Careers Up Close: Moira R. Dillon on Infants and Children, Humanlike AI, and Commonsense Psychology

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Image above: In October 2022, Moira Dillon presented on the cognitive origins of geometry at "An Evening of Unnecessary Detail," a New York City comedy event hosted by Matt Parker.

Moira Dillon is an assistant professor at New York University (NYU). Her research at the Lab for the Developing Mind at NYU explores how infants' intelligence can contribute to the future of developing humanlike artificial intelligence (AI).

Current role: Assistant professor of psychology, New York University, 2017–present

Previously: Doctoral student in psychology, Harvard University, 2011–2017

Terminal degree: PhD in psychology, Harvard University, 2017

Recognized as an APS Rising Star in 2021

Hitting the ground running

I received my PhD at the end of May 2017, and just about six weeks later, I started my job as an assistant professor at NYU. It was challenging to transition to this position directly from graduate school, but I was absolutely thrilled for the opportunity.

My team started small—only me and two full-time lab managers—and my initial goal was to put myself in a position to be competitive for a federal grant by the end of my first year. With the help of my team and the support of some internal funding from the Institute for Human Development and Social Change at NYU, I focused my efforts on questions that had always been at the core of my research program: the origins and development of uniquely human geometric cognition. I also worked to find outlets for scientific outreach that would allow me to collect data with children more efficiently and allow my science to engage with the community more broadly. By the end of the summer, I had served on a review panel for the grant program to which I planned to apply (I recommend reaching out to a program officer to volunteer!), my lab had pilot data in hand, and I had established a partnership with the National Museum of Mathematics (MoMath). It was an intense first year in which I met my goal of submitting a grant proposal I was proud of—and I ultimately got the grant (an NSF CAREER award)!

Working to be a good fit

When I was a 5th-year doctoral student, I applied to work in my current position, and I didn’t get an interview. The following year, the same job was posted again, and I again threw in my hat. This time, I landed it! Although it’s hard to know for certain, my sense is that a few things made me a good candidate for this position. The first was fit: My research program, including its content and methodology, complemented the existing strengths of the department. The second was practicalities: The department had the appropriate resources to support my research and saw ways that I could contribute to those resources in the future. And the third was the extension of my basic research program into life as lived outside the university. In particular, I had both a lab-based research program that examined the foundations of infants’ and children’s knowledge about the world as well as a translational research program directly informed by my basic research.

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Thanks to an incredible opportunity to collaborate with economist and Noble Prize laureate Esther Duflo during my doctoral training, I was able to translate my lab findings into field experiments to address ever-elusive causal questions about the acquisition of formal, school-relevant knowledge in a way attentive to the socio-economic conditions in which long-term learning happens. Field experiments might then show how lab findings can be harnessed to improve pedagogy and close achievement gaps. I believe this dual and mutually reinforcing aspect of my research program was appealing to the

department.

In 2022, Moira Dillon spoke at the Conference on Cognitive Computational Neuroscience on infant common sense.

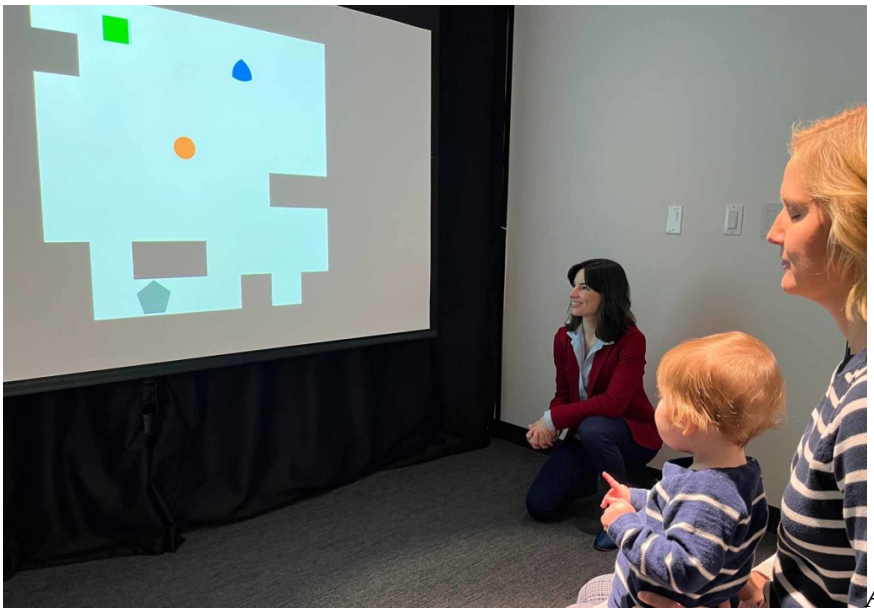
Studying “commonsense psychology” in infants and AI

When I became an APS Rising Star in 2021, my lab was focusing on one broad question: What do human infants and children know about the world? And my lab’s work still aims to answer this perennial question! We currently have an eye toward understanding how early emerging knowledge about objects, places, and people informs cultural achievements, such as our use of pictures; gives rise to our abstract formal systems of thought, such as Euclidean geometry; and inspires technological advances, such as AI that might one day represent and reason about the minds of others like humans do.

