CDN Lab Newsletter

Fall 2005

Fall has arrived, school is back in session, and the first annual CDN Lab Newsletter is finally complete. First and foremost, we want thank everyone who participated in our studies over the past three years. A lot has been going on here at the CDN Lab. Many of the studies that you helped us with are wrapping up, and we are preparing to start some exciting, new projects. Inside this newsletter are some summaries of our current studies and results that we have observed thus far. Thanks again for all your help and we hope to see you again soon. Happy reading!!!

Sincerely,

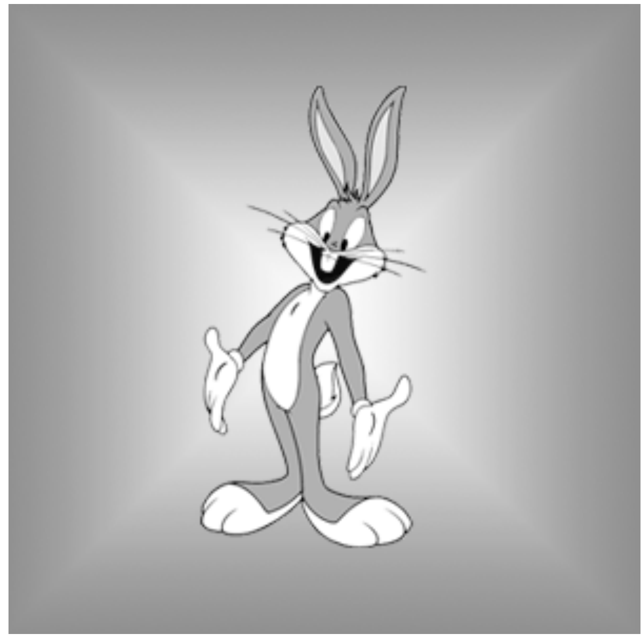
CDN Lab

The CDN Lab

What's Inside???

LEARNING HIDDEN PATTERNS

In a large project with three separate studies, we have been examining how learning changes with practice. We ask adults and children to catch cartoon characters that appear on the computer screen. The pictures sometimes follow a hidden pattern. We look at how quickly people can catch the characters to determine whether they learned the hidden pattern or not. We measure learning by seeing whether people are faster at catching the characters during the patterned parts than when there are no patterns.



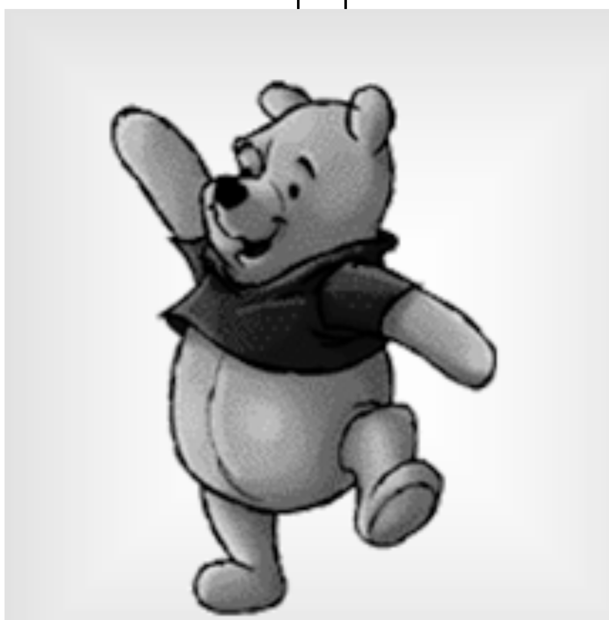
PART I: RESPONSE TYPES

In the first study, we have been exploring whether people learn more or less depending on the response that they are making. In the Response Types game, adults and 8-year-olds played 2 of 3 possible learning games. In one game, the Button Press game, players watched for cartoon characters appearing in 4 windows on the computer screen and pressed the button that matched the character’s location. Sometimes the characters moved in a pattern, going to the same windows over and over in the same order. We didn’t tell players about the pattern and most of them did not report seeing a pattern. However, they were faster to catch characters during the patterned parts than when there was no pattern. In the Touch Screen game, cartoon characters showed up in the same 4 windows and followed the same patterns, but players caught the characters by touching them on a touch screen computer. In the third game, the Eye-Tracking game, we measured how well players could learn the pattern with only their eyes. We used a special camera to follow where people were looking and how long it took them to “catch” the cartoon characters with their eyes.

