



# Play By Play

The DSCN Lab Newsletter

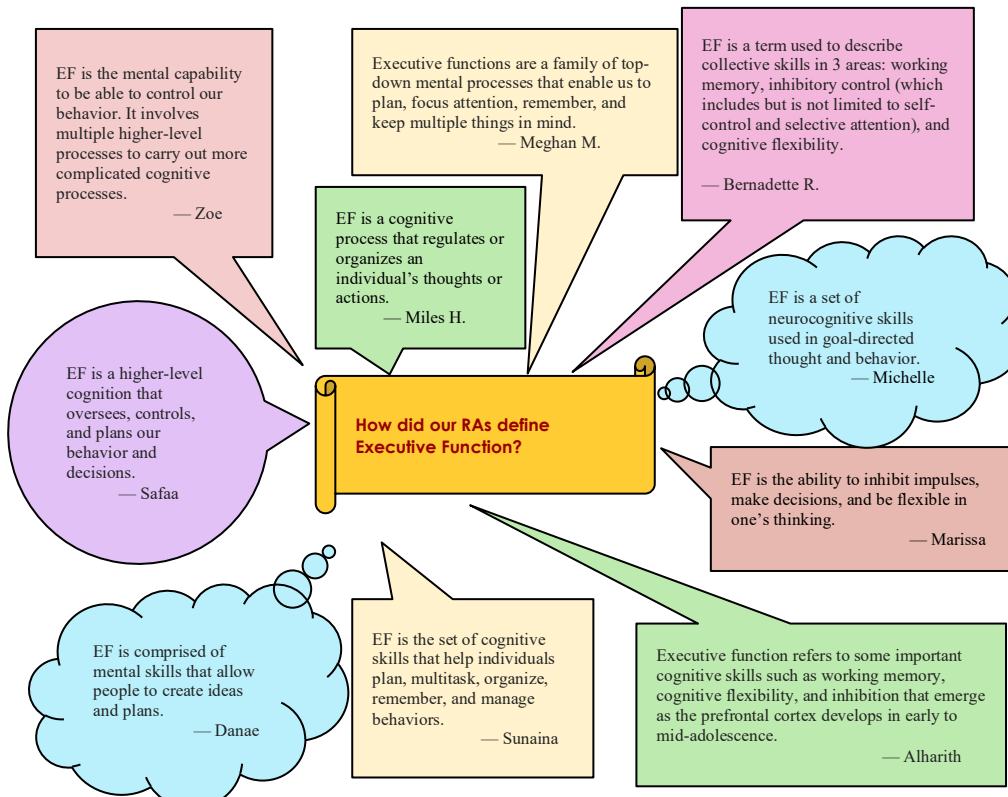
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## Welcome!

We're very excited to share updates and current research being conducted at the Developmental Social Cognitive Neuroscience Lab. Our main area of focus is executive function (EF), which includes skills related to self-control, memory, and attention. We strive to help parents, teachers, business leaders, and policy makers understand the importance of reflection and executive function skills for healthy social and cognitive development. The DSCN lab is located at the University of Minnesota Twin Cities campus and is directed by Dr. Stephanie Carlson and Dr. Philip Zelazo.

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## Can you ever have too many choices?

by Romulus Castelo, PhD Student

Choices are all around us. From ones that carry significant consequences like deciding which college to attend, to trivial ones like what kind of cereal to eat for breakfast. Choices, no matter how small, present all of us with opportunities to express our interests and preferences, and allow us to feel in control of our lives. Imagine that all the activities in your day are decided by another person — normal for the survival of an infant— but extremely harmful for a teenager or an adult. When choice is restricted, people experience decreased motivation, depression, and more anxiety.

### “Choice Overload”?

We know that presence of choice is good, but what about the other end of the spectrum? Is there such a thing as having too many choices? This idea has been previously termed *choice overload*. Although we tend to think that having more choices is always better, research with adult participants showed that we actually have a harder time choosing when there are many options to choose from. In one study, researchers set up a jam tasting booth at a grocery store. They offered a small selection of 6 flavors on some days and 24 flavors on other days. Very puzzlingly, customers who visited the booth when there were only 6 flavors were more likely to purchase a jar compared to when there was a larger selection. One explanation for this finding is that more choices mean more decisions, and making decisions uses up our

limited mental energy. As a result, it might actually be easier to choose when our options are limited.

### Preference for Choice in Preschoolers

Young children don't buy goods at the store just yet, but they do begin to demand choice from their parents, like being able to select what shoes to wear for the day. In a research study, we asked whether 2- to 3-year-old children preferred having choices and whether they experienced choice overload. Parents asked their child to make choices about which animal sticker they'd like from a book. Children were asked whether they'd like to choose a lone sticker located on one side of the page or if they would like to choose one sticker from a bunch of stickers that appeared on the other side.

We found that toddlers REALLY liked having options! In about 70% of all the trials, children preferred having choices. Importantly, we found that children became more likely to choose a sticker from the side with options as more and more options were offered. However, we did not find evidence for choice overload in this sample of children, who continued to prefer choosing even when it reached a maximum of 26 options.

We plan to conduct follow-up studies to further understand whether there are limitations on this behavior. For example, are children willing to wait or sacrifice resources to gain more choices? Are there age-related changes in these behaviors? How is choice preference related to executive functioning? We look forward to learning more about how kids make choices!



The CARTOON KRONICLES



## The Heart of Our Lab – The Team



The people in our lab are really the heart of DSCN and make it continually exciting to discover and share new findings through collaborative research. We strive to be on the frontier of our field and bring exciting news to our fellow scholars, as well as parents, teachers, clinicians, policymakers, and anyone who could benefit from our research.

The Carlson and Zelazo Lab is located in the newly constructed Campbell Hall, home of the Institute of Child Development (ICD) at the University of Minnesota.

(Photo on Nov. 3<sup>rd</sup>, 2022.)

## Highlights

- Congratulations to Dr. Jasmine Ernst for receiving her Ph.D. from the Institute of Child Development!
- Congratulations to Jasmine as well for starting a PURPOSE Post-doc at Purdue University in August, 2023!
- Congratulations to Jinyi Zhang (2023-2024) and Isabelle Morris (2022-2023) for being awarded the Minnesota Leadership Education in Neurodevelopmental and Related Disabilities ([MNLEND](#)) Fellowship at the U.S. Maternal & Child Health Bureau!
- Congratulations to both Colin Drexler and Seokyoung Kim for being the winner of Student and Early Career Council (SECC) Poster Competition at SRCD 2023!
- Romulus Castelo achieved his major program milestone: passed the orals exam and prospectus! Congrats!
- Congratulations to Seokyoung Kim for being awarded the Hauge Outstanding TA award (2023)!

