Temple University

Cognition & Learning Lab

2024 Newsletter

We hope everyone has had a wonderful summer and fall! We were very happy to be back in schools last year conducting research studies with children in person. We also have some big news to share: After 10 years at Temple University, the Cognition and Learning Lab is moving to Indiana University in Bloomington, Indiana. During the 2023-24 academic year, we have lab members in both locations, and we will complete the transition to IU in summer of 2024. Although we are excited for new opportunities, we will miss the school partners, parents, and children in the Philadelphia area who have contributed so much to our research over the years.

In this issue of our newsletter, we've included highlights from our recent research, conducted in schools in the past year. The Research Profiles include exciting results from two studies aimed at understanding and improving children's spatial skills. In one study with 4- and 5-year-olds, we found that reading picture books that we designed helped children improve their mental rotation skills. In another study with 2nd and 3rd graders, we found that watching a short video demonstrating rotations led to improvements in children's mental rotation skills and addition performance. Since mental rotation is strongly linked to success in science, technology, engineering, and math (STEM), these findings may help researchers and educators set children onto pathways to success in STEM.

In closing, thank you to everyone who has given their time so generously to these studies. Your participation is essential to answering these exciting research questions. We hope you find the information in this newsletter both interesting and useful. Our contact information is at the end of this newsletter if you have any questions. We wish you the best this year!

Liz Gunderson, Ph.D.

Professor
Department of Psychological and Brain Sciences
Indiana University

Research Profiles

Mental rotation training improves calculation skills for 2nd & 3rd graders (Part 1)

Xinhe Zhang, Graduate Student

Spatial activities like building blocks and playing with Legos are often believed to be beneficial for children's spatial skills. More interestingly, some recent studies have suggested that training children's spatial skills improves their mathematical performance. In this study, our lab delved into how mental rotation training improves children's conventional calculation (7+5=_), missing-term calculation (7+_=12), and two-step calculation (3+4+5=_) skills.

Mental rotation skill refers to the ability to mentally visualize and rotate objects in the mind. We proposed that improving mental rotation skills would help children represent numbers visually and mentally manipulate information (see Figure 1 for example). We expected this to allow them to use advanced strategies to calculate, for example, mentally transforming 7+_=12 into 12-7=_, and mentally storing the answer of the first step of 3+4+5=_ before solving the second step.

