Wesleyan University Cognitive Development Laboratory

Spring 2009 Newsletter

www.wesleyan.edu/cdl | 860.685.4887 | cdl@wesleyan.edu

Hello from the Cognitive Development Lab at Wesleyan University!

Here's an update about our recent research findings about number, space, and social reasoning.

Thank you to all of the families, businesses, children, and schools that made this work possible!

What We Do:

How do children learn about the world around them - about language, numbers, objects, space, and people?

To find out, we design studies to gain insight into children's thinking and how it changes.

Our Two Labs:

the blue lab•••

The Blue Lab section of the Cognitive Development Lab is directed by Dr. Anna Shusterman.

We're located in the blue laboratory space on the 4th floor of Judd Hall.

the yellow lab•••

The Yellow Lab section of the Cognitive Development Lab is directed by Dr. Hilary Barth.

We're located in the yellow laboratory space on the 2nd floor of Judd Hall.

Congratulations to our graduates!

Sarah Edelman will be staying with us as Lab Coordinator.

Barry Finder will be in the lab as a student in Wesleyan's 5th year masters program.

Lisa Drennan will be playing professional volleyball in Europe.

Annie Paladino will be teaching in Atlanta.

Jess Sullivan will be a PhD student at UC San Diego.

Keera Bhandari will be a researcher at Hartford Hospital.

Emily Compton is working with Texas Wildlife Research and Rehabilitation.

And hats off to
Eyal Bar-David,
Katie Grogan, and
Julie Neuspiel!

Lab News:

Professors Anna Shusterman and Hilary Barth welcome Post-Doctoral Fellow Dr. Mariah Schug to the Cognitive Development Lab. Dr. Schug researches social development in children and is the lead researcher on the Puppet Sharing Study.

Professor Shusterman was awarded a 5-year grant from the National Science Foundation to study counting and number development.

Several CDL members attended the Society for Research in Child Development conference in Denver this April. They presented Sticker Estimation, Puppet Game, and Animated Naming.

Professor Shusterman presented work on the Caterpillar Game at the Boston University Conference on Language Development, and the study was published in Wesleyan's campus psychology journal Mind Matters.

Sarah Edelman '09 completed her Honors thesis on preschool children's preferences for niceness and attractiveness in friends. Keera Bhandari BA '08/MA '09 defended her Master's Thesis on children's use of testimony.

Research Questions:

How do children learn and reason about numbers and basic math?
How do children's intuitions about numbers connect with learned skills like counting or basic arithmetic? How do intuitions about numbers and quantities change over the course of development?

How much of children's understanding of the world is dependent on language?
How do delays in language development affect children's conceptual knowledge?

How do children navigate through space?
How do children use physical landmarks to find their way? How do they use the spatial layout?

How do children reason about people?
How do they decide whom they should trust or learn from? How do they choose who would be a good friend?

Research Topics

How Children Perceive and Think About Numbers and Quantities

Most of the research we do in the Yellow Lab focuses on the development of quantitative thinking and reasoning. We study the perceptual and cognitive development of quantity understanding in preschool children, elementary school aged children, and adults.

We're interested in finding out how intuitive ideas about numbers and quantities change throughout life, and how children begin to connect formal, school-based learning with their early-developing mathematical intuitions.

Learning more about how kids integrate their intuitive knowledge of mathematics with cultural tools, like school-based math training, may lead to improvements in childhood education and in adult numeracy.

Most of our current child studies focus on quantitative thinking in children who have already learned how to count, so we've been working with kids between the ages of 4 and 8 this year.

How Children Think About and Learn From Other People

A second line of research in the Blue and Yellow Labs focuses on children's social reasoning. In order to navigate the social world, children need to learn a great deal about dealing with social partners.

Who is likely to be "nice" and share with them? Who is likely to be "mean" and refuse to share? Who is more likely to tell them the right thing, and who is more likely to be wrong? When should they learn from other people, and when should they learn from their own observations of the world? Who is more desirable to have as a friend?