We thought that, especially for children, the Button Press game might be the hardest because players have to decide which button matches each window on the screen. We expected the Eye-Tracking game to be the easiest and the Touch Screen game to be in the middle. The reaction times confirmed this pattern. People responded fastest during the Eye-Tracking, slowest during the Button Press, and in the middle for the Touch Screen. However, both adults and children actually learned more about the hidden sequences or patterns when they had to press buttons than when they used the touch screen. The best learning seemed to happen when people just looked at the pictures and followed them with their eyes.

PART II: FOUR BUTTONS OR ONE?

In the second study, we explored how learning of hidden patterns is affected by our level of attention. We wondered whether adults and children could learn a complicated hidden pattern if they were only paying attention to half of the information. In this study, adults and eight-year-olds played 2 of 3 different games. In one game, players watched for cartoon characters appearing in 4 windows on the computer screen and pressed the button that matched the character's location, just like the games in the Response Types study. In a second game, players used the same four buttons, but they only pressed if a certain cartoon character appeared (e.g., Scooby Doo, but not Shaggy or Daphne). In the third game, players used only one button and pressed the button every time a certain character (e.g., Scooby Doo) appeared, no matter which window it was in.



We found that both adults and children learned the hidden sequences, no matter which game they were playing. Adults learned more about the sequence than children did in all three games, showing that this kind of learning probably gets better as we get older. Kids made fewer mistakes when they only had to press one button to one target character. But, overall, children and adults actually learned the most when they had to press all of the buttons to all of the characters even though they may have been faster and made fewer mistakes during the other versions of the game. This might be because, even though it's harder to press all of the buttons correctly and quickly, players learned more when there was more information and they had to concentrate harder. One important finding was that eight-year-olds were just as fast and as accurate at the one-button game as adults were. This means that we will be able to use this one-button game in the future in our brain imaging studies comparing pattern learning in children and adults.

PART III: PLACES AND CHARACTERS

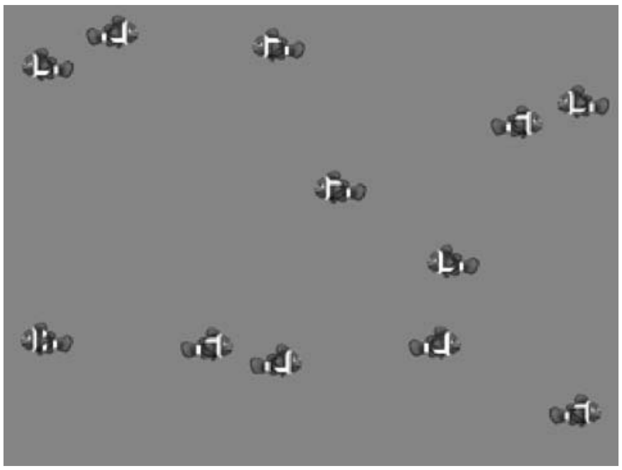
In the Places and Characters study, we compared learning of spatial sequences to learning of object sequences. In the Gopher game, we asked 8-year-olds and adults to pay attention to the *where* the Gopher appeared, and to press a button only when he appeared in the correct places. For example, players pressed the button when Gopher appeared in the top-left corner of the screen, but not when Gopher appeared in the bottom-left corner. In the second game, players had to pay attention to *which* character appeared on the screen (either in the center or in the four windows), and to press a button only when the correct characters appeared.

Just like the other pattern learning games, the pictures in both the Places and the Characters games sometimes followed a repeating pattern and other times were random. In the Places task, Gopher sometimes followed a sequence of locations (e.g., Window 1 - Window 3 - Window 4 - Window 2). In the Characters task, the Winnie-the-Pooh or Looney Tunes characters sometimes showed up in the same order again and again (e.g., Pooh-Tigger-Eeyore-Piglet). Most adults and children were not aware of these hidden patterns. However, even though people didn't know about the patterns, they were faster at the games during the patterns than during times when there was no pattern.

This faster speed shows that both adults and 8-year-olds were unconsciously learning the hidden patterns. Adults and 8-year-olds showed similar learning for patterns of places, but adults tended to learn more about sequences of characters than children did. In our preliminary studies with preschool children, even 4-year olds show unconscious learning in the Places task (the Gopher game). We plan to use functional MRI measures to see whether different brain systems support learning of spatial patterns vs. learning of object patterns.

