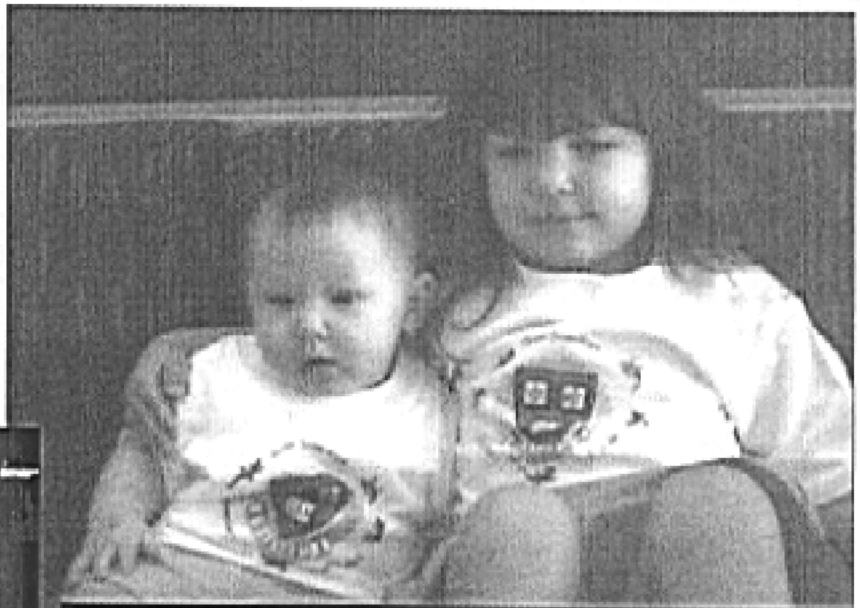

Hello again from the Lab for Developmental Studies at Harvard! Thank you so much for your recent participation in one of our studies! We'd like to share with you some of our findings...none of our research would be possible without your generous support.

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Summer/ Fall 2004

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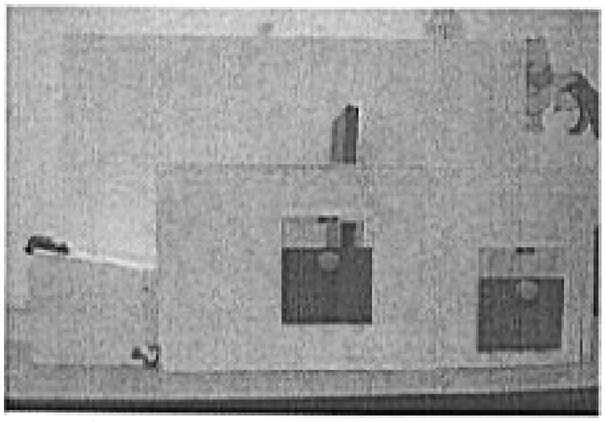
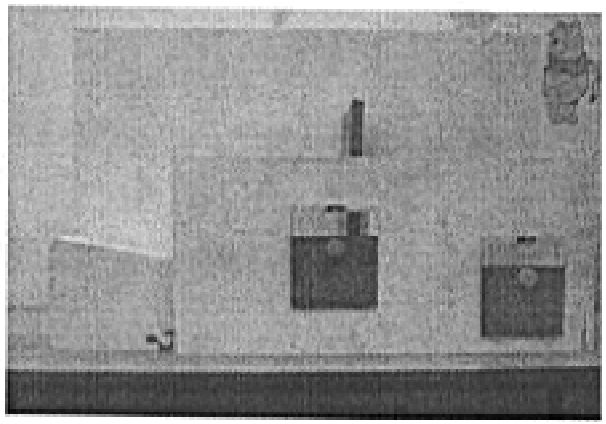
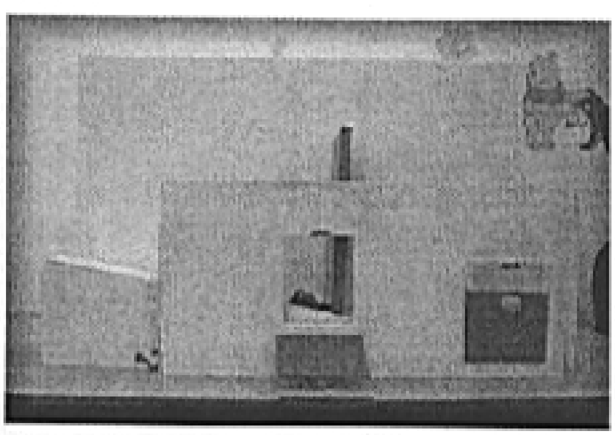
Toddler Ramp Studies