These important social skills develop throughout the early childhood years, and they may influence how young children acquire knowledge about objects and the world around them, and how they interact with their own social groups and with members of other social groups.

In this line of research, we want to know what kinds of information young children use to make judgments about individuals and groups of people. For these studies, we have been working with kids between the ages of 3 and 6.

How Children Perceive and Think About Space

In the Blue Lab, we investigate how children explore and remember their physical environment, how they acquire language to talk about abstract concepts like directions, and what spatial information they remember from visual stimuli like pictures. A big focus is how children learn about 'left' and 'right.' These words are difficult for children to learn before they are about five years old, and we want to understand why they are so difficult. We also look at the effects of learning these words on children's and adults' spatial reasoning and navigation. For example, one of our students is currently examining Ecuadorian Quechua, an indigenous language in which people are much more likely to talk about directions based on the sun (sunrise, sunset) than based on their bodies (left, right). We want to find out about the conceptual building blocks that flexibly prepare children to learn languages that are very different from each other, like English for children born in the US or Quechua for children born in Ecuador.

How Children Learn About Counting (3-5 year olds)

Many of the studies in the Blue Lab focus on children's learning about counting. Most children can count to ten sometime between their second and third birthdays. But it turns out that, for young children, counting to ten is sort of like reciting the ABC's –just a list of words that we say in order. It takes them about two years to figure out that "six" refers to a set with exactly six things in it.

Previous research has shown that children figure out number word meanings one at a time. First they learn one: If you ask them to give you one object, they will give just one. If you ask for two or more, they will give you some random amount more than one. Then children learn two: They can give one or two objects, but give some number more than two when asked for three, four, or any other number.

Then children learn three, then four, and then something mysterious happens: children seem to figure out how counting works, and they understand that the last word in the count tells you the quantity. They figure this out for all of the numbers they can count to (at least up to ten) in one fell swoop.

We call children who know one, two, three, or four "**subset knowers**" because they only "know" a subset of the numbers in their counting list, and we call the other children "**counting principle knowers**" or "**CP knowers**" because they have figured out how counting works.

Much of the work in our lab seeks to find out what CP knowers know that subset knowers do not.

Do it at home! Is your child a subset or CP knower?

1. Get a dish filled with at least 10 identical objects. Line the objects up and have your child count them. *Didn't count to 10?* Your child is probably a pre-counter and may not yet be a subset knower. *Counted to 10?* Your child may be a subset knower or CP knower.
Continue to the next step.

2. Place the items in a pile. Ask your child to place some number of items in the dish (see below). *Did not give the right number?* Take out the item and ask your child to count to make sure it's correct. *Still didn't give the right number?* Go back one trial. *Gave the right number (on either first or second try)?* Continue to the next trial.

3. **Trial 1:** 1 item **Trial 2:** 2 items **Trial 3:** 3 items
Trial 4: 4 items.
Trial 5: 5 items **Trial 6:** 7 items **Trial 7:** 6 items.

4. Every time your child gets the number right, continue to the next trial. Every time he or she gets it wrong, go back one trial. Continue until either your child has successfully completed Trial 7 or has given the correct number of items for a trial at least 2 out of 3 trials, and an incorrect number of items for the next trial 2 out of 3 times.

5. If your child completed Trial 7 correctly, he or she is a CP Knower. If not, your child is a subset knower. Subset knowers can be 1, 2, 3, 4, or 5 knowers. Test your child often to see how he/she changes!