## The Heart of Our Lab – Graduate Students



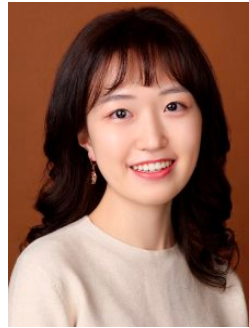
**Romulus Castelo** graduated from the University of Maryland (UMD) with a B.S. in Psychology. He then worked as a research coordinator at the UMD School of Medicine prior to arriving at ICD. He is interested in the development of executive function in the context of early life adversity and family influences.



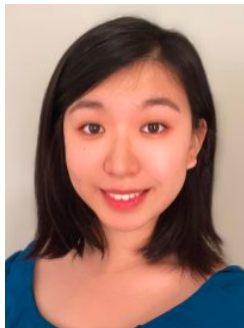
**Destany Calma-Birling** graduated from the University of Wisconsin-Green Bay with a B.S. in Psychology and Human Development. Her research interests include developmental neuroscience, executive function, and mindfulness.



**Isabelle Morris** received her B.A. in psychology from Stanford University in 2019. Her research interests include theory of mind and stimming (repetitive behaviors) as nonverbal communication in the autistic community. Being Autistic herself, Isabelle recognized the lack of autistic representation in autism research. She hopes to help change this through her recently launched participatory research project, RADAR. Isabelle is also a 2022-2023 MN LEND Fellow.



**Seokyoung Kim** graduated from Grinnell College in 2021 with B.A. in Psychology. She is interested in young children’s decision-making process when they are persisting on a task and how metacognition and executive function relate to individual differences in their decisions on task persistence.



**Jinyi Zhang** graduated from Emory University with a B.A. in Psychology. She is interested in the intersection of executive function and prosocial development, and how young children make decisions about selves and others. In her spare time, she enjoys outdoor hiking and trying out new recipes at home.



**Colin Drexler** graduated from Northwestern University with a B.A. in Psychology and History. He is interested in examining executive function, developmental neuroscience, and their effects on mental health.



**Timothy Martin** holds a M.A. in Clinical psychology from University of Hawai’i at Manoa (2019) and M.T.S in Buddhist Studies from Harvard Divinity School (2016). His research interests include developmental cognitive neuroscience and executive function. He is especially interested in educational practices and clinical interventions, such as self-reflection and mindfulness, which promote children’s cognitive functioning.

# No, Nagging. Yes, Nudging! The Influence of Reflection Scaffolding on Children's Decision-Making on a Persistence Task

by Seokyoung Kim, PhD Student

Children have a natural capacity for learning, but there are certain skills and knowledge they cannot acquire without the help of adults. This is where Vygotsky's concept of scaffolding in the zone of proximal development comes into play. Our upcoming study aims to examine how to assist young children to persist smartly in achieving assigned goals. In our prior study, we created a novel persistence task and found that 3-5-year-olds persisted inefficiently by perseverating on a losing strategy, whereas 6-7-year-old flexibly changed strategies when necessary (i.e., smart persistence). Furthermore, we found that children with stronger self-regulation skills were more likely to persist smartly than children with weaker self-regulation skills, no matter their age.

So, our upcoming study seeks to build on the previous work by exploring how adults can scaffold 3-5-year-olds' smart persistence through reflection prompts, given that reflection has been shown to improve children's self-regulation skills. Specifically, we are interested in whether scaffolding reflection can encourage more efficient task persistence by helping children to resist the temptation to continue in the face of failure and holistically track their past performance. This approach empowers children to become agents of their own decisions rather than relying on extrinsic motivation. So, the findings will have significant implications for parenting and teaching practices.

If you're interested in participating in this study, please email [persistence@umn.edu](mailto:persistence@umn.edu) or call 952-681-0550. Typically developing children ages 3-5 years and their primary caregivers are welcome to participate in this study.



In this study, we are interested in the typical course of development during early childhood. Unfortunately, this means that we can NOT include children who:

- **Are younger than 3 or have already turned 6**
- **Are non-English speakers** (bi-, multilingual is fine)
- **Currently have physical disabilities severely affecting vision, hearing, or motor skills** (e.g., if your child has vision issues or hearing issues that are corrected by glasses or a hearing aid, they're eligible to participate)
- **Currently have any known developmental disorders or delays**, such as autism, cerebral palsy, intellectual disability, severe speech comprehension problems, or severe speech delays
- **Are currently receiving special education services**, such as the individual education program or IEP (The IEP for speech articulation or fluency is fine)
- **Were born more than 3 weeks before their due date**



## Executive Function and Mathematics Skills

by Jasmine Ernst & Sarah Pan, PhD Students

**Collaborators:** Stephanie Carlson and Sarah Pan are collaborators on the study described below.

Executive function (EF) skills are thought to play an important role in doing and learning math. Both EF and math involve multiple components. EF includes working memory, inhibitory control, and cognitive flexibility. Additionally, early math involves various skills, such as counting items, reading numerals, and identifying patterns. In this study, we wanted to look at *which* math and EF skills were related to one another in the preschool years.

We had 111 4-year-old children complete EF and math activities with a member of our research team over Zoom, due to the COVID-19 pandemic. This project employed a new kind of methodology for the lab, as these research activities are generally done in-person.

### To assess EF, we measured:

- *Working memory*, which refers to holding and manipulating information in the mind. To measure working memory, the researcher stated a list of words, and the participant was asked to repeat the list backwards. If the researcher said “cat, sky” the child would say “sky, cat.”
- *Inhibitory control* which refers to resisting an automatic response. To measure inhibitory control, the participant was asked to say the word “night” when they saw a sun image and “day” when they saw a moon image.
- *Cognitive flexibility*, which includes considering multiple ways to solve a problem or switching from one task or rule to another. To measure cognitive flexibility, we asked participants to sort cards into boxes. The sorting rules changed during the game (e.g., color, shape).



### To assess math, we measured:

- Counting as high as you can
- Filling in missing pieces of a pattern
- Identifying which of two numbers is greater (Which is bigger? 2 or 3?)
- Pointing to which number the researcher said out loud
- Reading numbers (1, 9, 10)

### What we found:

- ★ It is possible to conduct EF and math assessments online with young children!
- ★ Working memory was the EF skill, among those measured, most strongly associated with numerical and patterning skills.
- ★ Some of the more challenging numerical items (e.g., reading two-digit numbers) were more strongly associated with EF than the less challenging items (e.g., reading one-digit numbers).

