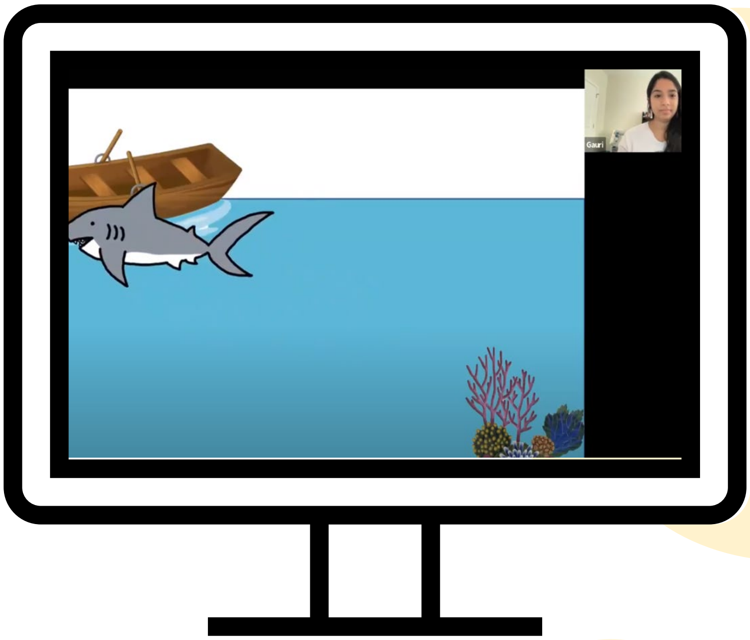
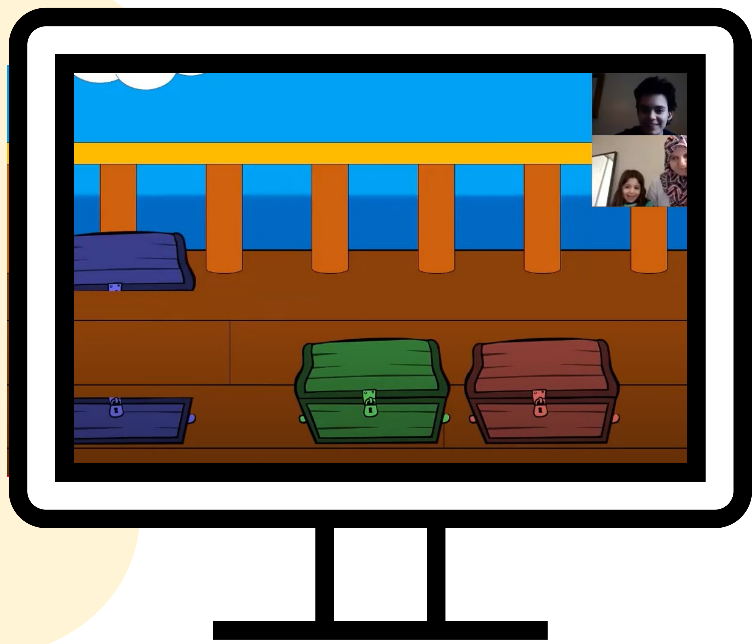


Harvard Lab for Developmental Studies



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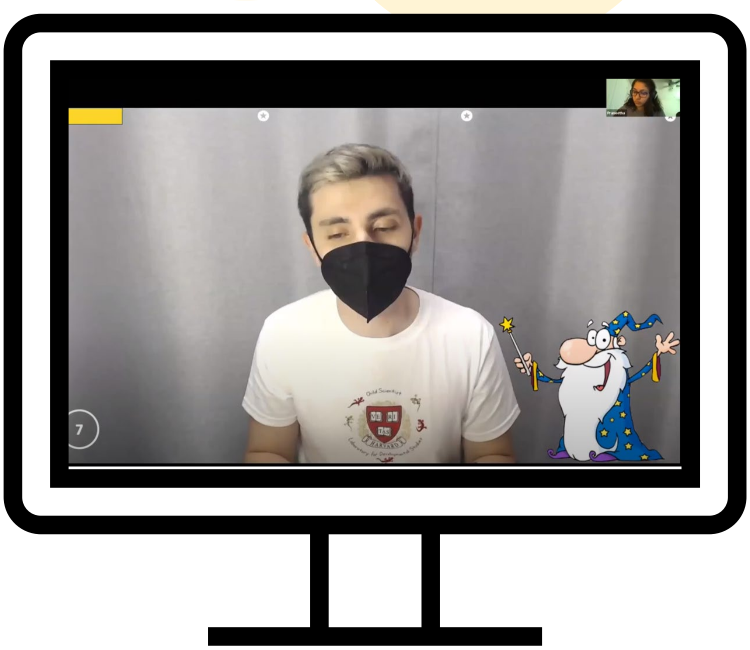

Zoom edition!

Child Scientist

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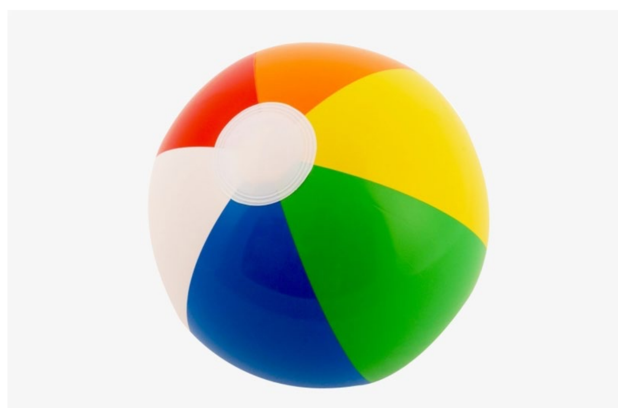
Comprehension of Negation in Toddlers

Annika McDermott-Hinman (Undergraduate Research Assistant), Masoud Jasbi (Postdoctoral Research Fellow), Susan Carey (Principal Investigator)

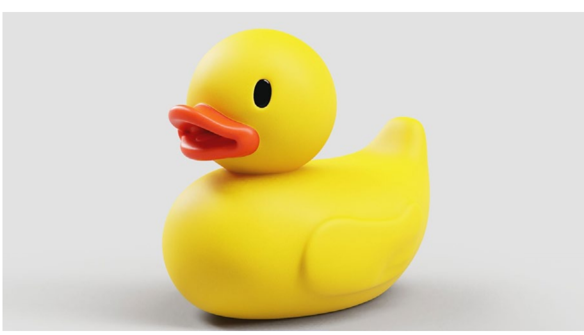
Parents dread the moment their child learns the word ‘no’, and once children learn it, they certainly make plenty of use of it! But what exactly do young children mean when they say ‘no’? As adults, we have a complex understanding of the concept of *negation*, which encompasses the meanings of words like ‘no’ and ‘not’, as well as sub-words like ‘-n’t’ (e.g., ‘don’t’, ‘can’t’) and ‘un-’ (e.g., ‘unhappy’). One of the central questions we at the LDS are trying to answer is whether that concept of *negation* is one that children know innately, or whether they have to figure it out from scratch using other concepts and their environment, including the spoken input they get from their caregivers.

In order to explore this question, we would like to know how old children are when they begin to understand the meanings of various negative words, such as ‘no’ and ‘not’. The patterns that we find in children’s understanding might be able to help us shed light on how the concept of negation develops in children, and how the language that they hear from their caregivers plays into that process.

In this study, we are testing a new, simple method to test for children’s understanding of the word ‘not’. The method relies on the fact that young children look longer at things that they find surprising. First, we familiarize all children with the study by showing them pictures and playing an audio that correctly labels the pictures. For example, a child might see a picture of a ball and hear the words “This is really a ball”.



“This is really a ball!”



“This is not a duck!”

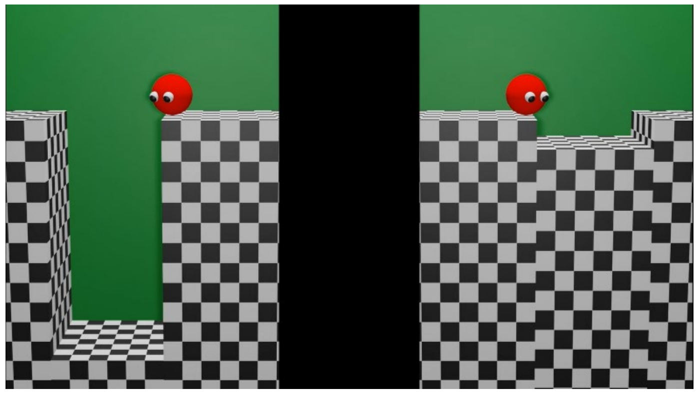
After familiarization, participants in the study are split into two groups: half of the children continue to hear these true labeling statements along with the correct pictures, while the other half begin to hear false statements that include the word ‘not’. For example, a child might see a picture of a rubber ducky and hear “This is not a duck”. We are testing to see whether the children who heard these false statements look longer at the pictures, which would imply to us that they are surprised by the pairing of the statement with the picture. The new negative statements follow exactly the same pattern as all of the previous true statements, so if children demonstrate surprise, it will indicate to us that they understand the word ‘not’ to mean something different from the positive adverbs like ‘really’ that they had been hearing before, and thus that they have some degree of understanding of the negative concept behind the word ‘not’.

We are currently running this study with two age groups. Children aged 26 - 28 months have been shown to understand the word ‘not’ in previous studies using different methods, so we are running the study on children at that age to test that our new method is consistent with previous research. The second age group we are working with is 20 - 22 month olds. Previous research has been somewhat inconclusive on exactly what these children understand when they hear the word not, so we hope that our research can shed some light on that question.

So far, we have only tested a small number of children, but the initial results are promising—children in both age groups who hear the false statements with the word ‘not’ are indicating surprise. Some children are looking longer than children who continue hearing true statements, as we predicted, while others are reacting in ways we hadn't anticipated, such as laughter. We need to test more children before we will know if these results are reliable, but for now we are optimistic, and we are, as always, incredibly thankful for the wonderful families that make our research possible!

Infant's Expectations of other people's behaviors in dangerous situations

Manasa Ganesh (Undergraduate Research Assistant), Shari Liu (Postdoctoral Researcher), Elizabeth Spelke (Principal Investigator)



Previous research conducted in the lab indicates that by the age of 13 months, infants expect other people to avoid dangerous actions when a safer alternative is available to get to a reward. These experiments have also indicated that, by the age of 13 months, infants expect other people to value rewards for which they engage in dangerous actions. Following up on these results, we decided to conduct another short experiment to investigate whether infants expect other people to behave differently in riskier and safer situations.

In this activity, infants watch two videos of a cartoon character approaching deeper and shallower trenches simultaneously. The cartoon character then stops at the edge, peers into the trench, and starts pulsing. While pulsing, the cartoon character either makes a laughing or crying sound. When the sounds are played in the background, we begin to examine infants' looking preferences. If 13-month-old infants, in this activity, prefer to look at the cartoon character peering into the deeper trench when the crying sound is played, it will indicate that they expect this specific character to cry. Hence, such a looking preference means that infants expect people in riskier situations (and not people in relatively safer conditions) to elicit crying noises.