This year's

blue lab studies

caterpillar game *number & counting*

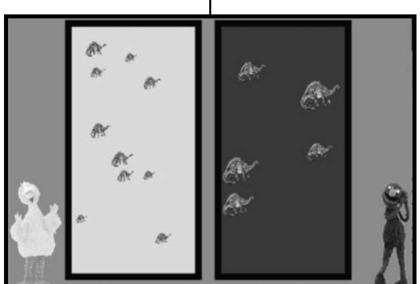
In the Caterpillar Game, children see a series of "caterpillars" (actually stuffed green athletic socks) with different numbers of "feet" sewn on. Their job is to get socks from a pile across the room, making sure to get "just enough" socks to cover the caterpillar's feet, by no more. We never ask the children to count or talk about how many feet there are – we are interested in their spontaneous ability to deal with quantity. We found a big difference between subset and CP knowers on this task. CP knowers were much more accurate, even when they didn't count, indicating that they see and think about quantities more precisely than do subset knowers. Interestingly, subset knowers were fairly accurate with 1, 2, 3, and 6-footed caterpillars, but much less accurate with the 7 and 9-footed caterpillars, showing that an understanding of counting is useful for thinking about bigger numbers, but not so important for thinking about smaller ones.

box game *number & counting*

The Box Game is similar to the Caterpillar Game because we ask children to think about numbers without counting. In this game, children see some balls (either 2, 3, or 6) placed on top of a box for a minute, then moved inside the box through a slit. Children then reached through the slit to retrieve the balls. Sometimes, the experimenter secretly removed one ball through a hidden slit in the back. We measured how long children searched for the last ball when they had retrieved the original set and when they had retrieved all but one. We found that both CP and subset knowers noticed when one ball was missing, and searched longer when the last ball was held back by the experimenter. This was true for trials with 2, 3, and 6 balls, showing that subset knowers can think precisely about some numbers, even if they don't have words for those numbers. Our next step is to try this with 7, 8, and 9 balls, to see whether subset knowers' performance will degrade as we move into the higher number range.

longitudinal study *number & counting*

In our longitudinal study, we are tracking children's verbal number knowledge and their non-verbal number acuity. Number acuity is a measure of the smallest distance between two sets that a person can distinguish. For example, without counting, you would probably be able to tell the difference between 6 and 8 dots, but not 66 and 68 dots. We test the children on a fun game where they get to choose which of two Sesame Street characters has more things. The results of this will tell us how precisely young children can tell the difference between two numbers. Current research suggests that young children's number acuity may be predictive of future math success, and we want to know why this could be. We are tracking a set of about 50 preschoolers every month to see whether changes in verbal number knowledge are accompanied by changes in non-verbal number acuity.



number line game for younger children *number & counting*

Our Number Line study tests whether children have intuitions about number lines the way that adults do. The difference between our preschoolers and adults, of course, is that the preschoolers have not had many years of math classes where they were shown how to think about number lines. So our main question is whether children can spontaneously lay out quantities in a linear order. Children were presented with our "number line" – actually a wooden dowel with a bead on it – and shown that zero went on one end and ten went on the other. Then they were given different stimuli – either pictures (say, four dots) or number words and symbols (say, a card with the number "4" printed on it) – and asked to move the bead to the right place. We found that both subset and CP knowers could do this, but CP-knowers' positioning of the bead was much more precise. This was the case both for stimuli that didn't require an understanding of number words (pictures) and for stimuli that did require a knowledge of number words, showing that changes in verbal and non-verbal thinking about numbers happen in parallel. We are conducting several follow-up studies to better understand the nature of these transitions. Specifically, we want to understand if children's number reasoning changes before or after developments in number language.

objects and sets game *number & counting*

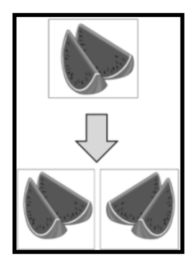
In the Objects and Sets Game, we tested the idea that subset knowers think, mistakenly, that number words refer to particular objects (e.g., this truck is the five), while CP knowers understand that number words refer to sets (e.g., there are five trucks here). We tested this idea in a bunch of different ways. For example, we laid out five objects on a spinning plate and asked children to count them. Then we turned the plate a half-turn and asked the children to count again. We reasoned that if children thought that number words are like labels that stick to objects, they would now count in the reverse direction, starting with the same object as "one" that they had before. We used a series of other simple questions too. To our surprise, subset knowers performed just like CP knowers. Everybody seemed to understand that number words refer to sets, not to discrete objects. This study shows more sophistication in subset knowers' understanding than previous research has reported, and shows us that children figure out a lot about number word meanings before they fully understand how counting works.