### Key Takeaways:

Holding and manipulating information in mind (i.e., working memory) plays a particularly important role in early math. Adults can help support children’s working memory during math, particularly when children are engaging with a math concept they are still learning or is challenging for them. For example, if you ask a preschooler, “How many forks, plates, and cups are at the picnic table?” and they are having difficulty remembering which items to count, you can support their working memory by breaking it up into smaller steps. Instead, you can say, “How many forks are at the picnic table?” Then after they finish counting forks you can prompt them to count the next item, like plates. This way they don’t have to hold too much information in their mind at once and can focus on counting! With practice and support, children can work their way up to mentally keeping track of multiple items as they count.



## Research on Autism, Driven by Autistic Researchers (RADAR)

by Isabelle Morris, PhD Student

Two years ago, I created a participatory, civic science project called [Research on Autism, Driven by Autistic Researchers \(RADAR\)](#). My research collaborators are not necessarily other autism researchers. Instead, collaborators are community members from across the U.S., some of whom have research experience, others not. I received a Howard Diversity Funds grant which is enabling me to pay my collaborators for contributing their time and expertise to the project.

Our first deliverable was an essay titled, "[What is Autism? An Introduction to the Autistic Experience](#)." This essay is written in plain language so that it is accessible to non-academics, though it also contains citations in order to be useful for scientific writing. Most importantly, the essay is not based in a pathology paradigm that describes autism in terms of deficits. Instead, it highlights the differences in the autistic way of thinking and being in the world and explores identity and community we create with like-minded individuals without minimizing the reality that differences can be disabling.

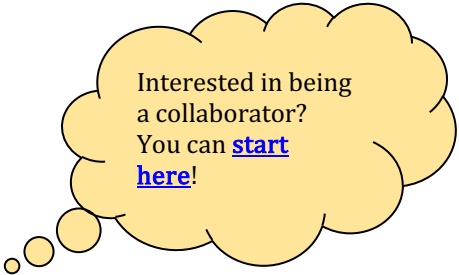
In 2023, we launched our first study as part of the RADAR project. This study seeks to understand autistic adults' experiences and

perceptions of stimming (repetitive and/or self-stimulatory behaviors). Most exciting so far is the diversity we've been able to capture. Many studies on autism are overwhelmingly male and they frequently exclude participants with other co-occurring conditions. However, having co-occurring conditions (e.g., ADHD, intellectual disability, mental health conditions) is more the rule than the exception in the autistic community. Gender identity, race/ethnicity, the presence of other diagnoses, educational attainment, employment status, and support needs all show that our sample (so far) is much more representative of the diversity of the spectrum than most other studies.

Currently, our research focuses on better understanding autistic adults' perceptions and experiences of repetitive, self-stimulatory "stimming" behaviors. So far, we've found that stimming is generally a positive experience, that it has important social-communication functions within the autistic community, and that specific stims can signal feeling a particular emotion. One of my collaborators and I presented our research at the Autistic Community Summit, and we will be presenting at the state autism conference in 2024. We're looking forward to completing data collection and submitting our first paper to a journal.

### Collaborators

Not all collaborators choose to have their participation in the project public. Those that do, are acknowledged here: Aysha Razzaque, Cruis, Jesica Sykes, Kallan Walters, Morgan.



Interested in being a collaborator? You can [start here!](#)

## First-Year Graduate Student Spotlight: Timothy Martin

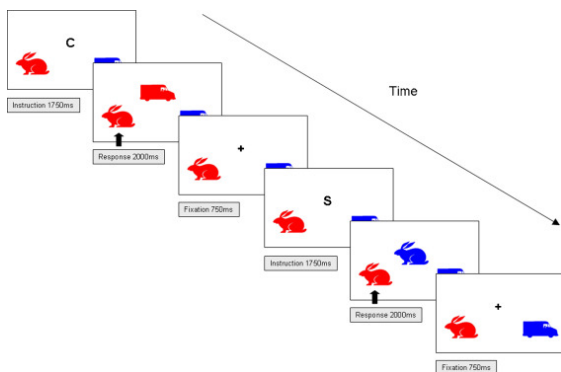
Tim recently received a two-year grant to study key mechanisms of contemplative education. This project will include a number of facets, including: (1) developing a developmentally appropriate behavioral measure of mindfulness for children, (2) contributing to a more nuanced theory of contemplative development based upon Dr. Zelazo and Dr. Carlson's prior theoretical work, and (3) evaluating key principles of contemplative education through an experimental study, employing a series of mindfulness and executive function measures in parallel with recordings of brain electrical activity.

Under Dr. Zelazo's guidance, Tim is assembling a research team to implement an intervention in the Twin Cities area that employs key effective contemplative practices with child participants. This protocol is being designed in collaboration with Middle Way Education, a non-profit committed to developing curriculum that implements Buddhist-inspired educational practices. The intent behind this study is to build upon prior research of mindfulness-based school programs to evaluate more immersive, holistic, and values-driven approaches to contemplative education in non-religious settings.

Tim and Dr. Zelazo are also working in collaboration with Beyza Hamamci and

other researchers at Middle East Technical University in Istanbul, Turkey, to conduct a meta-analysis of the Dimensional Change Card Sort task (DCCS; Zelazo, 2006). This project has been supported by lab manager Louise Zhuang and many undergraduate research assistants within the lab! The DCCS is a dynamic measure of executive function in children originally developed by Dr. Zelazo.

In particular, the DCCS measures specific aspects of executive function, such as rule use change. The meta-analysis aims to synthesize the results of studies that measured the association(s) between the DCCS and measures of language and/or math performance, in particular. A large selection of qualifying studies ( $N = 110$  reports) are being evaluated by inclusion criteria of randomized controlled trials. While data analysis is ongoing, the findings suggest that the DCCS is associated with measures of math and language performance. The results imply that executive function is associated with domain-specific academic success and overall school readiness. Tim plans to present a poster discussing the results of this study at the Jean Piaget Society conference (May 2024) in Toronto.





## Future-Oriented Imagination Helps Children Save More Resources

by Jinyi Zhang, PhD Student

Self-control plays a large role in our decision-making process. It helps us to move from *knowing* what would be good for us to actually putting it into practice. The neuro-cognitive basis of self-control is known as executive function (EF), which includes skills such as remembering goals, controlling impulses, and thinking flexibly. Young children are notoriously poor at making prudent and virtuous decisions in the face of temptation, yet evidence-based methods of improving these behaviors are lacking.

So, what can we do to help children make more future-oriented decisions in the face of temptation? Previous literature suggested that psychological distancing—taking a mental step back from the current situation—helps young children be more reflective and perform better on tasks requiring executive function and emotional regulation. For example, simply having children use their own name (third person) or pretend to be someone else (e.g., Batman) while performing difficult tasks can improve their performance. This phenomenon has become known as the “Batman Effect” based on a series of studies by Dr. Carlson.

