



2014 Newsletter

Lab for Developmental Studies at Harvard University



babylab@g.harvard.edu

617-384-7777

2014 Newsletter Articles

Beyond the Words: Language in a Social Context	4
Silent Priming	5
Oh, I know what happened!	6
Can toddlers use negative information to learn a name?	7
“One apple” and “two apples”: Language and number	8
Temporal Order and Language	9
Ordinal Numbers.....	10
Emphasis and Memory	11
Children’s Interpretation of Disfluencies.....	11
Children’s Interpretation of Sentences with ‘Only’	12
When do preschoolers ask for help?	13
Bribery	15
Desire, Understanding, and Helping.....	16
Agency and Happiness.....	17
Moral Wiggle Room	18
Discrete and Amorphous Sharing	19
Reciprocal Sharing in Toddlers	20
Third Party Intervention: A Cross-Cultural Study.....	21
Trust and Resource Distribution	22
Teaching Two and Three	23
"It's not in this bucket"	24
Understanding “No”	24
The Structure of Common-Sense Concepts	25
Object Recognition in Early Childhood.....	26
What’s in the Box? Language and Object Identity	27
The Process of Elimination	28
Reasoning and Causality	29
Language and Theory of Mind	30
Infants Desire Understanding	31
Expectations about Emotional Reactions among Friends and Non-friends.....	32
Investigations of Early Sensitivity to Pedagogical Communication.....	33
How do children form first impressions?.....	34
Music and Social Cognition.....	35

For young infants, is music social?.....	37
Finding Categories in Infancy: Objects vs. Animate	39
Imitation and Social Preferences	40
Learning about Behavior: Groups and Individuals, Conventions and Causal Actions.....	42
Social Clues	44
Happy Conversations	45
Developing Interpretations of Maps and Triangles	46
Infants' Detection of Shape Changes in Triangles	47
Infants' Detection of Shape Properties	48
How Kids Think About Family, Friends, & Strangers	49
Early Understanding of Social Interactions & Relationships	50
Working to Benefit the Self & Others	51
Finger Puppets Study: Do young children understand exact quantities?.....	52

Beyond the Words: Language in a Social Context

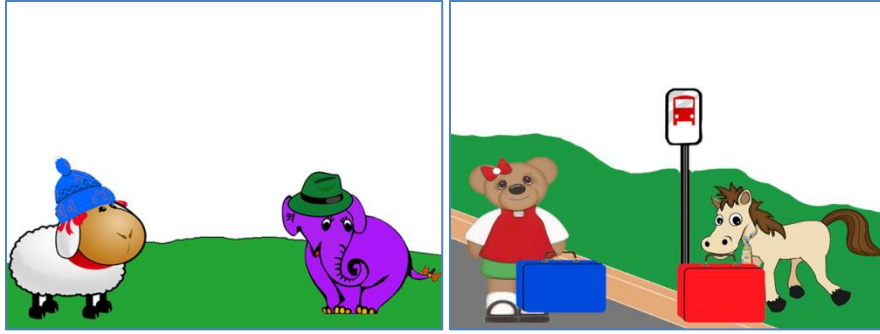
Ellie Kaplan and Tracy (Brookhyser) Reuter, Lab Managers

Communication involves both understanding the literal meaning of what is said (semantics) as well as making inferences about what is meant (pragmatics). We study how adults, typically-developing children, and children with Autism Spectrum Disorders (ASD) comprehend and produce language with two specific aspects of pragmatics: prosody and pronouns. Our study involves several tasks in lab, as well as a training period where children practice these aspects of language at home on an iTouch device.

Prosody can be understood as emphasis put on words (e.g. how long or loud a word is said). In some of our games, we examined how participants produced emphasis on words, and in other games, we examined how participants understood other's use of emphasis on words. For example, adults would understand a difference in meaning for the following sentences: (1) No, I don't want the BLUE hat. Choose again! (2) No, I don't want the blue HAT. Choose again! That is, when the Picky Prince doesn't want the BLUE hat, adults guess he wants the red one. Children seem to be still developing this pragmatic understanding between the ages of 7 – 10 years old, and it may be that children with ASD develop this understanding differently.



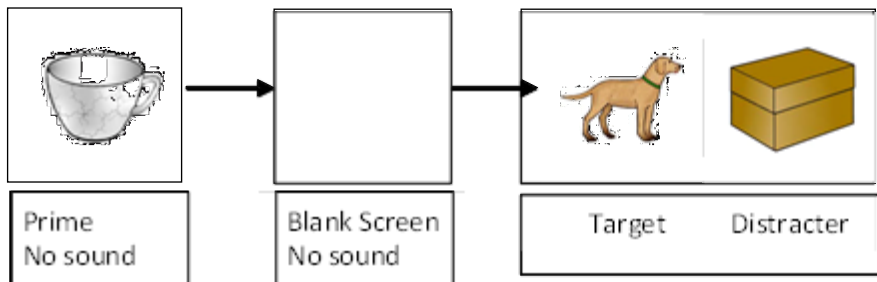
In our pronoun tasks, participants heard stories about characters. The stories are sometimes ambiguous. For example: “Henry the Horse is playing in the snow with Marky the Monkey. He is wearing red mittens.” Participants said whether the story was true or false. If it was false, they explained why. Adults usually think that “he” refers to first mentioned character in the first sentence. So we expect participants to look more towards Henry when they hear “he,” and to say, “False, he is wearing yellow mittens!” Again, children between the ages of 7 – 10 years old are likely still developing the bias we see in adults to interpret the pronoun as referring to the first mentioned character, and children with ASD may come to show this bias even later than typically developing children.



In the iTouch training, children practice some of the same tasks they did in lab. We want to know whether practicing language skills and receiving feedback on accuracy will help children to improve language skills. We are currently collecting data and hope to have some preliminary results to share with you in the next newsletter! Thank you for your participation!

Silent Priming Tracy (Brookhyser) Reuter, Lab Manager

We are interested in whether two-year-olds implicitly label the objects they see. That is, when they see a cup, they might think silently to themselves: “cup!” Spontaneous naming and pointing to objects is common during this age, but we want to better understand what toddlers are thinking silently. So we use a priming method. We show toddlers one picture (called a prime), followed by two pictures (called a target and a distractor). If they implicitly labeled the first picture, their preferences for looking at the two pictures might be influenced (primed) by this naming process.



Critically, there may be a “sub-prime” which mediates this effect between prime and target. This is called phonosemantic priming. That is, it combines priming effects from phonology (how words sound) and semantics (what words mean). For example, seeing a cup might prime children to think about other words that *sound* similar to cup (e.g. cat), which would then prime things with *meanings* similar to cat (e.g. dog). So in this case, cup could prime more looks to the target dog, even though the cat is never visible on screen. We are currently analyzing the data and hope to update you with results next year. Thank you!

Oh, I know what happened!
Tracy (Brookhyser) Reuter, Lab Manager

We are interested in how young children understand negated sentences, which include words like “no” and “not.” People use negated sentences frequently, so distinguishing the two is important in communication. Previous researchers have proposed that we understand the meaning of a negated sentence only through its affirmative counterpart. That is, to understand, “I didn’t read the book,” your thought process would be something like: “I read the book...not.” This would mean that processing negated sentences would take longer. However, the results of our studies indicate that children as young as 2 years old process negated sentences incrementally. That is, they are just as fast to understand a negated sentence as they are to understand an affirmative.

In the first study, children saw pictures on a screen, and heard a male narrator tell stories about things that Arthur and D.W. did or did not do. After each story, a female narrator, Dora, chimed in to say, for example: “*Oh, I know what happened! D.W. broke/didn’t break one of the plates. Which one was it?*” We recorded children’s responses, as well as which picture they looked at on the screen while they heard the critical sentence (e.g. *D.W. broke/didn’t break one of the plates*). This allows us to see whether children understand the sentence, and if so, how quickly.



We found that 3-year-old children understand both affirmative and negative sentences; looking quickly to the correct picture and selecting the correct picture in both cases. However, 2-year-olds had difficulty with this task, though those with bigger vocabularies tend to do better. For both affirmative and negative sentences, children initially looked to the correct picture, but upon hearing, “*Which one was it?*” they looked equally to the two pictures, and then selected the correct picture only ~50% of the time!

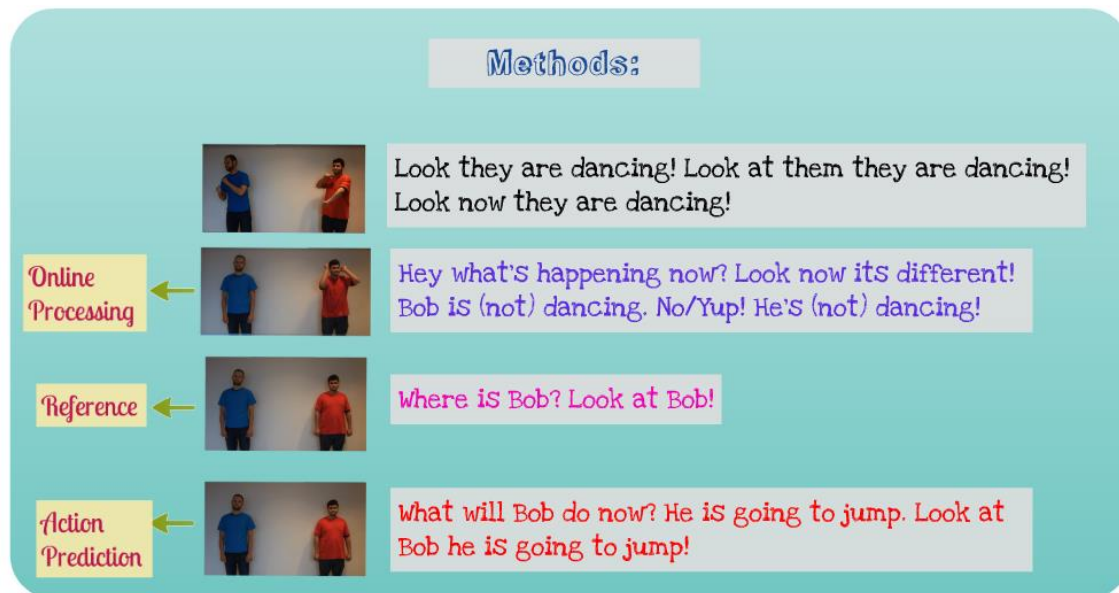
The second study was very similar, but we made some changes to make the task easier for the 2-year-olds. We included more practice trials, used a “blocked design” (e.g. 4 affirmatives followed by 4 negatives, or vice-versa), changed the items to a bowl and a plate, and changed the critical sentence to, for example: “*Show me the one D.W. broke/didn’t break.*” We recorded children’s responses, as well as which picture they looked at on the screen while they heard the critical sentence.



We again found that 3-year-old children understand both affirmative and negative sentences; looking quickly to the correct picture and selecting the correct picture in both cases. So far, it appears that 2-year-old children succeed in this task in a specific way. That is, children who heard 4 affirmative sentences followed by 4 negative sentences understood both types of sentences. Children who heard 4 negative sentences followed by 4 affirmative sentences did not understand. It may be that encountering the affirmative form helps scaffold the process so that younger children can understand negative sentences. We are excited to finish data analyses and tell you about our results next year! Thank you for your help with these studies!

Can toddlers use negative information to learn a name? **Roman Feiman, Graduate Student**

In another study looking at toddlers' understanding of the word and the concept "not", we use a video study to test whether younger and older two-year-olds can use information about who a person (say, John) is not, to figure out who he is. The video shows two characters who both start out dancing. Then, one of them stops, and a voice-over tells the child that "John is not dancing". Then both characters stop. Can the child find John? This requires some complicated reasoning! To identify John, they have to understand what "not dancing" means – that is, identify the character that isn't dancing, and then remember that that person's name is John for later.



We are still running this study, but so far, it seems that older two-year-olds are pretty good at looking at the not-dancing person when we say "John is not dancing", but not as good at identify John later on. The fact that they do process the negative word "not" at this age provides some converging evidence from another method that age two is around the time when children begin understanding verbal negations like "not" and "no" in their logical sense. We look forward to reporting our results in our next newsletter. Thank you for helping with our research!

“One apple” and “two apples”: Language and number

Dorothy Ahn, Graduate Student

The main goal of this research is to study how children learn number words, and how this learning process is related to language development. In some languages like English and Russian, certain linguistic elements are added to a noun in order to indicate whether the noun is singular or plural. For example, in English, the letter ‘s’ is added to a singular noun ‘(one) dog’ in order to make ‘(two) dogs.’ Some languages, like Japanese and Chinese, do not have such plural marking: the plural form of ‘dog’ would be ‘dog.’

Previous studies suggest that this overt marker of plurality may help children learn the initial numbers faster. English-learning children have been shown to learn the meaning of ‘one’ (vs. larger numbers) faster than children learning languages without plural marking. Also, children learning languages such as Slovenian, which distinguishes dual in addition to singular and plural, have been shown to learn the meaning of ‘two’ faster than children learning other languages.

In our study, we tried to investigate how the plural marker can help number learning. It might be that the plural marking must also occur when numbers bigger than ‘one’ are used, or merely having the plural marking might be enough. In order to find this out, we looked at Korean. Korean, like English, has a plural marker, but, unlike English, does not allow the marker to occur with number words.

English or Korean-learning children of age two to five played two number games. In one game, they were asked to place a given number of fish into a whale-shaped bowl. In the next game, they were presented with cards showing different number of objects (as shown below) and asked to tell the experimenter how many objects were on the cards. They also completed a language game which tested their knowledge of the plural marker.



Results so far demonstrate that children in both language groups learn the plural marker fairly early (around age two to three years old), and that there is no substantial delay in initial number learning in Korean-learning children. This suggests that it is the presence and the knowledge of the plural marking, and not its co-occurrence, that facilitates number learning. But we need more data before drawing conclusions. We plan to test more children in other language groups as well for more comparison. We hope to use these results to learn more about how the domain of language and the domain of numbers interact.

