THE OHIO STATE UNIVERSITY

COGNITIVE DEVELOPMENT LAB

2011 Research Results

As a parent, you know that children develop quickly during the first few years of life.. The Cognitive Development Lab tries to capture and explain some of these developmental changes by investigating early language and conceptual development of infants and children. Our research is very important in helping researchers and teachers understand early components of learning. However, our success depends critically on the willingness of parents, which is why we would like to take this opportunity to express our sincere thanks for your participation in our research studies. We would also like to take this opportunity to remind you of our ongoing studies and provide you with a brief summary of our recent findings, made possible by the participation of you and your family. Your patience in awaiting the current results is greatly appreciated.

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INFANT RESEARCH FINDINGS

BEHAVIORAL ATTENTION STUDIES

6-8 Month Olds

In this study, a set of visual stimuli consisting of various geometric shapes was presented to infants. All of the stimuli included a common ratio between white and black objects (i.e. 1:3). Once infants found the common ratio amongst all stimuli (the 1:3 ratio), they decreased looking at the objects. When we next presented the same infants with a new ratio (i.e. 2:3) they looked longer at the new information even though everything else about the stimuli remained the same (i.e. color, total numbers of shapes etc). Results indicate that infants were able to detect differences in ratio information when all other information stayed constant. In part two of this study, the same geometric shapes were presented with the addition of smiley faces to different infants. The infants in this study did not decrease looking to the common ratio the way infants in the first study did. Results indicate that the second group of infants did not detect ratio between white and black shapes and that these infants failed to discriminate one ratio from another ratio, likely because infants only focused on the attracting appearance of the smiley faces instead of the ratios.

10-24 Month Olds

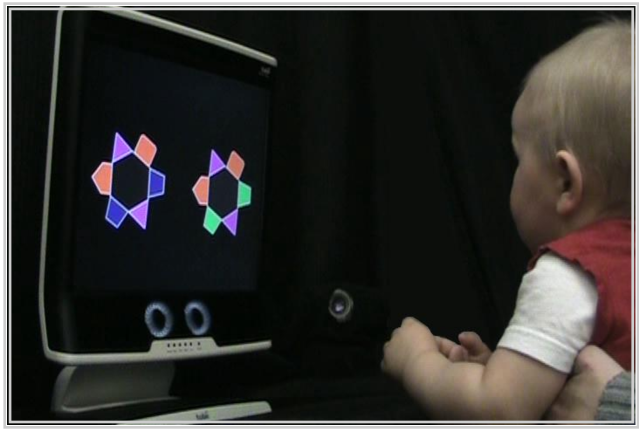
There are many ways to categorize objects in the environment, which requires young children to flexibly attend to different stimulus dimensions in different contexts. In this study, we wanted to see if infants could flexibly attend to shape in one context and attend to color in a different context. Children were familiarized to images presented in one of two contexts. When images appeared in one context (e.g., yellow background on left side of screen), they matched in shape. When images appeared in a second context (e.g., green background on right side of screen), they matched in color. After two minutes of seeing these images in both contexts, we tested infants by taking the dimension that was familiarized in one context and presenting it in a different context. For example, if infants were shown that items matched in shape on the left side of the screen and matched in color on the right side of the screen, we might have tested them by presenting images that matched in shape on the right side of the screen. Infants often increased looking on these new trials, which suggests that they learned the dimension-context pairings.

Infant Research Findings

Eye-Tracking Studies

The following studies used an eye tracking device in which pictures were presented on a special computer monitor with a built-in infrared camera. The camera records where, and for how long, participants look at objects on the screen. Eye-tracking has been an incredibly useful tool in helping researchers understand how infants distribute their visual attention during learning.

6–12 Month Olds In this study, infants were presented with objects that were either presented with the same word or in silence. We were primarily interested in how infants looked at the objects while they were being labeled, and if children who heard words would be more likely to learn the categories compared to children who did not hear words. There were several important findings. First, younger infants (6 to 8 months) who did not hear any words learned the object category. This was shown by increasing their looking to a new category after training. Furthermore, younger infants that *did* hear words did not increase looking to a new category, which suggests that they did not learn the object category. Older infants (9 to 13 months) were able to learn the object category regardless of if they heard words or were in silence while



This child scientist is participating in one of our many exciting Eye-Tracking Studies.