For the past couple of years, we have been focusing a lot on this last topic of how infant intelligence can inspire the future of humanlike AI. With my NYU collaborator at NYU Brenden Lake, our students, and support from the Machine Common Sense program at DARPA, we are creating suites of tasks (e.g., the “Baby Intuitions Benchmark”) that evaluate whether state-of-the-art AI can perform like human infants do when making basic inferences about the motivations that drive others’ actions. Can AI capture infants’ “commonsense psychology”? Our tasks can literally test both infants and machines, allowing for direct comparisons.

Though we’ve encountered many design challenges, and though data collection with infants is time and resource intensive, we believe our efforts are worth it: If an aim of AI is to build the flexible, commonsense thinker that human adults become, then machines might need to start like adults do, from the same core abilities as infants. And creating this framework to comprehensively characterize infants’ and machines’ knowledge will allow us to more fully describe the origins and development of human common sense.

Academic work affords opportunities for growth and learning, opportunities that would often be out of reach if I looked to pursue them outside of a work context. For example, at the end of my doctoral dissertation defense, I put up a map of the world and animated a photo to appear on all of the places I had gotten to visit (fully supported!) as part of my work during those past 6 years. Travels included 3 months in Paris to conduct research in a French lab; 10 days in New Delhi to pilot a field intervention; and 3 weeks in Buenos Aires to attend a summer school on the cognitive and neural sciences, to name a few. How lucky I was to have had opportunities like that to travel the world and meet new people from different places who all, in different ways, furthered my passion for cognitive science and research. Now, grateful for these opportunities, nothing makes me happier than to be in a position to support others in pursuing opportunities for their growth and learning.

 *An infant in Moira's lab sees the initial stimuli in planned tasks probing infants' and machines' recognition of potential social partners, another component of their commonsense psychology.*

Confronting challenges

I have faced a number of personal and professional challenges in my career as an assistant professor so far, but three big ones stand at the forefront. The first was my diagnosis of celiac disease, an autoimmune disease in which the body attacks the small intestines when the food protein gluten is ingested. When undiagnosed, as I had been for nearly a decade, the body destroys the lining of the small intestines, leading to a variety of health problems. After diagnosis, recovery and remission require hypervigilance and a strict regimen, which often cause social isolation. I am proud of how I have adapted to my new lifestyle post-diagnosis, and I am even prouder that, by sharing my experiences with students, I have been able to help others who suffer from similar, and often invisible, disabilities.

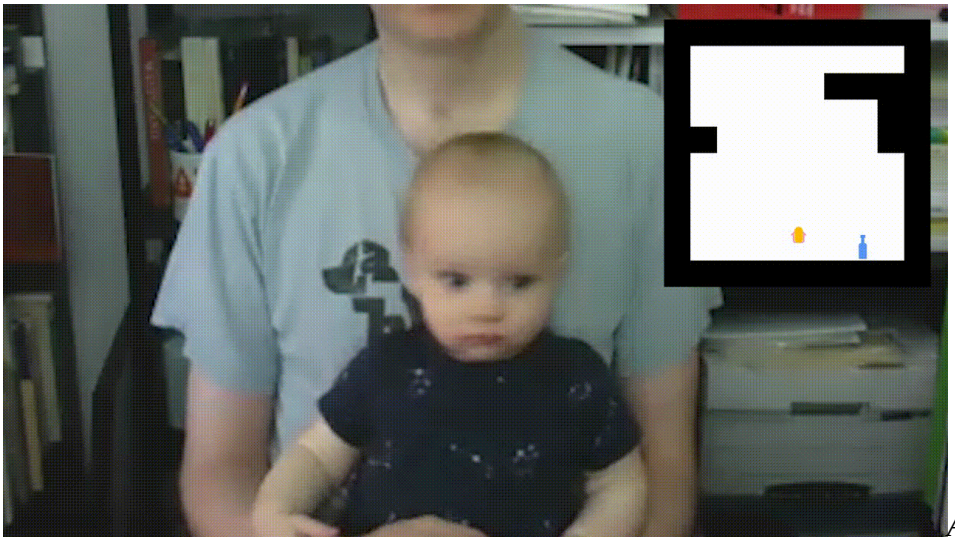
The next two challenges I faced happened at about the same time. They were the halt of in-person research due to the COVID-19 pandemic and becoming a mother. Of course, representing the second simply as a challenge is not at all right. Becoming a mother has been one of the greatest joys of my life! Nevertheless, it is hard to describe how difficult it was, especially given the social isolation of the pandemic, to both manage my new role at home and keep my lab going. I'm thankful to my partner for his endless support and my lab members for their patience as I figured out how to do it. And I'm still trying to figure out how to do it!