Temporal Order and Language

Annemarie Kocab, Graduate Student

Children's language abilities show remarkable growth in the first few years of life. Infants begin by producing one-word utterances dominated by social words like "bye" and concrete nouns referring to people and things, like "shoe" and "doggie," then start combining words and using more abstract terms such as adjectives and verbs. Are these increasingly sophisticated language abilities the result of a growing knowledge of the language the child is learning or more general cognitive maturation? Clues from work with special populations, such as internationally adopted children, who learn one language in their birth country and another in their adoptive country, suggest that both of these possibilities may be correct. Some aspects of language acquisition seem to reflect experience with a language while other features appear to be driven by cognitive development. Of interest to us is the finding that older international adoptees show earlier acquisition of time words referring to the past and future than younger adoptees. One explanation for this finding is that older children learn time words faster because they are better able to figure out what those words mean and represent their concepts.

The domain of time is a promising area of exploration because temporal language encodes basic features of experience that all living creatures are able to represent, such as order and simultaneity, but does so in an abstract way, generalizing across different situations and content. Moreover, all languages have ways of expressing temporal information, and other research shows that children progressively develop more sophisticated notions of time. In the current set of studies, we explored the development of children's memory for temporal events and children's ability to linguistically describe events with different temporal relations. Because children are initially slow to learn and use time words correctly and do not seem to achieve full mastery until the middle school years, we were interested in whether detecting changes in temporal order was more difficult than other types of non-temporal changes, such as changes in the object that was acted on, or the manner in which it was acted on.

In one study, a memory task, we looked at whether children could accurately remember events ordered in different temporal sequences and detect changes of different degrees. Children saw a video clip of a sequence of different events on a computer. Then they saw another sequence of events and were asked to say whether that sequence was the same or different from the original sequence. In another study, we used an interactive communication game where parents participated with their children. Both the child and parent saw pairs of movies, similar to the ones used in the memory task. In addition to the movies of events in different sequences, we used a second set of movies depicting two different events that varied in their temporal relation. For instance, in one movie, while a woman was spinning on a chair, a man was pacing back and forth. In the other movie, the same man did not begin his pacing until the woman had stopped spinning on her chair. The child was asked to describe one of the two movies and then the parent indicated which movie s/he thought the child was describing.

Our preliminary results suggest that there are developmental changes underlying children's memory for temporal events, with older children better able to remember events with different sequences than younger children. Moreover, older children seem to be better able to convey temporal information in a communication game-like task than younger children. In particular,

younger children have more difficulty describing ordered sequence of events than they do describing other kinds of temporal events. The results from our memory task suggest that cognitive maturation may account for at least some of the differences between older and younger children's abilities to describe temporally-ordered events.

Ordinal Numbers

Annemarie Kocab, Graduate Student

A large body of research has shown that learning how to count is a challenging task that takes children some time to figure out. Although much research has focused on children's ability to use cardinal numbers like "one," "two," and "three," ordinal numbers, such as "first," "second," and "third," have been studied much less. The few studies that have been done suggest that ordinal numbers may be even more difficult for children to acquire than cardinal numbers. One reason why ordinal numbers may be challenging is because learning those numbers involves understanding a principle that contradicts what children know about cardinal numbers. When counting a set of objects to determine the cardinal value of the set, it does not matter the order in which the child counts the object as long as s/he only counts each object once. In contrast, to determine the ordinal position of an object in a set, the order in which the objects are counted matters. Moreover, the child must figure out which side to begin counting from, following the correct (right to left or left to right, depending on the set) direction of the array.

In this study, we are looking at children's ability to describe sets of objects and events with different kinds of number words, and whether there is a relationship between children's production of these two different types of number words, cardinal and ordinal numbers. Children saw pictures of different objects and animations of brief events on a computer screen. All objects had a clear front and back as well as a destination object to the left or right of the screen. For example, one picture depicted a row of birds, all facing to the right (as indicated by the direction of their beaks) with a tree on the right side of the screen. The experimenter asked children questions about what they saw on the computer screen. Some of the questions were designed to elicit use of cardinal numbers; for example, "How many birds are there?" Other questions were designed to elicit ordinal numbers; for example, "Which bird flew to the tree?"



Preliminary results suggest that identifying the target object in a set of object and producing the correct ordinal description may indeed be challenging for children. One possible source of difficulty for children is remembering that the side they begin counting from affects the ordinal value they give, and that where to begin counting depends on the particular array of objects seen.

Emphasis and Memory

Eun-Kyung Lee, Post-Doctoral Fellow

Does how a person says something affect young children's memory of what is said? In this study, we asked whether emphasizing a word influences children's memory. Do they remember what Annette gave her brother when the speaker emphasized a related word (*Annette gave her brother the HAT.*) compared to when s/he did not (*Annette gave her brother the hat.*)? To study this question, we had 5-year old children hear a series of short stories while watching a related picture on the computer screen. We then asked them to complete some distractor tasks. In the test phase, children's memory for each story was tested (e.g., *Did Annette give her brother the hat or the scarf?*). Our results show that 5-year-olds remembered information better when it was produced with emphasis than when it was not. This suggests that emphasizing a word may improve children's memory for what they have heard.

Children's Interpretation of Disfluencies

Eun-Kyung Lee, Post-Doctoral Fellow

Spontaneous speech often contains disfluencies like *um*, and *uh*, which tend to occur when the speaker is having trouble planning an upcoming utterance. We tested whether children can use these disruptions in speech production to infer the speaker's mental state.

In this study, children (ages 5-6) listened to sentences with and without a disfluency (e.g., Click on thee uh yellow toaster. vs. Click on the yellow toaster.) while watching two clear images and two blurry images on the computer screen. We measured where children look on the screen at the moment of disfluencies. We predicted that if children use a disfluency to infer that the speaker is having difficulty describing images, they would be more likely to associate the disfluency with blurry images than with clear images.



While adults showed the predicted pattern, 5-6-year-olds preferred to look at clear images regardless of whether utterances were fluent or disfluent. We know from previous work that even 2-year-olds can predict that the speaker will next say something difficult to name when they hear disfluencies. Our results suggest that children's ability to draw inferences about the speaker's mental state using disfluencies may be task-specific and limited to a particular situation.

Children's Interpretation of Sentences with 'Only'
Eun-Kyung Lee, Post-Doctoral Fellow

Can children predict an upcoming word based on what has been previously mentioned? To test this question, we examined how children process sentences with 'only'. Consider these sentences:

- (1) a. Arthur picked the candy and the boots.
 b. D.W. only picked the cand...

When sentence (1b) follows sentence (1a), information in the latter may restrict a set of words that can possibly follow 'only' in the former. While listening to (1b), adults are known to predict that 'only' will be followed by one of the items mentioned in (1a). That is, they are more likely to look towards the candy than the candle, because it was previously mentioned.

In order to investigate whether children can make such predictions based on 'only' and the context, we had 6-year-old children listen to a pair of instructions like (1). We monitored children's eye movements to objects in the visual display while they were listening to the target sentence with or without 'only'. If 6-year-olds can use the context and 'only' to predict an upcoming word, they should be more likely to look at the previously mentioned items when they hear the word 'only' compared to when they hear the sentence without 'only'.



We found that children's eye movement behavior did not vary depending on the presence or absence of 'only'. This suggests that 6-year-olds have not yet achieved the ability to use 'only' and the context to generate predictions about upcoming words.

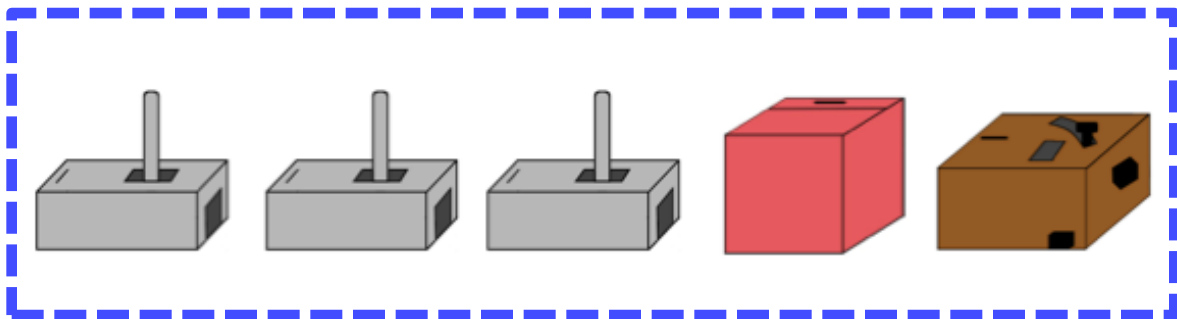
When do preschoolers ask for help?

Alex Was, Graduate Student

Preschoolers are active learners! They gather information about the world around them both by directly experimenting on their surroundings and by seeking out information from others. So, kids have access to a great deal of new information, but in order to be a “efficient learner”, kids need to be more than just “information sponges,” soaking up and accepting every piece of information that comes their way. As an efficient learner, you may want to pay attention to things like the usefulness or source of the information. At the most basic level, however, an efficient learner should be able to judge whether or not they need to learn at all. That is, they should be aware of whether or not their past experiences and knowledge enable them to solve a problem themselves, or whether they must turn to others to succeed.

This study focuses on this fundamental aspect of efficient learning, asking “Under what circumstances do children seek assistance from adults?” We were particularly interested in the importance of familiarity and novelty. That is, can kids recognize when their prior knowledge is applicable to a new situation (when the situation is familiar) and when they should seek help (when the situation is novel)? We also wanted to explore how children’s behavior might change across the preschool years.

Children were given a chance to explore a set of ‘puzzle boxes’ (boxes that contain a reward and take several steps to open) and were asked to decide whether or not to ask an experimenter for help in discovering how the boxes open. Sometimes, these boxes were identical to ones that children have encountered before, but sometimes they were completely different!



Current findings suggest that by 3 years of age, children know when to ask for help – at least in hypothetical situations. When shown sets of puzzle boxes and asked “Do you **think** you could open this box by yourself or would you need help?”, kids generally said they would need more help with boxes whose solution they hadn’t seen before (*different boxes*) than with boxes whose solution they knew (*identical boxes*). Moreover, this pattern became clearer with age. Whereas 3-year-olds and 4-year-olds sometimes said that they think they would need help with the identical boxes, 5-year-olds rarely said they’d need help with them!

Another version of this study explores whether children’s actions will match their verbal reports; although preschoolers seem to know when they *should* ask for help, do they actually ask for help when they need it? To test this, we asked children to choose between asking the experimenter to open the box for and trying to open the boxes themselves. Although kids should be able to open the identical boxes by themselves (and get the reward), the different boxes are very difficult to

figure out (so it makes more sense to ask the experimenter for help). We found that children indeed asked for help more with the different boxes than with the identical boxes, but, somewhat surprisingly, older kids were less likely to ask for help with any of the boxes. So, even though preschoolers are aware of when they should ask for help, they increasingly neglect to seek out the help they need as they get older.



These results made us wonder exactly why kids wanted to try the boxes (particularly the different ones) themselves. They had no previous experience with any of the different boxes and were thus unable to open any of them by themselves, making them miss out on rewards! One thing we thought might be influencing kids' decisions was their desire to learn about the boxes. When children asked the experimenter to help them, she opened the box out of their view and then gave them the reward. If kids wanted to learn about how the boxes worked, the only way to do so would be to try to figure it out on their own! To explore this possibility, we once again changed the two options children had to choose between for each box. This time, we asked: "Do you want a reward or do you want to see how the box works?" If they picked the reward, the experimenter put the box away and gave them a reward. If they picked to see how the box works, the experimenter opened the box in front of them and then she got to keep the reward. Although testing is ongoing, initial results suggest that kids choose to learn more about the different boxes than the identical boxes, and this tendency gets stronger with age. These results tell us that although children know when they should ask for help, they sometimes prefer to try problems themselves – particularly if they can learn something by doing so!

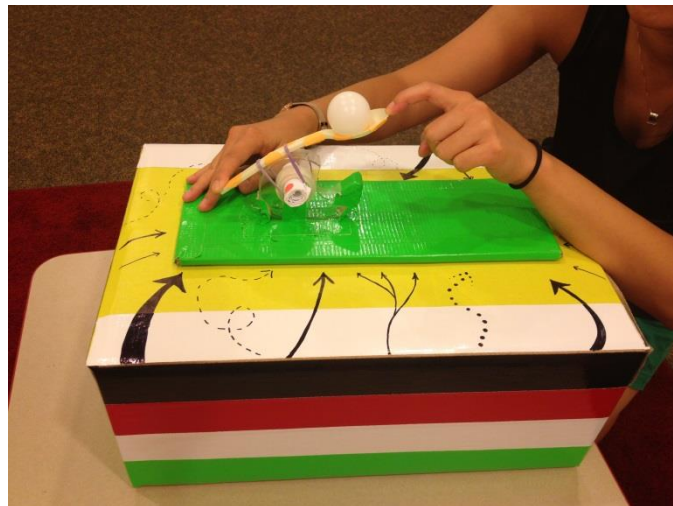
Bribery

Natalie Benjamin, Lab Manager

Although the word “bribery” often has negative implications, triggering thoughts of corruption and other undesirable behaviors, from a more formal point of view, bribery does not necessarily have a moral connotation. Instead, it involves a person giving a resource to someone in order to influence his or her behavior. Because of this, bribery is highly related to reciprocity, in that the briber must be confident that the recipient will reciprocate his or her behavior in a way that is beneficial to the briber. This study explores this phenomenon. We know that 5-year-olds will share significantly more with a partner who had higher-valued resources than with another partner who didn’t have the chance to reciprocate the gesture. But will children further understand that acting pro-socially toward the correct person can tip the scales in their favor? This study explores this question.

Children played with two adults (game owner & confederate). In the first step the child and the confederate each received two stickers, a high-valued and a low-valued sticker, and both were told to choose which one they wanted to keep for themselves and which one they wanted to give to the game owner. In the second step the game owner chose a partner to play a game with: she could choose either the child or the confederate. The crucial point of this task was that children knew in advance that the game owner was going to decide with whom to play in the second step. If children understand that they can influence the owner’s decision by being nice to her, they will give the best sticker to the owner.

We ran this study with both 5- and 7-year-olds, and found that both of these groups of children are more likely to give away the high-valued sticker to the game owner in order to be chosen to play the game. Based on patterns it seems as though children learn this behavior throughout the study; therefore, we are currently developing a subsequent version of the study, wherein we hope to investigate whether children can exhibit this behavior more spontaneously. To that end, we will be utilizing different pairs of toys with varying degrees of value, not just stickers. We have also run short studies with 5- and 7-year olds related to this study in which we asked them about their preferences for different toys, or about their preferences for different toys and games. Thank you to all the families who participated in this study! We look forward to updating you in the next newsletter.