Interested in participating in some of our research on campus? We are currently looking for participants willing to come in for Eye-Tracking experiments! Participants can be from 6 months to 2 years old
Please direct phone and email inquiries towards our research assistants at 614-688-3970, or via email at infants@osu.edu

6-8 Month Olds In one study we examined if infants could learn the rules of a new category of objects when given some guidance about which feature defined the category. To help infants learn a category rule, we primed their attention to the most important feature by showing a short video with only that feature (e.g., yellow triangle) flashing or spinning with an accompanying sound. We found that infants who were primed as to which feature was most important for category membership learned the category of objects by focusing on what was predictive and ignoring what was irrelevant. This finding suggesting that category learning can be aided if attention is guided or supervised in some way.

6-24 Month Olds In another study we investigated how infants know causal relations. Our hypothesis is that it might be learned during the first few months of life. For example, when a ball hits another ball, we know that the second ball moves *because* the first ball hit it (canonical causation). On the other hand, it has been reported that most adults and children do not think the first ball is the cause when the second ball moves after a delay (non-canonical causation). We think that this happens because most cause-effect relationships in our life are immediate, and without a delay. Therefore, if causal relationships are learned, it would be possible that even non-canonical causation could be perceived as causal with additional experience. We investigate this possibility by showing many non-canonical instances to the infants and see how they perceive non-canonical causal relations compared to those who did not see the non-canonical examples.

Preschooler Research Findings

Eye Tracking Studies

One important component of cognitive development is the ability to detect correlations in the environment and flexibly attend to different features (e.g., shape or color). For example, before children can learn that different dogs belong to the same category of *dog*, they first have to observe what features or behaviors are consistent across various kinds of dogs they encounter (e.g., they have four legs and fur, and they bark and wag their tails).

In one eye-tracking study, we examined: (a) if children could learn the rules of two never before seen categories of objects, and (b) whether learning a new category with a category label helps children learn faster than without a label. To answer these questions, 4-year-old children visited our lab to participate in an eye tracking study where we presented a story about a far away planet where bugs like to eat different kinds of flowers, and children needed to help feed the bugs the right kind of flowers. The story was presented on a special computer monitor with a built-in infrared camera that records where, and for how long someone looks at objects on the screen. We were primarily interested in how children looked at the flowers while they were being labeled, and if children who heard different labels would be more likely to learn the two categories compared to children who did not hear labels. We found that children could learn what important features defined a category of objects by focusing on what was predictive and ignoring what was irrelevant. However, when we provided category labels, children were actually slower to discriminate the two flower categories than if we presented all the flowers in silence. This difference suggests that providing auditory information simultaneously with visual information may slow down category learning because children's attention competes between the auditory category label and the visual category image.

> *"Children could learn what important features defined a category of objects by focusing on what was predictive and ignoring what was irrelevant."*

In a second eye-tracking study, we wanted to investigate children's attentional control when they learn a new category with conflicting information. In this study, children were presented a story with novel creatures and learned to match the creatures by the foods they like. Some creatures looked similar but liked different foods while some creatures looked dissimilar but liked the same kind of foods. In the study, the critical features, the food, were made less salient than distractors, the creatures. Eye tracking helped us to examine whether children will focus on the critical features to learn those new categories. However, the findings suggested that young children (3-year-old and 4-year-old children) could not inhibit attention to the distractors categories even under the situation where children were given the matching rule explicitly and repeatedly. The results indicate that when young children are learning new categories, they automatically pay attention to the salient perceptual features and lack of control to inhibit looking toward these features.

Relational Matching

In this study, we taught four-year-olds about two animations which were classified as either "daxing" or "not daxing". "Daxing" was defined as one object disappearing from a group of three objects; "not daxing" meant that the object moved, instead of disappearing. The animations involved either perceptually-rich or perceptually-sparse images. Children were then asked to identify new animations as either "daxing" or "not daxing" to test their newfound knowledge. We found that they were able to learn the original animations equally well with both types of images. However, when asked to identify new animations, children performed better after learning with perceptually-sparse images. Though potentially less interesting to look at, these perceptually-sparse images may have facilitated identification of new animations because they were less distracting and helped children focus on what was happening in the animations.

