures

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The current pandemic raises questions on how children reason about public-health measures like mask wearing. This study investigated whether framing novel protective behaviors as either self-directed or other-directed influences children's evaluations of these behaviors. Children viewed vignettes of alien characters who faced dilemmas such as covering up spikes on their body with heavy caps. While mirroring the dilemma faced regarding mask-wearing, we chose novel situations to prevent interference from children's pre-existing beliefs. In a within-subjects 2x2 design, we manipulated the framing (other-directed vs. self-directed) and severity (low vs. high harm) of the aliens' dilemmas and tested 48 children ages 5-10 years over Zoom. Our dependent measures were children's evaluation of aliens who followed versus violated the protective measure. Regression analyses showed that both framing and severity influenced children's evaluations: Across ages, children showed more positive ratings for followers than violators in the other-directed over the self-directed condition ($X2(2)=7.79,p=.02$), and in high versus low harm contexts ($X2(2)=54.25, p<.001$). These effects were also consistent in their ratings of each alien's friendship quality (f: $X2(2)=30.30, p<.001$;s: $X2(2)=27.56, p<.001$). A follow-up study (N = 61) replicated these findings. Framing public health measures as other-directed thus activates children's social-moral reasoning, which may affect how they value such behaviors.

4-P-90 How do infants represent legitimate leadership?

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Infants distinguish between fear-based power (bullying) and respect-based power (leadership). However, what cues do they use to represent legitimate leadership? Across seven experiments that varied the cues provided, we assessed whether infants expected agents to obey a character. In Exp. 1, we asked whether the act of bowing (which matches the respect displays found across cultures, and the prostration cues for subordination found across species) suffices in generating the representation. We tested this by assessing whether 21-mo-olds expect agents to obey a character if they have bowed for it. Infants saw three geometric agents bowing to a character. Next, it instructed them to go to bed, and they either complied while it watched but disobeyed after it left (disobedience) or continued to comply after it left (obedience). Infants looked longer at disobedience, indicating that they expected the agents to obey. Exp. 2 replicated the finding. In Exp. 3 the same events were shown but agents no longer

bowed (they moved back-and-forth sideways). In Exp. 4 the character conferred a benefit to the group giving them a ball, and in Exps. 5-6 it imposed a cost to the group, by stealing the ball (Exp. 5) or hitting them with a stick (Exp. 6). In Experiments 3-6, infants did not generate clear expectations. In Exp. 7 the character received a tribute (the ball) from the group, and infants expected disobedience. In sum, Norwegian infants use bowing as a cue for representing leadership.

R – Numerical & spatial cognition

4-R-91   Systematic errors in children's estimation of cumulative area

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Adults, and even children, can quickly and effortlessly estimate the number birds in a flock, the amount of 'stuff' in a shopping cart, and the density of people in a crowd. Remarkably, children's ability to estimate and discriminate visual quantities like these meaningfully predicts mathematics achievement in school. Thus, there has been considerable interest in understanding the mechanisms and development of quantity perception. Although number perception has received the most attention, other dimensions of quantity perception, like area or volume, have not been carefully investigated. Interestingly, though, work with adults reveals systematic distortions of perceived area. It has been suggested that adults' area judgments are best captured by an 'additive area heuristic' -- whereby the visual system adds rather than multiplies the spatial dimensions. Do children exhibit similar distortions of perceived area? We addressed this question in two ways. First, we asked whether 'additive area' explains area judgments better than true, mathematical area. We did so by varying the number and sizes of items in displays to orthogonalize these two key dimensions. Children (4-, 5-, 6-, and 7-year-olds; N=25 per age group) as young as four years old reliably discriminate sets that vary in 'additive area' (while true, mathematical area is controlled) but fail to discriminate sets that vary in true, mathematical area (while 'additive area' is controlled; see Figure). These results suggest that area perception in children, as in adults, is systematically distorted. Although regression analyses revealed no significant effect of the number of items in our first experiment, we nevertheless wanted to evaluate whether 'additive area' explains variance in children's area judgments even when number is controlled across sets. In a second experiment, we tested a separate group of children (4- and 5-year-olds; N=25 per age group) on a new stimulus set in which 'additive area' and true, mathematical area varied while number was held constant across the entire set (i.e., every stimulus contained 6 items). Unexpectedly, we found that while performance was roughly at chance for both 'additive area' and true area discriminations when number was held constant, children were highly systematic in their choices. Certain children consistently chose stimuli greater in 'additive area', whereas other children consistently chose stimuli greater in true, mathematical area. We conducted permutation tests to demonstrate that this level of systematicity is extremely unlikely to occur by chance (p<.0000001). The findings from our first experiment suggest that children's area judgments may be distorted, much like adults'. However, the findings from our second experiment suggest that there are certain circumstances where children are confused: In tightly controlled stimuli that vary along multiple dimensions, children fail to reliably discriminate based on either 'additive area' or true, mathematical area. Nevertheless, individual children are highly systematic, suggesting they employ some task-specific strategy in making their judgments. We speculate that this pattern may arise from children's general inability to integrate multiple cues to make judgments about quantity perception (as in classic Piagetian tasks).