Kristin Shults, Graduate Student







We wanted to briefly update the article "Toddler Ramp Studies" from the Winter-Spring 2004 newsletter. In these studies, we have been interested in examining how 2-year-olds think about objects that have gone out of view. In all of the ramp studies, toddlers are presented with a car that rolls down a ramp. On each trial, a panel containing two doors is placed in front of the ramp, the car is released to roll down the ramp, and then the toddler is asked to locate the car by opening one of the two doors. The car can stop behind either door depending on where the experimenter places a bright green stop wall.

The conclusion from Studies 1-3 (see "Toddler Ramp Studies," Winter-Spring 2004 for more details) was that toddlers are most successful at searching for an object (e.g. a car) that has gone out of view when they can see part of that object (e.g. its antenna) either through a door of the panel occluding the ramp or sticking out above the panel occluding the ramp. In a final study, Study 4, we asked what would happen if toddlers could see the bright green stop wall (but not any part of the car) through the window in the panel door. Would this help them use the wall to locate the hidden object? Surprisingly, making this change had no effect on toddlers' performance on the task; they were unable to locate the car even though they could see the stop wall right through the door they needed to open. Thus our previous conclusion was given more support: toddlers need to be able to see part of the object they must track in order to successfully locate it.

Actions vs. Goals

Laura Wagner, PhD

These studies are looking at what kinds of information babies and toddlers can keep track of in a motion event. When your baby watches you move around the house, is he or she thinking, "Mom's going into the kitchen" (the goal of your motion) or instead thinking "Mom's walking" (the way you were moving)? We're interested in whether babies and toddlers can keep track of both of these kinds of information and if they have a preference for tracking one over the other.

For the babies who participated in this study, we showed them a short play in which toy bunny moved to one of two goal locations (either a yellow tub or a purple platform) using some characteristic action (hopping, scooting, or gliding). We timed how long the babies looked at the bunny while it was performing one motion event, and then we changed it so that the bunny went to a different goal. We were interested in whether the new goal would attract the babies, attention and cause them to look at the display longer. So far, we have found that 11-month-old babies do track goal information (that is, they notice when the bunny changes goal objects) but only so long as the action used to get there wasn't too interesting: when the bunny scoots along its bottom to the goal, babies don't seem to notice the goal change.

In an ongoing follow-up study, we are looking to see which actions babies distinguish from each other to try to determine what makes an action more interesting than the goal of the event.

For the toddlers who participated in this study, we used small stuffed animals to act out a motion event , such as having a bunny hop into a bowl and having a frog swim across a board. Then we gave the animals to the toddlers and asked them to imitate what we had done. This study is still ongoing, but so far, it looks like 16 - 18 month olds are able to act out both the action and the goal part of the event. However, they have difficulty combining those parts into a single event. Usually, they act out just one element of the event (just the action, or just the goal) and sometimes they even act them out in the reverse order (putting the animal on the goal and then removing it to show the action)! We are continuing to work on this imitation study, and we're especially interested in how learning verbs might influence toddlers' understanding of events.

CONCRETE NUMBER TRAINING

Yi Ting Huang, Graduate Student

How do children acquire number words? These studies look at the link between development of numerical concepts and the process of language development in children between the ages of two and four years. Previous studies have shown that while children quickly learn to recite the number list at an early age (i.e. repeating the counting routine from one to ten), the mapping of these words onto specific quantities is a slow, stage-like progression that occurs over the course of several months.

We were very interested in children's representation of number words during these stages. Specifically, whether children are able to apply these number words to concrete objects such as toys and pictures, as well as whether children are able to use these words abstractly to quantify over domains that are not readily visible (i.e. sounds). Also, we were interested in what kinds of input and feedback underlies this process of concept to word mapping and whether we can teach children this relationship.

In the first step of this study, we found that children are indeed able to apply the number words they have learned in an abstract way. There seems to be a tight correlation between number word use in both concrete and abstract domains. For example, children who are able to use a *two* to quantify over a picture with two fish are also able to produce two sounds on a computer. In the second step of this study, we found a difference in children's ability to learn new number words. Specifically, preliminary data seems to suggest that children in the earlier stages of number word acquisition have trouble applying new number words onto new pictures objects while children in the later stages of acquisition could transfer new number words onto an approximate representation of the quantity. We are currently interested in studying the reasons underlying this difference in performance.