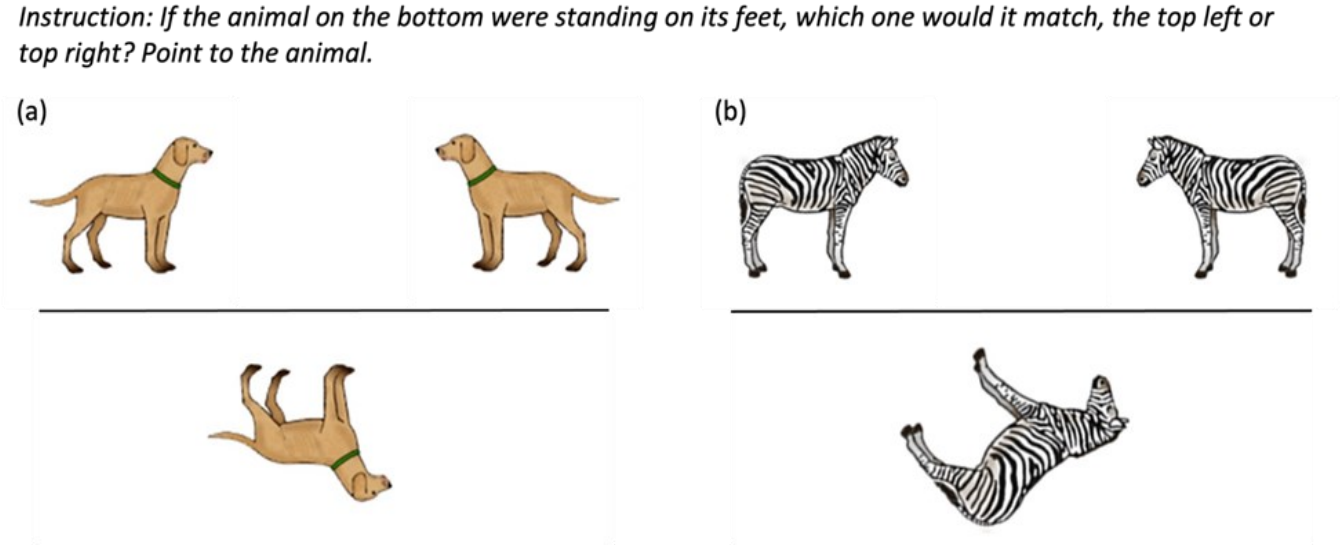

Figure 1. Examples of the Animal Mental Rotation Task

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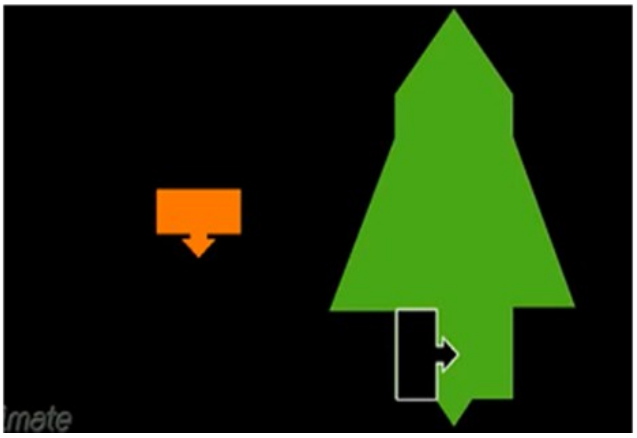
Research Profiles

Mental rotation training improves calculation skills for 2nd & 3rd graders (Part 2)

Xinhe Zhang, Graduate Student

To test these ideas, we conducted a short-term training study with 2nd and 3rd graders. Half of the children watched a mental rotation instructional video (about 3 minutes long) that showed examples of rotations and asked children to mentally rotate objects in their mind. The other half of the children watched a word-picture matching video (see Figure 2 for the screenshots of the videos). We measured children's spatial skills, calculation accuracy, and calculation strategies before and after the training. The results were intriguing. Children who watched the mental rotation video improved in mental rotation, missing-term calculation, and two-step calculation. But children's conventional calculation performance did not change, perhaps because it was already very high.

(a) Mental rotation video screenshot



(b) Word-picture matching video screenshot

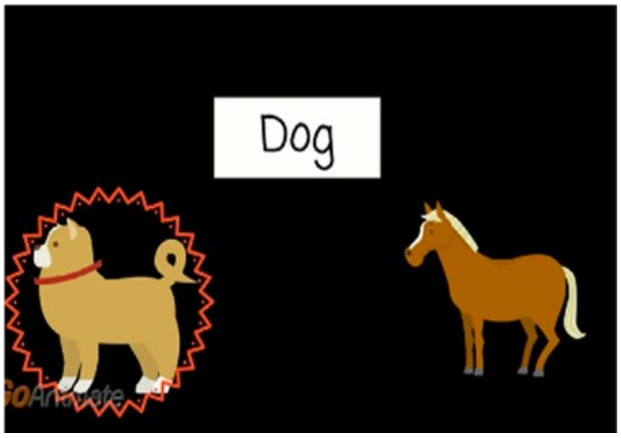


Figure 2. Screenshots of the training videos for (a) spatial group and (b) control group

As part of this project, we also asked children how they solved the arithmetic problems. We are still working on analyzing children's calculation strategies and examining whether children's calculation strategies were changed by watching the mental rotation video. By analyzing their calculation strategies, we hope to uncover how children use spatial strategies before and after these videos. The results from this project solidify the connection between mental rotation and calculation skills, and can deepen our understanding of the role spatial abilities play in supporting children's mathematical learning.