navigation and landmarks task *understanding space*

We are also investigating how children think about landmarks when they are navigating. In our Navigation and Landmarks task, children watch an experimenter hide a sticker in one corner of a simple room – a large square room with three white walls and one bright red wall. Children then put on a blindfold and turn around so that they lose their sense of orientation. Then they take off the blindfold and get to look for the sticker. If they could use the red wall as a landmark, they would be able to find the sticker every time – just as an adult would. But they don't! Children completely ignore the red wall and only find the sticker one out of four times – just what you would expect if they randomly search at the four corners. We are trying to understand why children have such a hard time using landmarks to navigate to a goal location, and what developmental changes are involved in learning how to use landmarks.

visual left-right game *understanding space*

Have you ever noticed your child drawing letters or words backwards, or looking at his shoes with utter confusion about which one goes on the left foot? Children seem to have trouble with left-right relations in some situations until they are well past 4 years old. In our Visual Left-Right Game we tested children to see whether they have difficulty perceiving, paying attention to, and remembering the left-right orientation of visual information. Children looked at amusing pictures (for example, an elephant facing left) and had to choose the matching picture from its mirror-reversed image (the same elephant facing right). In another task they had to remember a few pictures, and then, in a test phase, tell us whether they had seen those pictures before. Three-year-olds were completely confused about left and right: they were as likely to choose the mirror-reversed pictures as the original picture, suggesting that they do not pay attention to left-right orientation. Five-year-olds could choose the matching picture when they could see the original, but quickly forgot the orientation on the memory task: they correctly told us when they saw the original picture, but they also identified the mirror-inversed pictures as "old" – as though they had completely forgotten the orientation of the original pictures. In other studies we have found that children start succeeding on these visual tasks by age 7 or 8, and we are trying to understand what changes in children's visual system or conceptual understanding support this development.



social preferences *social reasoning*

In Social Preferences, we wanted to know what kinds of qualities preschoolers look for in a friend. Past research on adults has shown a strong preference for attractiveness in friends, and that attractiveness is often associated with being "good." However, adults also choose their friends based on positive personal attributes.

We wanted to know whether kids would prefer to be friends with an attractive child or a nice child. We showed preschoolers pictures of child models who were rated as either relatively attractive or relatively unattractive. These pictures were paired with stories of a nice or mean thing that that child had done. We found that, all else being equal, children will choose a nice friend over a mean friend, and an attractive friend over and unattractive friend.

However, when we pitted niceness and attractiveness against each other, we found some surprising results! Younger (3 year old) and older (4 year old) boys, as well as younger girls, preferred an attractive but mean friend. Older girls preferred a nice but unattractive friend. We will be continuing this research in the future to figure out whether these trends continue into the elementary school years, and how these findings might relate to adult research on preferences for attractive people.

puppet sharing study *social reasoning*

The Puppet Sharing study is a joint project between the blue and yellow labs, led by Dr. Mariah Schug. Children were given a social group to belong to, and were introduced to puppets who either belonged to the same group (in-group) or to a different group (out-group). First, we measured how much each child liked the puppets who were in their in-group versus the puppets who were in the out-group. Then, we had the children decide whether a puppet from their in-group or from the out-group would want to share with them. We asked these questions to find out to what extent group membership influences a child's ideas about the members of each group. Later, the children were shown a video of puppets sharing candies. In some videos, the puppets in the child's in-group were generous sharers and the puppets in the out-group were stingy sharers. In other videos, the puppets in in-child's group were stingy and the members of the out-group were generous.