How Kindergarteners Learn Motion Verbs

Carissa Kemp, Researcher

The purpose of this study was to see if 5-year-olds have the ability to learn verb biases for motion verbs. In this study, children watched video clips on a computer screen. The screen displayed single videos of ambiguous clips followed by a split screen with different actions occuring on each side of the screen. While watching the videos, the children were told what the person was doing and then asked about who was doing the same action. The experimenter recorded the child's responses on a sheet of paper.

In the first half of the study, the children saw familiar actions used in the sentences (for example, "She is throwing the toy.") The video on one half of the screen matched the initial motion (a guy throwing a toy airplane) and the other half of the screen did not match (a woman kicking a ball.) We found that children were able to point to the screen that was a correct match for the motion verb.

In the second half of the study, the children heard new verbs that we invented (for example, "She is gorping up the hill.") The children were asked to initially identify "Who is gorping" when the first split screen appeared. Then the children were shown a series of five more clips of different people performing similar actions. Finally, there was a second split screen and children were asked again to choose the correct action ("Who is gorping?") Each time the screen is split, one of the videos shows a person performing an action in the same manner (i.e. kicking) and in the other video a person is performing an action in the same path (i.e. up). For example, if the initial video shows a woman crawling up a hill, when the screen is split there would be one where a woman is crawling behind a chair (same manner, but different path) and the second video would show a woman hopping up a hill (same path, but different manner.)

Our goal was to see how children interpret the meaning of a motion verb that they have never heard before. Adult English speakers have a bias toward the manner of motion, whereas adult Spanish speakers have a bias toward the path of motion. Adults, however, can learn a new bias if you teach them enough new verbs. We expected children to have no initial bias, but to be capable of learning one if we taught them enough new motion verbs. This study is still in progress and is continuing for the fall (2004). In addition, we are in the process of beginning this study on 3 and 4-year-olds in a 4-session scenario to see if toddlers have this flexbility in their verb learning.

NUMBER TRAINING STUDY

Miles Shuman, Graduate Student

In this series of large number representation studies, we have young children look at paired sets of dots, or listen to paired sets of tones, and try to guess which set consists of a larger number of elements. We're interested in what kinds of sets children will be able to tell apart. More deeply, we hope to determine whether there is a single, abstract "number representation" system used for evaluating the numerosity of any kind of set, independent of perceptual "modality" (auditory, visual, etc.) – or whether there is a different system for estimating and comparing number in each modality.

Previous work has shown that adults' ability to discriminate between sets on the basis of number depends only on the ratio between the numerosities of the sets – not the absolute difference. That is, most adults can reliably tell that 6 is more than 5, and that 18 is more than 15 (both ratios of 1.2:1), but have a hard time discriminating 9 from 8 (1.125:1), or 11 from 10 (1.1:1). Previous work in our lab has shown that infants seem to have a similar kind of limitation – their ability to discriminate between sets depends only on the ratio – but with much lower acuity: 6-month-olds can tell sets are different when the numerosity ratio is at least 2:1, but fail when the ratio is 3:2 or smaller; 9-month-old infants succeed at 3:2 and larger ratios, but fail for 4:3. For infants, these thresholds seem to be the same for both visual and auditory sets.

In this series of experiments, we're examining the abilities of 3-5 year olds. The first study we completed suggested that children in this age range might have dramatically different ratio "thresholds" for auditory and visual set comparisons (see previous newsletter). However, a follow-up study showed that the greater difficulty of the auditory comparisons was due to the tone sequences being "arrhythmic" and random; with regular, rhythmic auditory tone sequences, performance improved to near the levels observed for visual array comparison.

These studies set the stage for our most recent (and most exciting!) experiment in this series. In this experiment, we're testing (1) whether practice with number comparison will improve performance, and (2) whether improvements in performance will "transfer" between perceptual modalities, from visual to auditory number comparison. Evidence of this kind of "transfer effect" would strongly support the theory that we have a single, abstract number representation system, not tied to any particular sensory modality.

The study is not yet complete, but preliminary results suggest that there is improvement with practice (the acuity of the representation is "plastic" with respect to experience) and further, that the improvement does transfer across modalities, with visual comparison practice improving auditory comparison performance! More work is needed to show that this improvement is specific to number, but the results so far support the idea that even young children have a very abstract representation of number.