Research Profiles

Using Books to Improve Mental Rotation Skills with 4- and 5-Year-Old Children (Part 1)

Nadia Tavassolie, Graduate Student

Early spatial skills are important as they are strong predictors of later achievement in math and science and pursuit of careers in science, technology, engineering, and mathematics (STEM). Mental rotation is a type of spatial skill that involves the ability to rotate an image in your mind. Mental rotation predicts a number of math skills, and previous studies have found this ability significantly increases between ages 3 and 5 years of age. Children's mental rotation skills can be improved through experiences, and previous studies have found that playing with blocks and puzzles are positively related to preschooler's mental rotation performance. However, blocks and puzzles have some downsides - they can be expensive, are not very portable, and may not appeal to all children and parents. Here, we investigated whether a different kind of activity – book-reading – could address these downsides and help young children to improve their mental rotation skills. Previous studies have successfully used books as a tool for supporting number and language skills. Therefore, for this study we created picture books that practice mental rotation (see Figure 1), and tested whether these books can be used effectively to improve preschoolers' spatial skills.

We recruited 80 4- and 5-year-olds from Catholic and private schools from Fall 2022 to Fall 2023. Experimenters worked with children for 8 sessions over two weeks. Before the book-reading sessions, we assessed children's mental rotation skills, spatial vocabulary, mental transformation, math achievement, and language skills. Then children were either assigned to read mental rotation books (Figure 1) with an experimenter during the next six sessions, or they were assigned to read control books that didn't practice mental rotation skills. Then children completed the same assessments they did on the first day to measure improvement.

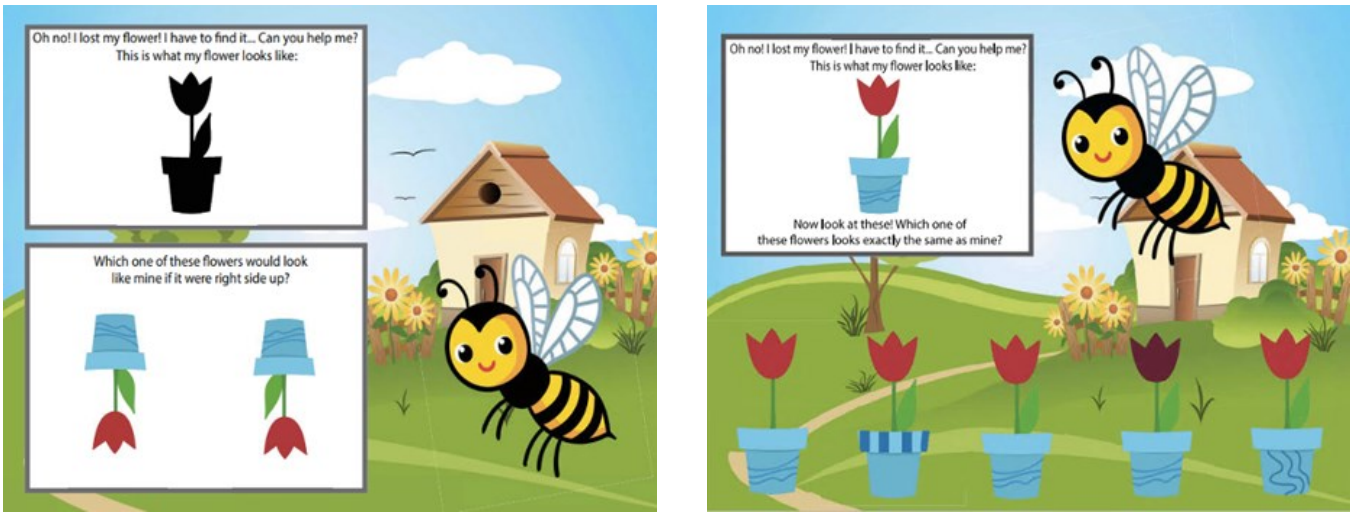


Figure 1. Example of the Mental Rotation Book and Control Book

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Research Profiles

Using Books to Improve Mental Rotation Skills with 4- and 5-Year-Old Children (Part 2)

Nadia Tavassolie, Graduate Student

We found that children who read books that practiced mental rotation had higher mental rotation accuracy at the end of the study than the control group. The children who read the mental rotation books improved from before the book-reading sessions to after the book-reading sessions, whereas those who read control books did not. Reading books that practice mental rotation skills did not, however, improve children's mental transformation skills or math achievement.