Another kind of self-distancing is called temporal distancing, which means that we can project ourselves into the future and think of what we would do or feel as our future selves. Research has shown that this practice can enhance future-oriented decision-making (e.g., taking \$20 now or waiting a week to receive \$100) in adults by having them focus on the long-term implications of their decisions. This strategy also has a direct effect on people’s saving behavior. When asked to put various amounts of money in a (pretend) retirement savings account, research participants who interacted with AI-generated avatars of their future selves (i.e., in their late 60s) in an immersive VR environment put significantly more money towards their retirement than those who interacted with avatars of their present selves. By projecting ourselves into the future, we mentally separate ourselves from desires associated with the current situation and focus on our experiences and gains in the future instead.



At the DSCN lab, we are interested to see whether we can leverage children’s perspective-taking and future-thinking abilities to help them improve self-control and save limited resources for the future.

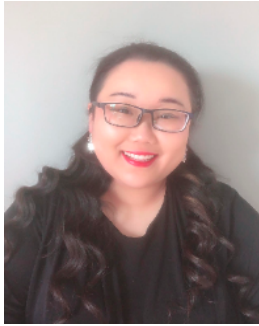
Over the past year, we developed a method for helping children imagine their future selves through play and assessed its effect on self-control. Over 130 4-year-old children were invited to participate in our study. They were first introduced to a small marble game where they could save some marbles for a big marble game later.

Before playing the small marble game, a researcher played one of 4 storyboard games with children. Two of the storyboard games involve them “play out” the future of their options (saving marbles and feeling positive vs. not saving marbles and feeling negative), and two involve bedtime routines (positive vs. negative emotion controls). Children in each scenario then predicted how they would feel by placing emoji stickers on the storyboard. Additionally, we measured children’s executive function (using sorting and matching games), verbal skills, and a few other cognitive skills, to see whether these are related to their saving decision.

We found that children who previously imagined the future consequences of their choices in the storyboard game saved more marbles than those who were in the control groups. More specifically, those who imagined saving a marble for the big marble game saved the most marbles in the game, regardless of cognitive skills and game order.

Our next step is to expand on the findings and to see whether the future-oriented storyboard game can be effective at improving other EF-related skills, such as prosocial sharing. Prosocial behavior is vital for society and has roots in empathy as well as EF and perspective-taking. Most research on children’s self-control examines decisions that are good for oneself (e.g., receiving more marshmallows). In the next study, we want to see how children make interpersonal decisions that pit the interest of self against that of others, and whether future-oriented imagination would help them see the long-term benefits of sharing.

## The Heart of Our Lab – Research Staff



“**Louise**” **Peiyue Zhuang** is a Research Coordinator supporting Dr. Zelazo in establishing a Civic Science Center. Her primary research interest lies in how executive function skills training can help with child maltreatment prevention and intervention. She is also interested in parent-child relationships beyond the stereotypical scales of cultural practices, so she would like to explore further into the field of translational research. Louise holds a B.S. in Developmental Psychology from the University of Minnesota, with two minors in Family Social Science and Integrative Neuroscience.

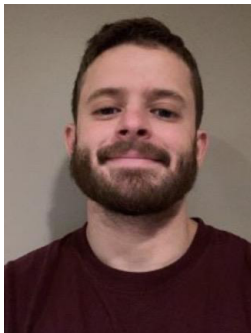
### Recent presentations:

**Zhuang, P.**, Liang, Y., **Calma-Birling, D.**, **Zelazo, P. D.** (2022). *Exposure to Chinese Culture-conforming Parenting and Subsequent Executive Function Skills in Chinese International College Students in the United States*. [Poster]. Undergraduate Research Opportunities Program, Minnesota, MN, United States.

### Recent Publications:

Ren, G., **Zhuang, P.**, Guan, X., Tian, K., & Zeng, J. (2022). How Do Blended Biochemistry Classes Influence Students' Academic Performance and Perceptions of Self-Cognition? *Frontiers in Psychology*. 13:843392. doi: 10.3389/fpsyg.2022.843392

Ren, G., Zeng, J., Guan, X., **Zhuang, P.**, Zhang, P., Liu, Z., & Tian, K. (2022). Assessment of blended biochemistry classes based on massive open online courses and a “semi-flipped” learning environment. *Biochemistry and Molecular Biology Education*, 50(6), 571-579.



**Riley Maloney** is a Research Coordinator supporting Dr. Carlson in the NSF-funded “Aligning Measurement of Personal Attributes for Predicting Career Outcomes” study. His research interests include executive function and emotional regulation, play, and the role of executive function and emotional regulation in psychopathology, particularly mood and anxiety disorders. He received his BA in Psychology from the University of Alabama in 2020 and a Masters in Social Science from the University of Chicago in June 2023.

# Civic Science: “Science that is designed by the group, tested by the group, and serves the group”

by Louise Zhuang, Researcher 1

**Collaborators:** Dr. Phil Zelazo and Ellen Galinsky

The term “*civic science*” has a long history. In the past, it has been used to describe efforts by scientists to teach the public about science — as in this example from 1873, intended to educate the public about the science behind the latest technological advances (e.g., electric light bulbs) (photo 1). Today, we use *civic science* to highlight scientists’ responsibility as citizens and use science to assess and respond to problems faced by other citizens; to draw on the lived experience of these citizens; and to engage them in the scientific process from the beginning.

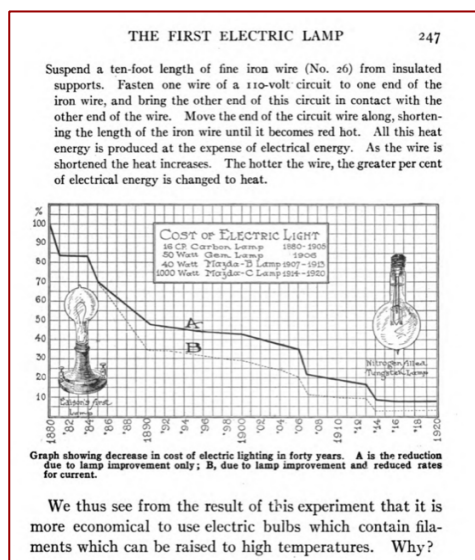


Photo 1. Hunter, G. W. & Whitman, W. G. (1921). *Civic science in the home*. New York, Cincinnati [etc.]: American book company.

