We hope everyone has had a wonderful Summer! With the new school year already underway, we wanted to send the teachers, administrators, and staff we work with, a big THANK YOU for all you do! We are extremely grateful to you, and to the students and parents who participate in our studies — without you, we could not answer these fascinating research questions. The Temple Cognition & Learning Lab hopes you find the information in this newsletter both interesting and useful!

This past year has been a busy and exciting one! We have been conducting research studies on how children develop mathematical skills, including research on number line estimation, linear measurement, and more. In this inaugural issue of our newsletter, we've included information on who we are, some of the research we've done these past few years, and events we've participated in this past Summer.

If you have any questions, want to get involved, or just want to reach out, please see our contact information at the end of this newsletter. We wish you the best this school year and hope to see you soon!

Liz Gunderson, Ph.D.

Assistant Professor of Psychology,
Temple University
Teacher Work Circle

This summer our Lab teamed up with Philadelphia teachers for our first Teacher Work Circle on August 17. The day-long workshop focused on spatial skills, namely what they are, why they are important, and how to improve spatial ability. Over coffee, pastries, and (later on) lunch, participants reviewed current spatial research, some results from the Lab, and ways that these findings may inform future studies and classroom activities. Discussion centered on the challenges students face when using spatial and math skills, including difficulties differentiating spatial vocabulary terms (flip, turn, rotate, etc.), understanding negative numbers, and learning that shapes are not defined by their rotation (i.e., that a turned triangle is still a triangle). Teachers also described past activities they’ve found helpful for fostering spatial ability, including number line games, a ruler making activity, and free-play with wooden building blocks.

The afternoon concluded with developing, and then presenting, spatial lesson plans based on teachers’ experiences, the presented research, and their lesson goals. These included a function machine activity for Kindergarteners and two fraction number line activities: an introductory version for 3rd & 4th graders, and a more intermediate fraction activity for students in 6th grade.

Please join us for our next Work Circle in 2019! We hope it’ll be a great opportunity for teachers, administrators, and researchers to meet, collaborate, and discuss education. If you have any questions, suggestions, or would like to be notified when next year’s event is planned, please contact Vicki Bartek, at Victoria.Bartek@temple.edu.
Dr. Elizabeth Gunderson
Elizabeth Gunderson, Ph.D., is an Assistant Professor in the Department of Psychology at Temple University. She received her Ph.D. in Developmental Psychology from the University of Chicago in 2012 and her B.A. in Computer Science & Psychology from Yale University in 2005. Dr. Gunderson’s research focuses on the cognitive and socio-emotional factors that affect young children’s academic achievement, especially in the domain of mathematics.

Cathy (Kexin) Ren
Cathy is a doctoral student in Psychology at Temple University, concentrating in Developmental Psychology. She received her B.S. in psychology at Sun Yat-sen University in China. She is interested in children’s numerical learning, especially difficulties they have in learning rational numbers. By doing research in this field, she hopes to find a way to help both children and teachers to better learn and teach mathematics.
Meet the Lab

Vicki Bartek
Vicki received her B.A. in Psychology in 2015 from The College of New Jersey and her M.S. in Experimental Psychology in 2017, from Seton Hall University. In her previous work she studied errors in memory recall with Dr. Marianne Lloyd, and the event related potentials correlated with recall and familiarity with Dr. Andrew Leynes. She hopes to examine the role of early spatial skills and parent and child interactions on mathematical performance.

Jorge Carvalho Pereira
Jorge received his B.A. in Psychology in 2015 from the University of Delaware and he then attended the M.A. in Psychology program at Rutgers University – Camden. His research focuses on the coalescence of nature and influence of early experiences in the long-term development of children and their abilities. In particular, Jorge’s current focus is centered on further understanding the contributions of early parent-child interactions for children’s later development along cognitive domains such as mathematical reasoning.

Yiqiao Wang
Yiqiao received her B.S. in Developmental Psychology from the University of California, San Diego, in 2018. In her previous work, she studied the early development of children’s numerical understanding and its relation to natural language with Dr. David Barner. Her current research interests include young children’s numerical learning and factors that contribute to individual differences in the math skills of young children.
This Summer we said goodbye to two of our long-time Lab Managers, Lindsey Hildebrand and Ying Lin. Both Lindsey and Ying are attending graduate school in order to obtain their Ph.D.’s in Psychology. We wish them all the best and certainly miss them in the Lab!

From left to right: Lindsey Hildebrand, RJ Nair, Lillian Ham, Marly Pred, and Ying Lin
Why do some elementary school students master the correct way to use ruler in measuring things more quickly? In one study, we measured 1st- to 3rd-graders’ performance on linear measurement using the shifted ruler task. Students were presented with an image of a ruler with a crayon misaligned with the start of the ruler and were asked to judge how many units long the crayon was by choosing one of four choices (see figure below). The four choices were the correct answer (counting spatial units), a hash-mark answer (counting the number of hash marks that flank the object), a read-off answer (the number that corresponds to the end of the crayon), and a foil (a random number). We categorized their strategies based on choices they made, with the read-off strategy being the least sophisticated, the hash-mark counting strategy being more advanced, and the correct strategy (counting spatial units) being the most mature and advanced. We also measured students’ inhibitory control – the ability to suppress their natural, habitual and dominant responses. One year later, students repeated the shifted ruler task. We found that students who started out with higher inhibitory control were more likely to shift to using a more mature strategy when measuring the crayon. This correlational study sets the stage for future research to experimentally test whether improving students’ inhibitory control could lead to improvements in their linear measurement strategies.
Teaching Fraction Magnitudes Using Number Lines

Liz Gunderson

Is the number line an effective teaching tool for introducing fractions to 2nd and 3rd graders? How does the number line compare to teaching children about fractions by dividing shapes, like circles and squares, into pieces?

In our study, we divided 2nd– and 3rd-graders into 3 groups. All three groups completed the same pretest and posttest, where they estimated the location of fractions on a number line, shaded circles to show fractions, and compared fractions to say which was larger (for example, which is larger, $1/3$ or $3/4$?). Between the pretest and posttest, each group received a different type of one-on-one lesson with a researcher:

- **In the Number Line Training group**, the researcher taught each child how to show fractions on a number line that was labelled from zero to one. The researcher showed the child how to **segment** the number line into equal parts using the denominator, then **shade** the number line starting from zero using the numerator, and finally **place** the fraction by labeling the point on the number line where the fraction should be located.

- **In the Circle Training group**, the researcher taught each child how to show fractions on a circle using the same steps.

- In the third group, the researcher and child completed crossword puzzles together — this group provided a baseline for how children would do at pretest and posttest without any special fraction instruction.

We first verified that children learned what we taught them, and they did. Children who learned about fractions using the number line did better at estimating fractions on number lines, and children who were taught about fractions using the circle did better at showing fractions on circles.

Our most important question was whether children would be able to use their new understanding of fractions to do something that we had not taught any of the groups—to say which of two fractions was larger. The results were striking: Children taught using the number line did better at comparing fractions than the other groups, even though we had never taught them to compare fractions! This is exciting because it shows that using the number line helped them to understand fraction magnitudes in a way that they could use in new situations.

We think that the number line is an especially useful tool for teaching fraction magnitudes because it has the beautiful property of organizing all real numbers along a single dimension, allowing children to incorporate fractions into their understanding of whole numbers along the number line.
Contact Information

If you would like more information about our research, or are interested in participating, please contact us via e-mail or phone.

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Check us out on the web!
https://sites.temple.edu/cognitionlearning/

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