Our findings show that book-reading may be a scalable method for improving mental rotation skills in early childhood, and warrants further investigation of the effects of book-reading at home or in schools to improve spatial skills.

Meet the Lab

Dr. Elizabeth Gunderson

Elizabeth Gunderson, Ph.D., is a Professor in the Department of Psychological and Brain Sciences at Indiana 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. Dr. Gunderson is in the process of transitioning her research program from the Temple University Cognition and Learning Lab to the Indiana University Cognition and Learning Lab.

Dr. Roberto A. Abreu-Mendoza

Roberto is a post-doctoral fellow in the Department of Psychological and Brain Sciences at Indiana University Bloomington. He completed his Ph.D. in Psychology at Rutgers University-Newark, under the supervision of Dr. Miriam Rosenberg-Lee. Roberto is interested in examining which cognitive capacities and neural correlates allow for the development of numerical abilities during a person's life.

Meet the Lab

Nadia Tavassolie

Nadia is a doctoral student in Developmental Psychology at Temple University. She received her B.A. at George Washington University double majoring in Anthropology and Human Services & Social Justice. She is interested in how children develop math knowledge, with a focus on social factors that influence academic motivation and achievement in math. She hopes to apply this research towards identifying the most important skills for later math achievement, and to develop tools that can be used at home or in school to cultivate those skills.

Grace Bennett-Pierre

Grace is pursuing her doctoral degree in Developmental Psychology at Temple University. She completed her B.A. in Psychology at Wellesley College in 2016. Her research focuses on how caregivers' beliefs and behavior shape children's challenge-seeking, and how non-rigid spatial skills support STEM and arts learning.

Xinhe Zhang

Xinhe is a third-year graduate student in Dr. Gunderson's Lab. She received her M.Sc. in Psychology at the University of Birmingham in 2017. She is interested in the development of spatial and numerical processing, with a focus on the relationship between spatial and numerical processing and the mechanisms of spatial and numerical training.

Meet the Lab

Emily D'Antonio

Emily is a full-time lab manager in the Temple University Cognition & Learning Lab. They received their B.A. in Psychology from Catholic University of America in 2021 and post-graduate certificate in Gender. Sexuality, and Women's Studies from Temple University. As a research assistant for Dr. Nancy Adleman, they studied social and attention abilities as well as the impacts of implicit memory on mood recall. They hope to study online relationship formation in minority communities and the development of identity formation in adolescents.

Noah Scott

Noah is a full-time lab manager in the Indiana University Cognition & Learning Lab. Noah received his B.A. in Psychology with a Clinical Psychology Certificate from Indiana University in 2023. As a research assistant in Dr. Linda Smith's Cognitive Development Lab, he studied possible contributors to the A-not-B error in 9-14-month-old children, including interaction timing and attention. He hopes studying new interventions for non-clinical child populations while in the Cognition and Learning Lab will help prepare him for a Clinical Psychology Ph.D. program.

Meet the Lab

Sherese Bennett

Undergraduate Intern

B.S expected Fall 2023

Major: Neuroscience

Minor: Psychology

Abigail Nietch

Undergraduate Intern

B.A. Psychology

Expected Spring 2025

Jules Mirales

Undergraduate Intern

B.A expected Spring 2025

Major: Psychology

Minor: Cognitive Neuroscience

Jamie-Nicole Luistro

Undergraduate Intern

B.A. Psychology

Expected Spring 2026

Dabin Yim

Undergraduate Intern

B.A. Psychology

Expected Spring 2026

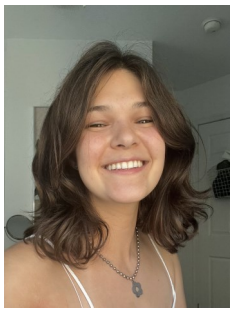
Jammie Letona

Undergraduate Intern

B.A. Psychology

Minor: Cognitive Neuroscience

Expected Spring 2024



Hannah Feinberg

Undergraduate Intern

B.A. Psychology

Expected Spring 2024

Contact us!

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://psych.indiana.edu/directory/faculty/gunderson-elizabeth.html

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