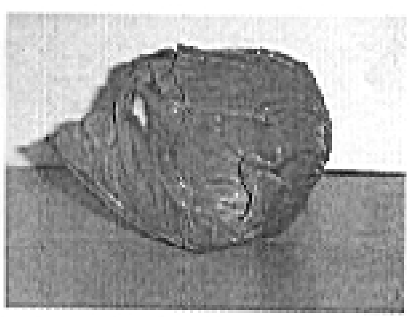
The Learning Adjectives Study

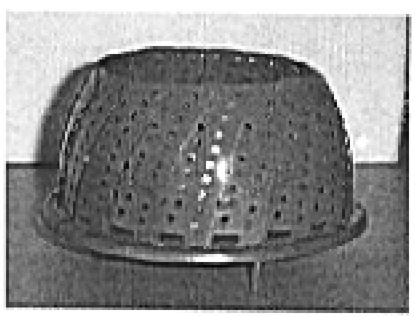
Ariel Grace, Researcher

In previous newsletters we've told you about our continuing investigation into how young children learn novel color adjectives, such as green or purple. Past research has indicated that color adjectives are difficult for young children to learn, appearing in children's speech several months later than other types of adjectives (i.e. size or texture adjectives).

Our current study explored the hypothesis that it might be easier to teach a child a novel color word in a domain where color might be particularly relevant– in this case, food. To that end, we attempted to teach some children a novel color word ("blicket") using food, such as pears and grapes. Other children saw similarly shaped artifacts, such as light bulbs and bells, instead. We introduced 2-year-old children to a puppet who taught them a word from his "puppet language." The puppet showed children pairs of items (food he liked to eat, or stuff he liked to use). If a child learned that in this pair the purple pear was "blicket" and the green pear wasn't, we were curious whether he or she would also later pick out the purple apple, or purple lettuce, as also being "blicket."

While it did seem that children who learned adjectives on pieces of food were better able to transfer to new types of food than children who learned on artifacts and transferred to artifacts, this difference was not statistically significant. One reason for this may be that, in contrast to past findings, many of our 2-year-olds already knew their (real) color words! In future studies we may investigate younger children who haven't learned color adjectives yet, or we may branch out and investigate how children learn other types of words, such as nouns as they apply to food or artifacts. We'll keep you posted!





Pictured above: Some children saw food (i.e. lettuce), and others saw similarly shaped objects (i.e. a basket).

Crossmodal Number Study

Hilary Barth, PhD

Jennifer Lipton, Graduate Student

In the last newsletter, we described some computer studies with 5-year-olds on rough arithmetic abilities. Children at this age have an intuitive understanding of numbers that they can use to perform arithmetic on large sets of objects, too big to count exactly. In an older version of the study, children watched animations on a computer that "acted out" addition problems with groups of dots. For example: 16 blue dots would appear on the screen, and then they would be covered by a box. Then 16 more blue dots would move across the screen and go behind the box (to make a total of 32 blue dots behind the screen). Then 40 red dots would move onto the screen, and the child would be asked, "Are there more blue dots, or more red dots?"

We wanted to find out if the children were depending on visual information to perform the task, so we tested children in a different version in which they never saw the red dots at all. Instead, they would only hear beeps representing the red dots. Here's how it worked. We started out with an introduction, showing the child 14 red dots and saying "Look, each dot beeps one time, like this!" [beeping] "And when the red dots hide behind their red box, you can't see them but you can still hear them, like this!" [beeping] "And when we take away the box, there they all are, see?" Then, in the actual task, 12 blue dots moved across the screen and hid behind the blue box. Then 13 more blue dots went behind the blue box. Then the child heard 15 beeps (representing red dots "hiding behind the red box"). We asked, "Are there more blue dots behind the blue box, or more red dots behind the red box?" Even though this is a complicated sequence of events, we were surprised at how well 5-year-olds could understand this task.