Our work at the DSCN Lab has long focused on supporting the healthy development of executive function (EF) skills. EF skills are the attention-regulation skills that make it possible to sustain attention, keep goals and information in mind, think again before responding immediately, resist distraction, tolerate feelings of frustration, consider the consequences of different behaviors, reflect on past experiences, and plan for the future.

Our work has shown that EF skills not only can be improved across the lifespan, but also provide a necessary foundation for learning and adaptation. Indeed, children’s EF skills predict major developmental outcomes, including achievement, health, wealth, and quality of life. Importantly, we now have methods to promote the healthy development of EF skills — in childhood and beyond.

Our civic science goal is to leverage what we know about EF skills for the benefit of all.

Working closely with Ellen Galinsky, President of the Families and Work Institute, and author of the best-selling book, *Mind in the Making*, and forthcoming *The Breakthrough Years*, we aim to engage with **families, youth, and community members** to design, develop, and disseminate evidence-based transformative **programs, products, and practices** that are thoughtfully embedded in existing communities and can be sustainable over time.

EF skills can be taught efficiently in PreK through G12 classrooms, and it makes good sense to teach children how to pay attention and learn effectively beyond teaching them how to read, write, and do arithmetic. Additionally, supporting students’ EF skills in multiple contexts can help “level the playing field” for students who are at risk for academic difficulties, reducing opportunity and achievement gaps. We believe a civic science approach will be the most effective way to help children, youth, and families acquire the foundational EF skills they need to succeed in school and in life, and we are looking forward to future collaborations across the Twin Cities.

If you have any questions about civic science at the DSCN, you can reach out to us at [csclab@umn.edu](mailto:csclab@umn.edu). We look forward to your input!



## The Awareness Study

By Colin Drexler, PhD Student

In this lab, we talk about executive function (EF) as the set of skills that allow us to plan ahead and regulate our own thoughts and actions.

Understanding what it feels like for children to use their EF skills is super important, because this changes how often and how effectively children actually end up using them. For example, a child might be very good at ignoring distractions sometimes, but if they're feeling stressed out, then they might not use this EF skill successfully in that moment. Or another child might be very good at resisting temptations sometimes, but if they aren't even aware that something is a temptation to be resisted, then they wouldn't use their EF skills at all in that moment. I'm currently collecting data for two projects that study exactly this: the internal and external conditions that determine how and when children use their EF skills.

First, let's look at Hot EF, or how we use EF skills in emotional, high-stakes situations. This is usually contrasted to Cool EF, which are the skills we use when emotions are not a large factor. One common feature that can increase the emotional stakes of any situation is time pressure, so we're currently collecting data on how young children (aged 3 to 7-years-old) use their EF skills differently when under time pressure. We predict that some children will perform better, and the time pressure will serve as a motivating factor. But we also predict that other children will

perform worse. For them, the time pressure will be stressful, making it more difficult to use EF skills. This study aims to discover what makes a child more likely to fall into either of these two categories.

Second, I want to talk about metacognition, which is defined as the awareness and control of one's own thoughts. Although this definition might sound similar to that of EF, many leading theories of child development say that metacognition and EF develop differently. Some children might use their EF skills automatically, without really knowing that they are using them and why. In contrast, other children might more purposefully select a course of action with full awareness of the complex interplay between their goals, behaviors, and thoughts. This project, which is also currently in the middle of data collection, is directly studying the relationship between metacognition and EF in 7 to 9-year-olds. We're measuring whether children who are metacognitively aware of their own thoughts, their own strategies, and their own EF skills, perform better on EF tasks. Using electroencephalography (EEG), we're also looking at how children's brains might respond differently while they're using EF skills, depending on their level of meta-awareness at that moment.

If you have a 3 to 9-year-old and are interested in participating in either of these two studies, please reach out to [awareness-study@umn.edu](mailto:awareness-study@umn.edu) for more information!



# Predictors of Career Interests

by Riley Maloney, Researcher 1

**Collaborators:** Dr. Stephanie Carlson and Seokyoung Kim

The fields of personality psychology, economics, and child development all have one thing in common. They have all reported a variety of empirical relationships connecting personal attributes (executive function, traits, and preferences), achievement in both elementary and secondary education, and choice of college major. These factors also have been shown to affect participation in STEM and non-STEM careers. Deficient communication between these fields begets a lack of appreciation and understanding of the full body of evidence concerning these relationships and the different methodological approaches. With funding from NSF, Dr. Carlson and Co-PIs James J. Heckman (U. Chicago), Patrick Kyllonen (ETS), and Thomas Dohmen (U. Bonn) are asking how growth in traits, skills, and preferences promote STEM skills and the choice of STEM education and STEM careers, as well as non-STEM education and careers.

## What exactly is “STEM”?

STEM is an acronym that stands for the fields of Science, Technology, Engineering, and Mathematics. This includes fields and concentrations such as chemistry, biology, computer science, geometry, physics, engineering, and everything in between. STEM education creates critical thinkers, increases science literacy, and enables the next generation of innovators. Innovation leads to new products and processes that sustain our economy. This innovation and science literacy depends on a solid knowledge base in the STEM areas.

If you have a child in 4th or 8th grade and would like to participate in this study, I have attached a QR code to a Qualtrics survey, which will take your information. If you'd like to know more about the study beforehand, please reach out to us at [careerstudy@umn.edu](mailto:careerstudy@umn.edu)



## What are our main goals in this research study?

Our long-term goal is to ascertain the value and accuracy of these measures in assessing students and schools and in advising teachers to personalize students' STEM education. We also seek to use standardized and interpretable measures to examine the factors that affect the evolution and co-evolution of traits, EF skills, and preferences over childhood in multiple data sets to explore student characteristics that foster STEM development.

## How do we plan on obtaining our results?

We will be administering multiple different tasks and surveys to children aged 9 and 13 to determine their executive function, personality, traits, preferences, and proficiency in STEM and non-STEM subjects/fields. Children will be assigned to complete different economic preference tasks/games; both incentivized and non-incentivized, which involve making different choices between token amounts to determine their risk tolerance. Additionally, the children's teacher and parent will be administered multiple different surveys regarding the child's interest in STEM and non-STEM topics, student performance, personality, behavior, self-control, and classroom environment, as well as demographic information from the parent and teacher. This is a longitudinal study, so we will be keeping up with all our participants for four years. The children aged 9 years old will be followed until they are 13, and the children aged 13 will be followed until they are 17 years old. During these four years, we will repeatedly administer all these surveys/tasks to the children as well as their parents and teachers.

As well as being able to ascertain the development, evolution, and coevolution of these different attributes in our participants, we will assess the predictive power of the economic preferences, executive function skills, and traits by age, gender, and other variables to predict both STEM and non-STEM outcomes such as performance in math and science courses and career preferences and choices.

