Our goal in the Cognitive Development Center is to understand thinking and how it changes with development. We work with infants and children to explore the development of memory, language, problem-solving, and flexibility. Learning how these abilities develop helps us understand not only how infants and children think, but also how we come to think as adults.

Do you remember your child’s visit with us? Following the fish along the wall to our center? The games we played? With your help we’ve learned a lot about the development of memory and thinking. None of this would be possible without parents like you who offer your time to contribute to the advancement of developmental science. Thank you!

We’d like to share all we’ve learned with you! Below you can find out what the games your child played told us!

WHERE DID THAT TOY GO?
Leaders: Katye and Julia
Age: 9-10 months old
Dates: July 2008-Ongoing
Game: Searching for a hidden toy
Major Finding: Babies who find toys in multiple locations can find them regardless of posture.

For many babies, finding a recently hidden toy is difficult, especially when its location changes. Often, infants will search for the toy in the old hiding location rather than changing their behavior to reach to the new location. Why do babies behave this way?

We think infants have a hard time switching to look at the new hiding spot because they use different kinds of memory for the new hiding spot and the old hiding spot. Reaching to the same location many times might build up a habit, or a “latent memory.” Reaching to the new location requires an active memory, which is harder for infants to construct. So, infants might keep reaching to the old hiding spot because their latent memories are stronger than their active memories.

To test these ideas, we played a variety of games. In the first game, a toy was hidden at location A. Then, before the toy was hidden at location B, infants practiced reaching to a different location. However, different types of practice did not help the infants find the toy at the second location.

In another game, a toy was hidden several times at A and then several times at B. In order to see if posture had any effect on toy finding, a phase was added where infants were stood up to look for the toy. So far, infants who found the toy over locations A and B were more likely to find the toy when standing.
We spend much of our lives preparing for potential events. However, young children do not always prepare themselves for the future. They seem only to react. When and how do children shift from reacting to preparing?

In the Blue and Spongebob game, children learned about items that Blue and Spongebob like and dislike. Children were then shown a picture of Blue or Spongebob followed by a picture of an item. After seeing these pictures, the children were asked to push a happy face button for items that Blue and Spongebob like or a sad face for items that they dislike.

We found that 6-year-olds seemed to plan ahead and decide which face to press before the second picture appeared. On the other hand, 5-year-olds relied more on reacting to the second picture, deciding which face to press after the second picture appeared on the computer screen. However, 5-year-olds knew that they had to press one of the faces at some point. So they generally prepared for a happy face, which was correct most of the time, then switched to a sad face at the last minute, suggesting that 5-year-olds are in the process of learning to plan ahead.

Flexible thinking is a critical component of human intelligence. For example, we use a key to open a door, but we can also use it to cut a piece of string if scissors are not available. In our projects, we explored children’s cognitive flexibility through various card sorting games and memory games.

In the card sorting games, children are asked to sort cards by a rule (e.g. shape or color). This task seems easy to five and six-year-olds, who succeed when the rule is repeated before every picture they are asked to match. However, these types of games become challenging when no reminders are given, and children must remember the rules themselves. Then, when asked to switch sorting rules, about half of the children keep sorting by the first rule they are given, instead of switching to the new rule.

We think that to switch between rules, children might have to do three things: remember the new rule, separate information into categories, or engage in mental speech.

In a previous project children played a memory game where they saw simple pictures (square or circle) then had to remember them over a delay of up to 16s. Children who switched between rules could remember the pictures over longer delays, suggesting that they have stronger memories for rules and pictures.

In a recent project, children played a game where they named pictures as fast as they could on the computer. When pictures were similar (e.g. all animals), children had a hard time switching away from the pictures they named before, so they often slowed down, and even said the wrong name. Currently, we are looking at whether telling children category names that make the pictures seem more distinct will help them switch more easily between similar pictures.
In a current project, we’re looking at how children remember the rules. Adults engage in mental speech to remember important information, but most children don’t begin to do this until they are seven to ten years old. We thought children who switch between rules might have discovered mental speech earlier than the children who get stuck. To find out, we added a memory game where children have to count backwards from 20 while remembering the pictures they just saw, making it very difficult to use mental speech. Children who switch still seem to be remembering better.

All of these projects deal with children’s ability to behave flexibly across situations. The projects showed us that children who behave flexibly are more able to remember information over delays, separate information into categories, and use mental speech in memory tasks.

**NOW OR LATER?**

**Leader:** Meghan and Chris  
**Age:** 5 years old  
**Dates:** April 2008-February 2009  
**Game:** Various games in two sessions: a teddy game, an owl game, and a number-line game  
**Major Finding:** Impulsivity can be predicted by how children play time and number games.

Children are notoriously impulsive. When they are given a choice between now and later, they usually choose now. This kind of impulsivity may be explained by how children view time and numbers.

Three different games were used to examine the relationships between impulsivity and perception. In the first game, children had to pick falling teddy bears based on speed and number of balloons. The goal was to get the highest score. We found that children were more willing to wait for bears with a larger number of balloons when both bears came down fast or when the balloon numbers were higher (10 vs. 9 instead of 2 vs. 3).

In the second game, children were asked to identify Barney the owl based on his hoot when compared to other owl noises. Children were good at identifying Barney based on the length of his hoot.

In the third game, children were asked to construct a number line for numbers 1-10. We found that children either place the numbers in a linear form, like adults, or placed lower numbers further up on the line (2 closer to 5) and compressed higher numbers near the top. Even after playing a game designed to help children form linear number representations, children still showed this behavior.

Using these three games, we found that children who waited for balloons in the teddy bear game also guessed Barney’s hooting accurately and placed numbers in a linear form on the number line. This may mean impulsivity could be explained by children’s time and number perceptions.

**PAY ATTENTION!**

**Leaders:** Maria, Amy, Danielle, and Chelsea  
**Age:** 6 years old  
**Dates:** December 2009-March 2010  
**Game:** Various computer games over two visits  
**Major Finding:** Actively remembering things can help you focus either narrowly or broadly.

People are constantly bombarded with information. Sometimes we need to focus narrowly to obtain important information and other times a more broad attentional focus is helpful. How do we decide what strategy to use? Are young children different from adults in this respect?

To answer these questions, children played several types of computer games. In one of the games, children were exposed both to situations where the narrow focus is a better strategy (when they had to respond to the direction of a fish that was flanked by fish swimming in the opposite direction) and where the broad focus is a better strategy (where the flanking fish were swimming in the same direction). In another type of game, children had to remember things they saw on the screen (such as digits or colors of squares) over a short delay.

We found that the ability to hold more things in mind in the second type of game was related to the ability to flexibly switch between narrow and broad attention strategies in 6-year-olds and adults. In the future, we would like to play these games with younger children to see if the relationship is different earlier in development.
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Have friends who would like to participate? Recently moved or welcomed a new family member?
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For a sampling of our recent publications, awards/grants, and other information on the Cognitive Development Center visit: http://psych.colorado.edu/~cdc/