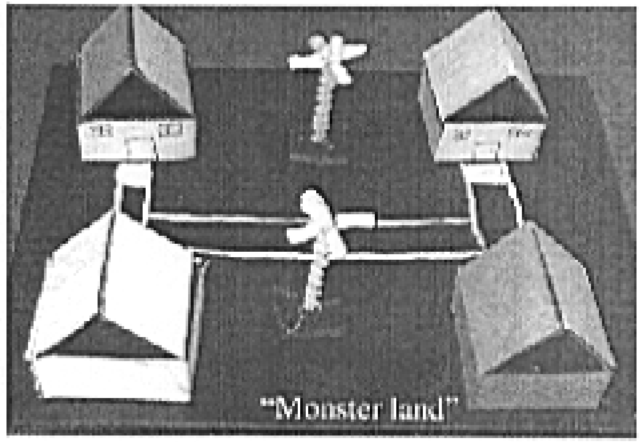
Our groups of 5-year-olds were successful at this dot/sound addition task and in a similar dot/sound comparison task (almost the same thing, but only one group of blue dots was presented). They were as good at adding as they were at simply comparing, and they were just as good when they had to integrate information from different senses as they were when everything was presented visually. These children did not show any understanding of symbolic addition with the same quantities. This shows that young children can perform approximate addition before they are formally trained to add large numbers. It also shows that this ability is based on an abstract ability to estimate number, and is not dependent on learning language-based addition strategies. Our growing understanding of children's intuitive math abilities may guide the development of new educational techniques.

Puppet Languages

Katherine Kinzler, Graduate Student
Ashley Groh, Undergraduate Research Assistant

This summer we ran a series of studies with three, four, and five-year-olds looking at children's early understanding of people in the world who speak different languages. Children played a few different games with puppets, all geared towards getting at what children know about different languages and people who speak them.

In the first game, children saw two puppets, one who spoke Spanish and one who spoke English. The puppets then were taken to "monster land" where monsters hide cookies. A monster would tell the puppets where a cookie was hidden, either in English or Spanish, and children would then be asked "which puppet will find the cookie?" It turns out that this task was *really* hard for kids. We then changed the task, this time taking out the presence of different languages, yet trying to make the task equally difficult. This way, we could try to discern whether the *different language* component of the task made it so hard, or whether the task was simply confusing in general. In the new task, the puppet either told one puppet where the cookie was hidden, and the other that "the cookie is made of real chocolate", OR children saw one puppet leave the room when the relevant directions about the cookie were given. Children did much better at this new non-foreign language task, suggesting that a metalinguistic understanding is very difficult for children to master.


"Monster land"

In the second game, children were asked to sort puppets into boxes based on the language that they spoke. Puppets "spoke" either English or Spanish phrases, and children were told to put puppets into the English or Spanish boxes. Four and five year olds were able to succeed at this task. Three-year-olds, however, had a lot of difficulty sorting the puppets based on language. We then changed the script of the study: instead of telling children that the puppets spoke in English and Spanish, we instead said that they "speak like we are speaking now," or "don't speak like we are speaking now." When we said this, three-year-olds were able to correctly sort Spanish and English puppets! This suggests to us that three-year-olds are able to tell the differences between languages, however children's early understanding of different languages in the world and people who speak different languages may be helped by an understanding of one's own language and linguistic group first.

Fair Game

Laura Wagner, PhD

This study looked at children's understanding of fairness. We gave 4-year-olds stickers and asked them to divide them up between themselves and a partner (a research assistant). We were interested in how children would choose to share their stickers, and how their choices related to how many stickers their partner gave them as well as to what they said was a nice number of stickers to give away. We also asked about children's sense of property ownership (do they, like typical adults, value something they own more than something they don't?) and their understanding of other's mental states. We are still collecting data on this study, but the preliminary results suggest that children are about as fair as adults (they usually give away roughly half their stickers), although lean towards being a bit more generous than adults typically are.

Toddler Counting

Kirsten Condry, PhD

We have conducted a long series of studies looking at how 3- to 3.5-year-olds understand number during this age when they are learning to count. In most of these studies, children are first asked to count a pile of fish, and then asked to put different numbers of fish in a small box (which we called a "pond"). In the first part of the study, we found that children's ability to count is very advanced at these ages, all children could count past 5, and many could count accurately past 10. Often children would recite the numbers in the teens (11-20) out of order, but many children at this age were familiar with most of the numbers from 1-15 or 20. In contrast, the results of the "give a fish" task showed that, although children are excellent counters, they often do not yet know exactly what their number words mean. In this part of the study, children could accurately give 1, 2 and sometimes 3 fish, but at some point, they would grab a handful of fish when asked for the next number in their count list. Our results suggest that, while memorizing the count list is very easy for young children, it is much more difficult to figure out what all the number words mean. Research in other labs has shown that although children begin counting around the age of 2-2.5 years, it often takes children another 1-3 years to sort out what all those number words refer to. Our research agrees with this finding, and also suggests that during this learning period children may have a "fuzzy" sense of some of their number words (so a child may ask for "3 cookies," by which she means she wants either exactly 3, more than 2, or lots more cookies). The next part of the research varies depending on which study your child participated in. In some of our studies we asked children to point to pictures with particular numbers of objects, or keep track of addition and subtraction problems with small and large numbers of objects. The results of these studies have been very interesting and informative, and we will send a more complete summary soon!