## The Heart of our Lab - Research Assistants

Jiyeon Lee

Jack Pollack

Alex Risdall

Tae Won Park

Meghan McGill

Mackenzie Caron

Henry Wilcox

Danae Parks

Mark Yuan

Stella Bloomer

Fiorella Paredes

Sharon Park

Bernadette Rechek

Connor Prok

Marissa Nelson

Emma Rieger

Randa Ung

Jiaying He

Naiya Wallace

Aissata Kaba

Alex Marszalek

Benjamin Ranny

Yuewei Xia

Yuan Chen

Miles Hill

Ruohang Ma

Nick Sanders

Zoe Psihos

Alharith Dameh

Safaa Mohamed

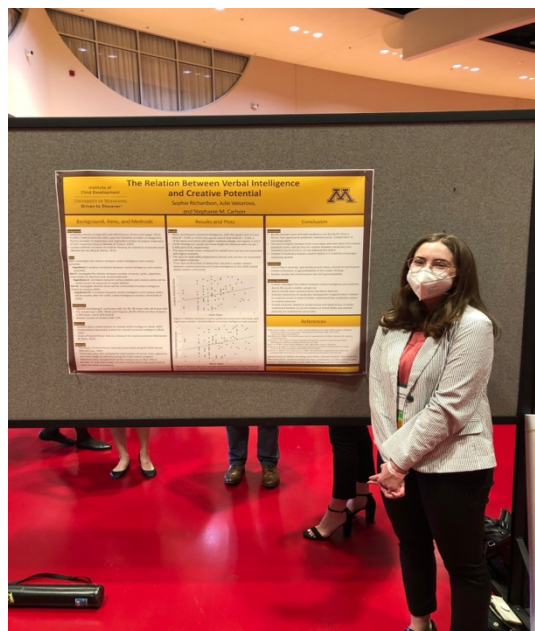
Jiayi Long

Michaela Haig

Abigail Maslow

Jack Yerxa

Sunaina Johri



*(Sophie Richardson presenting her poster at CDS in 2022.)*



**Join the Lab!**

Great opportunity for future educators and those interested in neuroscience, education, and executive function. RAs assist with recruitment, data collection, coding, transcription, and data entry.

Flexibility to assist with different studies throughout the semester  
We support students interested in doing a UROP and/or senior project. First and Second Years are encouraged to apply!

3+ credits preferred (9hrs/week), 2-semester commitment preferred.  
We accept applications on a rolling basis. Preference is given to those who apply early!

**Inquiries:** Louise Zhuang / Riley Maloney, Lab Coordinators  
([childlab@umn.edu](mailto:childlab@umn.edu))

Apply: Fill out the Google Form through [this link](#) or scan the QR code.



## Current Research

**Choice Preference:** We are investigating how much toddlers prefer choice over non-choice in a variety of ways. We are interested in associations among choice preference, executive function skills, and autonomy-supportive caregiving.

**Smart Persistence:** In a series of studies, we are studying the development of “smart persistence” across early childhood, in which children understand when it is best to persist at a task and when it is best to stop persisting.

**Future Simulation:** In a series of studies, we are studying the effects of helping preschool children think about their future selves on decision-making behaviors. Seed funding by the Office of the Vice President for Research to Dr. Carlson.

**Predictors of Career Interests:** In a 4-year longitudinal study, we are seeking to align measures of personal attributes (e.g., personality, economic decision-making, and executive function) in elementary and middle school students in order to optimally predict their interest and achievement in STEM fields. Funded by NSF, Dr. Carlson is Co-PI with James Heckman (University of Chicago), Patrick Kyllonen (Educational Testing Service), and Thomas Dohmen (University of Bonn).

**Civic Science Center:** Dr. Phil Zelazo and Ellen Galinsky are collaborating to establish a Civic Science Center, designed to support public engagement in basic research as well as practical innovation in developmental science.

**Awareness Study:** This study examines the relationship between metacognition and EF in 7 to 9-year-olds. Using electroencephalography (EEG), we're also looking at how children's brains might respond differently while they're using EF skills, depending on their level of meta-awareness at that moment. One common factor that can increase the emotional stakes of any situation is time pressure, so we're currently collecting data on how young children (aged 3 to 7 years old) use their EF skills differently when under time pressure. We predict that some children will perform better, and the time pressure will serve as a motivating factor. But we also predict that other children will perform worse. For them, the time pressure will be stressful, making it more difficult to use skills. This study is aiming to discover what makes a child more likely to fall into either of these two categories. If you have a 3 to 9-year-old and are interested in participating in either of these two studies, please reach out to [awareness-study@umn.edu](mailto:awareness-study@umn.edu) for more information!

**Mechanisms of Contemplative Education Study:** This study aims to: (1) develop a developmentally appropriate behavioral measure of mindfulness for children, (2) contribute to a more nuanced theory of contemplative development based upon Dr. Zelazo and Dr. Carlson's prior theoretical work, and (3) evaluate key principles of contemplative education through an experimental study, employing a series of mindfulness and executive function measures in parallel with EEG/ERP. The intent behind this study is to build upon prior research of mindfulness-based school programs to evaluate more immersive, holistic, and values-driven approaches to contemplative education.

### Participate in Our Research!

Participating in developmental research can be a rewarding and interesting experience for both children and parents. Join the [ICD Participant Pool!](#)

The ICD Participant Pool is a central and secure database for research labs in ICD. Researchers use the database to contact local families about taking part in studies.



## Outreach:

We have a responsibility to share what we know about children’s development, including how to support this development as parents and teachers. It’s also important to raise awareness about the value of scientific research on children and encourage families to participate in this research –especially those who are traditionally underrepresented in this process.

### Recent Outreach by our PIs!

Dr. Carlson’s outreach:

- K-12 Dive, [Teaching Self-Assessment can Support Executive Functioning Skills](#) 2/2024
- Your Child’s Growing Brain, Bright Horizons Family Solutions (4,600 attendees) 9/2023
- Reflection Sciences Blog, [EF and Math Success](#) 8/2023
- Glenbard Parent Series, [Roots of Success: Shaping EF in Early Childhood](#) 11/2022
- Executive functioning assessments in early childhood screenings. [ Minn-LInK Brief No. 50 ]. 11/2022
- K-12 Dive, [Hold that thought](#), article about reflection in the classroom 9/2022
- [Raising Good Humans](#) podcast on environmental influences on EF 6/2022
- Noggin blog, [5 Rainy Day Activities](#) to Build EF 5/2022
- Noggin blog, [Improving Executive Function Skills](#) 5/2022

Dr. Zelazo’s outreach:

Zelazo, P. D. 6 February, 2024, The Franklin Center (“Civic science: Understanding and promoting the healthy development of executive function skills”), Golden Valley, MN.

