



Baby & Toddler News, Summer 2003

Sometime over the last year, your baby participated in one of our studies. We are writing first of all to THANK YOU for your participation. We couldn't do our research without your help and we really appreciate your interest. We also wanted to let you know what we learned from the studies we conducted. In this newsletter, you will find out the results of several different studies completed recently in our lab.

If you have any questions about these studies or the lab in general, please feel free to call us at (617) 384-7930 or (617) 384-7777. We also have a web-page for the lab where you can find out more about us and our studies: www.wjh.harvard.edu/~lds

We hope to have you come visit for more studies soon! Thank you!

MESSY FOODS STUDIES

Kristin Shutts, graduate student

When an infant sitting in her highchair is presented with a bowl of white vanilla yogurt (her favorite) alongside a bowl of green mashed peas, does she know *before she tastes them* which of the two is the food she likes? Adults, young children, and even nonhuman primates use color information to recognize familiar foods and reason about novel foods. For example, even an adult who hadn't seen the containers from which the vanilla yogurt and peas came could easily guess which food was which by attending to color of the substances.

Do young infants know anything about the foods they eat? In particular, do they pay attention to color and texture information when looking at foods and do they use this information to reason about which foods are the same and which are different? For the past year and a half, we have been trying to find the answers to these questions by conducting "looking time" studies with 8-month-old infants. In these studies, we show infants different foods (e.g. solids foods such as lemons and watermelon chunks and substances such as orange juice and green sugar), change either the color or the shape of the foods, and then see whether infants notice these changes and think they are important. For example, we showed one group of infants a person taking a taste of sparkly green sugar over and over again until infants became bored with the display. Then, we showed these infants a person taking a taste of sparkly green sugar (the same thing they had already seen) alternated with a person taking a taste of pulpy orange juice. We thought that infants might look longer at the display with the new food (i.e. the orange juice) because it would be novel and therefore more interesting. Surprisingly, infants looked equally long at the new and old foods, suggesting that perhaps they didn't notice the color and texture of the original food.

We are currently pursuing other looking time studies to ask whether infants attend to shape information instead of color information when they see different kinds of foods. We are also planning to try other ways of asking our questions. For example, we might try actually giving infants the choice of their favorite food alongside a differently colored food to see for which food they will reach.

MOVING ANIMALS AND MOVING VEHICLES STUDIES

Kristin Shutts, graduate student

Can young infants learn and remember properties of objects they have only seen a few times? Are they capable of learning about all kinds of things in the world or only particular categories of objects? In the Moving Animals study, we investigated whether 7-month-old infants could successfully learn the movement behaviors of two different animal wind-up toys. In the learning phase of the study, infants were shown one animal that always moved around the stage on its own (we wound it up and let it go) alternated with a different animal that was always moved around the stage by the experiment's hand. In the test phase, the experimenter placed both of these animals on the stage and removed her hands; neither animal moved for several seconds. After the experiment was over, we watched to see which animal infants spent more time looking at. We reasoned that if infants had successfully mapped the method of movement onto each animal, in the test phase they would look longer at the animal that was previously self-propelled because they might expect it to start moving again. This is exactly what happened!

In follow-up Moving Animals studies, we asked which properties (e.g. shape, color) infants paid attention to when reasoning about the animals. Do infants, like adults, know that shape is an important property for categorizing animals? More specifically, do they think that if two animals share the same shape, they are likely to move in the same way? To answer this question, one group of infants was taught about two animals that differed only in shape (e.g. a pink hippo and a pink snail). In the test phase, the infants saw two animals in these same shapes, but in a new color (e.g. a green hippo and a green snail). In the test phase, infants looked longer at the animal that shared the same shape as the one that was previously self-propelled. Thus, it seems that young infants do know that shape is an important way to categorize and reason about animals – if two animals share the same shape, then they are likely to be the same animal and therefore move in the same way. Other groups of infants who were taught about two animals that differed only in color (e.g. a tan horse and a blue horse) and who, in the test phase, were shown either those same animals or two animals with the same colors but different shapes (e.g. a tan crab and a blue crab) did not look longer at the animal that shared the same color as the one that was previously self-propelled.

In a related study called Moving Vehicles we were interested in asking whether infants are capable of learning about objects other than animals. Therefore, we taught a group of 7-month-olds about how two different vehicles moved. So, for example, we showed them that a little gray and green truck was self-propelled, but that a yellow and orange backhoe was hand-moved. Then, just like in the Moving Animal studies described above, we put the two vehicles next to one another on the stage in the test phase. Infant looked longer at the vehicle that previously

moved on its own demonstrating learning that the vehicle (the truck, in this case) was self-propelled.

One conclusion from the Moving Animals and Moving Vehicles studies is that even young infants are capable of quickly picking up and remembering information about objects in the world. Additionally, like adults, infants seem to have intuitions about what kinds of information to attend to for particular categories of objects (e.g. for animals, shape is an important property). These capacities will serve them well as they are faced with such tasks as learning words that are applied to objects after hearing them only a few times and making predictions about the behaviors of different entities in the world.

