In a dynamic and uncertain world, how do we assemble our knowledge to make broadly applicable and informative predictions? When we wander through a crowded market, how we do isolate relevant features from the overwhelming displays before us? How do we represent and transform observations gleaned from environmental statistics, and in all cases what computations take place in our minds and brains? I am interested in the computational and neural processes underlying inference, investigated through the complementary methods of studying what high-level information is present in the human brain, and using computational modeling to formulate how information is processed in the mind.

My interest in inference emerged from my previous research opportunities, through which I **gained experience in studying the brain mechanisms underlying cognitive processing using cognitive neuroscience techniques**. For three years I worked as an undergraduate research assistant with Prof. Bevil Conway at Wellesley College and MIT, using psychophysics, fMRI, and electrophysiology to study the neural basis of color perception in macaque monkeys and humans. In an early project I processed **fMRI** data in FreeSurfer. For my senior thesis I investigated the neural basis of color perception, comparing macaques and humans. I used **MATLAB** to analyze macaque **electrophysiology** data collected from color-selective cells found in the higher visual processing area V4/PIT (posterior inferior temporal cortex), and collected human psychophysics data by **replicating the behavioral component** of this experiment in humans. We found that cell color tuning as a function of luminance did not correlate with human perceptual color matching responses, suggesting future work should search for the neural correlate of color perception in anterior areas of the color processing pathway. This work furthered my interest in the integration of neuroscience and cognitive science to study the computations throughout processing hierarchies that give rise to perception.

My junior spring I became interested in using **computational methods** to study representations at different processing stages. To gain the necessary background, I took the MIT courses “Introduction to Computational Neuroscience”, taught by Prof. Michale Fee, “Computational Cognitive Science”, a combined graduate/undergraduate course taught by Prof. Josh Tenenbaum, and “fMRI Investigations in the Human Brain”, taught by Prof. Nancy Kanwisher. As a continuation of my capstone project in Prof. Tenenbaum’s class, and to apply my **computational modeling** skills to the neural basis of color, I started an independent research project aimed at understanding how human color categories may have evolved. To determine whether low-level visual input may have driven color category formation, I applied clustering algorithms to both low-level neural and high-level perceptual representations of color space. For my capstone project in Prof. Kanwisher’s class, I developed a research proposal investigating the abstract representation of personality traits using **fMRI multi-voxel pattern analysis**.

To **gain additional experience in applying these techniques empirically, and to study the transformations of representations through learning**, I am currently pursuing a one-year, research-only masters program at the University of Cambridge, working with Dr. Zoe Kourtzi (Department of Experimental Psychology). Dr. Kourtzi investigates the strategies that humans use to implicitly extract structure from visual stimuli, and compares neural representations using fMRI before and after learning. Her lab has been employing a Bayesian participant-response tracking model to examine how subjects predict upcoming stimuli in hierarchical temporal sequences; I have begun work on a new, related experiment. This work has strengthened my dedication to studying the mechanisms of inference.

I would love to pursue these interests within Berkeley's interdisciplinary community. I am particularly interested in the department's ethos of studying cognition through the engagement of diverse methodologies and approaches, and would welcome the opportunity to explore and integrate a range of computational and experimental techniques. I feel my interests are aligned with several of the Neuroscience faculty, and could see myself working with Profs. Tom Griffiths, Jack Gallant, and David Whitney. I am very interested in Prof. Griffiths's work formalizing the algorithms underlying human inductive inference, creating models using machine learning, statistics, probability theory, and computer science to describe and compare human reasoning to optimal learning strategies. I would be keen to study the putative computational mechanisms by which humans transform observations into inferences: inferences about causes, categories, motivations, future strategies, and more broadly inductive solutions to computational problems encountered by humans and machines. Prof. Gallant's work is also fascinating, investigating abstract categorical neural representations by predicting brain activity with computational encoding and decoding models. I would be eager to learn and expand upon his work evaluating the feature spaces that humans infer from naturalistic multidimensional stimuli, studying the computations defining neural processing by isolating representations across neural processing stages. I am also very interested in Prof. Whitney's work, using psychophysics and modeling to investigate the processing mechanisms underlying our almost instantaneous extraction of high-level group information from visual input. I would hope to study the informational transformations driving our high-level perceptual abilities in his lab, building on his work studying the abstract inferences made in perception. I would embrace the opportunity to learn and use the techniques and approaches embodied in Prof. Griffiths's, Gallant's, and Whitney's labs to advance our understanding of cognitive and perceptual inference and representations in the brain and mind.

Humans face uncertain and ambiguous environments that require high-level, processing-intensive inferences from every sensory observation. My driving interest is how these inferences develop. To gain the background to address this question, I have explored several approaches: by understanding representations in the brain with neuroimaging, one learns about the information driving cognition at each processing stage; by developing computational models for learning and other cognitive processes, one describes how this information is transformed. I hope to study these topics in graduate school and ultimately within an academic position, with the long-term goal of understanding the algorithms underlying inference to the extent that they could be applied to training programs for impaired populations or executed in machines. It would be an honor to train at Berkeley in studying inference and high-level representations in the mind and brain.