4-R-92   Patterns of number elicitation in parents and children in the lab and at home

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Early math skills predict later educational outcomes (Duncan et al., 2007), and variability in math performance is already present before kindergarten (Jordan et al., 2006). Prior work found higher parental use of number talk (number words and questions about number concepts) predicts better math outcomes in preschoolers (Levine et al., 2010; Elliott et al., 2017), but exclusively considered the frequency of number words, or combined number words and questions. Recent evidence suggests number prompts may be particularly helpful for encouraging children's own number talk (Eason et al., 2021). Here, we examine use of number elicitations (questions and prompts used to evoke a response using number concepts which may be a key opportunity to scaffold attention to and seek information about number) during free play interactions in a standardized lab setting and the natural home environment (119 parent-child dyads; child M age=3.9 yrs). Parental use of number elicitations across both contexts predicts children's growth in math over the course of six months, but this association is mediated by children's use of number elicitations. This effect holds even controlling for children's baseline math performance, parents' and children's use of non-number elicitations, children's gender, age, and vocabulary. Furthermore, parents and children used more number elicitations in the lab than at home, suggesting common lab-based observation methods may not reflect the natural home environment.

4-R-93   Symmetry preference in 3D object completion

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Three-dimensional objects pose a challenge for our visual system, since we can only view objects from a single limited perspective at a given moment. Previous work found that given a limited perspective, infants represent 3D objects as solid and complete volumes. Our study explores whether, in addition, humans have a bias to represent visually limited 3D objects as symmetrical rather than asymmetrical across shape, size, texture, and color, and when this bias might emerge. 83 four- to seven-year-olds and 40 adults saw 12 novel 3D objects from limited viewpoints on a computer screen and were asked what each object would look like if it were rotated. They were asked to choose among a symmetrical possibility, an asymmetrical possibility, and an impossible distractor. Overall, there was an above-chance preference for symmetrical object completion (in shape, size, texture, and color) that increased with age. Despite the early emerging shape bias and attention to symmetry, both children and adults exhibited the weakest preference for symmetrical shape completions. The low-level perceptual similarity of choices did not predict participants' choices. Moreover, a self-supervised neural network (SimCLR) showed lower accuracy in object completion and weaker symmetry preference than children and adults on the same task, raising the possibility that incorporating human symmetry biases could improve computer vision.