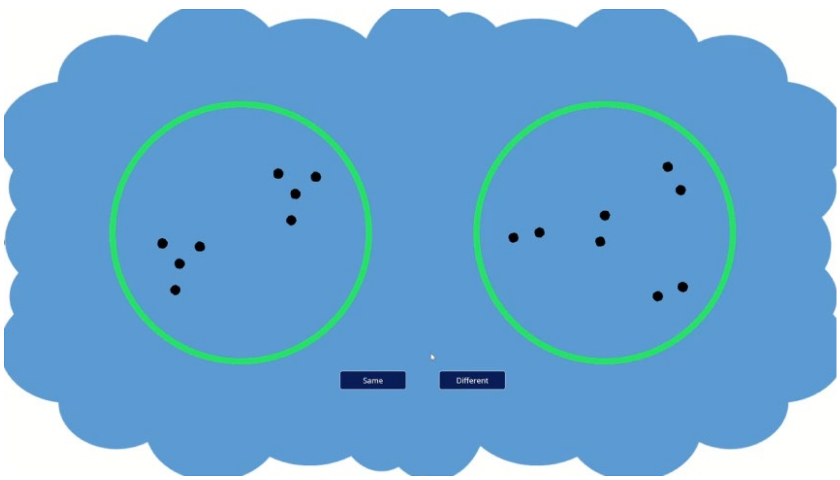
This study is still in the beginning stages, so we do not yet have results to share. If the study yields a significant result, in the future, we would also be interested in investigating whether infants expect other people to experience specific emotions such as fear or distress in dangerous environments. This work would not be possible without you, and we would like to thank you for your participation! We hope that you will continue participating with us in the future.

Do elementary school children know that 2x4 = 4x2?

Marie Amalric (Postdoctoral Researcher), Elizabeth Spelke (Principal Investigator)

Mathematical symbols are culturally acquired knowledge, typically learnt over many years of schooling. While it is suggested that symbolic abilities are built upon the human non-symbolic number sense and concrete understanding of quantities, the fact that symbolic calculation derives from non-symbolic numerical abilities is currently highly debated. The link that exists between both symbolic and non-symbolic numerical systems remains unclear, and it is now suggested that symbolic and non-symbolic numerical thinking mutually enhance one another over the course of mathematics education. In particular, formal learning of arithmetic operations seems to reshape the human perception of spatially organized dot arrays.

Here, we tested the influence of school learning about multiplication and its commutative principle on the perception of grouped dot arrays in 2nd and 3rd graders. In a Same/Different task, we asked children to compare the arithmetic outcomes of pairs of stimuli, such as 2 groups of 4 dots versus 4 groups of 2 dots, or 2x4 versus 4x2.



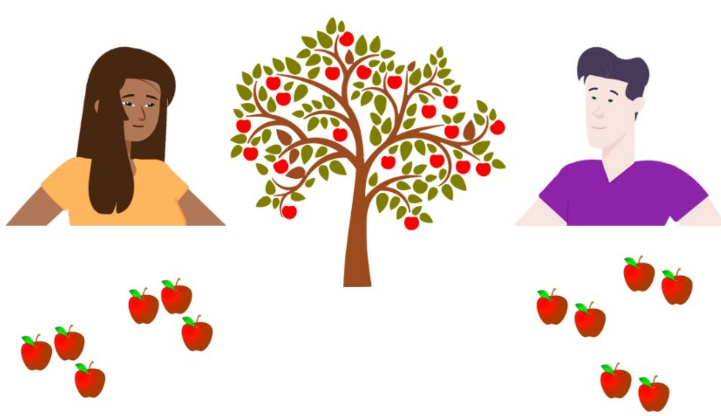
We found that children's symbolic mastering predicts their performance on non-symbolic trials, independently of their age or the grade they are in. In particular, while symbolic masters are able to identify that 2 groups of 4 dots and 4 groups of 2 dots contain the same number of dots, children who do not yet master symbolic multiplication are purely relying on estimation to compare spatially organized dot arrays that can be interpreted as a multiplication, and struggle to recognize commutative situations in non-symbolic contexts. These results seem to indicate that the commutative principle of multiplication is not intuitively grasped by children but emerges as an offshoot of formal symbolic knowledge.

Study of the precursors of commutativity in preschoolers

Marie Amalric (Postdoctoral Researcher), Ellie Harvie (Undergraduate Research Assistant), Nick Kendall (Undergraduate Research Assistant), Nergis Inal (Summer Intern), Elizabeth Spelke (Principal Investigator)

In the previous study, we assessed whether the abstract knowledge of arithmetic operations also underlies children's non-symbolic numerosity evaluation. Our results revealed that elementary school children do not perceive that 3 groups of 2 dots and 2 groups of 3 dots contain the same number of dots, unless they already know that 3x2 and 2x3 are equal. They, however, exhibit a better understanding of the commutativity of addition. A possible explanation for these findings is that, as opposed to addition, the symmetry in commutative multiplication directly appears only in the symbolic format, while linguistic and visuo-spatial non-symbolic representations, such as seeing or saying "2 groups of 3 dots", involve two levels of embedding that make them harder to interpret. In other words, the commutative principle in additive contexts is intrinsically one-dimensional, while it is intrinsically two-dimensional in multiplication.

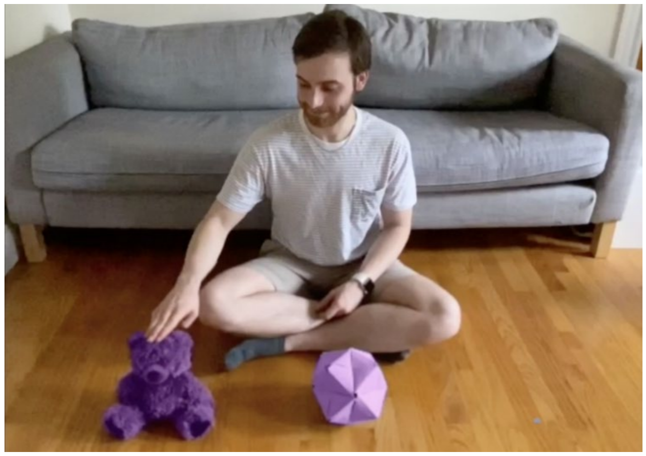
Here, we investigate the existence of precursors of the understanding of the commutative principle of multiplication in preschoolers, and the type of representations that preferentially support them. To do so, 5-year-old children are presented with situations in which they are asked to compare the quantity of apples that were picked by two characters. The pairs of apples probe commutative multiplication and addition versus ungrouped arrays of apples and test the influence of geometrical cues such as rectangular display and 90° rotation, as well as the influence of language on the perception of equal quantities.



Our preliminary results confirm that additive commutativity is more accurately perceived than multiplicative commutativity. Confronted to a set made of various groups, 5-year-old children seem to process primarily the number of groups, but not the number of items in each group. This leads them to think that 3 groups of 2 apples contain more apples than 2 groups of 3 apples. Finally, geometric cues but not linguistic cues seem to underlie early representations of multiplication and commutativity.

Goal Understanding in 3-Month-Old Babies

Brandon Woo (Graduate Student), Shari Liu (Postdoctoral researcher at MIT), Elizabeth Spelke (Principal Investigator)



A person sits in front of two objects, a ball on the left and a bear on the right. The person repeatedly reaches for one of the objects (e.g., the ball), always in the same location. Later, the two objects switch positions. Which object will the person reach for now: the same object, or for a different object in the original location that he had reached for? Previous work has found that whereas 6-month-old infants expect the person to continue reaching for the same object, 3-month-old infants do not. The present studies ask: What do 3-month-old infants understand about others' goals? Why have they failed to appreciate the goals of others' reaches? We explored one possibility: that 3-month-old infants may not yet appreciate that an object's identity matters more than its location. In one completed experiment, we presented 3-month-old infants with videos of a person who reached for an object, regardless of its location, and found that infants expected the person to continue reaching for that object when its location later changed. These findings suggest therefore provide evidence that 3-month-old infants can appreciate objects as the goals of others' reaches. (For recent conference proceedings related to this study, see https://cognitivesciencesociety.org/program/.) In ongoing work, we are now exploring whether 3-month-old infants can appreciate goals that are based on locations. If a person reaches for objects in the same location, regardless of what object is there, do infants expect him to continue reaching for objects in that location? Pilot data suggested that infants indeed expected him to do so. We are now collecting a full sample of data.

14- to 16-Month-Old Toddlers' Understanding of Others' Experiences

Brandon Woo (Graduate Student), Elizabeth Spelke (Principal Investigator)

The ability to appreciate others' experiences is important for communication, learning, and cooperation. Do toddlers appreciate that other people can look at the same object, and experience it differently (e.g., as upright versus upside-down)? In several experiments, we have now found that toddlers struggle to appreciate that pictures that are upright and upside-down to themselves may be in other orientations to other people. Instead, toddlers appear egocentric. Yet, in one experiment, we have found that toddlers appreciate differences in what pictures are visible to them and to others. (For recent conference proceedings on this work, see https://psyarxiv.com/d8c7u.) In ongoing work, we are exploring whether toddlers may be more sensitive to others' experiences when: these experiences are conveyed by language; and when these experiences are more relevant to social interaction.

Intention-Based Evaluations of Helping in Infants and Toddlers

Brandon Woo (Graduate Student), Elizabeth Spelke (Principal Investigator)

Do infants and toddlers prefer characters who cause positive outcomes over characters who cause negative ones, even if the outcomes that characters cause are unintended? In several studies of infants and toddlers, we have asked whether early social evaluations privilege intentions versus outcomes. We have found that 8-month-old infants and 15-month-old toddlers are not outcome-based in their social evaluations; instead, they preferentially look to and reach for characters with helpful intentions, even if characters unintentionally cause negative outcomes. (For a working paper based on our findings in 15-month-old infants, see https://psyarxiv.com/eczgp.)

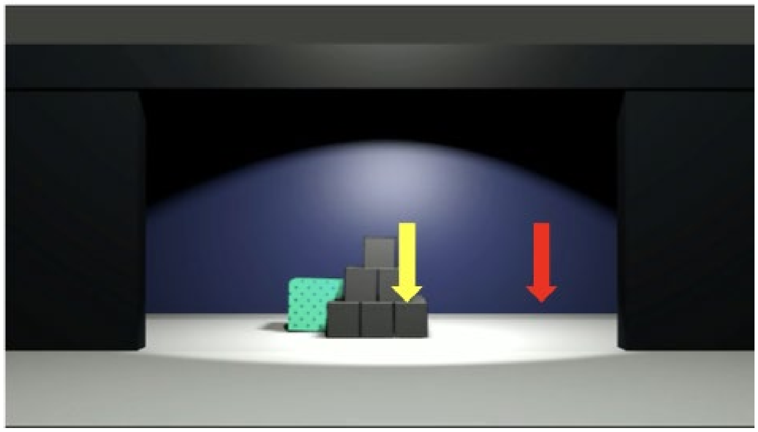
Whom to Learn From

Brandon Woo (Graduate Student), Maria Roldan (Undergraduate Research Assistant), Elizabeth Spelke (Principal Investigator)

A person takes a really inefficient route to get to a goal as two individuals observe. One observer takes the exact same route, whereas the second observer takes a much more direct route. What do children think of the two observers? Which one might be better at tasks that are relevant to culture (e.g., dance, music, cooking, etc.)? Which one might be better at tasks that are not as relevant to culture (e.g., making a puzzle, navigating a maze, etc.)? The present study aimed to examine 3- to 7-year-old children's inferences about someone's potential to teach tasks that are either culturally relevant or not culturally relevant. Pilot results were mixed, and so, we have paused data collection.