JUMPING PUPPET STUDY

Justin Wood, Graduate Student

Long before children learn verbal counting and symbolic arithmetic, very young infants (as young as 5 months!) have a remarkably sophisticated system for reasoning about number. Previous studies have revealed four main characteristics of how infants represent number. First, their representations are imprecise. For example, 6-month-olds discriminate 8 dots on a screen from 16 dots on a screen, but not 8 dots from 12 dots. Second, infants' numerical discrimination depends on the ratio between the numbers, rather than the absolute difference between them. So, infants who can tell the difference between 8 vs. 16 dots (but not 8 vs. 12 dots) can also tell the difference between 4 vs. 8 (but not 4 vs. 6) and 16 vs. 32 dots (but not 16 vs. 24). Third, infants become better at discriminating number as they age. For example, 6-month-olds can discriminate two numbers that differ by a 1:2 ratio, whereas 9-month-olds can discriminate two numbers that differ by a 2:3 ratio. And finally, and surprisingly, infants fail to discriminate small numbers altogether! So, although infants do discriminate 4 dots from 8 dots, they don't notice a difference between 2 dots and 4 dots.

Although these studies reveal that infants have an amazing ability to represent number, very few studies have examined what types of "individuals" this number system accepts. Adults, for example, show remarkable flexibility in the types of individuals they can enumerate, counting not only dots on a screen, but also parades, flocks of birds, homeruns, and arguments. In these studies, I looked at whether infants also show this same flexibility in the types of individuals they can enumerate. Specifically, I looked at whether infants represent the number of times a puppet jumps.

My results showed that in many cases, infants can successfully discriminate the number of times a puppet jumps. In particular, 6-month-olds successfully discriminated 4 from 8 jumps, but failed to discriminate 4 vs. 6 jumps and 2 vs. 4 jumps. By 9 months, however, infants successfully discriminated 4 vs. 6 jumps. This pattern of successes (and failures) is very similar to the levels of performance found in past studies, suggesting that infants have a single, abstract system for representing number.

FLASHING DOTS STUDY

Justin Wood, Graduate Student

A wealth of studies reveal that infants have a remarkable ability to represent and reason about their experiences in the world. In my studies, I focus on one of these systems, numerical knowledge, by exploring whether infants have a specialized system for reasoning about number, and if they do, how such a system works.

Research from our lab has found that infants do indeed represent number, regardless of whether the individuals they enumerate are dots, sounds, or puppet jumps. However, although these studies suggest that infants possess a single, abstract system for representing number, an important question remains: how do infants do this? When infants are presented with an array of objects, for example, how do they compute the number of objects before them? Two main theories have been proposed. Under the first theory, infants enumerate each individual one after the other, or in serial. Under the second theory, infants enumerate all of the individuals at one time, or in parallel. In my study, I am attempting to tease apart these two proposals.

In the first study of this series, I showed infants repeating presentations of dot arrays on a screen in order to learn the quickest amount of time 5-month-old infants need to form an accurate representation of number. For some infants, a new array of dots appeared every 2 seconds, whereas for other infants, a new array of dots appears every 1.5 seconds. Interestingly, infants successfully discriminated 4 dots from 8 dots when they saw a new array every 2 seconds, but did not discriminate when they saw a new array every 1.5 seconds. These results suggest that although infants have a remarkable ability to represent number, it takes about 2 seconds to form that representation. In my next study, I looked at whether infants would still succeed with a 2 second presentation rate when I presented larger sets of numbers (8 vs. 16 dots). This is the critical study. If infants enumerate the dots one after the other, it should take longer to count larger numbers of dots than smaller numbers of dots. In contrast, if infants enumerate all of the individuals at one time, they should take just as much time to enumerate the larger sets as the smaller sets. Although the results are still preliminary, it seems that the latter is true: infants successfully discriminated number when they saw each array for 2 seconds, regardless of whether that comparison is smaller (4 vs. 8 dots) or larger (8 vs. 16 dots). So, it looks like infants enumerate all individuals at one time, rather than one after the other!

LEARNING ADJECTIVES STUDY

Eugenia Steingold, Post-Doctoral Student and Kristin Shutts, Graduate Student

These studies investigate how children learn new adjectives that describe different kinds of object properties. We hypothesized that adjectives that refer to salient properties of objects in different domains should be learned faster and easier. For example, we found that young children easily learn size adjectives (e.g., big and small) when they describe animals, presumably because in the domain of animals, size correlates with age (e.g., a very small cat is probably a young kitty). Similarly, young children easily learn color adjectives when they are applied to food objects, presumably because color often predicts taste of food objects (e.g., red apple is probably sweet).