4-R-94 **Flexible attention to magnitudes: Investigating specificity in dimensional attention**

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Flexibly shifting focus between numerical and spatial magnitudes (number and size) is a unique challenge in preschool and predicts later math achievement, controlling for executive functioning (Fuhs et al., 2021). We asked whether preschoolers' math achievement was specifically related to number-size switching. We hypothesized that number-size switching would be more difficult and predict math achievement more strongly than when switching involved only one of those magnitudes, or neither. We created four Flexible Attention to Dimensions (FAD) tasks in a 2 (includes number) x 2 (includes size) design (number-size, number-color, size-color, color-shape). We analyzed 12 mixed trials where children selected one of two incongruent images (e.g., "which side has [bigger/more] stars," with 6 small stars vs. 3 large stars). Participants (N=131, Mage=54.5 months; SDage=10.0 months) completed one FAD task over Zoom (between-subjects) and a standardized math achievement test. We found a significant Includes Number x Includes Size interaction on percent of above-chance scorers. Surprisingly, children in the number-size condition were significantly more likely to score above chance (57%) than the number-color condition (31%); other conditions were intermediate. The correlation of math achievement to FAD did not significantly differ between conditions. These results suggest that switching focus between number and color was unintuitive, perhaps due to the continuous-categorical distinction.

T – Prosocial behavior

4-T-95 **Children are intuitively cooperative: Time pressure increases children's cooperative decisions in a public goods game**

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The tragedy of the commons, an event that occurs when individuals place personal incentives over those of the group (in other words they fail to cooperate), is a major cooperative dilemma that individuals face every day. Researchers have used the public goods game to empirically demonstrate that adults are intuitive cooperators, tending to make cooperative decisions faster than self-maximizing ones. To investigate the ontogenetic origins of intuitive cooperation, we examined the development of intuitive cooperation in middle childhood. We presented 150 children between 7 to 12 years of age with a child-accessible version of the public goods game. Children were given a choice between giving two resources to themselves or four to their group comprised of three unfamiliar partners. Children were randomly assigned to one of three conditions: time neutral, time delayed, or time pressured. The condition to which children were assigned predicted their rate of cooperative choices (LRT, χ^2=8.75, p=0.01). When decisions were made under time pressure, children cooperated more compared to when time was delayed or neutral (β=2.30, p=0.02). Furthermore, pressured responses only favored cooperation if children believed their unfamiliar partners also cooperated (β=3.60, p<0.001). These findings held across all ages in the study. In sum, our results suggest that by middle childhood children are already intuitively cooperative provided they believe others are cooperative too.

4-T-96   **The effect of counterfactual reasoning on children's moral evaluations**

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Engaging in counterfactual reasoning (reasoning about what could have happened) is an important skill for reasoning about free will and moral judgements. While prior research has shown children have this ability by preschool age, little is known about how individual differences in counterfactual reasoning impact children's social evaluations. In this study, we investigate how prompting children to engage in counterfactual thinking about prosocial actions influences their social evaluations. Eighty-seven 4- to 8-year-olds were introduced to a character who engaged in a prosocial behavior (sharing a sticker with a friend) and were prompted to generate either a high (five) or low (one) number of counterfactual possibilities (alternative actions) the character could have done with the sticker. Children were then asked a series of social evaluation questions comparing that character to a constrained one who was told to share and had no alternatives. Results indicate that younger, but not older, children who generated more selfish counterfactuals were more likely to evaluate the unconstrained character (who chose to share) more positively than the constrained character (p = .002). Additionally, older children were more likely to positively evaluate the unconstrained character regardless of the type of generated counterfactuals (p = .003). These findings highlight the importance of counterfactual reasoning in the development of social evaluations.

4-T-97   **Costly sharing in a virtual environment: Examining developmental trends from 3.5 to 11 years of age**

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Due to the pandemic, the study of cognitive development shifted online, and many researchers report that they will continue to work within the virtual environment even post-pandemic (Shore et al., in prep.). It is unclear how this change in interaction style will affect our measures, particularly in the study of behaviors like sharing, where we already know from in-person studies that the characteristics of the potential recipients matter, as well as the value of the to-be shared objects. Here, we examined costly sharing in early to mid-childhood in a virtual environment. Children earned 10 virtual coins and then could share with a needy recipient: an adult who was synchronously interacting or an unknown, unseen child. We also considered factors related to experience in the broader online context, namely screen habits (i.e., screen time and gaming). Participants were 125 3.5- to 11-year-olds (73 girls) in Canada and the United States. There was no difference in the amount of coins shared with the adult or unseen child. A general linear model suggested a developmental trend of increased costly sharing with online recipients (p<.001), consistent with in-person studies. For children age 6 years and older (n = 78), we found weak evidence for a positive relationship between screen time (p=.078) and playing collaborative video games (p=.050) with sharing. These results will be addressed in relation to a follow-up condition in which all testing occurred asynchronously.

