We’d like to start by expressing our gratitude to everyone who has helped us with our research! Whether you have brought your child(ren) in to participate in a study – or many studies – or have helped spread the word about our work, we couldn’t have done it without you! You are the reason we are able to continue learning and discovering what children know, and the reason our work has been featured in outlets like the New York Times, Time Magazine, and Good Morning America. Thank you!

Now that you have taken the time to make our research possible, we would like to take the time to update you on the progress of our studies.

Tuning Babies’ Intuitive Number Sense
Even at a few months old, babies already have an intuitive sense of number; that’s why when seeing two bowls with different amounts of Cheerios, babies can estimate which has more! In recent work we have been asking whether babies’ quantity estimates can be improved through experience. Can we help babies to tell the difference between hard-to-discriminate quantities? In the Baby Numerical Approximation Study, we measure 6-month-old babies’ looking time at displays of different numbers of dots.

For some babies, the quantities start out very easy to tell apart (like 30 dots versus 10 dots), and gradually get trickier to tell apart (like 30 dots versus 25 dots). For others, the quantities start out hard to tell apart and gradually get easier. We have been finding that babies who started out with the easier numerical discriminations end up able to tell two quantities apart, even when the quantities are pretty hard to distinguish! This tells us that experience “scaffolds” numerical abilities, even very early in life!

Babies’ Statistical Knowledge
Our past research has shown that babies recognize numerical quantities... but how sophisticated is this ability? As adults, we can go beyond keeping just one number in mind (for example, recognizing “eightness” when we see a room with 8 people in it) -- we can also keep track of dynamically changing numbers. For example, at the grocery store we can tell that there are 8 people in line, but also track the average number of items in their shopping carts. Can babies also track multiple dynamic quantities? In the Baby Statistics Study, we ask whether 6-month-olds can average across different numbers. So far, we are finding that after seeing images of different numbers of dots, babies can extract their approximate average. For example, babies recognize that the average of 10, 16, and 30 is closer to 18 than to 25! This suggests that babies are naive statisticians like us – they can spontaneously average across different numbers.

Babies’ Understanding of Mental Magnitudes
Humans are highly social, and excel at coordinating with others. For this, we need to be able to consider what other people believe about the world, and understand that these beliefs will guide what they will do. Previous research has shown that young infants track much about others’ mental states; for instance, they understand that these beliefs will guide what they will do. Previous research has shown that young infants track much about others’ mental states; for instance, they understand that these beliefs will guide what they will do. Previous research has shown that young infants track much about others’ mental states; for instance, they understand that these beliefs will guide what they will do. Previous research has shown that young infants track much about others’ mental states; for instance, they understand that these beliefs will guide what they will do.

In the Mental Magnitudes Study, we are asking whether 12-month-old babies understand that others can be mistaken about numerical quantities. We show babies videos of a person who always chooses the larger of two quantities. Then we show babies a situation in which the person sees the larger quantity hidden in Bucket A... but get secretly moved to Bucket B while the person is not looking. We want to know whether babies predict the person’s choice will be based on her belief about where the larger quantity is. This study is still ongoing, so stay tuned!
Research shows that babies look longer at events that are surprising than events that are expected. Previous research from our lab shows that they not only look longer at surprising events, but they also learn new information better following surprising events, and test the properties of objects involved in surprising events (like banging a ball against a surface after having seen it go through a solid wall)! In our Expectation Exploration Studies, we want to know more about how babies explore objects that are involved in different kinds of surprising events—for example, events in which an object “magically” changes its identity, like a shoe turning into a duck. One group of 12-14-month-old babies saw something expected (a toy shoe going into and being emptied out of a bucket), and one group saw something surprising (like a toy shoe going into the bucket, but then emerging as a duck). We then gave babies an opportunity to play with the shoe and the bucket. We found that unlike babies who saw the shoe go into and come out of the bucket, babies who saw the surprising identity change explored the bucket more, and repeatedly put the shoe into the bucket and overturned it, as if to recreate the surprising event! Later on, these surprised babies continued to show interest in buckets, both old and new, even when surrounded by new toys in a new room! These findings show us how unexpected events can be opportunities for learning!