We then asked the children to rate how much they liked the members of each group, and how willing they thought the group members would be to share with them. We wanted to know how children would incorporate information about group membership with information about how members of each group actually behave. Would they be more forgiving of stingy sharing for members of their own group? Could the generous behavior of the puppets who were in the child's out-group change the child's initial opinions of this group?

We found that children were very sensitive to the puppets' stingy sharing practices, especially for members of the out-group, but that they were forgiving of stingy sharing for members of their own group. These findings suggest that children are able to synthesize information about group membership with observations of group members' actions, but that children do this differently for individuals who are in the child's in-group versus their out-group. We are continuing this research to better understand which factors children are most likely to pay attention to when making judgments about individual members of a social group.

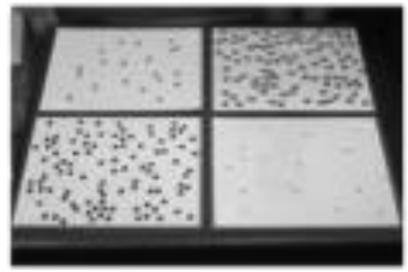
sticker estimation game *numbers and quantities*

The Sticker Estimation Game followed up on a series of earlier studies we conducted to investigate children's numerical estimation skills. During the study, we played a game in which each child was asked to guess how many stickers were on a card.

We were interested in children's intuitions about how number words should match up with sets, even when the children were unable to count the number of items in the set. We played this game with very young children who could not yet count to large numbers, and with older children who had learned to count very well.

During the game, no one was allowed to count – children just had to guess after taking a quick look at the card. In this series of studies, we have been exploring how children's verbal counting skills relate to their understanding of the logical structure of the number words and the counting system.

For example, an educated adult knows that number words appearing later in the counting sequence should always map onto larger quantities. Do young children also understand this? Do they know it as soon as they learn how to count, or do they need to reach a particular skill level before they understand this?



Previous research suggested that children don't start to understand that bigger number words should map onto bigger sets until they have learned how to count up to 100 reliably.

But in all of our studies so far, we have found something different: even children who could not yet count higher than 30 knew that bigger number words should go with larger sets (even for very large sets of 60, 80, or 100 stickers). This suggests that children do understand how number words relate to quantities, even before they have learned how to count skillfully.

This research project was recently accepted for publication in the journal Cognitive Development, and you can read a copy of the article on our website at www.wesleyan.edu/cdl!

number line game for older children *numbers and quantities*

In the Number Line Game (for children aged 5-8), children were presented with a horizontal number line on a piece of paper, marked with numbers only at the two ends (for example, "0" and "100"). Children were shown a number (for example, "33") and were asked to draw a mark on the line where that number should go.

We did this for many different numbers for each child. Typically, when children are asked to estimate the position of a given number on a number line, younger children are less accurate, and they produce estimates that are distorted in a systematic way.

Older children are more accurate, and they produce less distorted estimates. Some researchers have argued that this pattern of results means that there is a large developmental change in the nature of children's mental representations of number: in other words, that younger children really do think about numbers in a less accurate, more distorted way, and that as children grow older and gain experience with numbers, the way they think about numbers changes fundamentally, becoming more conventional and more accurate.

Our results suggest that a better explanation of children's estimation patterns may come from younger children's difficulty in making proportional judgments (for example, judging the size of the number "33" relative to the size of the number "100").