4-U-98   The effects of disagreement on young children's confidence and information search

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Disagreements are common occurrences in children's everyday lives. Does disagreeing (versus agreeing) with a social partner reduce children's confidence in their belief and motivate them to search for additional information? In Study 1, 4- to 6-year-olds (N=68) had to determine, together with a confederate, which toys in a set were "blickets" after being exposed to ambiguous evidence. We measured children's certainty regarding which toys are blickets before (t1) and after (t2) the confederate either disagreed or agreed with their belief. As predicted, children in the disagreement condition were less confident in their belief at t2 (W=454.5; p=.07) and searched longer for additional information (W=682; p=.07) compared to children in the agreement condition, although results were statistically not significant. In Study 2, we currently investigate whether the effects of disagreement are stronger if children disagree with an expert, whose opposing belief they might evaluate as more meaningful.

4-U-99   How self-directed executive functioning influences children's exploration & task performance

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Self-directed executive functioning (EF) refers to children's skills to independently structure and manage their time and has been linked to children's everyday experiences structuring their own activities (Barker et al., 2014). A common challenge of structuring activity is the explore-exploit tradeoff, wherein individuals must optimize between exploring novel options and exploiting known rewards when resources or time are limited (Cohen et al., 2007). Thus, the behavioral management associated with self-directed EF may enhance optimization between these two modes. To investigate how self-directed EF relates to 7- to 11-year-olds' (n = 64, MAGE = 9.25, 32 girls) exploration and solving of online games, children were shown two equally interesting exploration-based video games and assigned to one, with the goal of completing the game in seven minutes. Later, children answered questions about the game and self-directed EF was measured. Higher self-directed EF was positively associated with the total (r(61) = .27, p = .03) and hidden (r(61) = .24, p = .06) game rewards collected (see Figure 1). However, while increased exploration may come at a cost to exploitation (i.e., solving the game), self-directed EF scores did not negatively predict solving (p = .28). Thus, our results suggest that children's executive skills are important for evaluating time as a limited resource and exploring effectively but not for solving.

4-U-100   Generic testimony interacts with statistical evidence in adults' and children's category-based induction

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Prior work shows that children and adults assume properties covered by generic language are central to category membership (Cimpian et al., 2010; Butler & Markman, 2014). Less is known about how testimony and observation interact. Adults (N=122) and children (N=90, M=5.06, SD=.61) viewed a set of novel objects and saw that a subset (30%) of these objects possessed a causal property (made a machine go). Participants were randomly assigned to four conditions: one learned the objects' label, two heard claims about the category's causal property: Generic: "Blickets make the machine go", All: "All blickets make the machine go"), and one heard about the specific property of one item. We tested if each type of testimony influenced participants' property prevalence estimates for a new set of category members. Children (M=6.01, SE=.27) selected more objects than adults (M=3.26, SE=.16) in all conditions (t(192)=-8.734, p<.001). When testimony was generic or included "all", adults and children overestimated the prevalence of the property. When testimony was specific or only included a category label, adults' estimates were no different than the observed property while children still overestimated. These findings show how testimony and observations interact. For children, any testimony including a category label led to overestimation of the observed property (Gopnik & Sobel, 2000), while for adults, this overestimation only occurred when testimony included generic or "all" quantifiers.