The halt to in-person research was a huge challenge for me and my lab, and I think for the field of developmental cognitive science in general, especially because there was no real existing model for testing infants and children online. Tools had started to emerge like Lookit, an online child lab, which had been initiated at MIT a couple of years before the pandemic, but such tools were not yet widely used. My lab's core research also involved testing young children in specialized spaces, and it turned out to be nearly impossible to convey such specialized spaces through a computer screen. I wound up pivoting to focus my research more on questions of infant intelligence—my lab and the field more

generally were making swift progress on developing tools to test infants online.

> **Related content: Kids in Their Comfort Zones**

I learned that not every study with infants translates well to an online context, but there are some unique benefits to online testing. For example, online studies have the potential to reach more diverse populations. Online studies also afford the opportunity to test the same infant multiple times. This opportunity greatly benefited my work at the intersection of psychology and AI. We were able to test our entire suite of six tasks on commonsense psychology over six different Zoom sessions with the very same infants, yielding a comprehensive way to evaluate and describe infant common sense. These logistics would have been nearly impossible to implement in person.



An infant tested on Zoom is surprised (looks longer) when an agent (orange pill) that previously moved efficiently around black barriers in a grid world to a goal object (blue bottle) takes the same but now inefficient path to its goal object when the barriers are removed. During this video clip, the infant is seeing what's displayed in the upper right inset. Infants in general expect agents to move in rationally efficient ways to their goals. Learning-driving neural-network models, however, do not fully capture infants' expectations.

Continuing on the path of psychology and AI

I plan to continue the ongoing lines of research in my lab and to hopefully grow my lab to include more students and postdocs. In terms of my specific research program at the intersection of psychology and AI, my team is currently extending our first suite of tasks to investigate other aspects of commonsense psychology, including expectations of people's actions that signal potential social partners or indicate shared experiences, like states of perception and emotion. Such social expectations will become increasingly important for AI too as it is further embedded in real-world, multi-agent settings. In addition, I am exploring what kinds of computational models could succeed on all of our commonsense tasks. Ultimately, I believe this approach will allow me and my team to test whether human knowledge can be built, in human or machine, from the foundations that cognitive and developmental theories postulate.

Encouraging enthusiasm and staying supportive

My lab includes a diverse group of individuals, from undergraduate research assistants (who have hailed from NYU's New York, Shanghai, and Abu Dhabi campuses), to graduate students, to postdocs. I think two things really make a difference in my interactions with mentees. First, I freely express to them my enthusiasm about science and about their work: I was lucky enough as a doctoral student to feel the benefits of such enthusiasm firsthand from my mentor, Elizabeth Spelke (APS Mentor Award recipient and William James Fellow), who, as anyone who knows her would say, is contagiously enthusiastic about doing science in general and doing science with her mentees in particular. I try to bring that same energy to all my interactions with mentees. Second, I make sure my mentees know that I've got their backs and I'm there to listen, even if they are facing challenges outside of the lab. Academic life is hard, and I believe that communicating to my mentees that I care about them as whole persons, not just as people who do work in my lab, creates a supportive environment invaluable to their intellectual growth, curiosity, and happiness, all which ultimately contribute to their success.

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Advice to future researchers

I have three bits of advice. The first is to find friends in your graduate school cohort. This was important for me not only because it gave me a reliable social outlet, but also because it gave me a network of psychologists with diverse interests and specialties with whom I could share my work. This network becomes especially helpful when it is time to put together that job talk!

The second is to find ways to participate in scientific outreach. I value this in particular because it allows you to bring your science to those who may not have easy access to it. Let's make being a part of science open to everyone! Outreach also makes you practice communicating your scientific ideas clearly.

The third is to do your homework: Psychology and AI have been in dialogue for a surprisingly long time. While computing has advanced significantly in the past decade or so and tools like deep learning are relatively new to AI, the core debates that innervate the fields of psychology and AI go back over half a century—for example, the 1956 Dartmouth workshop—to say nothing of the so-called first cognitive revolution of the seventeenth century. Knowing this history—even if only part of it—is advantageous both so you don't find yourself trying to reinvent the wheel and because you will be more open to participating in this amazing, ongoing interdisciplinary discussion and thereby able to better learn from others.

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