Zelazo, P. D. The Boston Globe, 5 November, 2023, For struggling families, classes in resilience can be a lifeline. [https://www.bostonglobe.com/2023/11/05/opinion/maggie-jackson-uncertain-ready4routines/?s\\_campaign=8315](https://www.bostonglobe.com/2023/11/05/opinion/maggie-jackson-uncertain-ready4routines/?s_campaign=8315) by Maggie Jackson.

Zelazo, P. D. 12 September, 2023, The Breck School, Golden Valley, MN.  
 (“Reflection, executive function, and the developing brain”), Golden Valley, MN.

**We are committed to community engagement, and we encourage our students to participate in outreach activities.**

- **Isabelle Morris** has started teaching creative writing classes with Cow Tipping Press, an organization that supports adults with intellectual and developmental disabilities to become published authors.
- **Romulus Castelo** is Co-leading a Tri-Psych project aimed at developing a burnout prevention toolkit for AAPI college students.
- **Seokyoung Kim** has been going to Ascension Catholic School every week since last Fall to work with middle school students to develop research proposals through UMN ICD’s Young Scientist Program.
- **Seokyoung Kim** is also supporting underrepresented undergraduates or post-baccalaureates interested in applying to psychology Ph.D. programs and has been mentoring applicants from diverse backgrounds through the Next-Gen Psych Scholars Program.



## Recent Invited Presentations by Our PIs

**Carlson, S. M.** (2023, November). Executive function and reading. Invited keynote presentation, National Hsing Hua University, Taiwan.

**Zelazo, P. D.** (2023, November). Are executive function skills trainable, and how? Invited keynote presentation, National Hsing Hua University, Taiwan.

**Carlson, S. M.** (2023, November). Measurement of executive function skills. Invited keynote presentation, National Hsing Hua University, Taiwan.

**Zelazo, P. D.** (2023, November). Development of executive function. Invited keynote presentation, National Hsing Hua University, Taiwan.

**Carlson, S. M.** (2023, September). Executive function skills in school readiness and learning. Invited presentation, Harvard Graduate School of Education. Cambridge, MA.

**Zelazo, P. D.** (2023, July). How to build cognitive flexibility (and why). Science of Performance Series Kirkland & Ellis, LLP (online).

**Zelazo, P. D.** (2023, July). Reflection, executive function, and the developing brain. Invited Keynote, Science of Teaching and School Leadership Academy, St. Andrew's Episcopal School, Potomac, MD, and The Breck School, Golden Valley, MN.

**Zelazo, P. D.** (2023, April). Reflection, executive function, and the developing brain. Invited Harley Hotchkiss Memorial Lecture, Department of Neuroscience, University of Lethbridge, Canada.

**Carlson, S. M., & Zelazo, P. D.** (2023, February). Reflection, executive function, and the developing brain. Invited keynote presentation at Teaching Behaved Brains: Strategies for Challenging, Disruptive Behaviors, Autism, ADHD, and Executive Function. [Learning & the Brain](#). San Francisco, CA.

## Recent Publications

**Calma-Birling, D., Castelo, R., & Zelazo, P. D.** (in press). Executive function and self-regulation. In M. H. Bornstein & P. E. Shah (Eds.), *APA Handbook of Pediatric Psychology, Developmental-Behavioral Pediatrics, and Development Science*. Washington, DC: American Psychological Association.

**Calma-Birling, D., Semenov, A., & Zelazo, P. D.** (2023). Executive function and education. In R. Tierney, F. Rizvi, & K. Erkican (Editors-in-Chief), I. Wilkinson & J. Parr (Volume editors). *International Encyclopedia of Education (4<sup>th</sup> ed.): Learning, cognition and human development* (pp. 168-178). Elsevier. <https://dx.doi.org/10.1016/B978-0-12-818630-5.14022-9>

**Carlson, S. M.** (2023). Let Me Choose: The Role of Choice in the Development of Executive Function Skills. *Current Directions in Psychological Science*, 32(3), 220-227. <https://doi.org/10.1177/09637214231159052>

- Castellanos-Ryan, N., Parent, S., Chaput-Langlois, S. Rioux, C., Jacques, S., Simard, C., Tremblay, R. E., Séguin, J. R., & **Zelazo**, P. D. (2023). Modelling executive function across early childhood: Longitudinal invariance, development from 3.5 to 7 years and later academic performance. *Cognitive Development*, 68, 101365. <https://doi.org/10.1016/j.cogdev.2023.101365>
- Castelo**, R. J., **Kim**, S., & **Carlson**, S. M. (2023). More is more: toddlers do not show choice overload. *Frontiers in Developmental Psychology*, 1. <https://doi.org/10.3389/fdpys.2023.1317426>
- Cumming, M. M., Oblath, R., Qiu, Y., Frazier, S. L., **Zelazo**, P. D., Flores, H., & Park, J. (2023). Executive function, perceived stress, and academic performance among middle schoolers with and without behavior problems. *Remedial and Special Education*. <https://doi.org/10.1177/07419325231176762>
- Distefano**, R., Palmer, A. R., Kalstabakken, A. W., Hillyer, C. K., Seiwert, M. J., **Zelazo**, P. D., **Carlson**, S. M., & Masten, A. S. (2023). Predictive validity of NIH Toolbox Executive Function measures with Developmental Extensions: Pre-Kindergarten screening to third grade benchmark tests of achievement. *Developmental Neuropsychology*. <https://doi.org/10.1080/87565641.2023.2286353>
- Dumont, É., Parent, S., Castellanos-Ryan, N., Jacques, S., Freeston, M. H., **Zelazo**, P. D., Séguin, J. R. (2024). The role of executive function at 6 years in the association between behavioral inhibition at 5 years and anxiety at 7 years. *Research in Child and Adolescent Psychopathology*. <https://doi.org/10.1007/s10802-024-01175-z>
- Dumontheil, I., Lyons, K. E., Russell, T. A., & **Zelazo**, P. D. (2023). A preliminary neuroimaging investigation of the effects of mindfulness training on attention reorienting and amygdala reactivity to emotional faces in adolescent and adult females. *Journal of Adolescence*, 95, 181-189. <https://doi.org/10.1002/jad.12107>
- Grenell**, A., **Ernst**, J. R., & **Carlson**, S.M., (in press). Preschool children's science learning: instructional approaches and individual differences. *Early Education and Development*.
- Lasch, C., **Carlson**, S. M., & Elison, J. T. (2023). Responding to joint attention as a developmental catalyst: Longitudinal associations with language and social responsiveness. *Infancy*, 28(2), 339-366. <http://doi.org/10.1111/infa.12515>
- Pinsonneault, M., Parent, S., Castellanos-Ryan, N., **Zelazo**, P. D., Tremblay, R. E., & Séguin, J. (2023). Transactional associations between verbal skills and disruptive behaviors during the transition to formal schooling. *Development and Psychopathology*, 35, 1529-1539. doi:[10.1017/S0954579422000268](https://doi.org/10.1017/S0954579422000268)
- Prager**, E. O., **Ernst**, J., Mazzocco, M. M., & **Carlson**, S. M. (2023). Executive function and mathematics in preschool children: Training and transfer effects. *Journal of Experimental Child Psychology*. <https://doi.org/10.1016/j.jecp.2023.105663>
- Putnam, S. P., Selec, E., French, B., Gartstein, M.A., Lira Luttges, B. and 489 Members of the Global Temperament Project (in press). The Global Temperament Project: Parent-Reported Temperament in Infants, Toddlers and Children from 59 Nations. (S. M. **Carlson**, Member of Global Temperament Project). *Developmental Psychology*.
- Sherlock, P. Mansolf, M., Blackwell, C. K., Blair, C., Cella, D., Conradt, E., Deoni, S., Fry, R. C., Ganiban, J., Gershon, R., Herbstman, J. B., Lai, J-S., Leve, L., LeWinn, K, Z., Margolis, A., Miller, E. B., Oken, E., O'Shea, M., Neiderhiser, J. M., & **Zelazo**, P. D. (2023). Life satisfaction among