W – Social categories and groups

4-W-101 **Investigating the efficacy of prescribed labeling practices: conceptualizing persons with disabilities**

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Organizations interested in enhancing public understanding of and empathy towards persons with disabilities (e.g., Best Buddies International, National Association of Councils on Developmental Disabilities, Employer Assistance and Resource Network on Disability Inclusion) have for decades prescribed language to use when referring to folks with disabilities--namely, either person-first labels or condition-first labels. Although recent work has identified how individuals with disabilities would personally like to be labeled (Darling & Heckert, 2010; Forber-Pratt & Zape, 2017; Hahn & Belt, 2004; Jones, 2012; Phelan & Kinsella, 2014), little work has examined how these same labels influence how laypersons conceptualize folks with disabilities. We propose that given the little psychological evidence to advocate for the use of person-first vs. condition-first language, prescribing language to use when referring to persons with disabilities may be premature, and even contrary to the preferences of disabled people. In our work, we directly examined how lay conceptions of persons with physical, sensory, or cognitive disabilities are influenced when they are described using person-first vs. condition-first language. In two studies (N= 285) we presented participants (ranging in age from 21 to 70 years) with descriptions of persons with disabilities that used either person-first labels or condition-first labels; disability diagnoses were either made at birth or during the teenage years. We focused on how labels influence laypersons' essentializing of disabilities--their beliefs about how core a disability is to a person. Essentialism was a feasible place to find differential effects of person-first vs. condition-first language, and essentialism is often invoked by proponents of person-first and condition-first movements. To control for the influence of participants' knowledge of existing disabilities and to understand how labels influence lay concepts of new disabilities (i.e., disabilities they are learning about for the first time), participants reasoned about disabilities with novel names. For each description, participants judged how essential (consistent, deeply-rooted, broadly-ramifying) physical, sensory, or cognitive disability symptoms (Study 1) or diagnoses (Study 2) are to that person. Across both studies, for both younger and

older adults, participants judged disabilities to be equally essential to persons regardless of how they were labeled; this was robust whether diagnoses were made earlier or later in life. Although there may be other points of influence, these labels, which are primary targets of advocacy groups, do not seem to influence psychological essentialism of disabilities. Investigating how labels influence these conceptions may inform initiatives to enhance societal treatment and inclusion of persons with disabilities.

4-W-102   Do parents find children's gender biases concerning?

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In the present study, we evaluated parents' concern about children's gender biases in three domains: play, ability, and affiliation. Parents of 3- to 10-year-old children (N=399) read 21 scenarios about children's gender biases and reported how concerned they would be if their child was the actor in the scenario. We evaluated whether stereotype domain, parent gender, or child gender influenced parents' concern about children's gender biases. There was a significant interaction between parent gender and child gender in the ability domain (p<.01), but not in the play (p>.10) or affiliation (p>.10) domains. Namely, fathers expressed significantly less concern about ability biases than mothers, particularly when considering their sons. Collapsing across gender, parents' concern differed significantly between domains (p<.001), with the highest concern about ability stereotypes (M=4.41) then affiliation stereotypes, (M=3.92) then play stereotypes (M=2.98). Discussion will focus on how helping unconcerned parents recognize the consequences of children's gender biases could increase their motivation to attenuate children's biases that may initially seem innocuous.

4-W-103   Manipulating explanations of status differences influences children's biases and reasoning about status

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Young children are often biased in favor of high-status groups (Newheiser et al., 2014). In three studies, we interrogated how explanations for status differences might contribute to or mitigate these biases. In Studies 1 and 2, children were more likely to think that people can change their status when status was described as caused by structural "rules" rather than internal features (p=.008), but manipulating explanations in this manner did not mitigate children's preference for the high-status group. In Study 3, we further varied who children were told had engineered the determinative "rules": members of the high-status group, people who were unaffiliated, or no rule-makers (control). Telling children that the status difference was engineered by the high-status group reduced their bias in favor of that group relative to the other conditions (ps<.032; see Figure 1); in fact, they were no longer biased in favor of the high-status group at all. Children in the high-status rule-maker condition also perceived the status difference as less fair (ps<.004) and expressed a greater desire to rectify existing inequalities (ps<.025). Taken together, our research suggests that children's beliefs about who is responsible for engineering status hierarchies can powerfully influence their developing feelings about high- and low-status groups.