ATTENTION AND LEARNING - FINDING NEMO

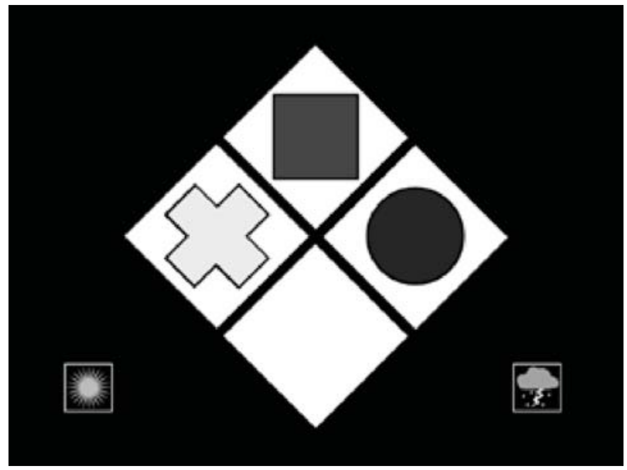
In the Finding Nemo experiment, players saw screens filled with orange and white clown fish and had to find Nemo, the one fish with three up-and-down stripes (some adults had to find the only “T” on a screen of “L” shapes).



When the players found Nemo, they pressed a button to tell us if he was swimming to the right or to the left. We didn't tell people, but some of the screens repeated throughout the experiment and others never repeated. Amazingly, no one ever noticed that some of the screens repeated! We wanted to figure out if people learn from the repeating screens, even though they don't know about them. We do this by looking at how fast they can find Nemo in screens that repeat and in screens that don't repeat. It turns out that with practice, people can find Nemo faster in screens that repeat than in screens that don’t repeat, but without ever knowing it! This is true for both adults and 9-year-old kids. Our next step will be to run this experiment using functional MRI to see if adults and kids are using their brains in the same way when they are searching for Nemo. We think they are probably not using them in exactly the same way because one part of the brain people use to find Nemo, the hippocampus, is not fully developed in kids.

LEARNING THE RULES - WEATHER PREDICTION

The Weather Prediction experiment is probably the least favorite game in our lab! In this experiment players see screens showing one, two or three shapes and have to guess whether the pattern of shapes predict sun or rain.

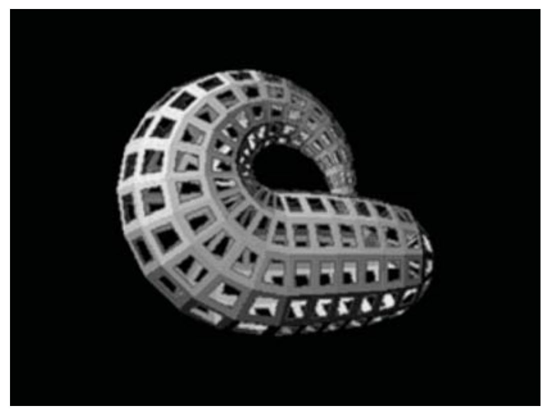


Some participants get very frustrated because everyone makes a lot of mistakes and sometimes it seems like the rules change. However, each combination of shapes really does predict sun or rain a certain percentage of the time. We want to know if adults and kids can learn something about how well each pattern of shapes predicts sun or rain. Even adults do not seem to learn the exact predictabilities for each pattern. Instead, they seem to group the patterns into three sets: High, Medium, and Low predictability groups. That means that a pattern that has a 70% chance of sun is lumped together with one that has a 90% chance of sun and adults act as though they both show an 80% chance of sun. The middle probabilities (40, 50, 60%) and low probabilities (10, 20, 30%) are also averaged together. This is interesting because it shows that adult’s responses do not simply match the predictabilities they are presented with. Instead, they seem to learn the information in categories or clusters. We are now collecting data from 9-year-old kids to see if they show the same kind of clustering behavior we see in adults.

ATTENTION AND INHIBITION -- THE POKEMON GAME

In this study, we were interested in how the brain manages thinking skills such as attention and inhibition across human development. We asked children and adults to play a game called a Go-NoGo task. In the Go-NoGo game, players were told to press a button each time they saw cartoon characters from the Pokemon series on a computer screen ("Go" characters). However, they were told NOT to press the button when they saw one special cartoon character, a cat called Meowth (the "No-Go" character). Most of the pictures (75%) were "Go" characters, so pressing the button was usually the right answer. This made it especially hard for people to inhibit their response or stop themselves from pressing the button for the "No-Go" character. Although we are still working on this study, we have found that adults are usually better at inhibiting their responses than children are. Our newest Pokemon study measures the electrical activity that the brain produces when adults and children are paying attention and inhibiting their button pressing. We think that the differences between adults and children on the Go-NoGo task may reflect the development of the frontal cortex of the brain. We'll keep you posted on our brain imaging results!

