

## The Cognitive Science Department

is pleased to announce the following seminar by



**Dr. Marina Dubova**

Santa Fe Institute

### “Cognitive Mechanisms of Discovery”

**Abstract:** *To understand and navigate our world, both individuals and scientific communities create simplifying representations, such as concepts and theories. How do we construct useful representations from our experiences, and how do we use these representations to guide our learning? In this talk, I discuss empirical research on the mechanisms of human concept learning, highlighting the ease with which we adopt new, even arbitrary, conceptualizations. I illustrate how these acquired concepts instantly shape how we perceive and explore the world. For example, I show that our perception of objects becomes biased by our conceptual needs and our knowledge about these objects. I demonstrate that similar mechanisms are at play when scientific conceptualizations, such as the DSM in psychology and the periodic table in chemistry, guide scientific exploration. Then, I discuss the double-edged nature of theory-guided discovery—although conceptualizations can efficiently steer us towards new experiences that further refine our knowledge, they can also lead our exploration astray. I present a computational model of scientific discovery in which agents conduct experiments, build theories, and share results to advance collective understanding of the world. The model reveals that when new experiments are guided by existing theoretical frameworks, scientific communities risk missing important aspects of the world not yet captured by their theories. I conclude by reviewing my current and future research that integrates cognitive psychology, machine learning, and philosophy of science to enhance our understanding of how theories and observations can inform each other to support—rather than hinder—human learning and scientific progress.*

**Bio:** *Marina Dubova is an Omidyar postdoctoral fellow at the Santa Fe Institute. She earned her Ph.D. in Cognitive Science from Indiana University in 2024 and a B.S. in Psychology from Saint Petersburg University in 2019. Marina’s research aims to reveal and inform the cognitive mechanisms of discovery. She employs formal (e.g., computational models) and empirical (e.g., behavioral experiments with scientists) methods to put the foundations of scientific method to rigorous tests. Her research has led to some arguably counterintuitive results, indicating that 1) more exploratory experimentation might help scientists develop more accurate & useful theories than the theory-informed experiments, or that 2) learning representations or theories with a complexity bias (i.e., expanding, rather than compressing, the dimensionality of one’s observations) sometimes leads to more efficient learning about the world. Outside of work, Marina enjoys windsurfing, singing, and making ceramic creatures.*