4-W-104   **Intuitive theories of Asian racial socialization**

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In the United States, about a third of Asian American and Pacific Islanders (AAPI) report having personally experienced discrimination. This discrimination occurs not only in adulthood but even as young as childhood. In 2021, nearly 1 in 3 AAPI parents reported that their child had experienced a hate incident in school (Jeung et al., 2021). Nonetheless, little empirical research has investigated how AAPI parents begin to discuss racial bias with their children and what factors may affect such decisions. In the current study, we found that AAPI college students who reflected on AAPI parents' racial socialization (n=113) indicated that many AAPI parents are hesitant to begin discussing such topics. Moreover, this hesitancy may be uniquely influenced and in fact increased by immigration status, language barriers, and the endorsement of certain cultural ideas such as the American Dream or the Model Minority Myth. This work provides initial evidence that AAPI racial socialization is heterogeneous and future work should consider more in-depth investigations into the consequences of different socialization practices for children.

4-W-105   **Children's categorization of hybrid novel social stimuli**

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Studies on multiracial face categorization suggest that children and adults favor dichotomous categorization over representing social groups on a continuum (Dunham & Olson, 2016). In this exploratory study, we examined how 4- to 7-year-olds categorize novel and minimally social characters that are a visual hybrid of two other minimally social characters (Figure 1). In Study 1, we asked children (N = 54, Mage = 6.09, SDage= 1.09, Range = 4.22-7.91) if the hybrid belonged to one of the two original groups, both, or neither group. Study 1 results showed a tendency towards non-dichotomous categories: most children categorized the hybrid as belonging to "both" groups, with older children giving more "both" responses than younger children ($\chi(6) = 63.970$, $p < .001$). In Study 2, children (ongoing, N = 23, Mage = 5.75, SDage= 1.31, Range = 4.20-7.87) were shown minimally social groups and a hybrid and were told about some attributes of each original group (e.g., preferences, norms, activities). Results showed that children's initial categorization of the hybrid character accounted for their predictions of its attributes and behaviors (See Figure 1, $\chi(4) = 40.953$, $p < .001$); kids who thought the hybrid belong to "both" groups said it would have attributes of both, and kids who thought the hybrid belonged to "neither" groups said it would have attributes of neither. In sum, visible features in the absence of rich social information may lead to hybrid categorization early in development.

4-W-106   **Children and adults infer novel social biases from causal difference-making information**

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Recent work suggests that social biases (e.g., sexism, racism, etc.) are present by preschool (e.g., Perszyk et al., 2019). How do these biases develop? Previous research has investigated children's rapid learning and generalization of social category information from sociolinguistic cues (e.g., generic language; details about group membership). Here, we investigate a novel mechanism by which biases may be acquired: social causal difference-making. Our preliminary experiment presents adults (N=30), younger children (aged 4-6, N=15) and older children (aged 7-10, N=13) with animated narratives depicting interactions between social agents. In each vignette, agents vary on three distinct features (e.g., wings, antennae, spots). Of these, two are irrelevant, while one makes a difference as to whether an agent is excluded from a social activity (e.g., playing a game). Trials begin with a training phase in which participants observe evidence that demonstrates which feature is causally relevant. At test, participants are prompted to predict which of two novel characters--one with the causally relevant feature, and one without--will be privileged in a subsequent interaction. Across 6 trials, adults and older children, but not younger children, rapidly learned which features were causally relevant to social outcomes, suggesting that children infer novel social biases from causal difference-making information by the second grade.

X – Social cognition & social learning

4-X-107   **"I really don't want to know": The development of information avoidance in children**