Desire, Understanding, and Helping

Kate Hobbs, Graduate Student

By about 14-months, infants seem to be genuinely helpful creatures. They often bring us toys and things to show us and will even help us when we can't reach an object. Of course, many parents report this all changes when the “terrible twos” roll around! But even if infants don't *want* to be helpful they still may know how to be helpful. This study begins to explore what infants know about others' emotions and how to be helpful.

To be maximally helpful one must be motivated to help by meeting another's needs, and one must be aware of exactly what that person's needs are. If your friend is hungry and prefers goldfish crackers to broccoli, giving her broccoli is nice enough, but not as helpful as it would be to give her some goldfish. Previous research has shown that by 18 months of age infants can figure out which of two food items someone likes based on her emotional responses to each, and will give the person her preferred food.

Our study explores the extent to which children can read others' emotions to figure out what their preferences are and also be intrinsically motivated to help accordingly. 2- and 3-year-old children first learn the rules of the game—toys the experimenter likes go in her backpack to take home, while toys she doesn't like get tossed in a bin and later recycled. Then kids have a few opportunities to try helping when an object falls off the table and out of the experimenter's reach. In these practice trials there's just one object and it's obvious whether the experimenter likes the object or not. In the test trials, things get a little trickier—there are two objects, one liked and one disliked, and both objects fall off the table at the same time. Once the two objects are out of the experimenter's reach, she doesn't give any hints about which one she wants—the child has to infer from her past emotions which one she liked and which one she wants now.

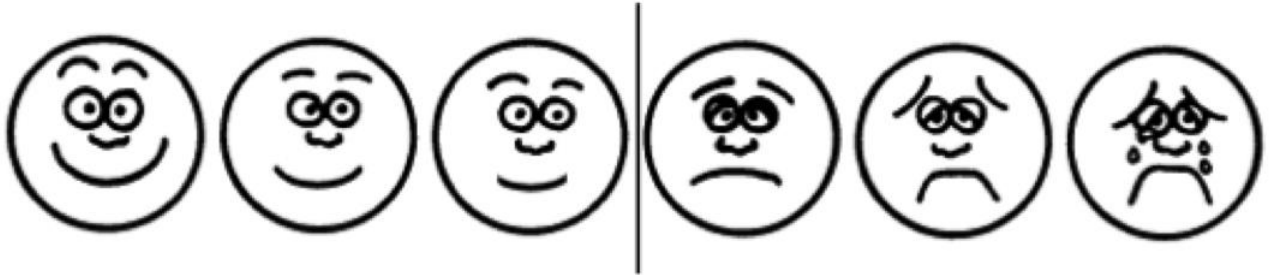


It turns out this is a pretty hard task! The two-year-olds in our study often did not help at all, perhaps because it was all too confusing. When the two-year-olds did help in the test trials they gave objects randomly, not in line with the experimenter's preferences. Three-year-olds, however, had the game figured out; they reliably gave her just the object she previously liked. This progression from helping generally to helping more specifically mirrors other findings with toddlers and shows that kids have a lot to learn in order to be good social partners. So don't worry if your little one is helpful, but not *that* helpful.

Agency and Happiness
Monica Burns, Graduate Student

In this study, we are interested in how children feel when they share with others. We know that adults are happier when they spend money on others than when they spend money on themselves. We think older children might be happier after giving candies away than after keeping candies for themselves, but younger children may be happiest keeping candies.

We are also interested in whether kids' happiness depends on whether they actively make the decision to share. In at least some situations, adults who spend money on themselves are happier when they do not have the burden of making the decision to do so. For example, adults who are given a choice to either keep some money or donate it are happier when a computer randomly decides for them than when they choose to keep the money. We want to know whether making the choice to share or donate candies similarly affects kids' happiness.



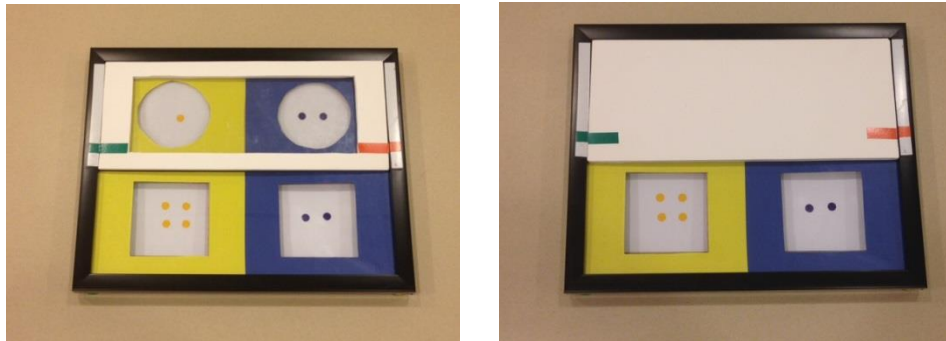
Children see different pairings of equal distributions of candies (e.g. 2 for the child, 2 for a recipient) and distributions in which they receive more candy than the other person (eg. 7 for the child, 1 for a recipient). Sometimes the child chooses one of these options, and sometimes an option is randomly selected for the child. Then, children pick one of six different faces that shows how they feel, from very very happy to very very sad. We have just begun this study, so we do not know what kids will actually do, but we think younger children will be happiest when they receive more candy, regardless of whether they made the decision. In contrast, we think older children will be happier receiving more candy when the decision was randomly selected than when they made the decision themselves.

Moral Wiggle Room

Monica Burns, Graduate Student

It is easier to be selfish when you can ignore the effect your selfishness has on others. We know that at least in some situations, adults will go out of their way to actively hide the effect their choices have on another person. For example, in an experiment, adults could choose one of two payouts for themselves and another person. Some options were equal payouts (e.g. \$5 each) and other options benefitted the chooser (\$6 for the chooser and \$1 for the other person). A majority of adults chose to cover up the amount of money the other person would receive. That way, they could select the higher payout for themselves and avoid any guilt about their selection being unfair to the other person.

We are interested to know whether children will similarly go out of their way to actively hide the amount of candy another person would receive in order to obtain the most candy for themselves. Children are given choices between two payouts of candy for themselves and another person. We explain that the amounts might be the same (e.g. 2 for the child, 2 for the other) or might be different (eg. 4 for the child, 1 for the other). Before revealing the payouts, children may choose to add a transparent piece so that they are able to see the payout for themselves *and* for the other person, or to add an opaque piece so that they only see their own payout options, and not have to consider the other person's.



We have only just begun to collect data, but so far it seems that children prefer to use the transparent piece. Unlike adults, it seems children want to know how much the other person will receive. Interestingly, this does not always lead them to select the equal option – young children who use the transparent piece often still select the option that yields more candies for themselves. One possible explanation is that children want to see both payouts to ensure the other person does not receive more than they do. If this is the case, this suggests that whereas adults prefer to hide another's payout to avoid guilt from selecting a selfish payout, children may prefer to see another person's payout to avoid envy from selecting a generous payout.

Discrete and Amorphous Sharing

Monica Burns, Graduate Student

In many experiments of children's sharing behavior, researchers give children prizes, usually stickers or candy, and ask whether they would like to share them with another person. Younger children often share some of their prizes, and older children (around 8 or 9 years of age) often share about half of them. But what would older children do if it were more difficult to determine how much is half? They might still share about equally, sometimes giving a little more than half and sometimes keeping a little more than half. Another possibility is they might take advantage of the ambiguity and consistently keep more than half. To test this, we give children materials like sand that they later trade in for candies to take home, and ask them whether they would like to share some of the sand with another person.

Sometimes the sand is portioned into six little cups. If a child wants to share half of the prizes, she should simply keep three cups of sand for herself and give three cups of sand away. Sometimes, the sand is all in one big



tub. In that case, it is more difficult to determine how much is half. We predict older children who divide the sand equally when it is in little cups will consistently take more than half of the sand when it is all in one tub. Data collection is ongoing, but we will hopefully have news to share in the next newsletter!

Reciprocal Sharing in Toddlers

Natalie Benjamin, Lab Manager



Most social relationships that we build throughout our lives are based upon reciprocal exchanges of resources, support, and help. We expect people we benefit to return the favor, and often we feel obligated to give back kindness to those who have been generous with us. In this study we are interested in this second type of reciprocal behavior, whether children are selective in their reciprocity based on past interactions.

We know from past studies that children as young as 21 months old are able to distinguish between adults who helped (or did not help) them in the past, and that

those children prefer to later help the adult who had good intentions toward helping them in the past. We also know that in a past study, 3-year-old children (but not 2-year-olds) have shared more when an adult has shared with them in the past than when the adult has not shared with them in the past. In this study we present children with two partners, one who shares and one who does not, and we explore whether children will distinguish these two partners in sharing differently with them.

We run this study with both 2.5- and 3.5-year-olds. In the study, we present children with a game apparatus (either a jingle box or a zigzag ramp), which requires golf balls in order to play with it. The child is introduced to two other players (puppets), and the three of them each get a chance to divide up eight golf balls between themselves and another one of the players. Each of the puppets plays with the child, and then the child plays with one of the puppets at a time. One of the puppets always shares the balls equally, keeping four for himself or herself and giving four to the child. The other puppet never shares with the child, keeping all eight balls for himself or herself. The child then gets to play with both puppets, one at a time.

We are interested in seeing if children will share differently with the puppet who consistently shares with them than with the puppet who never shares with them at all. Our findings will tell us not only if children can distinguish between these two individuals, but also whether children are selective in their sharing behaviors based on past interactions they have had with individuals. If so, this will signify to us that young children have an understanding of social reciprocity and use it in social situations. Data collection is under way and we look forward to sharing our results with you!

Third Party Intervention: A Cross-Cultural Study

Ann Finkel, Honors Thesis Student

How much candy should I get? How much candy should you get? How much candy should she get? These are very important childhood questions. From a very young age, children want to make sure that they don't receive less than another child. In fact, previous research has shown that children are willing to give up some of their own candy in order to prevent another child receiving more candy than them. Once children get older, starting at around age eight, they are also displeased with unequal distributions even when they themselves would be receiving more. At this age, children tend to reject all unfair distributions, even when such a distribution would be beneficial to them.

In a follow-up study, we investigated whether children accept or reject equal and unequal distributions of candy between two *other* children, whom they were told came into the lab yesterday to play the first part of a game. Children are shown distributions of candy between the two other players, and then make decisions about the fate of the candy. In one condition the children can accept or reject the distribution freely. In the other condition, children must give up some of their own skittles in order to reject the distributions. The results showed that children do prefer equal distributions, and are much more likely to reject unequal distributions. While children of all ages rejected more distributions in the free than in the costly condition, six year olds were much more likely than five year olds to reject unequal distributions in both conditions. This suggests that the tendency to perform third-party intervention develops between ages five and six.

In order to investigate whether this tendency is universal or culture-specific, I am performing this study in rural primary schools in Uganda, as well as Cambridge. In Uganda, my research assistant will conduct the study in Rutooro, the local language. I tell the child that two other children, Faith and Mary, came in yesterday and played this game, and today the child's job is to be the decider. I say that yesterday Faith was the divider, and drew pictures of how she wanted to divide the Skittles between herself and Mary. Half of the pictures show an equal distribution, and half show a distribution in which Faith gets six Skittles and Mary gets zero. For each picture, the child gets to accept or reject the distributions. If she accepts, the Skittles will be put in the bags for Faith and Mary to take home, and if she rejects, the Skittles will be put into a black box for no one to take home. In the free condition, the child can accept or reject the distributions freely, without giving up any of her own Skittles. In the costly condition, the child must give up one of her own Skittles in order to reject the distribution. By comparing the results from Cambridge and Uganda, we will gain some insight into whether Third Party Intervention is a behavior that is fostered by a specific culture, or whether it is a universal tendency in children all over the world.



Trust and Resource Distribution

Natalie Benjamin, Lab Manager

Many social relationships are based on reciprocity in various forms and domains. In order for reciprocity to occur, each party must trust that the other will return a favor or a benefit that is bestowed on them. Often we do favors for people with the mutual understanding that they will return the favor at a later time, and that we will benefit from the interaction. This study explores the extent to which children may trust another individual to repay a favor in the future.

In this study, we introduce 6-year-old children to an apparatus with trays that are filled with coins. The child plays with a partner (a puppet), and both the child and the puppet have their own banks, where they will put the coins that they get during the game. In the apparatus, each tray can have a maximum of four coins in it. If the tray is filled with all four coins, the child can push the tray across the table to their partner. The partner will then decide how to split the coins between herself and the child. When the partner has her own choice, she splits the coins equally between herself and the child (two and two). However, sometimes there is a box on the child's bank that prevents the puppet from giving the child any coins. In that case, the puppet is forced to keep all four coins for herself, and the child receives none. Children are then presented with trays that are full with three coins, and are given a coin and told that they can decide what to do with the coin: they can put the coin in the tray and push the tray across to their partner (who will then decide what to do with the whole tray of four coins), or they can keep the coin and put it directly in their own bank. We are interested to see if children will make different decisions based on whether the puppet has access to the child's bank. If the puppet can access the child's bank, she can reciprocate the child's sharing action. If not, the puppet cannot reciprocate and the child receives no coins.



We have also run a slightly different version of this study with 4-year-olds. The setup is the same, but there is no partner who plays with the child. Instead, we manipulate whether or not the children themselves can access the tray once it's pushed through the apparatus. If they can, they will be able to put all four coins in their bank; if they can't, the coins get thrown away and the child receives none of them. In this version we are interested to see if children will make different decisions based on their access to the tray once it's pushed through the apparatus.

The results from this study indicate whether children are able to distinguish between the two different conditions they are put in, and if they understand what is the most profitable action for them to take given the situation they are in. Thank you to all the families who participated in our studies this year!