Our procedure is very straightforward. We introduce a puppet, who speaks a special puppet language. Instead of the real adjective (e.g., *red*), the puppet says a nonsense adjective (e.g., *blicket*). In one of our studies, we showed children the red and yellow apples that the puppet likes to eat. Then we pointed to the red apple, and said that this apple is *blicket*. During the test trials we showed children different kinds of food objects (e.g., red and yellow tomatoes, cherries and candies) and asked children to find the *blicket* ones. Previous work has found that children find it difficult to learn color terms in the domains of tools and animals. We have found, however, that in the domain of food, children successfully learned novel color adjectives.

Our current project uses the same procedure to investigate how children represent food objects. We hypothesized that children can represent food objects as solid objects and as edible substances. Consistent with this hypothesis, we found that children can learn novel color adjectives that describe non-edible substances equally well as they learn color adjectives that describe edible substances. We also found that children easily transfer novel color adjectives from substance foods (e.g., pudding and jelly) to solid foods (e.g., apples and cherries). However, our preliminary data suggest that children experience a cost when they transfer the newly-learned color adjective from a non-edible substance (e.g., lotion) to a solid artifact (e.g., comb). These results suggest that children can reanalyze food objects as substances and, hence, transfer novel color adjectives from edible substances to solid foods. However, children represent artifacts as solid objects, and hence, the transfer of novel adjective from non-edible substances to solid artifacts is more difficult.

ACTIONS VS. GOALS STUDY

Laura Wagner, Postdoctoral Fellow

This study looked at what kinds of information babies can keep track of in a motion event. There are (at least!) three kinds of things to look at in a motion event: where it began (the source), where it ended (the goal), and how you got from the source to the goal (the action). When babies watch people moving around in the world, do they think about where they're headed? Where they started from? Or do they mostly watch the ways people move?

There were two phases to the study: habituation and test. In the habituation phase, we showed the babies (9 and 11-months old) a little play in which a bunny rabbit hopped around on the stage. For some babies, the bunny hopped, for others, he spun in circles, and for others, he just glided across the stage. There were always two objects on the stage – a yellow tub and a purple platform – and the bunny always hopped either to (goal) or away from (source) the same one. We showed this action as often as needed until the baby grew accustomed to it. Then, we switched the location of the two objects. During the test phase, the bunny hopped, spun, or glided either to/from the same object (though it was now in a new location), or to/from the other object (though it was now in the old location). We timed how long the babies looked at each event. If the baby considered an event “novel”, he or she would look longer at it than if he or she considered it no different from what had happened during habituation.

So far, our results seem to show that 9-month-old babies have a pretty hard time keeping track of the goal object. They find it especially hard when there the bunny uses an interesting manner of motion (like hopping), and they find it harder still when the bunny uses a spinning motion – although we’re not sure if spinning is harder because the bunny doesn’t look at the goal most of the time, or because spinning is more interesting than hopping. It also looks like infants find tracking changes in the source object to be quite difficult. Eleven-month-old babies seem to be able to keep track of the goal object, but we’ve only just begun to systematically look at what these older babies can do.

GOAL-ORIENTED REACHING STUDY

Liesje Spaepen, Research Assistant

This study looked at how children interpret the goal of an actor’s reach. Previous studies have shown that babies as young as 5 months understand that a reach is an intentional, goal-directed action. In other words, babies do not think a reach is a meaningless hand motion, or even a motion in a particular direction; instead, they think that people reach for objects. This study asked about how babies think about the object of a reach. Do people reach for a particular object (“she’s reaching for *the* doll”) or toward a category of object (she’s reaching for *a* doll.)? There were two phases to the study: habituation and test. In the habituation phase, we showed the babies (all 12-months old) two toys (a doll and a truck) and an actor reached for one of them. We showed this action as often as needed until the baby grew accustomed to it. Then, out of the baby’s view, we switched the location of the two objects. During the test phase, the actor reached either for the same object as before, but in a new location, or to the other object on the stage, but in the same location as before. We timed how long the babies looked at each event. If the baby considered the event “novel”, he or she would look longer at it than if he or she considered it no different from what had happened during habituation.

We did several versions of this study (each with different babies!). In the first version, we found that babies look longer at a reach for a new toy in the test phase compared to a reach to a new location. In the second version, we not only switched the locations of the toys, but we also switched the objects themselves. That is, if the baby had seen a black female doll on the left and an orange dump truck on the right during habituation, he or she would now see a white male doll on the right and a red tow truck on the left. In this version, babies looked longer at a reach toward the new category of object, suggesting that they interpret the goal of an actor’s reach as category-based (“she’s reaching for *a* doll”).

More evidence for this claim came from our third version, where babies saw an actor reach either for one of two trucks on the stage or one of two dolls. During test trials, these babies showed no difference in looking at the new object compared to the new location, suggesting that they didn’t care which doll (or truck) the actor reached for. To double-check this results, we checked to make sure that babies can tell the difference between our dolls (and trucks) – they can. We also checked to see if babies would do better if they saw us move the toys to their new locations – they don’t. We’re doing more studies on this problem, but so far it looks like babies expect people to reach for kinds of objects (dolls, trucks, etc.) but they don’t necessarily think you’re reaching for one doll or truck in particular.