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Humans have unprecedented access to free, useful, and easily accessible information spanning all aspects of life. Despite this access, we may nonetheless opt to remain ignorant (Golman et al, 2017, Sweeney et al, 2010) - a fact rendered especially puzzling given that information can be highly valuable and personally impactful. Much is known about information avoidance in adults across different domains of life. For example, people at high-risk of contracting HIV avoid learning their test results (Sullivan et al., 2004), people avoid information about their attractiveness and IQ ratings when given hints that these scores are not as good as they anticipated (Eil & Rao, 2011), and people avoid information that challenges their religious and political beliefs (Narayan et al., 2011). Albeit a rich area of research in adults, little is known about the ontogeny and development of information avoidance. Here, we present the first investigation of the emergence of information avoidance in young children, examining the trajectory by which children transition from indiscriminate information-seekers, to selective information-avoiders. Across three studies, we examined the development of selective information avoidance in 5-10-year-old children. In Study 1, children were presented with scenarios intended to induce different motivations for avoiding information: Protecting Beliefs, Preferences, Biases, maintaining perceptions of Competence, Likeability, avoiding negative Emotions, and acting in Self-Interest. Within each trial type, children were presented with one scenario in which the motivation to avoid information was present (i.e., where we would expect information avoidance), and an analogous scenario in which the motivation to avoid information was not present (i.e., where would not expect information avoidance). We found that children's information avoidance increased with age and depended on the scenario; older children were more likely than younger children to avoid information related to their Beliefs, Emotions and Likeability, and Preferences. Interestingly, with age children were more likely to seek information pertaining to Competence. In Study 2, we pre-registered, replicated, and extended our findings to also include a child-friendly version of a classic moral wiggle room task (Dana et al., 2007) to examine whether children selectively avoided information to facilitate self-interested

behaviors. In this task, children decided between two payouts (Payout A and Payout B), each resulting in a different distribution of stickers between themselves and their ostensible partner. We found that when we made the relationship between children's choice (i.e., choice of Payout A or Payout B) and the subsequent outcome (i.e., partner's payout) ambiguous, the resulting moral "wiggle room" facilitated more self-interested information avoidance with age. In Study 3, we are conducting a behavioral study focusing on the moral wiggle room task, this time involving real payouts to participants. We predict that with age, children will avoid information about their partner's payout in order to opt for the more self-interested payout. Together, these studies document the developmental origins of information avoidance. Rather than trying to intervene in maladaptive information avoidance in adulthood, shifting our attention to a developmental population allows us to change the developmental trajectory of information avoidance as it develops in real-time.

4-X-108 **Children more robustly fix functions to tools in the context of social others' even when learning via screens**

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When children encounter an unknown object in person, they appear to take advantage of social cues to quickly attach a specific function to it. Using eye-tracking and behavioral methods, this study examined the degree to which the presence (vs absence) of a visible social other might impact learning about objects and their functions. Thirty-five participants aged 7-10 years (M=8.46 years, SD= 1.48 years,19 female) watched a tool-learning video sequence wherein a novel object (e.g., a "blicket") was used to complete an action (e.g., to ring a hidden bell). The sequence either included the visual presence of a person (social condition, N=17) or showed the same events without a person present (nonsocial condition, N=18). Overall attention to the video was not significantly different across conditions (p=.26). Yet when children were asked which tool was "for" a particular job, their visual attention to the correct item differed: Children in the social condition looked longer at the correct object than children in the nonsocial condition (one-tailed t-test, p=.04). Furthermore, in a subsequent behavioral task using tools introduced in the video, children's performance was significantly better for those in the social condition than the nonsocial condition (p = .03). Results suggest that tool function might be particularly "fixed" by the social context in which children learn about an object's purpose, even when the social other is only present digitally. Data collection is ongoing.

4-X-109 **The development and consequences of field-specific beliefs about brilliance and social competence**

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The present study focuses on a potentially powerful contributor to gender disparities in both STEM and non-STEM fields: we propose that beliefs about what is required in a field (field-specific beliefs) matter. Given that women are associated with low intelligence (Bian et al., 2017) and high social skills (Fiske et al., 2002), fields that value intellectual talents and devalue social competence may be incompatible with women's self-image. Here, we investigate the development of these field-specific beliefs, and how they

affect children's motivation. Five to ten-year-olds (N = 80, planned N = 144) heard two stories: one about a brilliant person and one about a socially competent person. Then, we asked children to guess if the person worked in computer science, biology, psychology or music composition. With age, children were more likely to say that the brilliant character was a computer scientist, and that the social character was a psychologist. Moreover, children's perceived similarity to each character predicted motivation: those who rated themselves as more similar to the brilliant character were more interested in computer science and less interested in psychology, whereas those who rated themselves as more similar to the social character showed the reversed pattern. These results indicate that children develop stereotypic beliefs of field-specific features from a young age, which may be a mechanism perpetuating women's underrepresentation.