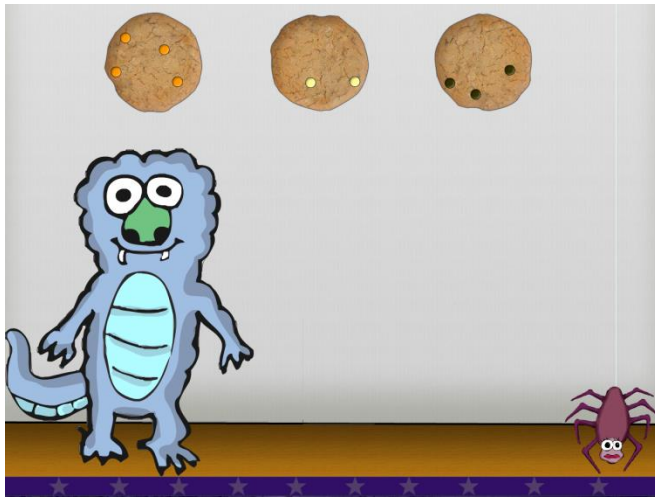
Teaching Two and Three

Rebecca Distefano, Lab Manager

Previous research has shown that children learn the meanings of the numerals long after they have learned to recite the verbal count list (1-10). For example, at around two years old, children may be able to articulate the words “one”, “two”, “three”, “four” while pointing to each item in an ordered set of objects. However, they do not yet know that “one” identifies a set of exactly one individual. During this stage, if you asked a child for one ball, they would probably give you back a handful.

Children acquire these exact meanings slowly. By two and a half years old, most children understand that the numeral “one” refers to exactly one individual (one-knowers). About 6 months later, they have an understanding of two (two-knowers), and several months later they understand three (three-knowers). By the time they acquire the meaning of four, most children have an understanding of all other numerals in the count list. Why are these meanings acquired so slowly? What types of knowledge do children use to develop a full understanding of “one”, “two” and “three”?

One way to begin to answer this question is to attempt to train children on the next number in their count list and vary the types of feedback we give to them. For example, children at this age have developed rich systems of singular-plural morphology and quantification as part of their language (e.g. at 22 months of age children understand the difference between ‘book’ and ‘books’). In order to gain a better insight into what input facilitates the development of early numerals, we attempt to train one-knowers on the number two, and two-knowers on the number three through a series of computerized take home training games in which feedback differs based on a natural language morphology condition, a counting condition, and a visual feedback condition.



We’re still in the process of collecting data, but preliminary results show that there seems to be a difference among children’s improvement in the different feedback conditions. The children in the experimental groups (natural language, counting and visual feedback) manage to acquire the meaning of the next numeral at a higher rate than children in the control condition (children who are trained on a numeral they already know). This suggests that the training game might help improve children’s number knowledge. We have not

detected any significant difference between the effects of the counting and the natural language groups and we are at the beginning of collecting data for the visual feedback condition. We’ll keep you posted on our results in next year’s newsletter!

"It's not in this bucket"

Roman Feiman, Graduate Student

When do babies and toddlers understand what the word "no" means? This question might have a lot of interest for parents worried about when their child can understand a prohibition or reprimand, but it is also interesting for its broader logical meaning. As adults, we frequently think thoughts and say sentences like, "I'm *not* going to the store today" or "that's *not* a very good book". When do we come to understand what the "not" part of those sentences means?

In an ongoing study, we are exploring this question by setting up a hiding-and-seeking game with kids, where we hide a ball in one of two buckets behind a screen that prevents the child from seeing which bucket we hid it in. In one study, we remove the screen and then tell the child that it's *not* in one of the buckets. We then ask the child to find the ball and see if they go to look in the other bucket spontaneously. In a complimentary study, we show the child that one bucket is empty, and then asked them to find the ball. We wanted to know if they would use the concept of "not" without language to guide them -- whether being shown that one bucket is empty would tell them that the ball is *not* in that one, and therefore must be in the other bucket.

So far it looks like the ability to understand logical "not" emerges around 26-28 months of age, and that learning the word isn't easy. Slightly younger children won't use linguistic information about where the ball is "not" to infer where it is, but they will successfully avoid looking in the bucket they saw was empty. We are still conducting these studies, so the results might change. But if there is a gap between when kids can reason about the empty bucket, and when they can use the word "not" in that reasoning, it would mean that learning the word in this context isn't as easy as a lot of other word-learning is, like the names of objects, which kids often learn after they've heard them once. "Not" is not as easy as just learning to match verbal content like, "it's not in the bucket" with the experience of seeing the empty bucket.

Understanding "No"

Nicolò Cesana Arlotti, Visiting Graduate Student & Sophia Sanborn, Lab Manager

"No" is a word with a highly abstract meaning. The word "no" does not refer to any one thing in the world. In fact, when "no" is used, it usually refers to what *isn't* present and what *wasn't* said. It can be used to express many subtly different meanings that center on a general concept of "negation"; for instance, "no" can be used to reject something unwanted, to assert that something is not present, or to assert that a statement is not true. These last two uses are particularly important for reasoning about our world. Despite the fact that "no" has such an abstract meaning, it is one of the earliest words that children learn. Several researchers in our lab are interested in determining what children mean by "no" when they first learn it and how this concept develops into a more complex form that can be used to draw inferences about the world.

This particular study of "no" investigates the age at which children understand that "no" can be used to assert that something is not present. We are currently running this study with two-year-olds. In this study, children watch a video on a screen that tracks where they are looking. We can infer how children interpret the sentences they hear based on what they pay attention to during

the video. Children see an object (an apple, ball, boy, or cup) hide in one of two empty boxes. They are then asked either question (1) or (2):

- (1) “Where is the box with **the apple?**”
- (2) “Where is the box with **no apple?**”

If children understand that “no” can be used to describe the location where the apple is *not* present, they should pay more attention to the empty box when they hear question (2). We are still collecting data for this study, so we cannot yet draw conclusions about whether children at this age understand this type of negation, but we hope to complete data collection during the fall semester.

The Structure of Common-Sense Concepts **Paul Haward, Graduate Student**

Some of our most basic concepts, such as “table”, “ship” and “cow” appear to be universal across natural languages. Furthermore, children learn these concepts at a remarkable rate — often up to ten words a day during the peak periods of language growth. One of the projects in cognitive science, then, is to determine the properties of these concepts and how the child acquires them at the rate that they do.

One way to access the structure of a concept like “cow” is to look at the different ways that children naturally explain the properties that compose the concept “cow” (e.g. having four legs, having a tail, eating grass). Previous studies have shown that adults explain some properties of concepts by simply referring to the kind of thing it is. For example, when asked why a car has four wheels, adults might reply “because it is a car”, but when asked why a car has a radio, the answer “because it is a car” does not seem as applicable. These observations allow us to better understand the structure of our linguistic concepts by helping identify some kind-property relations that are more principled than others: they help us learn about the implicit structure in the child’s understanding of words such as “car” and “cow”.

In our study, we are interested in how children understand the relation between the kind of thing something is (e.g. a car) and its properties. To test this, we have developed a task that involves a puppet and a picture book. Each child is shown pictures of basic concepts, for example, pictures of cows. They are then told a story about the items, followed by a game where they are asked to explain to the puppet why some of the properties exist as part of the object (e.g. “why do these things have four legs?” while pointing at cows). We are looking to see if children also treat some properties as special, in that they license an explanation in terms of the abstract category (e.g. Researcher: “why do these things have four legs?” Child: “because they are cows”).

We are still collecting data for this study, so we cannot yet draw strong conclusions, but we hope to complete data collection during the fall semester. Initial results suggest that children, like adults, do privilege some properties and explain those properties by referring to the abstract category.

Object Recognition in Early Childhood

Bria Long, Graduate Student

As adults, certain categories seem to be more important than others for how we recognize objects. For example, the distinction between animals and objects seems to have a privileged status. Whether or not something is an animal or an object determines where it is represented in the parts of the brain that are active when we recognize objects. In addition, whether something is a big object (e.g., cars, couches, airplanes) or a small object (e.g., keys, cups, coins) also determines what regions of our brain respond when we recognize an object.

Why is this the case? One idea is that this is simply because of the way that objects look. For example, all animals might look more like each other than they do like inanimate objects. On the other hand, both animals and objects can have many different shapes (e.g., ants and elephants), and so it not obvious that this would be the true.

How can we test if two categories “look different” to children (and adults)? Visual search is a task that can be used to measure this. During visual search, participants look for a target object among a set of distractors they have to ignore. In general, if you are searching through a display for a particular target (e.g. a hammer), it is harder to find it among distractors that look very similar to the target (e.g. other hammers), and easier to find it when it is among distractors that look very different from the target (e.g. cars). Based on this logic, if two categories tend to look very different from each other, it should be easier to find a target object among different-category vs. same-category distractors.

We played a tactile visual search game with young children (3-5 years old) using an iPad. Children were shown the exact picture of an object they had to search for. After they touched the preview of the target object, it disappeared for a half a second and then reappeared among five distractor objects, which were either from the same category as the target or different category as the target. We found that children found objects faster when targets and distractors differed across animacy (e.g., an animal among objects vs. an animal among animals).

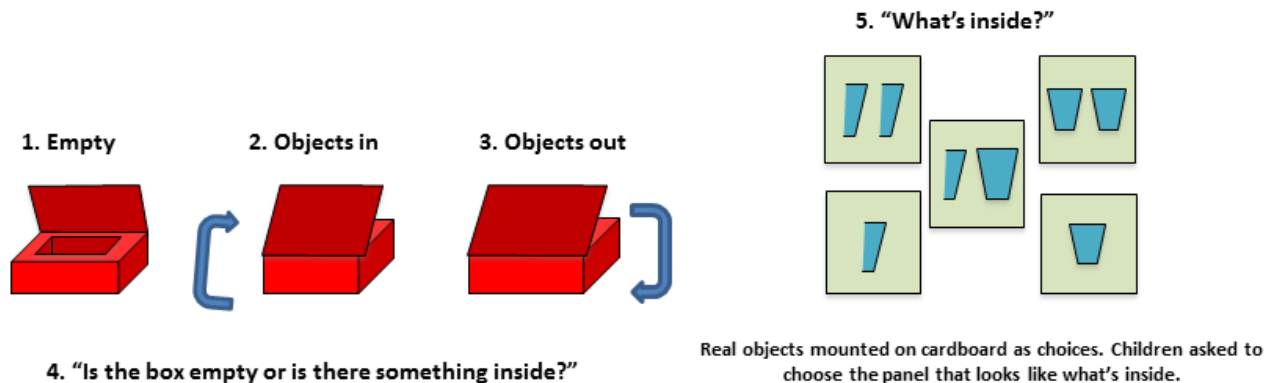
In a second experiment, we also tested whether or not this would also be true for the distinction between big-objects and small-objects. We found that children also found targets faster when distractors differed in real-world object size (e.g., a small object among big objects vs. a small object among small objects). These results suggest that these broad distinctions of animacy and real-world object size are important for how young children recognize objects and infer what they look like.

What's in the Box? Language and Object Identity

Peggy Li, Research Fellow

As children become more and more familiar with the physical world, they begin to learn how to track and identify objects through time and space. Four month olds who see a toy passing in and out of sight can identify it as the same toy. 12-month-olds who see two physically distinct toys at separate times can identify them as two different toys. However, children still have trouble identifying some objects even as older toddlers.

In this study, children played a box game in which they watched as an experimenter placed a number of objects in a box (e.g. two half cups and two whole cups) and took a number of objects out (e.g. one half cup and two whole cups). Children were asked if the box was empty, and if not, what was inside. Children then had to choose what was inside from a set of panels.



Children also completed a language assessment task in which they were tested on partitive vocabulary including "whole," "half," and "pieces." Results demonstrated that children who knew the vocabulary for partitives performed better at the box game, as they were better able to identify and attend to what was in the box. This suggests that language may play an important role in object identification.

Currently, another similar study is being performed examining simple adjectives including "big," "small," "large," and "little." Children play the same box game with big cups and small cups. We are investigating the relationship between adjective comprehension and ability to identify what is in the box. We are curious whether we will find the same relationship—do children who know the terms for "big" and "small" better able to identify the big and small cups in the box? We hope that these studies, exploring the relationship between language and ability to identify objects, will provide insight into how children use language to attend to objects around them.

The Process of Elimination

Shilpa Mody, Graduate Student

What kinds of logical reasoning skills emerge early in development, and how do those skills change as we grow older? In this study, we asked whether toddlers at different ages could use one particular reasoning tool: the process of elimination. Children and adults use the process of elimination effortlessly in everyday settings. For example, if you know you left your cellphone either in your bag or on the counter, and you've already searched in your bag, you can assume that it's on the counter without having to check. To reason like this, you have to be able to consider multiple alternatives, and then update your beliefs with new information about where your cellphone is *not*, and finally combine all this to infer where your cellphone must be.

We investigated this line of reasoning in toddlers by playing a searching game. They watched while we hid a toy in one of two buckets, but couldn't tell which one we'd put it in. Next, we showed them that one of the buckets was empty. Then we asked them to look for the toy. Using the process of elimination, they should reason that since the toy isn't in the empty bucket, it must be in the other one. 23-month-olds and 17-month-olds looked in the correct bucket about 75% of the time, suggesting that they're successfully using the process of elimination. However, 15-month-olds only chose the correct bucket 50% of the time, meaning that half the time they were looking in the empty bucket!

Our next step was to try to understand the reason behind the 15-month-olds' behavior. One possible reason is that they just weren't interested in finding the toy. To investigate this possibility, we conducted a new version of the study in which 15-month-olds could see which bucket we were hiding the toy in, rather than having to infer its location using the process of elimination. In this situation, they looked in the correct bucket about 70% of the time – suggesting that they were indeed motivated to find it, but that they couldn't use the process of elimination to lead them to the correct bucket.

Based on this study, it seems that children start to be able to use the process of elimination to find hidden things between 15 and 17 months of age. However, we still don't know why that might be. What aspects of cognition are changing between 15 and 17 months? Is the change related to infants developing language skills? Thanks so much to all the families that participated!

Our other Process of Elimination study asked when toddlers begin to use the process of elimination to find a hidden object. In this study, we're asking the same question, but using an eye-tracker to record the results instead of looking at children's active searching behavior.

From other studies, we know that active measurements like reaching or approaching can sometimes underestimate infants' cognitive abilities. Coordinating their actions is hard work for babies! Measuring infants' eye-movements or looking time can sometimes uncover a cognitive ability at a younger age than an active measure.