Heavy and Light: Children's and Infants' Reasoning About Mass

Brandon Woo (Graduate Student), Delaney Caldwell (Undergraduate Research Assistant), Vanessa Kudrnova (Undergraduate Research Assistant), Tomer Ullman (Assistant Professor), Elizabeth Spelke (Principal Investigator)



A box hits a blue block, and the blue block only moves a little bit. The box, moving at the same speed, hits a green block, and the green block moves much further. Which block is heavier? How will each block act in a new situation (e.g., when hitting a block tower)? This study asks whether 4- to 5-year-old children and 9- to 11-month-old infants can: reason about the mass of objects based on how they act in different situations; and make predictions about how objects will act in new situations. Some past work has argued that children should find it difficult to form such predictions. Everything for the present study is in the piloting phase, and so, we are unable to comment on trends in data.

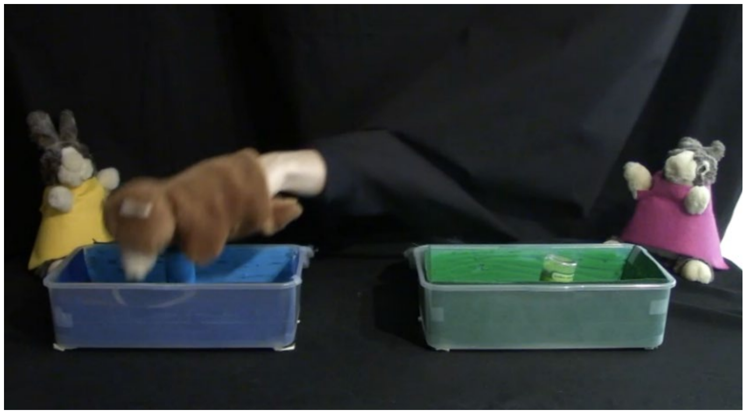
Children's Understanding of Others' Experience

Brandon Woo (Graduate Student), Maria Roldan (Undergraduate Research Assistant), Elizabeth Spelke (Principal Investigator)

Past studies have found that young children are often egocentric when verbally reasoning about others' experiences of pictures (e.g., as upright versus upside-down). The present pilot study asked whether young children would be more sensitive to others' experiences in more social contexts, when individuals shared pictures with a social partner. Specifically, do young children think it is nice to share pictures that are upright to others, even if pictures end up being upside-down to children themselves? Pilot results were mixed, and so, we have paused data collection.

Goal Understanding and Infants' Evaluations of Helping

Brandon Woo (Graduate Student), Elizabeth Spelke (Principal Investigator)



A large and growing body of work has found that infants prefer characters who help a protagonist over characters who hinder the protagonist in the pursuit of their goals. Importantly, if infants and toddlers are seeing these actions as helping and hindering the protagonist, then they must understand the protagonist's goal. In the present studies, we presented 8-month-old infants with a protagonist who grasped a toy that was inside a box. We found that infants both: (i) inferred that the protagonist desired the toy, rather than just the box; and (ii) preferred a character who later provided access to that toy, even when it was no longer in the same box. We are currently preparing a manuscript to submit this paper for publication.

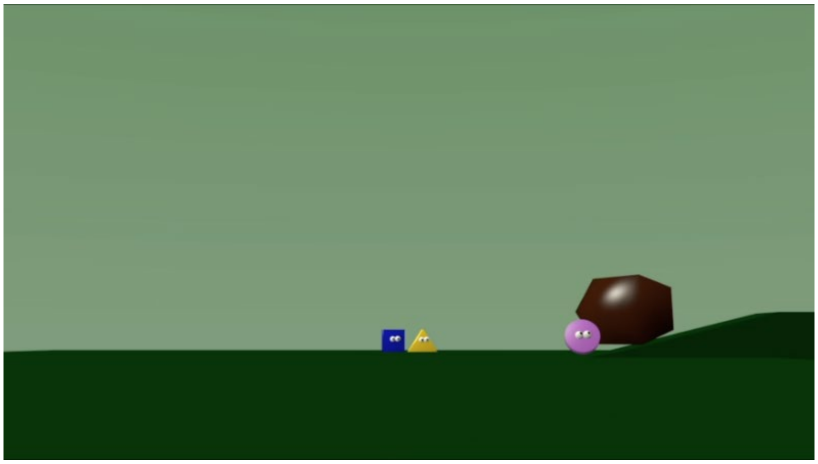
The Influence of Experimenters on Children's Understanding About Others' Minds

Brandon Woo (Graduate Student), Manasa Kumar (Undergraduate Research Assistant), Elizabeth Spelke (Principal Investigator)

A large body of research has found that young children struggle to verbally reason about others' minds. However, this may have been complicated by the fact that the experimenters asking children about others' minds are often fully knowledgeable themselves. Children may therefore have been confused about whose mind is more important when answering questions: that of the knowledgeable experimenter, or that of an unknowledgeable character in a story. To address this possibility, we designed an experiment in which an unknowledgeable experimenter asked children questions about others' minds. Pilot results were mixed, and so, we have paused data collection.

Need-Based Evaluations of Helping in Toddlers

Brandon Woo (Graduate Student), Shari Liu (Postdoctoral Researcher at MIT), Hyowon Gweon, (Associate Professor at Stanford), Elizabeth Spelke (Principal Investigator)



Imagine a person trying to carry five bags of groceries, and a second person trying to carry a single orange. If you could help one of them, which one would you help? In several experiments, we have now found that 16-month-old toddlers prefer reaching for and looking at characters who help others in greater need. (For the abstract of a recent conference poster related to this study, see https://cognitivesciencesociety.org/program/.) These findings suggest that toddlers' social evaluations are sensitive to the costs of others' actions.

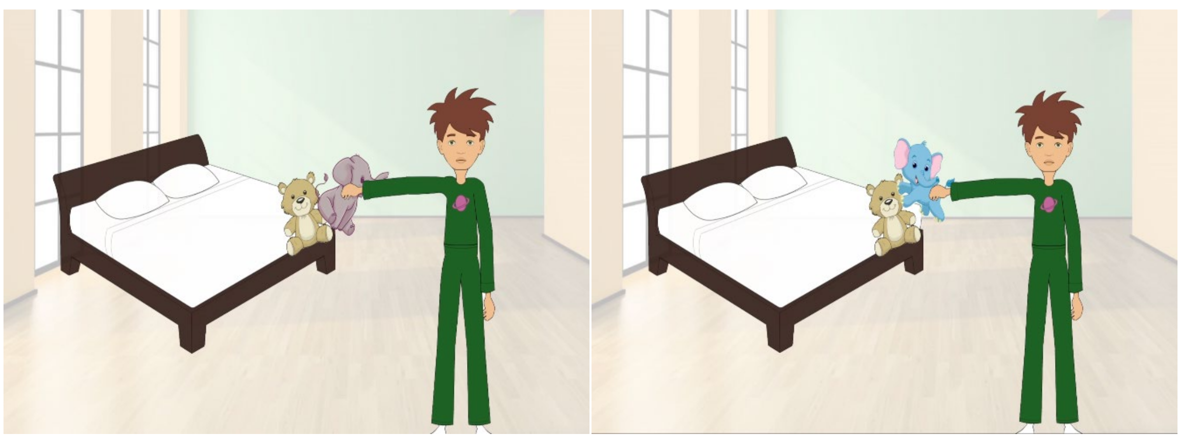
How do children remember events?

Gauri Harindranath (Research Assistant), Briony Waite (Lab Manager), Annemarie Kocab (Post-Doctoral Researcher), Jesse Snedeker (Principal Investigator)

Events in the world typically involve one or more participants each taking on a different role. For example, *eating* involves an eater and a thing being eaten, while *breaking* involves a breaker and a thing being broken. Languages group these roles into broad categories: for example, the breaker is commonly called an **Instrument**, the doer of events. In contrast, the broken things are **Themes**, the entities affected by the action.

Interestingly, not all roles are equal. Previous studies looked at one kind of role pairing: Goal-Source. Adults and children were shown different motion events with someone moving from one object (the **Source**) to another object (the **Goal**), for example, a baby crawling from a chair to a desk. These movies were presented a second time, and some of the movies were changed (e.g., the color of the desk changed from red to green). Children and adults better remembered changes to Goals compared to Sources, and were more likely to mention Goals over Sources when describing what happened (e.g., “the baby crawled to the desk” vs. “the baby crawled from the chair”). This finding suggests that Goals are privileged over Sources in language and cognition.

In this study, we want to see whether a similar asymmetry in memory arises with other kinds of roles, primarily Theme and Instruments. We created new events that depicted this role pairing (e.g., a child knocking over a teddy bear with a toy elephant (Instrument-Theme)). We showed 6 year-old children these videos on Zoom. The videos were then shown a second time, with some of the videos changed in some way (e.g., the toy elephant changed from purple to blue). Children were asked to say whether or not each video was the same or different as before. We are interested in whether changes to some roles are harder to remember than others. For example, is it easier or harder to remember a change to the elephant’s color compared to a change in the teddy bear’s color?



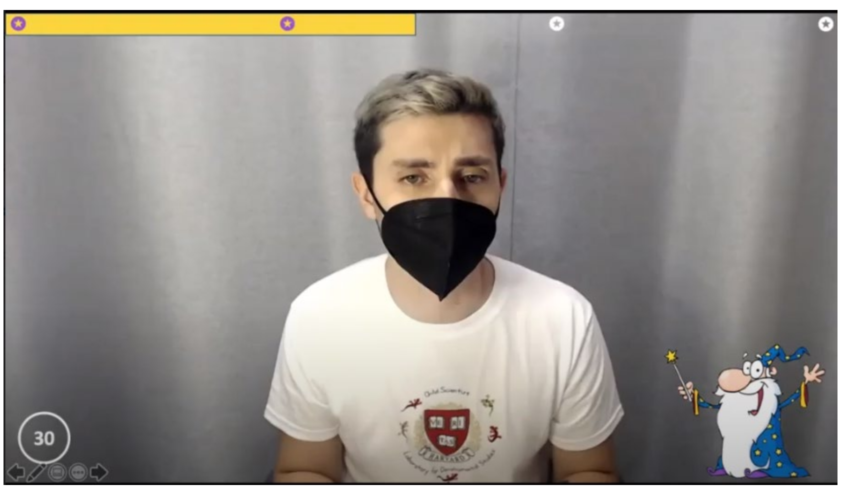
We are still collecting data for this study. We look forward to sharing our results next year! Thanks for playing with us!

What Comes Next?

Praneetha Inampudi (Undergraduate Research Assistant), Briony Waite (Lab Manager), Anthony Yacovone (Graduate Student), Jesse Snedeker (Principal Investigator)

In this study, we are interested in how people can sometimes know what someone is about to say before they say it! This type of "mind-reading" is often called *linguistic prediction*, and this study is interested in how adults and children make these predictions during comprehension. Research has shown that adults, relative to children, find it easier to anticipate what someone is about to say before they say it. We are interested in quantifying the differences between adults' and children's abilities to make linguistic predictions. We think that children may not be as reliable in their predictions as adults, and thus they may show more variability in the types of guesses that they make.

This study was conducted entirely online using Zoom. During a Zoom call with a researcher, your child watched a video of someone reading a children's story. Throughout the story, the video would occasionally stop, and your child would guess the next word in the story. This procedure is often called a *cloze task* in psycholinguistic research, and it is largely used to assess 1) how predictable certain words are given their preceding contexts and 2) how well participants can guess those words during comprehension.