Using Counting to Improve Memory

Like adults, babies have a limited capacity to remember things. They can usually remember 1, 2, or 3 hidden objects, but they often fail to remember 4 or more. Although adults have this same limited capacity, we can increase the number of hidden objects we can remember if we count the objects prior to their hiding. How does learning how to count first affect memory? Many children start to hear and learn about number words even before they are 2. Does this very early stage of counting already affect children’s thinking about and memory for objects? In the Countbox study, we ask whether watching someone count can expand babies’ memory. We play a hide-and-seek game with 18-month-olds, where we show them some toys and hide the toys in the box. Critically, sometimes we count the toys before hiding them; other times we point to the toys but do not count them. So far, we are finding that babies indeed remember more toys after seeing the counting sequence. This study suggests that early on, children form a mental link between counting and number, and that this association helps their memory!

Primming Children’s Intuitive Number Sense to Improve Math Performance

Before entering school, children can use their intuitive sense of number to estimate quantities. For example, when seeing a picture of 5 animals and a picture of 20 animals, a child can tell that the picture with 20 animals has more. How does this intuitive, non-symbolic sense of number relate to children’s learning and performance of school mathematics? In the TransforMath, Estimation and Learning Choice Studies, we engage children with computer games that tap into this intuitive number sense. In our game, children see groups of dots appear on a screen, and have to guess which group has more dots without counting. Critically, some children play the computer game in a scaffolded order -- they start with easy questions first and gradually move on to harder ones. This is intended to help prime their intuitive number sense. After playing this computer game, we ask children to complete a math test. So far, we are finding that children who played the scaffolded version of the game tended to do better on the math test. These results suggest that priming children’s intuitive number sense may help them perform school math. We’re continuing to investigate whether letting children choose the difficulty of the computer game for themselves also impacts their math performance.

Children’s Intuitive Beliefs about Abilities

Research in psychology and education has shown that different abilities are acquired in different ways. Some abilities -- like the ability to estimate quantities -- stem from intuitions that people make automatically and have had available to them since infancy; other abilities involve formal education and take many years to learn. In the Mathitude
study, we want to understand children’s intuitions about the origin of different abilities. We introduce children to our puppet friend, Alex, who shows them pictures of people and animals demonstrating several kinds of abilities. Then, we ask children where they think these abilities come from. From this research, we hope to find out whether children have the same kind of intuitions about different abilities as adults do.

Impact of Ability-Origin Statements on Children’s Math Performance

Many people think of math as an ability you’re born with, something inherently fixed and unchanging. For example, we often hear people say things like, “I’m just not a math person.” It seems that people talk about math in a way that emphasizes being born good or bad at it, rather than it being something you can practice and improve at. In the Essentialism in Math Performance Study, we want to know whether the way we talk about the origin of math abilities influences children’s actual math performance. In particular, we are asking whether telling children that it is important to work hard and practice math a lot will influence their effort and performance in a subsequent math test. We are finding that children who hear about the importance of practicing math score higher in our math test than children who hear about the importance of just being born good at math—this effect is strongest in children who report having some anxiety about math and math-related situations. This has inspired us to ask whether this effect is specific to math in particular, or whether telling children about the importance of practicing anything (for instance, spelling) influences how well they do in a math test. We’ll be continuing to invite participants in to help us determine how the messages kids hear from adults influence their beliefs and abilities!

Linking Math Attitudes with Performance

How would you feel if you had to do a hard math problem in front of your peers? An estimated 25% of college students and 80% of community college students would report feelings of apprehension or fear at the prospect of doing math, especially when others are watching. But how do these adults come to have math anxiety and poor performance in math? Last year we asked families with children in K — 8th grade to visit the lab to help us find out how math anxiety unfolds over time, and to what extent children’s feelings about math correlate with actual math performance. Preliminary results from our Math Attitudes and Performance Study suggest that many children experience math anxiety as early as kindergarten, but that math anxiety has a stronger negative influence on math performance in middle school than in early elementary school. Since last year a majority of families who participated in this study returned to the lab for a 2nd visit, which will help us be able to ask critically important questions about the causal relationship between math anxiety and math performance!

Come visit us again soon!

If you have any questions, please feel free to contact us. Thank you for being part of our research family!!