For this reason, we're looking at toddlers' ability to reason using the process of elimination using eye-tracking. Children watched an animated video of two cards that flipped over to reveal a face on one card and a ball on the other. After this, we played a bell sound and the face danced around. We showed this sequence several times, with the positions of the face and the ball

changing, in order to teach children that the face danced whenever they heard the bell. Next, we moved on to the test trials, in which only one of the cards flipped over while the other remained facedown. Finally, we played the bell sound again, and used the eye-tracker to observe which card children looked at.

On test trials where the face was revealed, we expected that toddlers would look at the face, since they expected it to dance. However, the most important trials were the ones where the ball was revealed: on these trials, children had to use the process of elimination to determine that the face was on the *other* card and look there, even though they hadn't seen it.

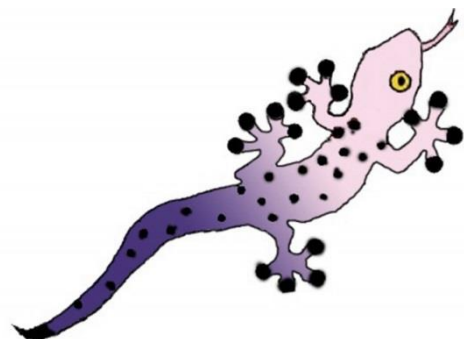
Our results so far suggest that 10-month-olds don't use the process of elimination in this situation. On the key test trials where they saw the ball, they looked at both cards about equally. This suggests that they couldn't use the process of elimination to figure out where the face was. We're still working on analyzing the data from the 17-month-olds, but look forward to sharing those results with you in the next newsletter!

Reasoning and Causality **Shilpa Mody, Graduate Student**

Deciphering cause and effect relationships is an important skill for understanding the world around us. In some situations, there are multiple possible causes of an event; for example, a headache could be due to stress, a lack of sleep, a lack of coffee, or any number of other things. However, if you always get a headache when you haven't had your morning coffee, regardless of your sleepiness or stress levels, the coffee is the most likely cause of the headache. In this study, we're looking at toddlers' ability to use different patterns of evidence to determine the most likely cause of an event.

We introduce children to a toy that lights up when some – but not all – blocks are placed on it. On each trial, we demonstrate the effect of two or three blocks on the toy, including some combinations of the blocks. In some trials, children are shown unambiguous evidence that only one of the blocks causes the effect, while the other doesn't. In other trials, the evidence that children see is more ambiguous: more than one block might cause the effect, but one block is more certain to do so than the others. We then encourage children to choose one of the blocks to try out. Based on their choices, we can infer what kinds of reasoning patterns they use to understand cause and effect.

So far, it looks like 19- and 24-month-old children are succeeding on the unambiguous trials: when there is one block that makes the toy light up and one that doesn't, they pick the correct block about 75% of the time. We're still working on the ambiguous trials, and we hope to have some interesting results to share with you in the next newsletter!

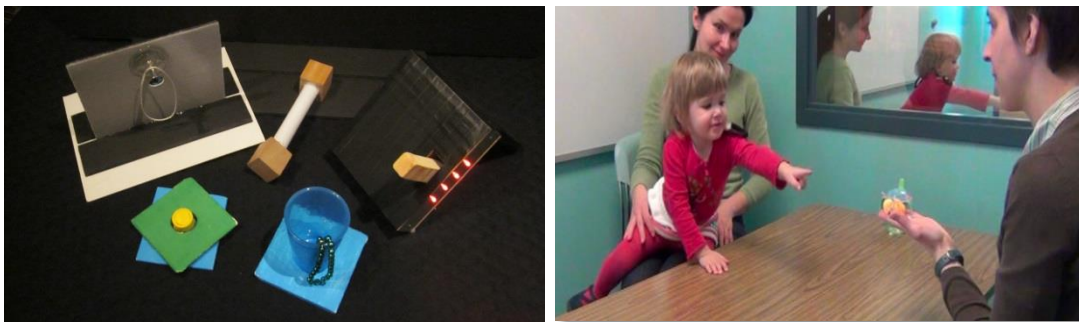


Language and Theory of Mind

Kate Hobbs, Graduate Student

Our research project aims to investigate the role of language on the development of reasoning about others' thoughts, beliefs, feelings, goals and desires—what researchers call a “Theory of Mind (ToM).” In preschool-aged children, studies have found a strong link between language abilities and ToM. Our research aims to extend this kind of research to even younger children, asking where in development this relationship between language and ToM begins. We have tested both typically developing hearing children and deaf children between 17 and 27 months to find out whether differences in early language abilities are related to the development of social reasoning.

Our study uses three interactive tasks to measure children's social understanding. In the imitation task we ask whether children can figure out what the experimenter was trying to do with a toy, even though she never succeeded. In the pointing task we measure how children use pointing to request objects or inform others and how they respond appropriately to others' pointing. In our helping game we ask whether children use information about an actor's knowledge state to figure out her goal and help her appropriately. We also play a memory game with children to measure their cognitive development outside the domain of social reasoning. And to measure vocabulary knowledge, parents fill out checklists indicating the words their children say and/or understand.



We have completed testing of both hearing and deaf children. In the hearing group we have found no relationship between how many words a child knows and how they perform on our tasks of social understanding. In comparing the deaf children to same-age hearing children we do find that on average deaf children know fewer words. But despite this difference in vocabulary size, there are no apparent differences in social understanding between the deaf and hearing children in our study. These results suggests that early social cognitive abilities—such as reading others' intentions, using and responding to pointing communicatively, and reasoning about others' goals and desires—develop independently of language acquisition. These early abilities provide a strong foundation for later development of more complex ToM skills, such as reasoning about others' thoughts and beliefs.

Infants Desire Understanding

Kate Hobbs, Graduate Student

From the time they can walk, infants engage in acts of helping others. In particular, kids are great at handing us objects and helping us complete instrumental actions. But exactly what aspects of our needs, goals and desires are children actually considering when they help us in these ways? Research in our lab over the past few years has tried to address this question.

In previous work we investigated infants' abilities to help appropriately when an experimenter likes only one of two toys. We first familiarized children with the actor's preference (figure 1). In the subsequent test trials the objects were out of the experimenter's reach and sight (figure 2), and she asked the child for help. We found that 24- but not 14-month-olds help an experimenter by giving her her preferred object reliably; 14-month-olds give either of two objects indiscriminately. While 14-month-olds are not yet maximally helpful when the experimenter's goal is unclear at the moment they need to help, they *can* help appropriately when it remains clear at test which object she prefers (figure 3).



Figure 1

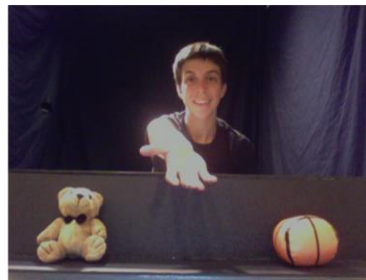


Figure 2



Figure 3

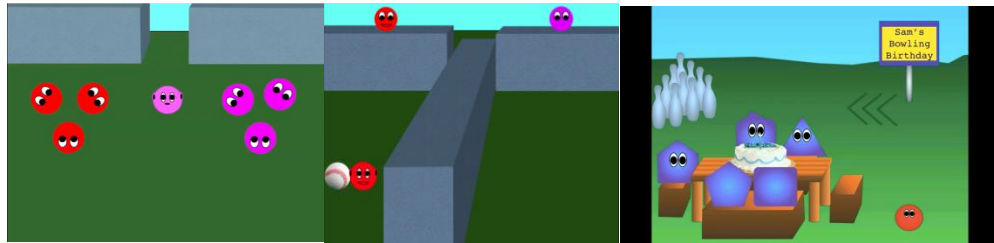
We recently ran two studies to add to the previous findings about infants' understanding of goals and helping. The first study asks whether children prioritize past preferences of current goals in deciding how to help others. This experiment begins with the experimenter reaching for one of two toys, three times in a row. In the test trials, the toys are out of her reach, but now she tries to get the *other* toy. We wanted to know whether children would override her current reach to help in accordance with her past preference, or simply go with her present reach. It turns out children help based on the actor's *current* reach only, and easily disregard her past goal.

A second study sought to demonstrate that the infants in our past studies really did encode the actor's goal based on the scenes we showed them (a replication of a past study by other researchers). In this looking-time study we first habituated babies to the actor reaching for one of two objects over and over. Then in the test trials we switched the locations of the two objects and showed infants two kinds of events—one where the actor reached for the same object as before but in a new location, and the other where the actor reached for the new object in the location she had reached to previously. These two types of test trials allow us to ask which event infants see as more different from what they previously saw—reaching to a new place or for a new object. Infants looked longer when they saw the actor reaching for a new toy, indicating they had encoded her past actions as being directed towards that specific object, not that location. This result allows us to assume infants in our earlier experiments did understand the actor's goal, and yet still did not always give her the preferred object. We're just about to re-submit a manuscript on this work for publication in the journal *Cognition*. Keep an eye on the lab website for the published paper soon!

Expectations about Emotional Reactions among Friends and Non-friends

Francesca Fulciniti, Honors Thesis Student

Emotional responses to others are often affected by different social relationships and variable group membership. For example, adults would tend to respond with a similar emotional reaction if a friend expressed happiness or sadness, but maybe would not respond as strongly to a stranger's or a rival's emotional expressions. Previous research in the lab has shown that even young infants are sensitive to emotions in others, and have emerging abilities to reason about these emotions. Previous research has also suggested that infants are sensitive to cues that indicate group membership. We conducted three studies to investigate when infants or kids might be able to use social information (i.e. information about social relationships and groups) to form expectations about emotional reactions. Specifically, we ask how babies and kids think about emotions within and across two groups. Do they take social relationships into account when reasoning about emotional reactions?



Sample stimuli from studies 1,2,3

sample stimulus from study 3

In the first two studies, we showed infants two different groups of characters who displayed different emotional reactions to different events that affected one of their friends, or group members. Based on the results from these studies, it seems that infants between 10-11 months don't yet use social information to form expectations about emotional reactions; infants didn't differentiate between similar or different emotions that groups displayed in response to their friend's emotions. When we showed the same stimuli to 6-8 year olds, however, they clearly were able to use social group information to form expectations about emotions. For example, children expected a group of characters to be happier when a group member was happy than when a group member was sad. We also showed children some short video clips and asked them what they thought characters were feeling to establish if kids have more basic emotion assessment skills at this age. Our results show that kids 6-8 have good emotion assessment skills – that is, they are able to guess a character's emotional state based on what happened to him or her, or based on his or her facial expression. Further work may focus on when exactly kids develop these social-based emotion reasoning skills, and why exactly infants do not yet have these abilities at 10-11 months.

Investigations of Early Sensitivity to Pedagogical Communication

Jenn Hatfield, Honors Thesis Student

This study investigated how children respond to people who try to teach them things based on the quality of the teaching. Children 20 months to 5 years old watched a puppet show featuring pairs of teachers. These teachers each taught something to a learner puppet and then children were given the opportunity to pick a puppet to learn for themselves. The teaching quality varied based on the accuracy and completeness of the teaching: for example, in one pair of teachers, one teacher correctly identified an object (like a dog or a ball), while the other incorrectly identified that object. In another teaching pair, one teacher had lots of toys that she could potentially teach the learner puppet about, but only taught about a single toy. The other teacher just had one toy, and taught the learner puppet about it. We expected children to choose to learn from the teachers who taught accurate information and who taught about all of the toys available to them.



Left picture, from left to right: teacher puppet, learner puppet, teacher puppet (these teachers varied based on the accuracy of their teaching)

Right picture, from left to right: teacher puppet, learner puppet, teacher puppet (these teachers varied based the completeness of their teaching. You can see that, in this case, the teacher puppet on the left has more toys in her cupboard, but would only teach about one.)

With the youngest participants, aged 2 and 3, we found that children did not prefer to learn from any particular teacher. 4- and 5-year-olds, on the other hand, trended toward choosing to learn from the teacher who was accurate. They also very much preferred to learn from the teacher who was incomplete in her teaching, suggesting that they may have expected only that teacher to have additional information to share when it was the children's turn to learn.

This study suggests several ideas that build on previous research and add to our existing knowledge of how children learn from others. One, the ability to process and make decisions based on teacher quality is quite difficult. Accuracy and completeness are two different measures of teacher quality, and children who succeed at distinguishing based on one measure do not necessarily do better with the other measure. So, this was a very difficult task for even the oldest children, to watch and process this puppet show and make decisions based on the information provided. Second, it may be that children don't consistently use previous information about teacher quality to make learning decisions until they are of school age, which is older than other researchers have claimed. Thank you to all of the participants in this study. We hope it was enjoyable for parents and children alike to 'meet' these puppets!

How do children form first impressions? Emily Cogsdill, Graduate Student

Previous research has shown that adults use facial characteristics to attribute personality characteristics to other people both rapidly and with a high amount of agreement. However, although research suggests that children begin to attribute personalities to other people starting at around age seven, little is known about how and when they use physical appearances to make such judgments.

In this research, we look at the developmental origins of face-based personality attributions. Last year, we found that even children as young as 3-4 years of age are beginning to attribute both traits (like “mean” or “nice,” or “strong,” “smart,” etc.) and trait-related behaviors (e.g., helping friends) to people based on their facial features in the same way that adults do so. These early findings were striking in demonstrating that the first impressions we make as adults first start to take root very early in childhood, and perhaps even earlier.

In this study, we sought to investigate just how strong this tendency is in children. In our earlier work, we used only one type of face, which consisted of computer-generated faces that were designed to elicit certain trait judgments, such as “trustworthy” or “untrustworthy” (as in the two examples below). But would children show this same type of agreement for different types of faces – particularly those obtained naturally rather than generated by a computer?



To study this, we looked at whether children ages 3-12 and adults would consistently categorize three different types of faces as “nice” or “mean.” These three types of faces consisted of those belonging to 1) adults, 2) children ages 7-12, and 3) monkeys (specifically, rhesus macaques). The images below show a few examples of faces we used in this study that adults had judged to look “mean” or “nice.” We hypothesized that, just as in our earlier work, even the youngest children tested would show significant agreement with adults, suggesting that adult judgments about faces develop very early in life.