For example, here's an example sentence from the story that your child heard during the study:

1. *The library was a huge room with thousands of books stacked on rows of shelves that went all the way up to the* _______ .

If we asked 10 adults to listen to this sentence and tell us the next word, we would probably expect a majority of them to say *ceiling*. However, children may provide a much wider range of answers like *sky, moon, roof, mountain top,* etc. This is because children may pay less attention to the context of the entire story, and therefore not realize that the most likely continuation here is *ceiling*.

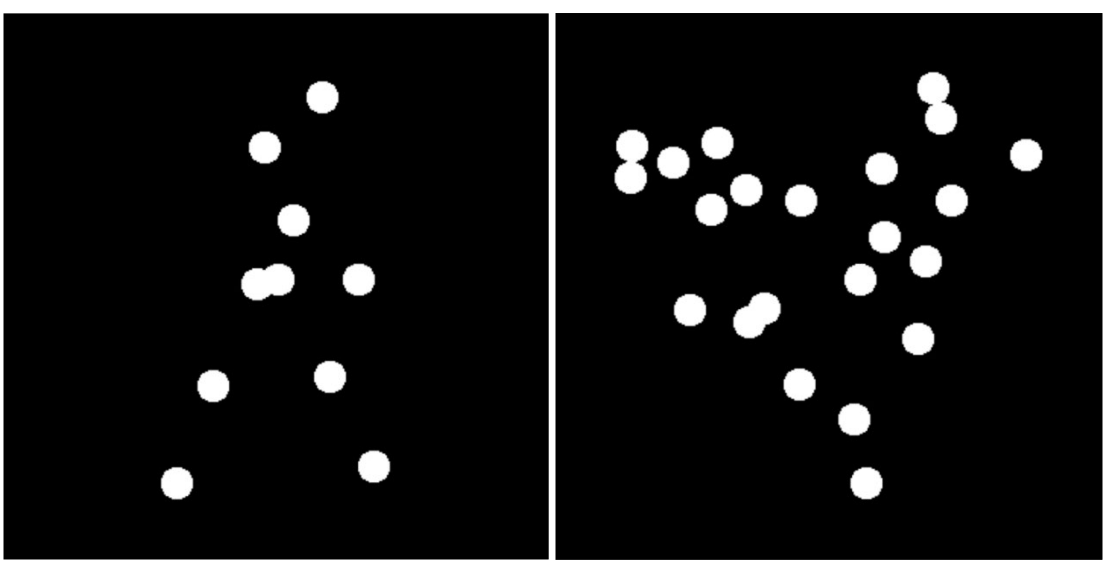
We hope that this research will shed light on how children make linguistic predictions and what type of information they pay attention to when making their guesses. We plan to compare the types of guesses that we get from adults to those that we get from children doing the exact same task. We also plan on using these data about how predictable certain words are in our particular stories in future studies.

This study is still in the piloting stage, so we do not have any results to share this year. We hope to have findings to share next year! Thanks for playing with us!

Point Light Display of Biological Motions

William Pepe and Cristina Sarmiento (Lab Managers), Elizabeth Spelke (Principal Investigator)

Past research has shown that humans have a preference for biological motion. In this study we're interested in whether infants are sensitive to the natural motion of trees. Our videos show babies an arrangement of dots that are shaped to look like a human or tree. Throughout the study, 6-month-olds see the arrangement of dots appear upright, up-side down, or in a random arrangement. We are curious to see whether infants spend more time looking at the arrangement of dots that are shaped like a human and tree when they appear upright. Our study is in its early stage, and we do not have any findings just yet.



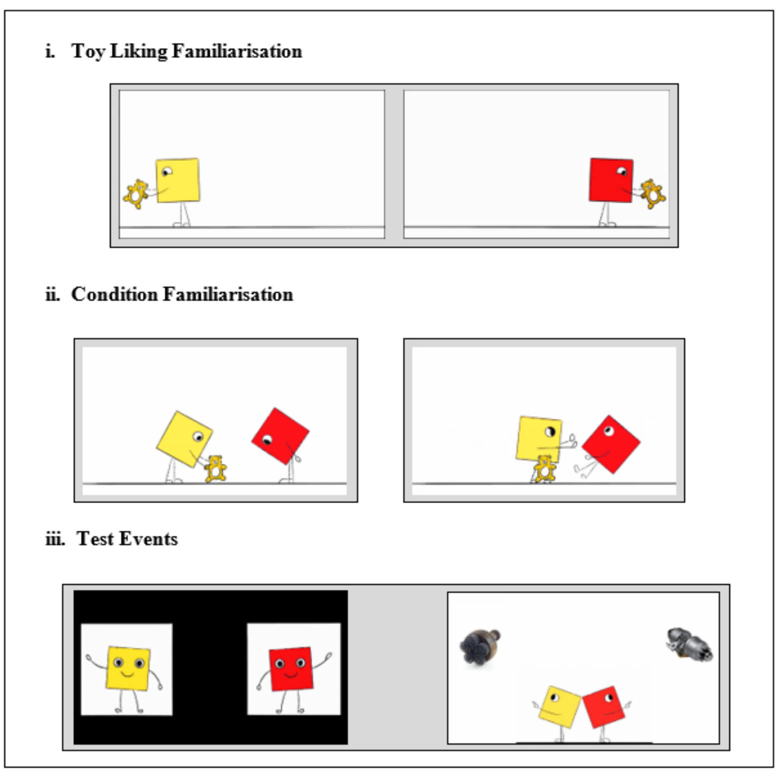
Investigating Toddlers' Social Preferences and Expectations of Knowledge for Forceful and Deferred-to Winners of Resource Conflicts

William Adams (Undergraduate Research Assistant), Ashley Thomas (Postdoctoral Researcher), Elizabeth Spelke (Principal Investigator)

Some accounts of social status see it as determined both by the ability to inflict costs on others (dominance) and the ability to confer benefits (prestige). Do we recognize and act on these bases of status from an early age? Other studies have found that toddlers prefer to reach for high-status winners when they are deferred to except when they have won by force (Thomas et al., 2018), thus this study examined whether means of winning affects whether toddlers also expect a deferred-to agent to have superior knowledge in line with a prestige account of status.

In this study, we used a preferential looking method with 23–26-month-old toddlers. We did not find evidence for any *looking* preferences for either forceful or deferred-to winners, suggesting that toddlers may not have formed any social preferences.

Since these results seem inconsistent with findings from previous studies, we now hope to run the study again using modified methods to investigate whether this reflects differences in how toddlers respond to *looking* versus *reaching* methods. We also hope to see whether the type of competition which someone 'wins' affects the inferences toddlers draw.



Recognizing violations of physics over Zoom

Emily Walco (Graduate Student), Elizabeth Spelke (Principal Investigator)

Over the past several decades, researchers have demonstrated that infants are surprised by objects that behave in impossible ways. Even from just a few months of age, infants look longer when an object hovers in midair than when it remains supported, or when an object appears to roll through a wall than when it stops at one. Further research has shown that these types of surprising events seem to provide infants with special opportunities for learning; infants learn new things about surprising objects more easily than unsurprising ones, and they want to explore surprising objects more. In order to further explore the ways in which infants use surprise as a cue that there is something to learn, we had to first assess whether infants find physically impossible events surprising when they are displayed in pre-recorded videos over Zoom rather than live in the lab.

In this study, we showed 9-month-old infants videos of objects behaving in ways that were either surprising or unsurprising and recorded how long they looked to each event. Preliminary results indicate that infants do in fact find the impossible events surprising, even on a 2D display, as infants who saw impossible events tended to look longer than did infants who saw possible events! Future studies will use these videos of impossible events to surprise infants so that we can better understand how they learn from surprising events!

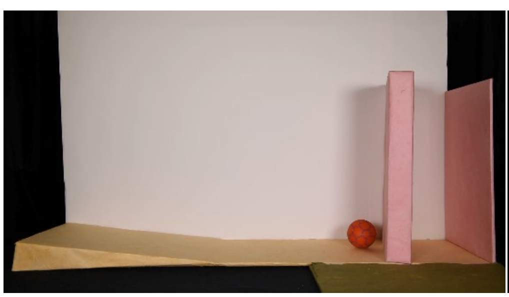


Figure 1 Ball appears to stop at wall

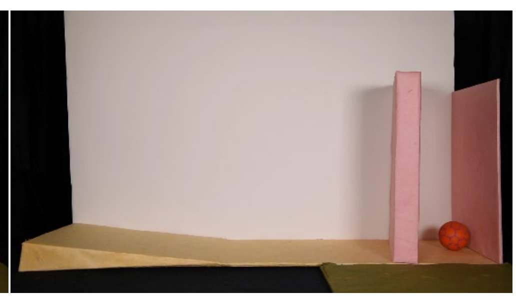


Figure 2 Ball appears to roll through wall

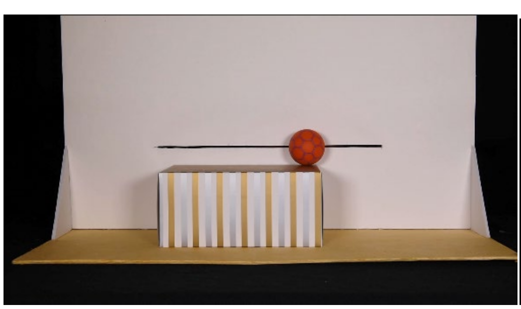


Figure 3 Ball remains supported

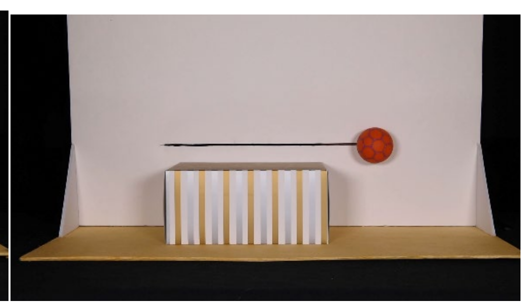


Figure 4 Ball appears to float in midair

Do infants attend to more informative actions after witnessing a surprise?

Emily Walco (Graduate Student), Elizabeth Spelke (Principal Investigator)

When infants are born, there is so much information in the world around them that if they did not have some way of determining what to learn from and what to ignore, learning would be very overwhelming. Past research has shown that one way that babies can prioritize certain events to learn from is to pay special attention when something surprises them. Seeing something that doesn't match what the baby expects indicates to babies that there is something to learn. In past studies, infants learned new things about surprising objects more easily than unsurprising ones, and they tended to explore surprising objects more. Even more amazingly, there is evidence that infants explore differently depending on *how* an object surprises them. In one study, infants who saw an object roll through a wall were then more likely to bang that object, testing if it was really solid, whereas infants who saw an object hover in midair were more likely to drop the object, testing if it would violate gravity. However, when we attempted to replicate this finding, our results did not show the same effect. Therefore, this study tries to help us understand how infants might be tailoring their *visual* attention after they see something surprising. Instead of giving babies the objects after showing them the surprising events, we instead showed 9-month-old infants videos of someone else interacting with the objects and observed what the infants preferred to watch. When an infant saw a ball roll through a wall, did they prefer to watch someone bang than object than drop it? And when an infant saw a ball roll off a surface and hover in midair, did they prefer to watch someone drop it than bang it? This study is still in early stages, so we don't have a clear answer to these questions just yet!