MEMORY FOR KNOWN AND UNKNOWN OBJECTS



In the Continuous Recognition Memory experiment, we showed kids and adults lots of pictures, one after another, and asked them to press buttons to tell us if each picture was new (one they were seeing for the first time) or old (one that was repeating). We are interested in the development of the brain areas that support memory. In this study, we used to different measures of brain activity. One, called EEG or ERP (event-related potentials), measures the size and timing if the electrical signal that the brain makes during the computer task. We measured this with a wet stretchy net that goes on your head. The second, called functional MRI, can show us exactly which areas in the brain are using the most energy. We measure this as people lie in an MRI tunnel and play the game. We think that a specific brain region called the hippocampus is important for memory and that this part of the brain continues to develop as kids get older.

In our memory game, adults were faster and made fewer mistakes than kids. But, we found that both adults and kids made more mistakes when there was a longer time before the picture repeated, and that they made more mistakes for pictures of unknown or abstract objects than for pictures of everyday objects. The ERP data show that adults' brains distinguish new and old objects very quickly (as fast as 1/3 of a second after the picture appears). Kids' brains, however, don't do distinguish these until much later (about 1 second after the picture appears). Our fMRI data show that both adults and kids activate the hippocampus more the first time they see a picture than when they see it the second time. This findings may mean that the hippocampus is most important when you are storing new information in memory than when you are getting information back out of memory. We also found that kids show more activity in the hippocampus for pictures of everyday objects than for hard-to-name, computer generated objects, suggesting that children may have a harder time encoding or storing the hard-to-name, computer generated objects. We don't know yet if this is because the hippocampus is less mature in kids or if it is because the connections between the hippocampus and other parts of the brain are less developed, or both. These are the kinds of questions we hope to look at in future experiments.

BRAIN RESPONSE TO HUMAN FACES

In the Brain Response to Faces study, we showed participants pictures of human faces showing different emotions. We measured brain activity to see whether there is a different pattern of response depending on the emotion on the face. A differential response might show that separate brain areas are used to understand fearful faces compared to happy faces, or that we recognize and process negative emotions faster than positive emotions, for example. We measured brain activity in our participants using one of two techniques. *Event-related-potentials* or *ERPs* measure the electrical activity of the brain using a wet, stretchy net with sponge-tipped electrodes (kind of like wearing a swim cap or hair net). *Functional magnetic resonance imaging* or *fMRI* measures energy use (oxygen) in different parts of the brain.

In addition to finding out how the brain responds to different emotions, we are also interested in whether the brain can recognize emotional faces even when we can't. Previous studies have suggested that a certain area of the brain called the amygdala may be so sensitive to potential threats in our environment that it might be activated even before we are consciously aware of the danger. To examine this in our computer task, we actually showed two different emotional faces at almost the same time. One face appeared for just 26 milliseconds - too fast for most people to know what they are seeing - and a second face was presented immediately after for a longer period of time, so that most participants only reported seeing the second face. We wanted to find out whether the amygdala was able to see the first face even though the participant was not aware of having seen it. We are particularly interested in how children learn to recognize different facial expressions, and how the brain develops its response to facial emotions.

We have finished running all of the adult participants in this experiment and are in the process of analyzing both the ERP and fMRI data. We are continuing this study with children and hope to have our results soon!

ATTENTION IN PRESCHOOLERS

In the spring, we began a study of attention and impulse control in preschoolers. We asked 4-year-olds to play two computer games. In the Nemo game, children have to discover which of two chests contains the hidden treasure and then to always choose the correct chest. This game requires children to pay careful attention because the treasure periodically shifts to the other chest which was previously the "wrong" answer. In the Toy Story game, we ask children to help collect Lego blocks of a particular color but to avoid picking up blocks of the wrong color. The correct blocks are much more frequent so it requires a lot of impulse control to avoid pressing for the rare incorrect block. This study is still in the early stages but we will keep you updated on the results in the coming year.

Our lab is currently recruiting 8 & 9 year old children for various research projects.

For continued updates or information on how to participate in our current studies please visit our lab on the web

http://education.umn.edu/ICD/CDNLab

or call the CDN Lab at

612-624-0075

To add or remove a child from the Institute of Child Development's list of potential participants, please call the Infant Participant Pool at 612-624-5219.

That's all for now.
The CDN Lab thanks you!!!