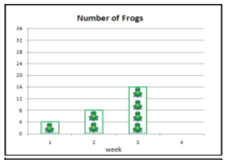
Child EEG Study

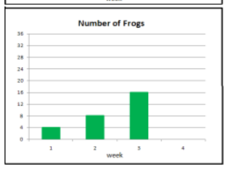
4-5 Year Olds In this study, children visited our lab to help us examine how children and adults process multisensory information by presenting children and adults with sounds, pictures, or sounds and pictures together. Participants had to press a button whenever the picture or sound changed. In addition to collecting response times, we also examined participants' brain waves (EEG) to monitor how quickly the brain detected these changes. Preliminary findings suggest that presenting information to multiple sensory modalities can both facilitate and interfere with processing. When both the sound and the picture changed, participants were faster at detecting these changes compared to when the sounds or pictures were presented in isolation. However, when only the sound or picture changed, processing of the visual (but not auditory) information slowed down. These findings suggest that sensory modalities may compete for attention with the auditory modality winning this competition.

Elementary School Research Findings

Reading Graphs

Graphs are an effective way of communicating quantitative information. Most students are introduced to simple graphs in elementary school. This spring, we have been exploring how extraneous information in a graphical display affects children's ability to interpret the relevant information.

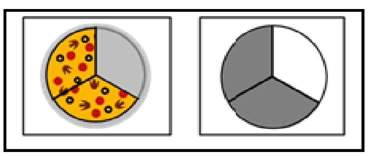




We presented Kindergarten and first graders with different graphs and asked them to read the graphs and try to recognize the pattern by which the data is changing. What we are finding is that children are very capable at reading graphs, but can be misled when irrelevant information is present.

Learning Fractions

The concept of fraction appears throughout elementary and middle school curriculum and can be difficult for children to acquire. In the past year, we have conducted several studies in which students in first, second, and third grade learned different aspects of fraction knowledge. Students learned through computer presentations. Fractions were represented as proportions of familiar everyday objects such as pizzas or they were represented as proportions of generic shapes such as sectors of a circle.



After learning, children were asked to apply fraction labels to proportions involving novel objects. They were also asked to make judgments of fraction magnitudes and solve simple story problems. The results of these studies show that children successfully learned to label different proportions with appropriate fractions. In addition, our findings suggest that when it comes to more difficult questions such as story problems or magnitude comparisons, there may be an advantage for learning with simple, generic material over learning with more familiar material.

Associations

Under the direction of Roger Ratcliff, a professor of Psychology at Ohio State, we visited second-grade classrooms to conduct research about the ways in which children learn associations between objects. Students were asked to study pairs of pictures and, later, determine whether a single picture had been studied at all, or whether a pair had been studied together. The latter task, which involves learning a relationship between two objects, is considerably more difficult than learning a single piece of information. This skill is incredibly useful (i.e., it is how we learn that "green" means "Go!" or that the letter "g" matches the sound /g/), and has been implicated in early reading acquisition processes. Although we have not yet finished our analysis of the data, we will compare data from children to data from college students, as well as from older adults, who demonstrate considerable difficulty with memory for associations. We want to put together a picture of how this valuable skill changes across the lifespan.

Episodic Memory

It is known that children are not good with episodic memory (memory of autobiographical events). They are likely to mix up times, places and the surroundings in their memory, and sometimes these inaccuracies could create a problem (e.g. children's court testimony). However, not much has been known about how episodic memory develops in detail. Our study uses child friendly cartoon characters and objects for the children (age 4 and 7) to remember. When recalling the events, their overall performance shows that children are not good at episodic memory when they need to use a complex structure in forming memory. For example, if on Monday mom takes me to the daycare and dad picks me up for home, and on Tuesday dad takes me to the daycare and mom picks me up, the components to remember (mom, dad, go daycare, go home) are the same for Monday's and Tuesday's event. However one has to bind these components accurately when asked "who picked you up on Monday?" This kind of situation requires a complex memory structure (i.e. 3-way binding structure) and the current research shows that children are not good at forming these complex structures. Moreover, using computational models and analyzing their error patterns, it is also shown that children are not sensitive in using context cues (times, places and the surroundings), and therefore focusing only on the main events (going home, going to the daycare).

Future research is planned to use brain imaging methods to link their behavior patterns with brain development.

Our exciting results have been presented at the Conference for the Society for Research in Child Development, the International Conference for Infant Studies, and the Conference of the Cognitive Science Society. The current findings will also be disseminated through a variety of peer-reviewed journals. If you are interested in obtaining specific information about the research studies, you can download the manuscripts from our website at http://cogdev.cog.ohio-state.edu.html, or contact the lab at (614) 688-5856.

Sincerely,

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And the Rest of the Research Team

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