Our results were highly consistent with this hypothesis. Judgments about which faces are “nice” or “mean” were very similar across all ages tested for all three of these new types of stimuli. This

was particularly impressive given that the images were modified to appear relatively homogenous. For example, adult faces were cropped into circles so that hair, clothing, and external features (such as jawlines and ears) were not visible. They were also presented in black-and-white, with all images controlled for brightness. Even with these additional steps taken, which we expected to make children more likely to respond randomly, we still found that even very young children systematically select as “nice” and “mean” the same faces that their older counterparts do.

This study thus provides even stronger evidence that the human tendency to attribute personality traits to faces is one that develops at a very early age. This tendency is thus so robust in humans that it emerges in the earliest years of life and does not require extensive social experience to develop. Future work will investigate whether these judgments actually impact how children behave towards other people (e.g., whether they will be more likely to do nice things for “nice”-looking people), which will help to deepen our understanding of how this basic social judgment emerges and shapes our social lives, even early in childhood.

Music and Social Cognition **Samuel Mehr, Graduate student**

Infants are avid fans of music, but little is known about what information musical experience provides to young listeners. In this series of studies, we asked whether infants selectively respond to adults with whom they share musical knowledge. We found interesting but obscure/unfamiliar songs and familiarized infants to just *one* song: either by teaching the parent to sing the song, or by giving the parent a small stuffed animal that played a recording of the song. Then, depending on age, we tested infants in one of several paradigms designed to probe infants’ social responses to novel people who had previously sung the song the infant learned in the study.

The studies had three parts: an initial lab visit, a period of at-home exposure, and a follow-up visit. At the initial visit, parents were either given a music lesson or a musical toy. Parents also filled out questionnaires about demographics, arts activities, opinions about the arts, and infant behavior at home. After the initial visit, there was a 1-2 week period during which we asked parents to sing their song with their infant, or to play the toy for their infant. To help us keep track of how much exposure the infants had to the song, parents also completed a brief survey each evening. After 1-2 weeks, parents and infants returned to the lab for a follow-up visit, where we collected looking time data from infants in several ways, detailed below. In each case, infants saw two novel adults singing each of two songs. Critically, because we had randomly assigned infants to learn *one song or the other*, only one song was familiar to the infant at the time of testing.

3-month-old and 5-month-old infants: These young infants had the simplest test. After each woman sang, we showed infants videos of the two women side-by-side, standing silently, and tracked how long infants would look to each singer. We gave infants a maximum of 16 seconds to look. Our results indicate that at 5 months infants selectively attend to the singers of the familiar song, over and above the amount attributable to chance, and over and above any initial preference for one person over the other – but only when they learned the song from a parent,

and not when they learned it from a toy. That is, despite comparable levels of familiarity with the song, from an attractive toy, those infants who didn't learn the song in an explicitly social context didn't display an attentional preference to the singer of the familiar song.

At 3 months, the results are a bit fuzzier. While these younger infants appear to show a preference for the singer of the familiar song in the parent-singing condition, their interaction with the toy indicated that they may not have realized that the musical toy was producing the song. So, even if we see a comparable result to the 5-month-old result (above), it won't be clear that the lack of attentional preference at test is because of the context of their musical learning – it might just be that 3-month-olds don't really understand toys. We are now planning a new study in which we are building musical mobiles, which this very young age group may be more familiar with.

10-month-old infants: Here, we took advantage of 10-month-old infants' interest in objects and reaching by giving them the opportunity to choose between objects associated with two new singers. As in the younger groups, first each of two women sang a song, only one of which was familiar to the infant. Then, we showed infants the two women standing together, each playing with an attractive toy (we used both stuffed animals and toy fruits). They smiled at the toy, showed the toy to the infant, smiled at the infant, and then pointed to a table in front of the infant, where two identical toys were sitting. At this point, the researcher gently pushed the infant's high chair forward so that he/she could choose between the two objects. We coded the number of reaches for each toy, the amount of time spent playing with each toy, and the duration of looking time toward each toy.

This study is still in progress, but preliminary results suggest that infants in *both* groups – parent-singing and toy-singing – show a stronger interest in the toys associated with the singer of the familiar song than the singer of the unfamiliar song! We don't yet know if this result will hold up, as we're currently only halfway done running this study. If it does, it may suggest that by 10 months of age, infants have learned that the objects their parents present to them are meaningful sources of information – or there might be some simpler, less interesting explanation, such as an increased interest in toys in the toy-singing group, primed by the infants' extra exposure to musical toys during the study.

15-to-20-month-old infants: In this oldest group of infants, we used a *selective pedagogy* paradigm to test whether infants would be more likely to learn a new action from a person who had previously sung a familiar song than from someone who had sung something else. We introduced infants to two research assistants in the lab, who each subsequently sang a song. As in the above paradigms, only one song was familiar to the infant. Then, the research assistants demonstrated two different actions on a novel object, and gave the infant the opportunity to play with this object. We coded the number of imitative actions for each singer, as well as the amount of time spent imitating each singer. This study has only just begun, but we predict that infants in the parent-singing condition will be more likely to imitate the actions of the singer of the familiar song than the infants in the toy-singing condition. We'll keep you posted on the results!

Long term follow-ups: Lastly, we have begun running brief follow-up studies for many of the infants who participated in our music studies over the last year and a half, when they were 5

months old. The goal of these follow-up studies is to provide a manipulation check to the original findings, to determine (1) whether infants remember the song and (2) if so, whether they will display a social preference for the singer of a familiar song, even upwards of a year after the original exposure to the song. Infants whose parents sang in the original study are tested in the 10mo paradigm described above – if they remember the song, we expect a preference for the objects associated with the singer of the familiar song. Infants whose parents played a toy in the original study are given a quick discrimination task, where they play with two stuffed animals from the original study, only one of which is familiar to them – if they remember the toy’s song, we expect a difference in looking time to each toy. The follow-up studies are still in progress, but so far it looks like infants do indeed have impressive memories for the song!

Importantly, infants’ exposure to the song over the last 1-2 years differs widely between different families in the study. We were very interested to learn that everyone’s participation in the study was a bit different: after the original study ended, some parents continued singing the song from the study for a long time, some parents sang it once in a while, and some parents didn’t sing it at all. This means that the infants across the whole parent-singing cohort have a very wide variety of experiences with the song. This variety isn’t present, though, in the toy-singing cohort, because the parents returned the toy to the lab at the end of the study, so we will likely see very different responses to the songs from the infants in each group.

What does it all mean? While this line of work is just getting started, our first results suggest that infants attribute social meaning to the songs they hear from people, but that that social meaning is not necessarily present in the auditory signal of the song itself. If it were, we should see comparable levels of social attention at test regardless of how infants learned their songs (from a parent or from a toy). We didn’t: 5-month-old infants who learned the song from their parents were more likely to attend to the singer of the familiar song than those infants who learned the song from a toy. We’re following up on that striking result with the other studies detailed above, which aim to determine the degree and extent of that effect in different age groups, with different musical material and different testing methods. These studies are our current attempts to figure out how music works in infancy, which hopefully will yield clues as to how the human capacity for music came to be in the first place. Last, and most important: A **huge** thank-you to all the parents and infants for their participation in our music studies!

For young infants, is music social?
Lee Ann Song, Honors Thesis Student



Why has music persisted across time and culture in human societies? There is evidence suggesting that it may be because music conveys important social information, and that vocal song recognition, for example, may be one way infants identify who is in their social in-group. Previous studies in this lab have exposed infants to an original lullaby—either by way of a parent, whom we taught the song to and instructed to sing to their baby for a week, or by way of a singing stuffed animal, which played the song when squeezed. Interestingly, we found that at the second visit, the infants who had been familiarized to the

lullaby by way of their parents singing paid more attention to the new singer of the familiar lullaby, whereas the infants who had heard the lullaby from a toy all week showed no preference for the new singer of the familiar lullaby. This suggests that it makes a difference whether infants learn a song from a social figure. But do babies simply like songs they've heard from their parents or is this a broadly social effect such that live song exposure from *any* social partner induces a social preference for a new singer of that song?

This current study seeks to tease apart this distinction and investigates the effects of live non-kin musical exposure on infants' social cognition. It's a two-part study with a ten-day long break, during which the infant learns an original lullaby from a research assistant (not a toy or the parent) via daily Skype sessions to see if live, non-kin song exposure can induce the same selective attention effect as was seen in the parent-singing condition.

At the first visit, parents filled out a demographics & arts questionnaire and a behavioral questionnaire while the research assistant played and sang with their infant. The families were sent home with an iPad and Skype called for 10 minutes each day with the research assistant. During the Skype calls, the researcher engaged with the infant and sang intermittently to approximate an in-person interaction as best as possible. When families came back for the second 30 minute visit, infants sat in their parents lap and watched a video of two new people singing different lullabies. The two lullabies were very in timing and identical in lyrics but differed in their melody so to distinguish between the familiar and unfamiliar lullaby, babies must have recognized the difference in their melodies.

While data is still being collected for this study and has not yet been analyzed, we do have several hypotheses and predictions. By tracking eye movements, we can find how long infants look at a video of new people who sing either the familiar song or an unfamiliar one. If we find that infants who heard the song from the RA through Skype looked longer to the singer of the familiar song, this suggests that music plays a significant functional role in general human social behavior. If we don't find this effect, it may be that infants only prefer songs they've heard from their parents, or that Skype is not a meaningful form of social interaction for infants. Before the development of modern technology, infants and adults learned songs only from other humans. Thus, even an unfamiliar person who sings something that is sung by members of one's own community would thereby signal a social connection to that community, whereas one who sings a song that is unfamiliar, or that has never been sung by a community member, would not.

Furthermore, the findings from this study may have widespread implications for modern families, who often communicate through online video chat. Military parents on duty or extended families that live far away from each other may interact with infants through Skype, but these situations raise the question of whether or not infants consider virtual chatting to be meaningful social interactions. In addition to its examination of the social components of music-sharing, this project calls for research into the increased use of virtual communication and its consequences on infants' social and linguistic development.

Finding Categories in Infancy: Objects vs. Animate

Lindsey Powell, Post-Doctoral Fellow

One of the critical tools we have for thinking about the world is the use of categories. We group things – objects, animals, people, events – into kinds, and this allows us to apply the things we learn about one individual or instance of a kind to a new one. This is the sort of thought that allows us to drive a rental car we’ve never been in or use a new computer without learning how it works all over again – we assume that the unfamiliar car or computer will work a lot like other ones we have used in the past. When it comes to people categories can also be useful. It’s helpful, for example, to treat an infant or child you’ve just met differently from a new adult acquaintance, a trick we accomplish by grouping people into categories based on age. Of course, there are also cases where the categorical generalizations made about people are unfair or inaccurate, but this only makes it all the more important to understand how such categorical thinking works and how it develops in infancy and childhood.

In the past, we’ve asked whether infants generalize certain properties, like weight or behavior, from one member of a category they encounter to another. But in one of the new studies we ran this past year we took a step back and simply asked, how do infants identify different categories in the world? Do they use the same kinds of cues to pick out categories of different sorts? In particular, we focused on social categorization vs. object categorization. We hypothesized that there might be one kind of cue that is particularly important for identifying social categories or groups, namely looking out for individuals who tend to hang out near one another and to move together. In contrast, this isn’t necessarily such a good cue to object kind – if you were to look at your desk or kitchen table there might be objects of many different sorts all lying next to one another by chance.

To test whether infants use closeness and common action to pick out either social groups or object kinds in the world, we split infants into two groups. One group saw animations featuring the little shape characters with faces that we often use in our studies of social cognition. Infants in the other group saw the same shapes, but with the faces replaced by a black and white stripe so that infants would perceive the shapes as objects rather than as animate characters. We then split each of these two groups in half again; some infants in both the social and object groups saw all four characters or shapes grouped together in the middle of the screen, moving in synchrony, while other infants saw the characters or shapes grouped in two separate pairs, one in the top left corner and the other in the bottom right corner. In addition to being spaced apart, these pairs took turns moving independently from one another. The idea behind these differences was that infants in the “grouped together” version of the study might be more likely to think of all four individuals as members of the same category than infants in the “grouped in pairs” version, who might instead think of the characters or shapes as members of two different categories.

To test for this difference in categorization, there was one more part to the study that was the same for all infants. Many of our studies take advantage of a phenomenon called ‘habituation’ that parents are all familiar with as well. Essentially, infants get bored when they’re presented with similar things over and over again. The more similar the events or objects you’re showing them are, the faster this boredom sets in. Thus, we reasoned that if we showed infants the four characters or shapes they had seen in the first round one at a time, over and over again for 12

trials they would get bored. And the more similar they thought those individuals were, the faster their looking time to each one would drop off. In particular, infants who thought of the four individuals as part of the same category might get bored faster than infants who saw them as part of two different, and thus alternating, categories.

We're only about three quarters of the way done collecting data for this study, but so far the data are matching our expectations. Infants in the social version of the study are getting bored and looking away from the sequence of individual characters faster when they saw all those characters danced together at the beginning of the study, compared to when they saw the characters dancing in two separate pairs. This suggests that the "together" versus "in pairs" videos prompted infants to group the individuals into one social category or into two, respectively. In contrast, infants in the object conditions are looking away at about equal rates, regardless of how the shapes were grouped at the beginning of the study, suggesting infants don't consider closeness to be as important a cue to object category membership as to membership in a social category. If these results hold up in the final sample, the study will have told us not just that infants are looking to pick out different categories in the world, but that the way they do so already depends on their understanding of the sorts of things they're looking at. We look forward to reporting results in our next newsletter! Thank you!

Imitation and Social Preferences **Lindsey Powell, Post-Doctoral Fellow**

Imitation is a big part of social life for both kids and adults. Children learn many things from imitating others, from words and social gestures to how things work. As adults we continue to imitate, though more subtly and often for specifically social purposes. Imagine having an interesting conversation with an acquaintance; you might find yourself mimicking their posture and gestures, or using the same tone of voice or verbal and facial expressions they're producing. This sort of social mimicry tends to make interactions between adults go more smoothly and to make us like one another more.

The goal of our current experiments is to understand the early development of this sort of social imitation. We aren't asking about infants' own imitation skills – it can be difficult to elicit imitation from shy, uncoordinated, young babies – but instead how they react to witnessing imitation amongst others. In all of these studies, we show infants, from 4 months all the way up to 13 months, movies featuring three individuals. One of the individuals (let's call him the center character) interacts with each of the other two separately. Some infants see the center character start off the interactions, doing a particular action or making a particular sound, which is imitated by one of the other two characters but not the other. Other infants see the side characters start off the interactions, performing different actions or making different sounds, and see the center character imitate one of them but not the other. After this introduction to the characters' behaviors, different studies ask different questions.