Quantity judgment and plurals

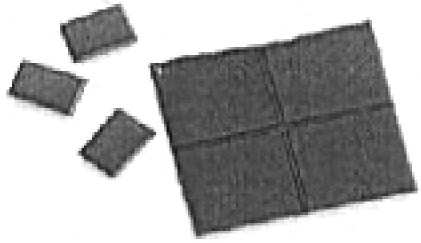
David Barner, Graduate Student

This study examined how children interpret abstract structures in language, and whether the structure of sentences predicts meaning. In the Quantity Judgment study, we tested whether children used mappings between meaning and structure by studying children's judgments of quantity. When adults use ordinary nouns (e.g., string, stone) the way that the word is used in the sentence systematically changes our judgments about how to measure the stuff in question. For example, if one person has 1 giant piece of string and the other has 3 tiny pieces, the first person may have more string but fewer strings. In fact, it is nearly always the case that words that can't be pluralized measure things according to continuous amount, while words that can be pluralized measure according to number. Our question was when children would figure out this subtle yet important aspect of language.

To examine this question, we performed a series of experiments. In Experiment 1, we tested 24 three-year-old children by asking them which of two characters had more stuff – the one with more things, or the one with one big thing or portion. We tested four different words: string, stone, chocolate and paper. In a previous study we found that 4-year-olds were able to shift judgments according to whether words were used as plural nouns. For 3-year-olds we found a similar result, although the younger children appeared to be just beginning to understand how the distinction works. For plural nouns (e.g., who has more strings), children said that the bigger number of tiny things was "more" than the one big thing about 77% of the time, while for non-plurals (e.g., who has more string), children judged by number only 44% of the time.

In Experiment 2, we tested children between two-and-a-half and three-and-a-half by teaching them new words for funny objects and gooey substances. This time we asked children whether the character with one weird object/substance or the one with three weird objects/substances had (for example) some kutches. Following this, we asked each child which of two characters had more kutches - a character who had three tiny ones or the character who had one giant one. Interestingly, when we asked children these questions and the stimuli were weird gooey substances, they correctly chose the three portions of stuff to be (for example) the "kutches" but incorrectly chose the one big portion to be "more kutches". This study suggests that although children are beginning to understand how sentence structure relates to amount, they still have a strong bias to ignore grammar and base their judgments on mass or volume when the things being talked about are non-solid stuff. According to our results for adults, this bias disappears at least by the the time kids enter college!

More chocolates or more chocolate?



Based on these results, we concluded that at around 3-years-old, children may be just figuring out the meaning of the word "more" and how it is shifted by different grammatical constructions. Future studies (perhaps a good one for parents to try at home) might test whether children would rather eat a small portion of a treat (e.g., chocolate) broken in three pieces or one much larger piece. Such a study would resolve whether children's early problems with "more" affect their judgments of what constitutes a greater overall amount of stuff (e.g., to eat), or if is strictly a problem with language.

In the Different Faces study we are interested in investigating the development of face recognition in toddlers and preschoolers. In the current set of studies, we are especially interested in asking about young children's memory for same- and other-race faces.

Different Faces Study

Kristin Shutts and Joan Chiao, Graduate Students

Several researchers have found that adults are better at recognizing faces of their own race than of another race. Is this true of children as well? To ask this question, we play a short game on a laptop computer called "find my friend." In the game we show children a picture of a person, tell them the person's name and something interesting about them (e.g. "George likes to eat peanut butter cookies) and then later ask if they can help us find that friend on a different screen. The faces in the study are African-American and white males. After the study, we ask parents to fill out a questionnaire about their child's exposure to people of different races because we are interested in the role of experience in the development of the same-race advantage that has been found with adults.

The study isn't finished yet, but we'll certainly let you know the results when it is!

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