4-X-110 **A matter of record: Children's understanding of authorship and knowledge transmission for text- and audio-based knowledge artifacts**
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Children access a diverse array of knowledge artifacts, or secondhand information sources such as books. In recent research, many children privilege information from text, possibly because they do not know about the author (e.g. Corriveau et al., 2014). In two studies, we examine whether 4-to- 6-year-old children use the knowledge of an author and/or general preferences to trust text and/or audio artifacts to epistemically evaluate artifacts. Children completed the three trials where an author was either knowledgeable or ignorant (between-subjects condition) and created a text (Study 1, n = 70) or audio (Study 2, n =55) artifact. In both studies, multilevel binary logistic regressions found that children's likelihood to endorse an artifact's information was significantly predicted by artifact preferences (text or audio) and author knowledgeability condition. Overall, results indicate children consider author knowledge relevant to their trust but display a stronger tendency to prefer both types of knowledge artifact.

4-X-111 **Preschool-aged children can use communicators' influence on others to infer what they know**
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How do children know what others know? Beyond prior work that investigated children's inferences about what a single agent knows, the current work explores whether preschool-aged children can infer others' knowledge by observing a communicative interaction between two agents. Study 1 asked whether children are sensitive to how a communicator influences the outcome of the learner's actions. Children (age:3;1-5;11, N=72) observed two scenarios where a listener failed to activate a toy before succeeding. In the Effective-Communicator (EC) scenario, communication (nonsense speech) occurred after the learner's failure and immediately before success; in the Ineffective-Communicator (IC) scenario, communication occurred before the listener's failure. When asked which speaker was knowledgeable, 5-year-olds (but not younger) preferred the one in the EC scenario (p = .02). Study 2 (ongoing) asked whether children attribute knowledge to a speaker who causes the learner to perform

an action that would be implausible without communication. In the EC scenario, the listener changed the course of their action after communication; in the IC scenario, the listener's course of action did not change. Preliminary results suggest 4- and 5-year-olds (N=15) judge the communicator in the EC scenario as more knowledgeable. The current findings suggest young children can infer communicators' knowledge from the influence of their communication over the outcome and likelihood of listeners' actions.

4-X-112   The Sandbox Task: Measuring egocentric and altercentric biases with the same task format

Feride Nur Haskaraca Kizilay[1], Hannes Rakoczy[1], Ulf Liszkowski[2]
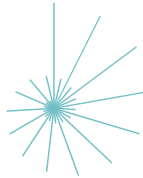*[1]University of Goettingen, [2]University of Hamburg*

It has been long assumed that a theory of mind (ToM), our ability to ascribe mental states to others and ourselves, emerges around age four, as indicated in performance on explicit false belief (FB) tasks (Wellman et al., 2001). More recent studies assessing FB understanding with implicit measures suggested that some form of ToM may be present even in infancy (Scott & Baillargeon, 2017). However, implicit ToM studies are now facing serious replicability issues (e.g., Dörrenberg et al., 2018). Here, we focus on different biases as windows into explicit and implicit ToM. Egocentric bias pertains to explicit ToM: individuals are slowed down and led into error by their own perspective when they are explicitly asked to judge others' perspectives. Altercentric bias is an indicator of implicit ToM: subjects are slower and more error-prone in making first-order judgments about the world if another agent in the scene holds a diverging perspective --even if this perspective is completely irrelevant (Samson et al., 2010). In three experiments conducted either with 3- and 6-year-olds or adults (current N=282), we tapped both biases within the same task format, i.e., the Sandbox task (a FB task with continuous locations, Sommerville et al., 2013). Results so far have revealed neither an egocentric nor an altercentric bias (all ps > .07, all rs < 0.3). Overall, these findings raise critical issues regarding the replicability and validity of measures of egocentric and altercentric biases.

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