- adolescents with neurodevelopmental disabilities during the COVID-19 pandemic. *Pediatric Research*. <https://doi.org/10.1038/s41390-023-02852-3>
- Zelazo, P. D., Morris, I., Qu, L., & Kesek, A. C.** (in press). Hot executive function: Emotion and the development of cognitive control. In S. Calkins and M. A. Bell (Eds.), *Child Development at the Intersection of Cognition and Emotion* (2<sup>nd</sup> Ed.). Washington, DC: American Psychological Association.
- Zelazo, P. D., Calma-Birling, D., & Galinsky, E.** (2024). Fostering executive function skills and promoting far transfer to real-world outcomes: The importance of life skills and civic science. *Current Directions in Psychological Science*, 1-7. <https://doi.org/10.1177/09637214241229664>
- Zelazo, P. D., & Carlson, S. M.** (2023). Reconciling the context-dependency and domain-generality of executive function skills from a developmental systems perspective. *Journal of Cognition and Development*, 24, 161-171. <https://doi.org/10.1080/15248372.2022.2156515>
- Zhang, J., Botto, S. V., & Rochat, P.** (2023). Altruism and hyperaltruism in children of three cultures. *Journal of Experimental Child Psychology*, 234, 105708. <https://doi.org/10.1016/j.jecp.2023.105708>

## Recent Presentations

- Castelo, R. J., & Carlson, S. M.** (2024, March). *A new questionnaire measure of autonomy support for parents of preschool children*. [Poster]. Cognitive Development Society, Pasadena, CA.
- Castelo, R.J. & Carlson, S.M.** (2023, March). *More is more: Examining choice overload in toddlers*. [Poster]. Society for Research in Child Development, Salt Lake City, UT.
- Drexler, C. L., Flynn, R. M., Dworak, E. M., Oakes, L. M., Carlson, S. M., Zelazo, P. D.** (2023, March). *Developing Measures of Executive Function, Learning, and Memory for the NIH Infant and Toddler Toolbox*. [Poster]. Society for Research in Child Development, Salt Lake City, UT.
- Ernst, J.R., Carlson, S.M., & Mazzocco, M.M.M.** (2023, March). *Variation in risk for math learning difficulties: numerical and non-numerical skill relations to math achievement*. [Poster]. Society for Research in Child Development, Salt Lake City, UT.
- Kim, S., Doan, S., Wang, L., Hirabayashi, H., Kazama, M., Karasawa, M., & Ip, K.** (2024, March). *Cultural scripts of emotion: Exploring cross-cultural variations in children & emotion knowledge and parental socialization practices*. [Poster]. Cognitive Development Society, Pasadena, CA.
- Kim, S., Berry, D., & Carlson, S. M.** (2023, June). *Should I stay or go? Roles of executive functions and metacognition in children's smart persistence*. Paper presented at the Jean Piaget Society, Madrid, Spain.
- Kim, S. & Carlson, S. M.** (2023, March). *Should I stay or should I go? Young children's task persistence*. [Poster]. Society for Research in Child Development, Salt Lake City, UT.
- Martin, T., Zelazo, P. D.** (2024, June) *Meta-analysis of the relations between the Dimensional Change Card Sort (DCCS) and measures of math and reading*. [Poster]. Jean Piaget Society, Toronto, Canada.

- Morris, I., & Zelazo, P.D.** (2023, June) *Research on Autism, Driven by Autistic Researchers (RADAR): A civic science project*. Paper presented in P. D. Zelazo (Chair), *Civic Science: Understanding and Promoting Healthy Human Development*. Jean Piaget Society, Madrid, Spain.
- Park, T., Castelo, R. J., Kim, S., & Carlson, S. M.** (2024, March). *Examining the reliability and validity of the Short Executive Functioning Questionnaire*. [Poster]. Cognitive Development Society, Pasadena, CA.
- Vaisarova, J., & Carlson, S. M.** (2023, March). *Can young children control their creativity? The role of executive function in modifying creative processes*. In J. Vaisarova & N. Evans (Co-Chairs), *Building on divergent thinking: Expanding approaches to measuring children's creativity*. Paper symposium at the Society for Research in Child Development. Salt Lake City, UT.
- Zhang, J., Vohs, K., Carlson, S. M.** (2023, March) *Imagining the future improves self-control in preschoolers*. [Poster]. Society for Research in Child Development, Salt Lake City, UT.
- Zhang, J., Vohs, K., Carlson, S. M.** (2024, March). *The effect of future imagination on prosocial sharing in preschoolers*. [Poster]. Cognitive Development Society, Pasadena, CA.



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## DSCN

The Carlson and Zelazo Developmental Social Cognitive Neuroscience Lab

### About Us

The DSCN Lab is co-directed by Dr. Stephanie M. Carlson and Dr. Philip D. Zelazo, leading scientists in the field of cognitive development. Our lab focuses on the research of developmental social cognitive neuroscience, with executive function (conscious control of thought, action, and emotion) at its core.

### Visit us on the Web!

<https://innovation.umn.edu/child-lab/>