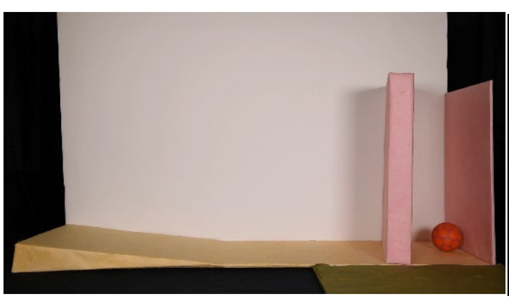


Figure 5 Ball appears to float in midair

Figure 6 Ball appears to roll through wall

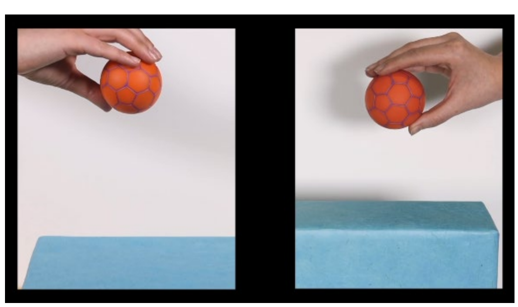


Figure 7 The hand on the left will bang the ball and the hand on the right will drop it

Do infants learn more easily about an object that surprises someone?

Emily Walco (Graduate Student), Elizabeth Spelke (Principal Investigator)

When infants are born, there is so much information in the world around them that if they did not have some way of determining what to learn from and what to ignore, learning would be very overwhelming. Past research has shown that one way that babies can prioritize certain events to learn from is to pay special attention when something surprises them. Seeing something that doesn't match what the baby expects indicates to babies that there is something to learn. In past studies, infants learned new things about surprising objects more easily than unsurprising ones, and they tended to explore surprising objects more. One thing that we don't know yet is whether it's the *feeling* of surprise that triggers infants' learning about surprising objects, or if it's just the knowledge that something was surprising. One way to test this is to see whether infants can use someone else's surprise as a cue that there is something to learn. This would also allow for many more opportunities for babies to learn, such as when they weren't looking when something surprising happened, or when an event occurs that they might not know to find surprising.

In this study, we showed 18-month-old infants videos of an object rolling behind a wall with an adult watching from behind the wall. When one object rolls behind the wall, she smiles and says, "oh, cool!", but when a different object rolls behind she gasps and says, "oh, wow!". We then taught babies something new about the objects (either a new sound or a new word) and then observed which object they looked at when we played the word or sound again. If babies had learned about the surprising object more easily, they should look more to that object at test (compared to how much they looked at the unsurprising object when they were taught about that object). This study is still in early stages, so we don't have a clear answer to these questions just yet!

Figure 8 Experimenter is not surprised by the object

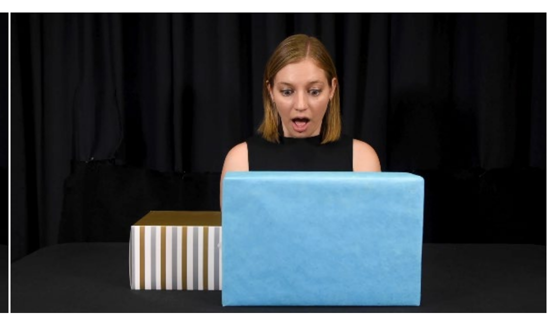


Figure 9 Experimenter is surprised by the object

Can children learn new words from games at home?

Joseph Coffey (Graduate Student), Jesse Snedeker (Principal Investigator)

Early in life, children encounter new kinds of language across a range of contexts. Normally, psychologists research the conditions under which children learn different linguistic concepts in a controlled lab setting. The recent expansion of online experimenting allows us to probe these same phenomena in children's home environments. To this end, we are interested in whether children can be taught novel vocabulary through games they play at home.

In order to test this hypothesis, we construct and send games to the homes of children between the ages of 6 to 8-years through mail. We then meet with these children over Zoom to teach them the rules for these games. The games should all be familiar to children and involve a number of fun novel creatures children will learn about. We will meet a total of three times over the course of a week to refresh children on the rules and play with them.

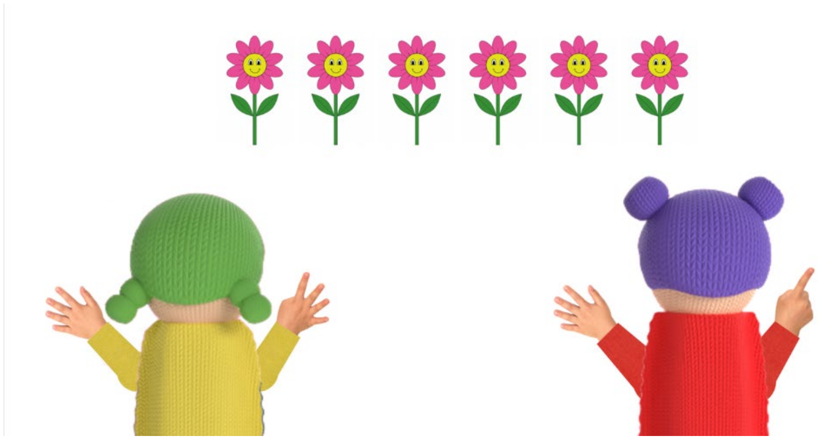
We are currently in our piloting phase, and we hope to report our results in the next newsletter!

Fingers as Tally Systems

Peggy Li (Research Fellow), Sarah Chiang (Undergraduate Research Assistant), Susan Carey (Principal Investigator)

This project aims to add to our understanding of the origin of the natural number concept. Researchers have claimed that the natural number concept is not innate, but a cultural construction. There are cultures without count lists. Adult members of such communities tend to make errors when asked to match sets greater than 4 or perform arithmetic. Children also take a surprisingly long time to learn the meanings of number words. For example, while 2-year-olds can typically recite numbers 1 through 10, they do not use counting when asked to give numbers of objects ("give me five fish"). In fact, the first numbers are acquired slowly, one at a time. The present study explores innate representations that may support the cultural evolution of counting systems. The earliest precursor to a counting system likely involves tallies, where tally marks are placed in 1-to-1 correspondence with the set of objects to be tracked.

Tallies often begin with fingers and toes, then extend to other body parts. In this study, we explore what 3- to 4-year-olds understand about the use of tallies to track the number of objects. We look at whether they can use the number of fingers to represent the number of objects, even before they know the meanings of number words. Since hand gestures require dexterity, in addition to asking children to use their fingers to represent sets of objects, we also implement a forced choice task where children choose between characters' hand gestures.



Name Those Pictures!

Margaret Kandel (Graduate Student), Jesse Snedeker (Principal Investigator)

This study investigated the incremental processes involved in planning speech. In particular, we were interested in how far in advance speakers plan before starting to speak, whether this advance planning scope can be flexible, and whether adults and kids demonstrate different advance planning strategies. Since younger children's linguistic and cognitive abilities are still developing, they may use different speech planning strategies from adults.

In this study, we were specifically investigating how the length of the first word of a multi-word utterance influences planning of the second word. Previous studies (including our earlier **Name Game!** study) have found that both adults and kids are slower to begin saying longer words in isolation (e.g. speakers would be faster to name a picture of a dog than a picture of a helicopter). A prior experiment from a different lab found, however, that when the first word of a two word utterance is longer, adult speakers actually begin to speak sooner (Griffin, 2003). This reversed length effect could suggest that adult speakers are able to use the articulation time of the first word to plan the second word as they speak (instead of fully planning both words in advance before they start to speak) and that they adjust their speech onset time accordingly. Longer first words provide more time to plan the second word during speech, so speakers can start speaking sooner than when they have less time to plan the second word while saying the first. We were interested whether children would also show this flexibility in their advance planning scope.

The experiment used the same task as Griffin's (2003) original study. Participants were instructed to name two side-by-side pictures. We manipulated the length of the first picture's name. As in the Griffin (2003) study, we recorded participant's responses as well as their eye movements, which can give an indication of when speakers focus on pictures and start planning their names. Specifically, we were interested in testing 5 and 6 year-olds who were native, monolingual speakers of American English.

We piloted the task to make sure that it was an activity that kids could complete online, but before running the full child experiment, we first ran the experiment with adults to make sure that we could reproduce the reversed length effect when expected. We did not find the anticipated effect in adults, however, so now we are working on figuring out why our experiment did not show the same pattern of results as Griffin (2003) before we investigate what kids do!

Griffin, Z. M. (2003). A reversed word length effect in coordinating the preparation and articulation of words in speaking. *Psychonomic Bulletin & Review*, *10*(3), 603–609. doi: 10.3758/bf03196521

Picture Detective

Margaret Kandel (Graduate Student), Jesse Snedeker (Principal Investigator)

Since the onset of the COVID-19 pandemic and the resulting halts on in-person research, our lab has been investigating what kinds of experiments traditionally run in the lab can be transitioned to a web-based format. This study investigates whether a webcam eye-tracker is sensitive enough to detect information about real-time language processing in kids.

In the lab, eye movements are often used as an indication of how listeners process incoming sounds as they hear a word. We are investigating whether eye movements collected virtually by a webcam eye-tracker can be used in a similar way. Webcam eye-trackers are typically designed to work with adult faces, so we are curious whether they can reliably be used with children as well. To assess this, we are testing whether we can replicate online an eye-tracking phenomenon previously observed with both adults and kids called the phonemic cohort effect. In-lab experiments have shown that as a listener begins to hear the name of a picture on the screen (e.g. "bed"), if there is another picture on the screen whose name starts with the same sounds (e.g. "belt"), the listener will initially look to both pictures as they hear the start of the word (e.g. "be-"). Listeners will continue to look at both images until the sounds they hear no longer match both names (e.g. when they hear the "d" in "bed"). This effect shows that listeners are continuously trying to match the sounds they are hearing with the words they know instead of waiting until they've heard a complete word before trying to identify which word it was.

We are running this experiment with 5-6 year-olds who are native, monolingual American English speakers. In the task, children are presented with arrays of pictures and instructed to look at one of the pictures. We collect children's eye movements as they do this task to see whether we detect phonemic cohort effects when there is another picture on the screen that starts with the same sound as the one they are supposed to look at. Data collection is still in progress, but we hope to have results soon!

Alien Game

Margaret Kandel (Graduate Student), Jesse Snedeker (Principal Investigator)

This study investigates how children and adults identify the words they hear and how the predictability of a word and the presence of nearby related words influences this process.

It has been found in previous experiments that if someone encounters a word (e.g. *leaf*), they process that word more easily if it is preceded by a related word (e.g. *tree*) than an unrelated word (e.g. *truck*). Typically these experiments involve presenting participants with two words (a prime and a target) and then measuring a response to the second word (the target). This semantic priming effect has been shown using various measures, including electrical activity on the scalp (EEG) and lexical decision times (how long it takes someone to identify whether or not a word is a real word of their language).

Prior studies with adults have found that the size of the semantic priming effect is influenced by the statistics of the experiment setting: the more related word pairs in the experiment, the greater the effect. Increasing the number of related word pairs in an experiment increases how predictable the target word is in the task; when the prime is usually related to the target, it is easier to guess what the target will be in a trial after only seeing the prime. This result suggests that adults are sensitive to the predictability of words in an experiment and that their language processing system can use this information to strategically engage predictive processing, which allows them to more easily process a word when it matches their prediction. We are interested in whether this manipulation is a fundamental property of the language system or an ability that develops with time and/or linguistic experience.