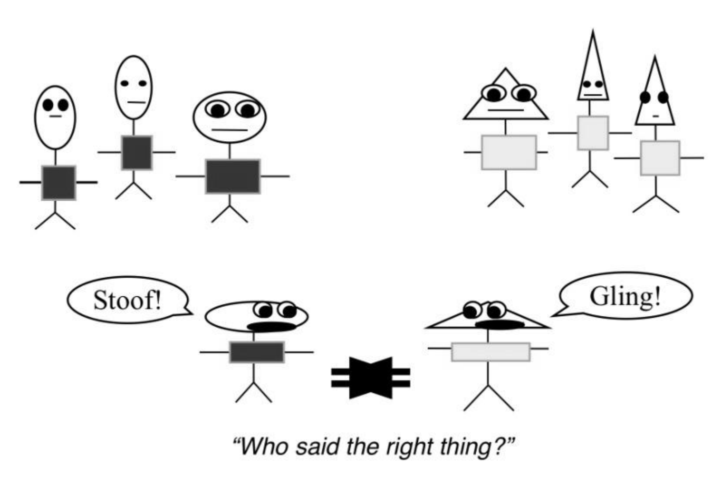
The developmental changes we see in number line estimation may come from changes in children's proportional judgment skill, not from a drastic change in the way they think about numbers. Number line estimation performance is highly correlated with school-based arithmetic skills, so this project has important implications for mathematics education.

puppet game *social reasoning*

In the Puppet Game, we investigated a new question about a cognitive bias called the "curse of knowledge." The "curse of knowledge" is the idea that children (and adults!) have difficulty understanding that other people don't always have the same information they do. Previous research has shown that preschool children exhibit the "curse of knowledge" when they have been shown what kind of toy is in a small box: after they see what is in the box, they are biased to think that a puppet (who has not seen inside the box) also knows what kind of toy is in the box. We asked whether the testimony of another person could also produce this "curse of knowledge" effect in preschoolers. Does the child have to perceive what is in the box directly (by looking at it), or does s/he overattribute knowledge to the puppet even after simply being told what is in the box? Some previous evidence shows that information children hear from other people is not weighted as strongly as information they gain by direct experience. However, we found that testimony alone – being told what was in the box – was sufficient to produce the curse of knowledge: children who had been told what the box contained thought that the puppet would also know what was in the box. Our results suggest that, at least in this case, knowledge obtained through the testimony of others is subject to some of the same cognitive biases that are present when children learn by direct observation. This work, in combination with the follow-up studies we are currently conducting, can tell us more about how children learn from others.

animated naming game *social reasoning*

In the Animated Naming Game, children saw simple videos containing animated cartoon characters and pictures of common objects. One character gave reliable information about the common objects (for example, by saying "apple" when a picture of an apple appeared) and the other character provided unreliable information (for example, by labeling the apple as a "shoe"). Previous research shows that even 3-year-olds pay attention to speakers' histories of accuracy and inaccuracy in situations like these. They choose to learn new information from the speaker who was previously correct, and reject new information from the speaker who was previously incorrect. In our study, we wanted to find out if children's trust in the previously accurate speaker was very specific to that character, or if children extended that trust to other members of the character's social group. After demonstrating to preschool children that one character was reliable and the other was unreliable by showing the animation described above, we introduced two new characters: one of them looked more like the reliable speaker and the other looked more like the unreliable speaker. Then a picture of a novel object (an unfamiliar shape) appeared, and each new character labeled it with a novel, made-up name. Even though these two new characters had no history of either accuracy or inaccuracy, preschoolers thought the new character who resembled the previously reliable speaker was more likely to be correct. These results suggest that children's trust in what other people say is not person-specific: it can spread to other members of the same social group.



"Who said the right thing?"

thank you!

Here at the Cognitive Development Lab at Wesleyan University, we study how children think and learn about the world around them.

Our studies depend on you: the local families, schools, and daycare centers that help us with our research projects. In this newsletter, you can read about some of our recent research findings.

Thank you for your generous support!

We also acknowledge the enormous research contributions of all of the undergraduate members of the Cognitive Development Lab.

contact us!

We are always looking for families to come play in our labs, and for schools and daycares who are interested in our research. Our studies are brief, fun for kids, and informative for parents and educators.

Please contact us if your family is interested in participating in studies. You can share your contact information by phone or on our website. We'll call to let you know when we have a study for your child's age group.

www.wesleyan.edu/cdl | 860.685.4887 | cdl@wesleyan.edu

Cognitive Development Lab
Wesleyan University
Psychology Department
Judd Hall
Middletown, CT 06459