Using imitation to learn about others' preferences

Some studies ask whether infants have any expectations about which of the characters like one another. We do this by showing infants events where the characters are approaching one another. Sometimes it's the targets of the imitation who are doing the approaching; for example, the center character might take turns approaching the side character who had imitated

him and the side character that had not. Other times infants see the responders doing the approaching; for example, two side characters, one of whom had imitated the center character and one of whom had not, would take turns approaching that center character. The idea here is that if infants have made any inferences about who likes who on the basis of which characters engaged in imitation together, then they should respond differently to approaches between characters who did engage in imitation and ones who didn't.

In last year's newsletter, we reported that we were starting to notice an interesting asymmetry in our youngest participants: if the center character has imitated one of the side characters but not the other, then even 4-month-old infants expect him to approach the character he imitated and are surprised when he approaches the other character instead. But at this age, infants do not extend this expectation to the targets of imitation – they look equally when a center character takes turns approaching one side character who imitated him and one who did not, suggesting that neither of those actions is more surprising. One way we think this finding might be interpreted is that, at least for very young infants, positive social actions like imitation are a good guide to the attitudes or preferences of the actor (in this case the imitator), but that at this age infants don't reason well about how such actions impact the social attitudes or preferences of the people they are directed toward. This might help to explain why young infants don't engage in much imitation themselves; they might need to learn that it's a good way to elicit positive feelings from others before they'll intentionally start to imitate what the people around them are doing. We're following this idea up now by testing older infants!

Infants' own preferences for imitation

In other versions of this study, we have been asking whether infants consider imitation to be a sign of a good social partner by testing whether infants themselves like imitators more than non-imitators. Following the demonstration of who imitates who, we give infants a preference test; for young infants, we hold up physical copies of the imitator and non-imitator and measure how long they look at each, while for older infants we hold the characters out and let them reach for one or the other. As reported last year, these studies reliably show that infants prefer imitators to non-imitators at all ages tested, from 4 months to 1 year of age. In the past year, we've been following this finding up by asking what it is about the imitator that infants like. One possibility is that they simply like repetition: when the imitator copies the center character, he's making a sound that is a little more familiar and predictable than the new sound or action produced by the non-imitator, and infants may find this attractive. On the other hand, it may be that infants' preference is really about imitation – they might specifically like an individual who responds by mirroring his social partner's behavior, just as adults often mirror one another in conversation. To test this, we've been asking whether it matters to infants that the imitator can see what the center character is doing. If an "imitator" repeats the center character's action without having been able to see it, suggesting he's just coincidentally repeated the same action rather than really imitating, will infants still prefer this imitator to a non-imitator? Early results suggest no! In one completed study, 12- to 13-month-olds showed no reliable preference for an imitator over a non-imitator when the imitator could not see the center character's action and was just copying coincidentally. We're following this up with a study on younger infants, which is so far showing similar results. These initial results suggest infants have a true preference for social imitation, liking those who intentionally respond by reciprocating the behaviors they've seen others engage in. Together, we hope all this research sheds light on the development of a key human social skill!

Learning about Behavior: Groups and Individuals, Conventions and Causal Actions

Lindsey Powell, Post-Doctoral Fellow

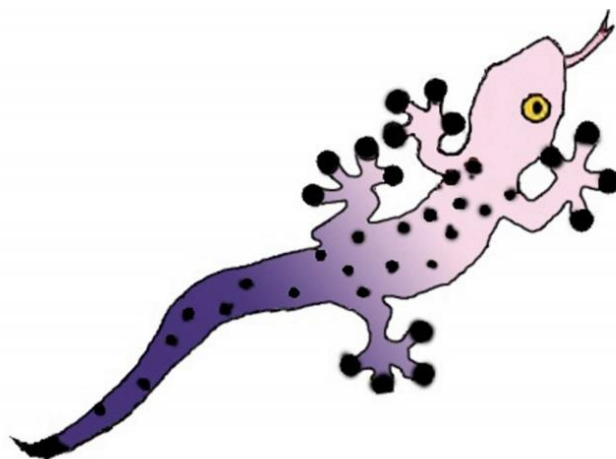
One of the challenges we face in every day social interactions is figuring out how other people will act. There are a few different strategies we use to do this as adults. One is to use an individual's past behavior to predict how he or she will act in the future. For example, you probably draw upon your experience with your child's past behavior to predict when he will nap or what she might like to eat. There are a lot of times, however, when we interact with strangers or acquaintances, and don't have any experience with those particular people that can help us anticipate their choices or actions. In these situations, we tend to use the categories people belong to as a way to guide our interactions with them. For instance, when you go to a restaurant, you know that the person who comes over to your table is a waiter and that you can ask him for a menu and a glass of water, even if you've never met that individual before. Similarly, when you go to the park and meet a new mom and her child, you probably treat the mom and the child differently right away, because you're applying different knowledge about adults versus children when interacting with each of them.

Some of our past work has asked whether infants attempt to use this second strategy – do they try to group people into categories and use what they learn about some individuals in the category to predict the behavior of others? What we found (published in Powell & Spelke, 2013) was that infants use some kinds of categories to predict behavior but not others. In particular, infants expected that members of social groups – sets of characters who had interacted together in the past – would act alike. They did not, however, have the same expectation for characters or shapes that merely looked alike. Take one case where each character or shape jumped on one of two colored boxes. If the first two members of a social group jumped on one box, infants were surprised and looked longer when the last group member jumped on a different box. There was no such difference in looking time, however, when the third object in an inanimate category landed on a different box than the first two.

In the past year, we've been following up on these studies in two ways. The first set of follow-ups asks whether the kind of action the social characters are engaged in matters. In our original studies, we always used actions that could be compared in some way to simple gestures or preferences – the characters jumped up and down, or chose to land on one box instead of another – rather than actions that actually changed the environment in any way. This latter type of action could be referred to as “causal” actions, that is actions that cause some sort of change in the world. We thought that infants might be less likely to generalize causal actions across social groups because they might have an alternative explanation as to why group members would be engaging in the same action; rather than thinking that two individuals were engaging in the same action, like jumping, because that behavior was typical of the social group, they might think the both individuals engaged in the same action because they wanted to produce the same change in the environments and may not necessarily expect additional group members to share this goal. This hypothesis has been born out by our research – at both 8 and 12 months of age, infants fail to expect social group members to engage in the same causal actions, in stark contrast to the strong expectations of shared non-causal behaviors we found previously. We're currently following up to make sure that infants really do perceive the actions in these new studies as goal-directed or causal, and are not just distracted by the effects the actions produce (e.g. bright boxes changing colors).

In a complementary series of studies, we've been asking whether infants need specific evidence to conclude that an action is a social one and *should* be generalized across social groups. An initial hint that infants don't automatically assume an action is social came from a study on how much evidence infants need before they will expect all members of a group to act alike. We found that simply showing them that one member of a group engages in an action isn't enough to get them to expect that other members of that group will act alike. One possibility was that infants wouldn't expect group members to act alike until they saw the action was shared by multiple group members or even a majority of group members. After all, this was the kind of evidence we had given them in our previous studies, where we showed them that 2 out of 3 group members did the same thing before testing their expectations about the third group member. An alternative hypothesis, though, is that infants pay attention to what actions are repeated by social partners in the world (e.g. two people waving or saying hi to one another), and learn that these are the sorts of social actions that might be shared amongst group members. So far, the data are fitting this latter hypothesis better. When we start off a study by showing infants two individuals repeating the same action (e.g. jumping on a platform) back and forth to one another, then infants are quicker to expect all members of a new group to share this action, even if we only show them one individual from the group engaging in the action before testing for such expectations.

Together, these two lines of follow up work suggest something exciting to us: even before their first birthdays, infants seem to understand that some actions are meant to achieve things in the physical world while others are meant to achieve things in the social world. Moreover, they seem to have a systematic way of recognizing which are which! Obviously, there's a lot more nuance to be gained as infants grow older. For instance, some actions have both instrumental and social goals – eating with a knife and fork both gets the food to your mouth and comes across as more polite than eating with your hands – and recognizing such dual purposes is likely to take a little more development. Still, we're excited to follow up on this idea that young infants are already recognizing both physical and social goals and to understand how each type contributes to their learning about the world around them.



Social Clues

Narges Afshordi, Graduate Student

The social world is full of information about connections between people: Who knows who, who likes who, who doesn't get along with who, etc. We use this information to figure out the relationships between people and to predict their behavior towards ourselves and others. In this study, we were interested in finding out how young children, four-year-olds to be precise, interpret information about connections between individuals.

To test this, we showed children pictures of a target child and two potential friends and provided information about the connections between them. We then asked who the target's friend was. In one condition, for instance, children were told that the target had interacted with one child (e.g. by helping her clean up her room), and that she had something random in common with the other child (e.g. they had both been to the aquarium recently). As a group, children typically thought that the person with the meaningful social connection was the target's friend.

In the next step, we went further and asked what interpretations children make about others' behaviors given the same kind of information as before. Once again we showed them pictures of three children and told similar stories about their connections. Instead of asking about the target's friend, however, we asked who shared the target's preference for a particular toy or food. We wanted to see whether kids expect friends to have similar taste for activities and edibles. And we found something quite interesting! As a group, kids expected the target child and her friend to like the same toys and games, but they didn't have the same expectation with regard to food. The reason for this could be that children experience shared enjoyment from playing with a single toy or game when engaging with others. Food preferences, on the other hand, can be more personal and children may have noticed this already. These findings are interesting as they hint at the development of children's intuitions about social relationships between others.

In follow-up studies, we are exploring other information children might use to predict others' choices in social situations. For instance, do children expect a person to follow the choices of their friends even when they are absent or to go with the flow and follow those that are present in the situation? You can look for those results in next year's newsletter!



Happy Conversations

Narges Afshordi, Graduate Student

One of the best ways for us to socially connect with others is through talking to them. Speech can convey our thoughts and feelings, and the desire to speak with others is strongest towards those with whom we have a social relationship. In this study, we wanted to see whether infants link pleasant conversations between two people with other signs of friendly behavior.

In the experiment, we showed infants videos of three people sitting on a bench. The person sitting in the center (let's call her the 'target') turns to one side, smiles and speaks a short sentence with positive intonation. She also turns to the other side and coughs in the general direction of the person sitting on that side. Infants saw these events a few times to have a chance to process what was happening.



Babies then watched the target in two new *test* events: she took turns between happily scooting over to the person she had talked to and the person she had coughed at. In line with many prior experiments, we monitored and recorded the duration of time that babies looked at each test event as a way of measuring their attention. The simple, yet powerful idea behind looking time methods used in many baby studies including this one is that infants typically look longer at things that surprise them. If our hypothesis is correct and infants do in fact expect the target to show more liking for the person she had talked to, they should be surprised to see her approach the person she coughed at. So in short, we expected infants to look longer when the target approached the person she coughed at.

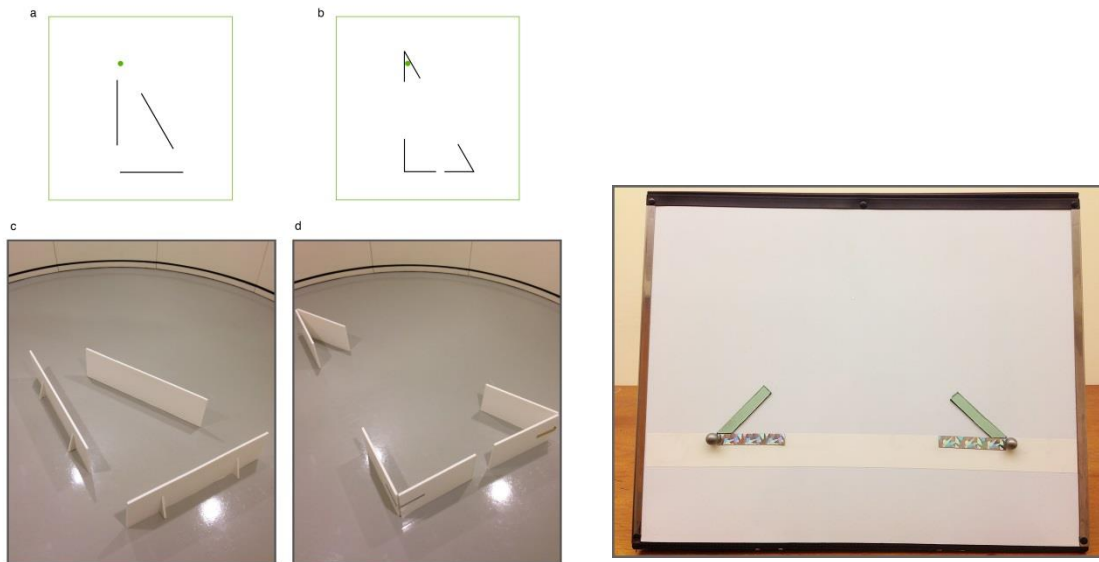
Contrary to our hypothesis, however, we did not find evidence of babies looking at the two test events differently. This may indicate that our hypothesis was not correct. It may also be due to other complications: for instance the videos may have been too complicated or confusing for babies. More effort is needed to untangle our results, and we'll be sure to update you once we know more!

Developing Interpretations of Maps and Triangles

Moira (Molly) Dillon, Graduate Student

Adults across human cultures use maps and other spatial symbols to navigate the world. Children as young as two years can also use the geometric information in maps to find locations in the environment. However, it is unclear whether and how this ability relates to more slowly emerging and advanced geometric intuitions, such as those described in Euclid's postulates. We hypothesize that the same spatial abilities children use early on during map reading also come to support these later emerging more abstract intuitions about geometry.

In this study, we examined how tightly linked map reading is to answering abstract questions about triangles, such as “What happens to the third angle of a triangle when the other two angles get bigger”? By testing children at age 4, 6, 10, and 12 years (a total of 128 children!), we not only charted the use of geometry in maps, but also measured the relationship between this ability and more abstract geometric knowledge through development. We found that children's use of the symbolic geometry in maps at 10 and 12 years predicts their success at answering more abstract questions about geometry. But, this relationship is not found at younger ages, potentially because the relevant geometric concepts have not yet developed. Once these concepts do develop at older ages however, children appear to recruit the same knowledge to solve geometry problems whether they're presented in a symbolic or abstract format.