To investigate this, we developed a novel lexical decision task that can be used with younger children. In this task, participants help an alien named Zip practice his English with his teacher. Zip and his teacher are playing a simple word game over Zoom. First the teacher says a word in English (the prime), and then Zip says a word (the target). In the experiment, Zip can either say an English word (which can be related or unrelated to the prime) or he can make a mistake and say an alien word instead. In the game, Zip's microphone is broken, so the participant helps Zip play by pushing a button to let Zip's teacher know whether he said an English word or an alien word. As participants do the task, they help Zip unlock prizes to bring with him on his upcoming field trip to Earth. Between participants, we manipulated the number of times Zip said an English word that was related to the word his teacher said.

We piloted the task with 6 and 7 year-olds (native American English speakers) and confirmed that they were able to make lexical decision judgments in this framework – to our knowledge, lexical decision tasks have not been run before with children this young. We then ran the experiment with adults to see if we could elicit the expected semantic priming effect and its modulation. We observed the semantic priming effect (participants were faster to identify the real words Zip said as English words when they were preceded by a related prime), however we did not see a reliable difference in this effect based on whether the participant completed a version of the experiment with a high or low proportion of related prime–target pairs. Our next steps for this project are to try to identify why we did not find the expected modulation of the semantic priming effect in adults before returning to our child study.

Can Infants and Toddlers Connect Affiliative Cues?

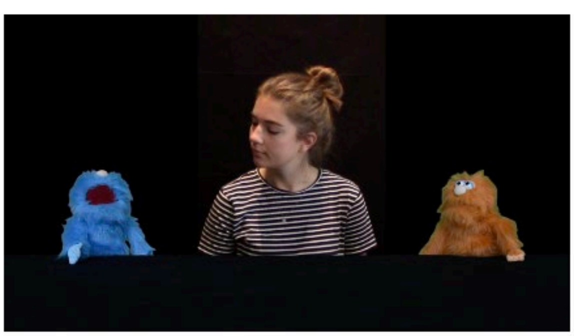
Vanessa Kudrnova (Undergraduate Research Assistant), Ashley Thomas (Postdoctoral Researcher), Elizabeth Spelke (Principal Investigator)

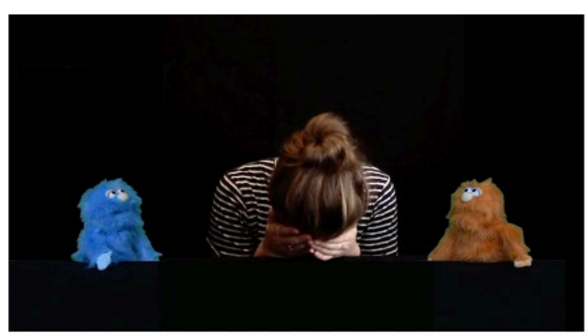
Earlier work suggests that infants make inferences about others engaging in imitation, which vary by age and a character's role in imitation. Indeed, 4-month-olds who watch one character imitate and one not imitate a common target, look longer at imitators and 12-month-olds reach for the imitator. Four-month-olds also expect the imitator to approach and affiliate with its target and do not expect the target to approach its imitator. Lastly, 12-month-olds watching a one character either imitate or not imitate a puppet, reach more for the not-imitated puppet.

Moreover, infants and toddlers appear to expect others to react to individuals in distress across situations. For example, 4- and 12-month-olds look longer at scenarios of a woman approaching a laundry basket rather than a crying, but not laughing baby. Furthermore, when a puppet expresses distress 8-10- and 16–18-month-olds expect (look first and longer at) a person who previously shared food (commonly occurring between close others), rather than a person who passed a ball with a puppet (commonly occurring between more distanced others), to react.

From this literature, it is yet unclear whether infants and toddlers see imitation and responses to distress as cues of the same underlying type of relationship, and whether infants and toddlers think differently about behaviors depending on whether they are reasoning about the targets of imitation compared to those who perform imitation.

Hence, the current study asks whether 11.5 to 12.5 and 16.5 to 18.5-month-olds see imitation as predictive of who will respond to another individual's distress, and whether these predictions are affected by the direction of imitation. For this, babies watched a set of videos of one puppet imitating a central human character and one not, and another set in which one puppet was imitated by a central human character and one not. After each set of videos, the relevant central character expressed distress and we measured which puppet babies looked at first and for how long, as though they expected that puppet to respond.





We found that infants and toddlers expected the imitator and imitated puppet to respond to their central character in distress. Therefore, we incorporated a control exploring whether these expectations were based on the relationship (i.e., imitation interaction) babies saw, or prosocial traits of the imitator and imitated. Interestingly, when the central characters were replaced by new individuals not involved in the prior imitation interactions, we found that babies were at chance with looks towards puppets, suggesting that infants and toddlers only expect the imitator and imitated to react to the distress of their social partner, and not just anyone.

Which one do you want to throw away?

Children's choices about what they don't want show that they cannot consider alternative possibilities

Brian Leahy (Graduate Student), Michael Huemer (Graduate Student), Matt Steele (Undergraduate Research Assistant), Stephanie Alderete (Undergraduate Research Assistant), Susan Carey (Principal Investigator)

Suppose you see the setup in figure 1 below: There are 3 cups on a stage. One of them is occluded, and a prize is hidden there; then the pair is occluded, and a prize is hidden there. You are given one chance to choose a cup; you can have whatever's inside. Since you want the prize, the wise choice is the singleton cup (Experiment 1, highlighted in green).

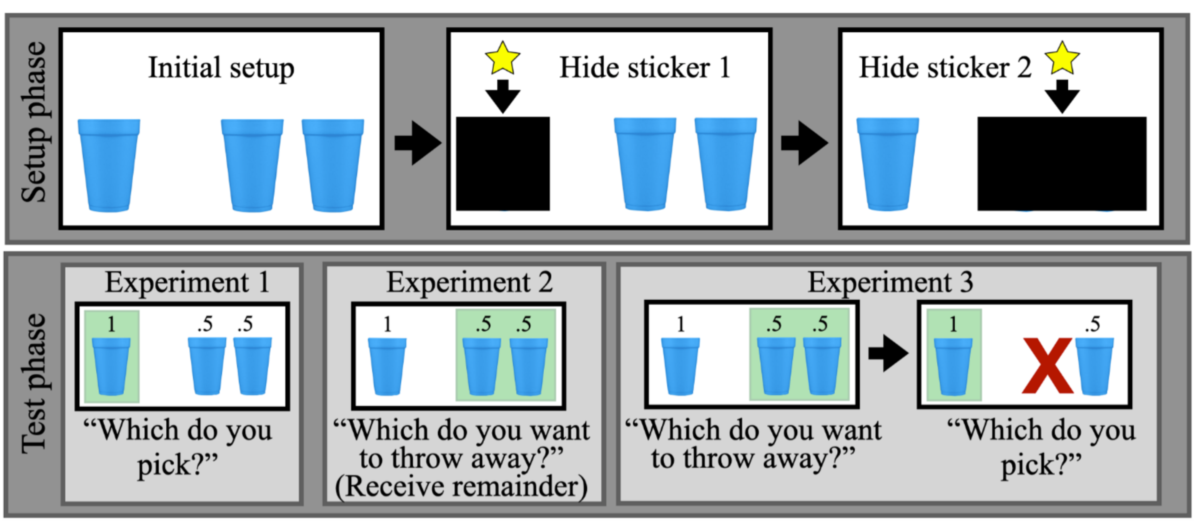


Figure 1: Structure of three experiments. All three experiments have a common setup phase. The question posed in the test phase differs across the three experiments. The red "X" in the test phase of experiment 3 is a place holder, indicating the location of the cup that was thrown away. Numbers above cups in the test phase indicate the probability that the cup holds a sticker. Green rectangles indicate a decision that maximizes the participant's expected number of stickers.

Surprisingly, 3-year-olds do not always make this wise choice, no matter how much they want the reward. They choose wisely about 60% of the time. This is better than chance (33%), but still surprisingly poor. This finding has been replicated in different labs, with prizes of different value, yet performance hardly changes at all (Figure 2a).

Why don't they choose the singleton cup? Why is this problem so hard to solve? One hypothesis is that children this young do not understand that there can be more than one possibility for a single state of affairs. They cannot see that the second sticker might be in the right cup, *and might not*--it might be in the middle cup. Once they come up with one possibility, they stop there and take that possibility to be reality. Thus they "know" where the second sticker is, and they choose at random between the two cups that they believe hold a sticker. Over many trials, we expect them to choose the target cup about 50% of the time.

That's almost what we observe, but not quite: performance is reliably 60%. This suggests that about 20% of 3-year-olds can think about more than one version of a single reality.

Now, that's one experiment, but there are always many hypotheses consistent with one dataset. For example, maybe most children just pick a sticker in advance as "the one they want to get", and don't bother to check the probabilities. If that's true, then they should pick the singleton cup at similar rates on the "Throw away" task (Figure 1, experiment 2). This experiment has the same setup phase. But after the stickers were hidden, participants were asked which cup they would like to throw away; they could have the contents of the remaining cups. Children threw away from the side with two cups nearly 90% of the time (Figure 2b, left). This accords with our predictions: children have a belief about which cup is empty, so they throw that one away. It does not accord with the hypothesis that children are choosing, in advance, the sticker that they want to get.

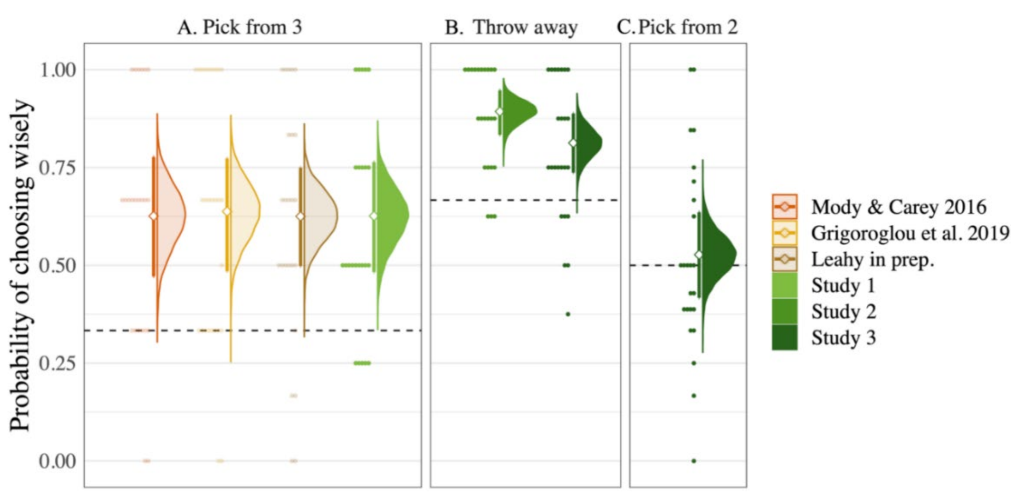
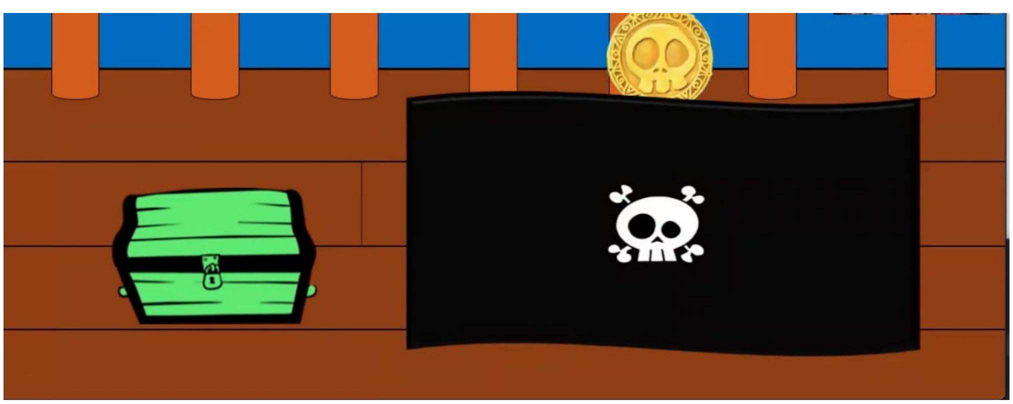


Figure 2. Probability of choosing wisely on three measures: Picking one of three cups to receive its contents; picking a cup to throw away so that its contents are not obtainable; picking one cup to receive its contents after a cup has been thrown away. Point estimates are posterior medians. Error bars are 95\% Credible Intervals. Distributions are Bayesian posteriors. Small dots are individual participants' proportion choice of the singleton cup. Dashed lines indicate chance. Data from previously published 3-cups tasks with 3-year-olds are shown in reduced opacity.

