Lucy Lai
NYU Neural Science PhD Academic Statement of Purpose

As a neuroscientist and future professor, I plan to combine experiments and theory to elucidate the processing principles underlying sensorimotor integration and decision-making. By pursuing a Ph.D. in Neural Science, I seek to acquire the tools necessary to conduct rigorous experimental investigations of behavior and to discover the computational principles that govern the neural circuits underlying complex behaviors.

Inspired by my thirteen years of training as a classical pianist, I became fascinated with how the brain processes complex perceptual scenes and learns sophisticated motor sequences. Curious as to how our brains guided our interactions with the world, I joined Dr. Jeffrey Yau's lab at Baylor College of Medicine (BCM) in my freshman year to investigate how the brain combines multisensory information. I designed and ran a psychophysical experiment to understand how multisensory cues interact in various contexts. I then developed a computational model that explains the observed behavioral data and predicts conditions under which the same sensory inputs can be flexibly interpreted. Our findings emphasize that multisensory interactions are flexible and dependent on the context of cues.

In the summer after my sophomore year, I joined Dr. Jazayeri's lab at the Massachusetts Institute of Technology (MIT) as part of the Center for Sensorimotor Neural Engineering's (CSNE) NSF-REU program to investigate how timing is represented in memory. I designed and ran a psychophysical experiment where human subjects recalled and produced time intervals from memory. I then developed a Bayesian inference model that could explain subjects' bias and variance in production times. Our findings suggest that the nervous system uses an internal representation of duration to calibrate and reduce variability in the production of accurately timed responses.

Behavioral psychophysics and computational modeling provide methods to study perception and sensorimotor action in humans. However, I also wanted to understand the underlying neural mechanisms that drive complex behaviors. Seeking to learn neurophysiology, I joined Dr. Joshua Dudman's lab at Janelia Research Campus (JRC) as part of the Janelia Undergraduate Scholars program to probe the neural representations underlying action selection. By recording extracellularly from neurons in the motor cortex and striatum of mice performing a directional reaching task, I found that while both motor cortex and striatum represented action choice, striatum showed more sensitivity to the kinematic parameters, such as velocity, of the action.

My experiences at BCM, MIT, and JRC equipped me with the skills necessary to articulate my research questions and to design robust experiments to answer them. I seek to continue pursuing my curiosities in the NYU Neural Science PhD Program, where I plan to build a broad, interdisciplinary skillset for conducting research on sensorimotor integration and decision-making at different levels of explanation. Many vibrant labs at NYU provide exceptional environments for the kind of graduate training I seek. In particular, Dr. Simon Peron and Dr. David Schneider's research resonates with my interest in understanding the cortical circuit computations and cell types involved in sensorimotor transformations. Dr. Nic Tritsch's research on the neural circuitry and role of dopamine in the basal ganglia resonates with my interest in understanding the circuit dynamics and computations underlying motor control and action selection. Finally, I am also interested in Dr. Wei Ji Ma's use of psychophysics and modelling to understand the computational principles underlying decision-making in complex cognitive tasks.

With access to the diverse expertise of faculty ranging from molecular biology to systems and cognitive neuroscience, the Center for Neural Science and Sackler Institute provide unique resources for investigating neural circuit function from an interdisciplinary perspective. I intend to make the most of this enriching environment by collaborating with experimentalists and theorists across disciplines during graduate school. As my next step in training, the NYU Neural Science PhD program will equip me with the skills and resources to conduct rigorous investigations of nervous system function that will reveal how the brain gives rise to behavior, and how knowledge of the underlying mechanisms can be leveraged to improve human experiences compromised by disease.

Lucy Lai
NYU Neural Science PhD Program Personal History Statement

Twenty-two years ago, my parents left rural China and came to the United States to look for new opportunities and a better life. Starting at minimum wage jobs, they worked hard in pursuit of the American Dream. In spite of our initial poverty, they always emphasized, in the words of a Chinese proverb, that “knowledge is true wealth.” Growing up, I held tightly to this mantra and greatly valued learning and inquiry. As a result, I never considered our economic status nor any circumstantial setback as a barrier to my intellectual interests.

In my junior year of high school, I was diagnosed with lupus, a chronic autoimmune disease that inflicted me with fevers, fatigue, and frequent visits to the hospital. While lupus limited my physical stamina, it could not limit my ability to ask questions. My physicians could not tell me *what* caused the onset of lupus, *why* lupus mostly afflicted young females of minority descent, or *how* my disease might progress in the coming years. But remembering that “knowledge is true wealth,” I decided to turn my unfortunate condition into a scientific quest. My desire to better understand lupus and chronic illness led me towards a high school research internship with Dr. Eyal Muscal, a rheumatologist and scientist at the Texas Children’s Hospital. With Dr. Muscal, I worked on a case report on a patient with a rare form of lupus-induced prosopagnosia, or the inability to recognize faces. The cognitive effects of lupus intrigued me, and so I began reading the literature on neurological disease. To my surprise, the more papers that I read, the more questions I conjured. It didn’t take long for me to realize that an abundance of basic mechanisms in the body and brain were still poorly understood. Driven by a curiosity to probe the unknown, I continued pursuing research opportunities in college.

Throughout college, I had the privilege of conducting research at various institutions across the United States, taking my spirit of inquiry everywhere I went. I became fascinated with the scientific process and found designing experiments and collecting data to be thrilling. Working together with scientists at Baylor College of Medicine, MIT, and Janelia Research Campus led me to appreciate the rigor and diversity of thought necessary for innovative discovery. I was captivated by the collaborative spirit of science, and felt inspired to begin sharing my work with other scientists. In my junior year, I had the privilege of presenting posters at multiple conferences. Talking about science and hearing about others’ work was invigorating, and only confirmed my desire to pursue a lifelong career in intellectual discovery.

One particular conference, Computational and Systems Neuroscience (Cosyne), inspired my interest in computational neuroscience. Convinced that theory unified principles of neural computation, I began adding quantitative courses in mathematics, statistics, and computer science to my curriculum in hopes of applying theoretical approaches to my research. In my junior year, I found myself to be the only undergraduate female sitting in my graduate-level machine learning class as well as in a theoretical neuroscience course. As I became increasingly cognizant of the gender disparities in science and especially in computational fields of study, I also became increasingly dissatisfied with the inequalities that still persisted in STEM education. Knowing that I would not be where I am today without the educational opportunities that my parents provided, I began engaging underrepresented minorities through BrainSTEM, an after-school neuroscience program in an underprivileged Houston neighborhood. Though BrainSTEM, I discovered my love for teaching. The meaningful relationships I have developed with my students allows me to especially invest in young girls by showing them that careers in science, math, and engineering are not just reserved for boys. As my goal of becoming a professor weaves my passions for research and teaching, I am eager to continue mentoring students and developing my teaching skills at NYU.

A simple Chinese proverb became my mantra in the midst of challenges and setbacks and continues to inspire me towards attaining a Ph.D. in Neural Science. Despite the reality of failed experiments and the levels of persistence and patience required in research, I remain driven by the satisfaction that comes from inquiry and discovery. Because “knowledge is true wealth,” I am eager to pursue an intellectually stimulating career and to instill the same spirit of inquiry in the next generation of researchers. As a neuroscientist and future professor, I wish to not only understand the brain but to also promote science and learning in my local community, reminding all curious minds that “knowledge is true wealth.”