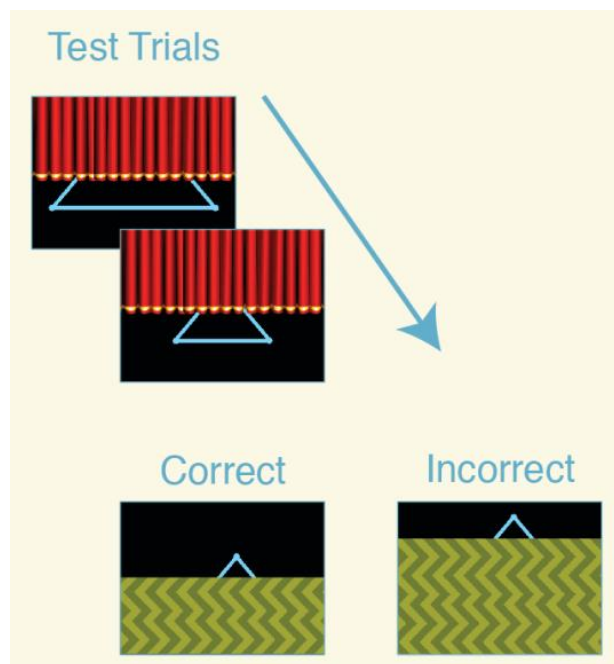
We are excited to delve deeper into children's understanding of geometry and hope to uncover more information about how children's early emerging spatial abilities might contribute to their later more complex geometric understanding, especially the kind of understanding that relates to learning math in school.

Infants' Detection of Shape Changes in Triangles

Moira (Molly) Dillon, Graduate Student

Some geometric knowledge takes a long time to develop, such as explicit judgments about the properties of triangles. However, other geometric knowledge, such as the ability to navigate the environment and recognize objects by their shapes is not only present very early in development, but also is present in other animal species. Previous research has shown that these early-emerging abilities contribute to uniquely human geometric skills such as map reading. Could such early sensitivities to geometric information in infancy also support implicit knowledge about the properties of triangles?

In this study, we are testing whether 11-13-month-old infants recognize that the top corner of a triangle should move up or move down when the triangle is scaled up or scaled down respectively. Infants see only the bottom two corners of the triangle during the transformation, and they are then shown the top corner of the triangle either in the correct location or in the original, incorrect location. Since infants tend to look longer at things that surprise them, we hypothesized that infants would look longer when the top corner was in the incorrect location.



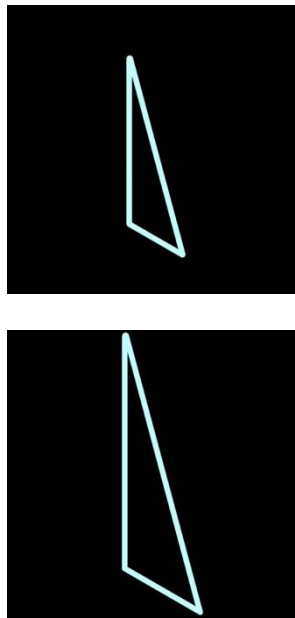
The first group of infants we tested showed the hypothesized pattern of looking! We are now testing infants in two more scenarios: with either an angle change to the bottom two corners or with a more subtle scale change. We are excited to know whether some properties of triangles are implicitly recognized in infancy, even if their explicit understanding takes many more years to develop.

Infants' Detection of Shape Properties

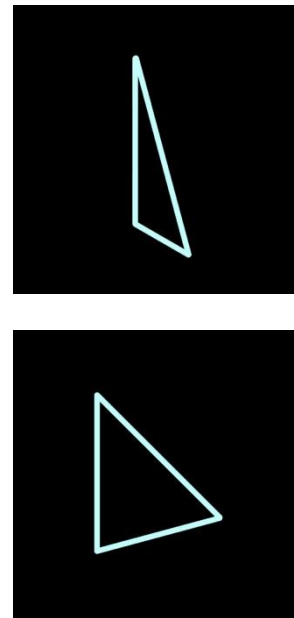
Moirira (Molly) Dillon, Graduate Student

Infants' brains come equipped with certain spatial abilities very early in development. One such ability is the recognition of objects by their shapes. But, what specific shape properties are infants using, and how might this early sensitivity to shape information form the building blocks of later geometric understanding? In this study, we are presenting 6-7-month-old infants with two streams of images presented on either side of our big screen. On one side are two figures that are changing shape, such as two differently-shaped triangles. On the other side, are two figures of the same shape but changing size, such as two similar triangles. We measure how long infants look at the shape-change versus size-change image stream. To really focus our study on shape information, we control for other spatial factors including, area, position, orientation, and left-right direction across the two image streams.

Similar Triangles
Flipping Back and Forth on One Side



Triangles of Different Shapes
Flipping Back and Forth on the Other Side



Since infants tend to look longer at things they find interesting, we use this design to measure whether infants detect and prefer shape changes. In our first pass with full triangles, infants looked longer at the shape change side! Our next step is to successively remove confounded shape cues, which are present in triangles (e.g. the relationship between an angle size in one corner and the length of the side across from it) to pinpoint exactly which shape properties infants are sensitive to. So for example, we will present free-standing angles and measure if infants are sensitive to angle information isolated from relative length information.

In addition to determining whether infants as a group detect these shape changes, we also measure individual preference scores for the shape-change stream. Families who participated in this study may get a call back from us in a couple months to see if such preferences are stable through infancy. We hope to see you again then! Thank you!

How Kids Think About Family, Friends, & Strangers

Annie Spokes, Graduate Student

In this set of studies, we continued exploring whether young children see kinship as a social category and how children expect social interactions to occur among kin and non-kin members. We presented 3- to 5-year-old children with an interactive storybook that either included fictional characters or people from children's own lives. In both versions, the storybook had people with different types of relationships, including siblings, friends, and strangers. Throughout the story, we asked questions about the types of relationships (*Example: Which one might live in the same house: a sibling or a stranger?*), and how they thought the characters might interact with each other (*Example: Which one would you like to share an extra cupcake with: a friend or a sibling?*). Children who were asked about people in their own lives also colored in a character that would be them in the storybook.



An example page from the storybook & various children's colored-in characters.

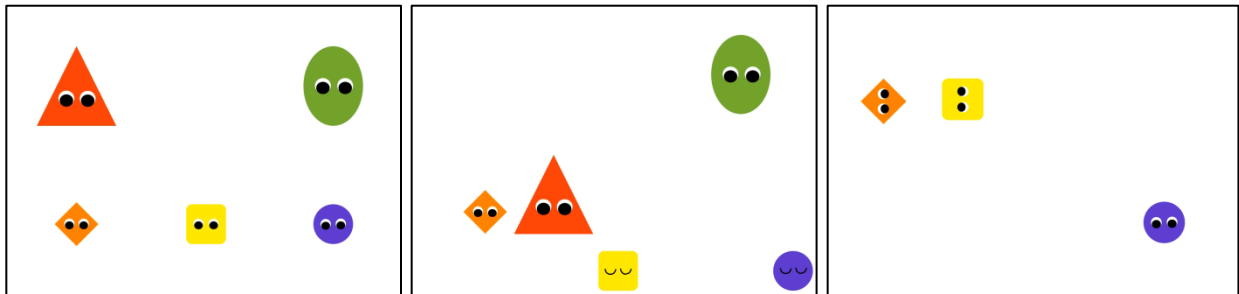
We found that children of all ages expected resources to go to a friend or family member over a stranger. However, children expected a character to share with a friend and sibling about equally when choosing between the two. In questions asking about their understanding of different types of relationships, children showed clear understanding of the differences between friends and strangers as well as siblings and strangers, but they were not as clear when answering questions that distinguish between family and friends. We found that children answered sharing questions the same for fictional characters and when deciding about people they knew. However, for questions that asked about how the types of relationships are different, 4-year-old children performed better when answering about people they knew rather than fictional characters. Three-year-olds did only slightly better when answering about people they knew, and 5-year-olds performed well in both types of stories.

Taken together, these results suggest that children have explicit knowledge and understanding of relationships among familiar individuals—friends and family—when they are compared to unfamiliar individuals—strangers. However, children do not as clearly differentiate between friends and family both in understanding and expectation for their interactions. We appreciate all of the help from children and participants who have been involved with these studies!

Early Understanding of Social Interactions & Relationships

Annie Spokes, Graduate Student

In the past year, we have been working on a series of video animation studies looking at different social interactions and relationships. We showed animated shapes with eyes that were helping and nurturing each other or laughing and playing together to see how infants expect characters to interact. These studies included babies at 9, 11, and 15 to 18 months.

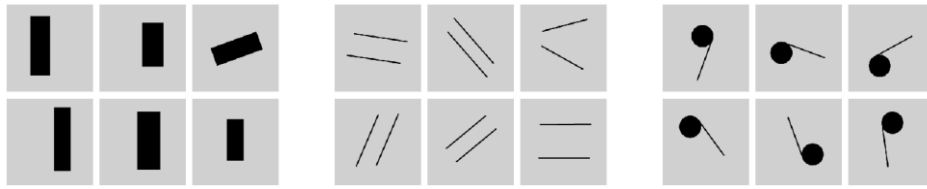


Animation Examples (from left): 1- Five characters in the video; 2- Example of a soothing event with red triangle soothing orange diamond; 3- Example of a test event with orange diamond & yellow square playing together

In one study with 15- to 18-month-olds, there were two large shapes that represented caregivers and three small shapes that represented babies. In the first half of the study, infants watch as each baby cries in distress, and one of the caregivers comes to soothe the baby. One caregiver helps two babies, and the second caregiver helps the third baby. Then, in the second part of the show, the babies now interact and play together. We alternated between showing two babies playing together who were helped by the same caregiver and two babies that were helped by different caregivers. We watched to see how long infants looked at these two types of events to see if they might look longer to one type. We found that infants at this age look much longer to interactions between babies with different caregivers, suggesting that they do not expect this interaction as much as interactions between babies with the same caregiver. We then ran another study where characters were laughing and playing together rather than being soothed, and infants no longer expected those who played with the same character to interact with each other in the future. There seems to be something unique to relationships that involve helping and soothing. We ran the same study with 9- and 11-month-olds and found that at 11 months, but not 9 months, infants also seem to tell the difference between the social interactions in the test events.

We are continuing studies with 11- and 15- to 18-month-olds to further explore these helping and nurturing relationships. For example, one study involves three characters: two adults and one baby. If one adult soothes the other adult and the baby, what happens when that first adult now needs help? In other words, do infants expect everyone to help back, or might they expect an adult to help another adult more than a baby to help an adult? These studies are still ongoing, so we look forward to sharing more about results in the next newsletter. Thank you to all babies and parents who helped to make these studies possible!

Working to Benefit the Self & Others
Annie Spokes, Graduate Student



Examples from the Geometric Intruder Task

We started a new study this year with 4- and 5-year-old children looking at how much effort they are willing to put in to win prizes for themselves and other people. In this study, children play a geometric intruder game on the computer. We show them a group of six pictures that all have something in common except for one picture that does not belong. We ask them to point out which one is not the same as the rest. We have a big set of these for them to play, but they get to choose when to stop. The more they play and get right, the more stickers they win. Sometimes children win stickers for themselves, and sometimes they win for other people.

In early versions of this study, we had children play the game once to win stickers for themselves or other people. More recently, children play the game three times: once for themselves and twice for other people. They play for family members—a parent or sibling, friends, or kids they have never met before. We are keeping track of how long kids play the game and how many they get correct so that we can look at how much overall effort they put in depending on who they are winning prizes for.



This study is based on a previous study with adults that showed that they were willing to sit longer in an uncomfortable position—a “wall-sit”—when winning money for people who were closely related to them. That study found a linear relationship between relatedness and how much effort people put in. We are trying out this idea with children but using the challenging geometry game instead of a physical test, and we look forward to seeing what children do!

Finger Puppets Study: Do young children understand exact quantities?
Veronique Izard, Visiting Scholar



Nina has a strawberry for each finger ... Will this still be true if she eats one strawberry?

Young children tend to be fascinated with numbers – they love to do counting activities, and they love trying to count all kinds of different things. Yet, for a long time, children do not understand what the point of counting is: they do not understand that the point of counting is to evaluate how many objects there are in a group. They seem to think that counting is just another rhyme or game, like patty-cake. This is particularly striking, given that children around 2, 3 years of age are formidable word-learners. They can learn new words just upon hearing them a few times, and they can learn up to several words a day. So why is it so hard for them to learn the meaning of the number words, and of the counting activities they enjoy?

We think this might be because they do not have a concept of exact numbers, ready to be applied to these words. Even infants do know some things about numbers and quantities, and this knowledge is present in young children too, but this knowledge is really about approximate numbers (“a little”, “some more”, “a lot”). Infants and young children may not be able to appreciate that if one take some number of objects, and adds only one more object, this now makes a different quantity, even if the difference is not perceptible.

In the Finger Puppets experiment, we ask how children understand this notion of exact quantities. The children play a game with puppets that live on the branches of a tree – one puppet for each branch. At night, puppets go sleep in a box, then morning comes, and children need to place the puppets back on the tree. We observe whether children use the branches to know when exactly all puppets are back on the tree. Sometimes, stories happen to the group of puppets during the night, such that at the morning, there is one more puppets, one less puppets, or one puppet was replaced by a friend ... Will children use the branches to keep track of exact quantities through these transformations?

Over the last two summers, we tested 3-year-old children in this study. At this age, children’s understanding of counting varies a lot, depending on the individual interests of each child. We wondered whether the children who understood number words better would use the branches more. To our surprise, we found that all 3-year-olds are able to use the branches, independently of their understanding of counting. They use the branches when the number of puppets present stays the same, and they use the branches to keep track of additions and subtractions!

Understanding the concept of exact number, and its tight links with one-to-one correspondence, is not related to the learning of number words.

Thank you to all the families who participated!

Our research is only possible with your support.



If you have any questions, want to refer a friend,
or would like to participate in more studies,
please contact us!

babylab@g.harvard.edu
617-384-7777

<http://software.rc.fas.harvard.edu/lds/>

<https://www.facebook.com/laboratoryfordevelopmentalstudies>