A reasonable objection, now, is that perhaps having children think about which cup is empty--about where the sticker is not--prompts them to think about the possibilities in a way that they just did not bother to do in the first experiment. To test this hypothesis we ran experiment 3. Now we ask participants to first throw away one of the chests, then choose from the remaining two which they want to have (they receive its contents). If kids are now thinking about the possibilities, they should throw away a cup from the pair, but always choose the singleton cup. This is not what we observed. Children still reliably throw away a chest from the pair--the one they think is empty (figure 2b, right: mean 79%). But when it comes time to pick a cup and get its contents, they choose at random between the two remaining cups--each of which they believe holds a sticker. They chose the singleton cup just 52% of the time (Figure 2c).

Over the course of 3 experiments, we found a striking pattern of successes and failures. This pattern was predicted in advance by our proposal, and steadily bourne out by the data. We take this as striking evidence that most 3-year-olds cannot see multiple possible versions of a single event.

We didn't actually use cups for this study; we used pirate-themed treasure chests! If you are trying to find the study your children participated in, maybe you can recognize it from this image. Thank you for participating!



Might and might not: Modal concepts and modal comprehension

Brian Leahy (Graduate Student), Eimantas Zalnieriunas (Undergraduate Research Assistant), Scarlett Close (Undergraduate Research Assistant), Susan Carey (Principal Investigator)

Several studies from our lab suggest that many children cannot think about alternative possibilities before they turn 4. However, children start talking about possibilities around their second birthday. What explains this disconnect? To explore this, we developed an apparatus that allows us to systematically test children's comprehension of possibility verbs (in our study, *can*, *hafta (have to)*, and *will*), and to test the relationship between the ability to talk about possibilities and to solve problems that require thinking about possibilities.

Children saw the apparatus shown in Figure 1. We could drop two marbles into this apparatus at the same time. Children could place a small receptacle (a wagon) underneath one of the openings to try to catch a marble. Since the marble on the left follows a determinate path, while the marble on the right might go either of two ways, the safe bet is the marble on the left.

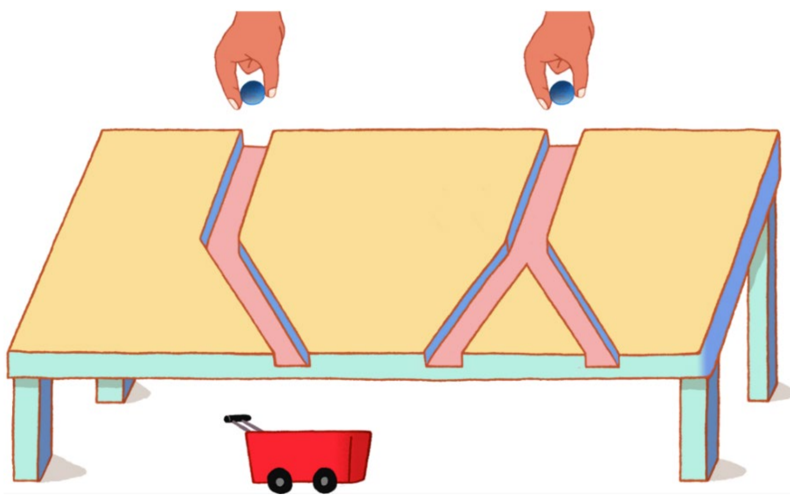


Figure 1: A nonlinguistic test of the ability to think about multiple possibilities.

Then we tested children's comprehension of the language of possibilities (Figure 2). We would hold a marble above one of the slides, indicate one of the outlets, and ask, "If I drop a marble in here, can it/will it/does it hafta come out here?" We repeated this question 6 times for each verb (2 entrances x 3 outlets each). This gave us a strong test of children's comprehension of modal verbs.

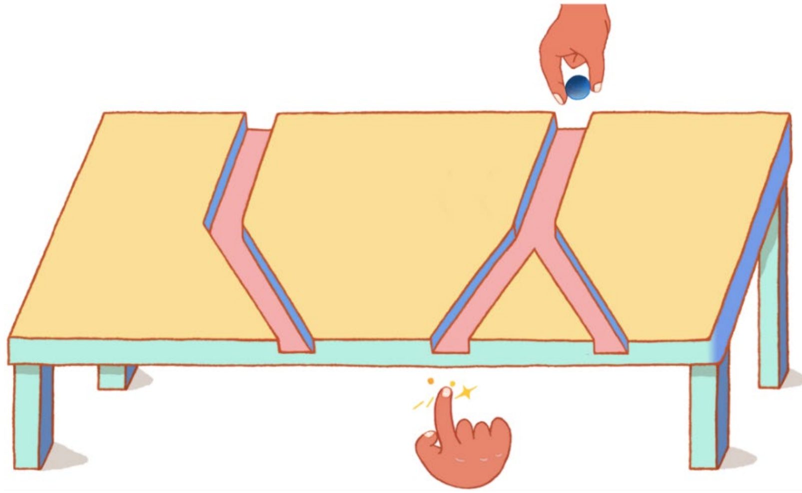


Figure 2: A test of children's comprehension of possibility verbs.

After asking all of these questions, we gave kids six more chances to catch a marble. This allowed us to check whether children were able to learn to solve the problem, either by learning over trials or through being prompted to think about the possibilities by our questions.

We tested children from ages 4 through 7, and adults. We found that even 4-year-olds tended to answer 'can'-questions correctly; however, they gave the same pattern of responses to 'hafta' and 'will' questions, suggesting that they have not differentiated these three verbs. While they use these words from age 2, it is possible that they do not understand their meanings even at age 4.

Second, we found that 4-year-olds largely failed the behavioral task, placing the wagon under the nonbranching slide just 50% of the time. This is expected if 4-year-olds are not thinking about the possibilities for the marble in the branching slide, but rather making an assumption about where that marble will come out, and then making a 50/50 choice between the two locations where they "know" a marble will emerge. Performance improved with age, as in figure 3.

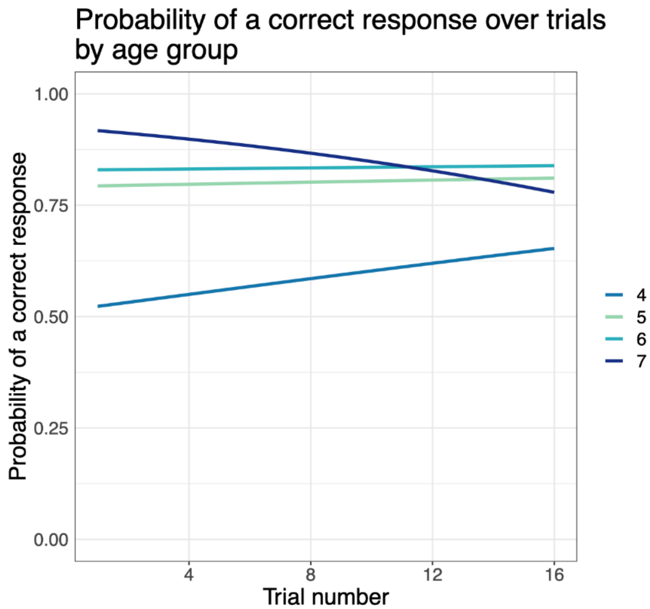


Figure 3. Probability of placing the wagon under the nonbranching slide, as predicted by age group, trial number, and their interaction. 4-year-olds chose the nonbranching slide about half the time; their improvement was not significant. Almost all 7-year-olds chose the nonbranching slide on their first trial, but did so significantly less as trials wore on. They may have become bored.

The most interesting results, though, came from the relationship between answering possibility questions and catching marbles. At ages 4, 5 and 6, children who answered the 'can' questions incorrectly placed the wagon under the nonbranching slide just 50% of the time (no 7-year-olds answered 'can'-questions incorrectly). But 5- and 6-year-olds who answered 'can' questions correctly placed it under the nonbranching slide 85% of the time. And while 4-year-olds who answered 'can'-questions correctly placed the wagon under the nonbranching slide just 50% of the time before we asked the possibility questions, they were significantly better than 50% after we asked the possibility questions. This suggests that they learned how to solve the problem. It looks like only children who have learned to talk about possibilities have the conceptual resources to solve the nonlinguistic task.

These findings suggest an intriguing hypothesis: perhaps children learn to think about possibilities by learning to talk about possibilities. Thank you to all the parents and children who helped us put this interesting proposal on the table!

Games to enhance children's reading and numerical skills

Akshita Srinivasan (Graduate Student), Elizabeth Spelke (Advisor)

Learning how to read and learning about numbers are two important aspects of early schooling. However, these concepts and skills can be really hard for children to learn. While learning how to read, it can be hard for children to figure out what letters and their combinations sound like. In English, this is especially hard as the same letters can take on different sounds. For example, the letter "u" sounds different in "nut" and "put". Similarly, learning about numbers can be hard, as the symbols and words that represent them do not transparently convey their meanings. For example, it is not obvious to children that a number word like "twenty-three" is made up of two tens and three ones. The meaning of a written symbol like "23" is also not obvious to them, as, it depends upon the understanding of place value codes, where the value of a digit varies based upon the position it occupies in a number, making "23" and "32" different quantities. Given the importance and difficulty of learning reading and about numbers, we designed two board games for 6-7-year-old-children. We hope that these games will be fun for children while helping them become better prepared for school.

In this study, children and their caregiver(s) will participate in two Zoom sessions, 2-3 weeks apart, from their own homes. In between the Zoom sessions, children will play either the reading game or the number game at home with the caregiver or sibling. During both the Zoom sessions, we will ask children some questions about numbers and words. We are interested in finding out whether these games improve children's school-relevant reading and numerical skills.

Data collection for this project is ongoing, so stay tuned for the findings!

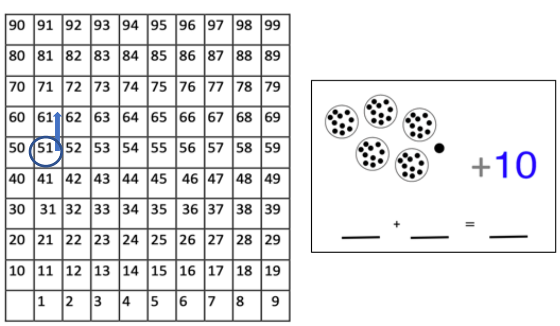


Figure 1: Number game. In this game, children first locate the number of black dots (51) on the board (left) and then add the number in blue (10). They are taught to jump up the line to add 10, that is directly move from 51 to 61.

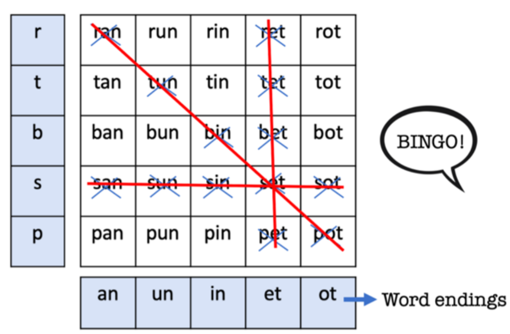
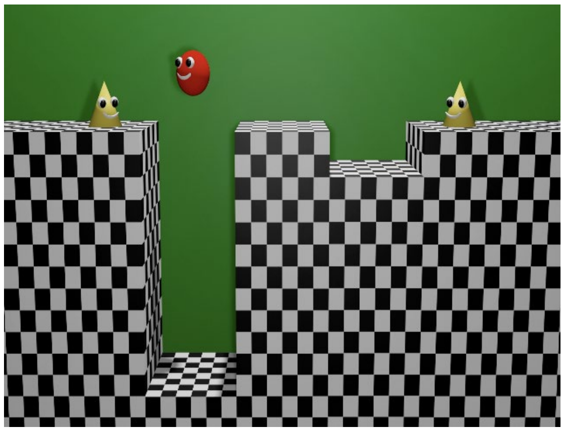


Figure 2. Reading game. In this game, children try to find words, like "pun", on the board by using the word beginnings like "p" on the left and word endings like "un" at the bottom. Once they find 5 consecutive words in a row, column, or along the diagonal, they say "bingo" and move to the next level.

Infants understanding of the danger in other people's actions

Manasa Ganesh (Undergraduate Research Assistant), Shari Liu (Postdoctoral Researcher), Elizabeth Spelke (Principal Investigator)



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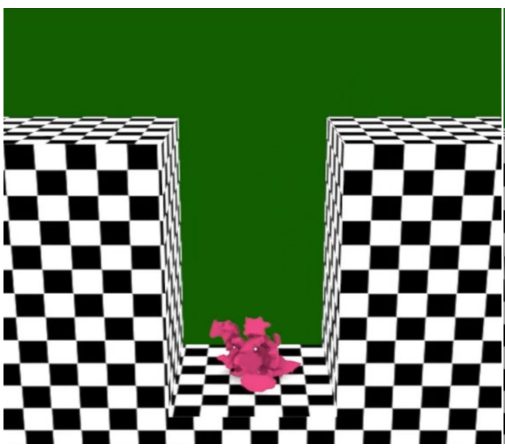
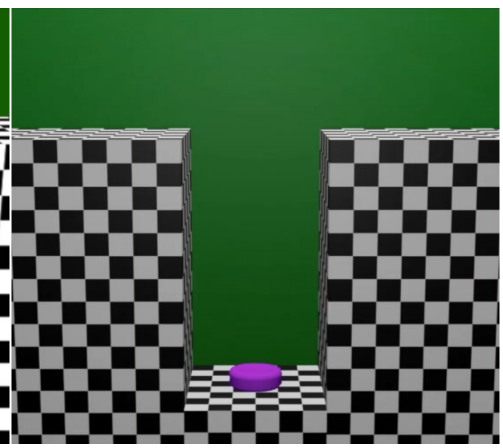




B. **C.**

Some situations are more dangerous than others. Standing at the edge of a tall ledge, for example, is more dangerous than standing on solid ground. We understand this intuitively as adults, but where do these abilities come from? Previous studies conducted in the lab have shown that infants, by the age of 13 months, understand some aspects of danger: For example, they look longer in surprise when a character jumps over a deep trench to get to a goal, when they could have jumped a shallow trench instead (see Figure A). We conducted these experiments in both 13-month-old and 10-month-old infants, and we found that 13-month-olds robustly succeeded, and 10-month-olds weakly succeeded. One key question is whether this age difference is robust. Another key question is how infants arrived at the idea that deeper trenches are more dangerous. In our previous studies, infants saw an object break and shatter when it was dropped into these trenches (see Figure B). Could they have learned, from this event, which situations are more dangerous, or do they appreciate this information, even without those events?

Thus, this year, we conducted the same experiment over Zoom with 10-month-old and 13-month-old infants. In this study, we took away infants' opportunity to learn about the negative consequences of falling from a height during the study. We did this by replacing the video of the object shattering with another video of a soft jelly-like object falling from different heights. The soft object deformed the most on falling from the greatest height, but did not break or shatter (see Figure C). We measured 10-month-olds' and 13-month-olds' looking times to these videos to gauge their expectations.

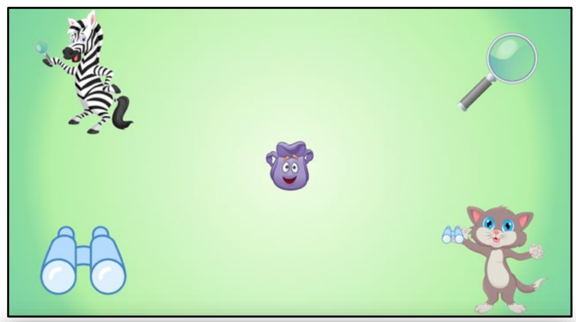
Our data showed that while 13-month-old infants looked longer when the character jumped over the deeper trench (when a safer, shallower trench was also available), 10-month-olds did not. Therefore, our results provide evidence that by the age of 13 months, infants expect others to engage in safer actions instead of dangerous ones when the final rewards of both these actions are equal. These findings are important as they show that by 13 months of age, infants expect other people to consider the possible consequences of their actions before acting.

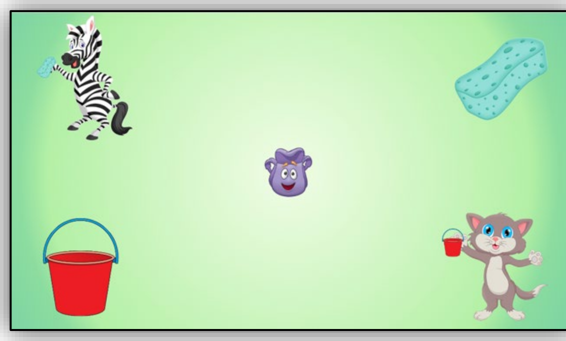
In our study, we only investigated whether infants understood the danger associated with falling from greater heights. In the future, however, we are curious to see whether infants may understand other forms of danger as well! This work would have been impossible without your participation, and so we would like to thank you! We also hope that you will continue participating with us in the future.

How should we look at the zebra with the magnifying glass?

Anthony Yacovone (Graduate Student), Barb Hlachova (Undergraduate Research Assistant), Jesse Snedeker (Principal Investigator)

Prior work has shown that adults and children use different sources of information to understand what someone is saying to them. This means that adults and children can sometimes interpret identical sentences in different ways—especially if those sentences are ambiguous. For example, imagine that we are playing a game with the four objects in the top image below: there is a zebra holding a tiny magnifying glass, a large magnifying glass, binoculars, and a cat holding tiny binoculars. Then, I ask you to *Look at the zebra with the magnifying glass.* This sentence has two possible meanings: 1) you could simply *look at the zebra that is holding the magnifying glass*; or 2) you could *pick up the large magnifying glass and use it to look the zebra*. Both interpretations are perfectly acceptable in this instance.





Now imagine that I showed you the toys from the bottom image: there is a zebra holding a sponge, a large sponge, a bucket, and a cat holding a bucket. Then, I ask you to *Look at the zebra with the sponge*. Like the sentence above, this sentence has two possible meanings: 1) *look at the zebra that is holding the sponge*; or 2) *use the sponge in some way to look at the zebra*. However, only one sentence interpretation makes sense given our knowledge about sponges and what they are best used for (i.e. they are not good instruments for looking at things!). Interestingly, children will still consider the interpretation that involves using the sponge as an instrument for looking at the zebra, whereas adults will quickly dismiss this interpretation and favor the alternative one.

The present study is interested in why children, unlike adults, will still consider the highly implausible sentence interpretation. One hypothesis is that children simply need more time to process the sentence that they are hearing. People often speak very quickly—and it may take some additional time to think about what someone is saying, calculate all the possible interpretations, and then select the one that seems most plausible based on real-world knowledge. Thus, to investigate this question, we manipulated the speed of our critical sentences by either playing them at normal speaking speeds or slowing them down drastically.

Our preliminary findings support the hypothesis that having more time to process the sentences helps children better utilize their real-world knowledge when understanding ambiguous sentences. We are still collecting data at this time, so stay tuned for more results!

If you have any questions about this study, please contact Anthony Yacovone (anthony_yacovone@g.harvard.edu).

Do infants recognize social closeness?

Ashley Thomas (Postdoctoral Researcher), Elizabeth Spelke (Principal Investigator)

In all human societies, people form 'thick' relationships, which are characterized by strong and enduring attachments and specific moral obligations. While thick relationships often occur between genetic relatives, not all thick relationships are between genetic relatives and not all genetic relatives form thick relationships. How do young children identify thick relationships in their social environments? One possible cue is the sharing of bodily fluids, which occurs within thick relationships across many cultural settings.

In these studies, we found that children, toddlers, and infants infer that individuals who act in ways which suggest saliva-sharing have a different kind of relationship with one another than do other social partners. Children expected saliva sharing to happen within nuclear families, and infants and toddlers expect these behaviors to occur between individuals who respond to one another in states of distress. We're currently running a study to ask whether infants and toddlers were simply more interested in the person who had shared food in a way that implied saliva-sharing.

Do infants pay special attention to how their caregivers treat new people?

Ashley Thomas (Postdoctoral Researcher), Elizabeth Spelke (Principal Investigator)

In this study we're interested in finding out whether infants pay attention to how their caregivers interact with new people. Across cultures, people imitate those who they like. And in fact, when infants see someone imitate one person but not another, they expect that the person doing the imitating will approach the person they imitated.

In this study, we showed infants a video where their caregiver imitated one puppet and didn't imitate another puppet, to show the infants that their caregiver 'likes' one of the puppets more. Then we asked, 'who does the infant expect to talk to them'. To ask this last part, we showed infants both of the puppets from the previous interaction and asked who they looked at more when one voice talked in a friendly way and used the infant's name.

We found that 12 month old infants looked more at the puppet who their caregiver had imitated. What is really interesting is that when infants had previously seen *another* infant's caregiver, they didn't show this pattern. This shows that their behavior is specific to watching their own caregiver's interactions.

Next, we wanted to ask if infants would make the reverse inference. Here we first showed infants one puppet speaking to them ("Hi, Ashley Hi!") and another puppet who danced on screen to infant friendly music. Then we showed a video where their own caregiver expressed distress. Infants looked first at the puppet who had previously spoken to them as though they expected that puppet to respond to their parent's distress. Again, this was only true when they saw their own caregiver express distress not when they saw another caregiver.

We loved seeing you over Zoom this year

and we hope to see you again soon!