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**Research statement**

I’ve always been fascinated about understanding how the brain and mind work. To fulfill this curiosity, I pursued degrees in the fields of psychology and neuroscience. The more I learned about these topics, the more amazed I became at how complex and fascinating the brain is. However, I also learned how distant we are from understanding the computations performed by neural circuitry. While the brain is very intricate and we don’t have general theories of how the brain works, the field of neuroscience is thriving and I believe how the brain solves complex tasks won’t remain a mystery forever. I’m curious to see what such theories will look like, and I want to study theoretical neuroscience so I can help us get there. My PhD will help me develop the advanced computational skills I need to become a proficient theoretician in neuroscience. These computational skills will allow me to not only collaborate with experimentalists, but also support my peers in their research.

My goal has always been to be a scientist, which is why I’ve dedicated a lot of my academic training into research. My first real taste of independent research was in my third year of undergraduate studies, where I was given the opportunity to be in charge of my own research project. My work afforded me a first-author publication in the Journal of Cognitive Neuroscience titled **“Modulating episodic memory alters risk preference during decision-making”**, where we found that engaging episodic memory processes increased preferences towards risky decisions. This work in cognitive psychology made me realize that my curiosity would be better fulfilled by understanding the brain at the systems level than at the cognitive level. I also realized that I yearned for more computational research, and for the opportunity to use the programming skills I had learned in my undergraduate studies. For these reasons, I started my Master’s in Curtis Baker’s lab at McGill University, where I used machine learning to predict recorded responses from the primary visual cortex. This research granted me a first-author paper in the Journal of Neuroscience, entitled **“Model-based approach shows ON pathway afferents elicit a transient decrease of V1 responses”**. This paper uses machine learning to show how primary visual cortex neurons have weaker inhibition to dark than light stimuli in their early, but not late, responses. This project helped me develop my expertise in both visual neuroscience and machine learning. It also made me realize that I would rather contribute to neuroscience through my computational than my experimental skills.

My curiosity led me to develop multiple computational skills during my undergraduate studies. I became especially proficient in statistics and in programming. This expertise put me in a great position to help my community and teach computational methods. During my Master’s, I taught a workshop about how to program in R to graduate students in the neuroscience program. I also tutored undergraduate students through their statistics courses. More importantly, my computational skills allowed me to become a resource my friends and peers would go to for help when they struggled to analyze their data. Helping many people has not only felt very rewarding, but also taught me the value of collaborations in research. What started with helping a post-doc next door to analyze her data eventually turned into designing a new statistical method. This project which granted me a second-author publication in PL0S computational biology, entitled **“Visual perception of texture regularity: Conjoint measurements and a wavelet response-distribution model”**. This experience taught me that helping others with their analyses is not only fulfilling, but could become an essential aspect of my research career. I plan to further develop my computational skills in my PhD, which I hope will enable me to pursue this endeavor of helping the people around me.

My Master’s allowed me to realize that my curiosity about neuroscience would be better fulfilled by theoretical rather than experimental work. This is why I started my PhD in Neurobiology at Duke University under the supervision of John Pearson. I study efficient coding, which is one of the most successful theories in neuroscience. This theory provides us with a mathematical framework to understand how neurons *should* encode information, which can then be experimentally tested against how neurons *actually* do so. Over the past 60 years, efficient coding has successfully explained many experimental findings in different sensory modalities such as vision4, 10, 15, 24, 25, 28, audition20 and touch23. This hypothesis has been especially successful in the retina, where it can explain many features of retinal encoding such as center-surround receptive fields and ON-OFF pathways2-4, 10, 15. However, we still lack efficient coding predictions for how the retina processes many complex features of the visual world such as color and motion. My work will tackle this problem by providing a theoretical account of how the retina integrates redundant inputs across different color channels and across time. The fellowship will be used to tackle the first aim of this project, where we will provide a theoretical understanding of how color is processed in the retina. More specifically, we will use efficient coding to explain why most neurons in the retina encode the difference between red and green stimuli. Completion of this project will result in testable predictions for efficient coding of motion in natural images, which we will be able to compare to experimental data from the Field Lab at UCLA. All my training obligations will be completed this Spring, which will really allow me to dedicate myself to my research in my 3rd year of my PhD studies. This training will teach me how to do research in theoretical neuroscience, and will be the first step towards my goal of becoming a proficient theoretical neuroscientist.

After I complete my graduate training at Duke, I want to pursue a post-doc with the goal of becoming a professor in theoretical neuroscience at a top university like Duke. I want to develop theories of how the brain works that not only apply to the retina, but to the brain as a whole. I am especially interested in studying computational models of inhibition and synaptic plasticity, and use such models to explain how systems (e.g. vision) process information. Combined with my current rigorous training in computational methods, my previous training in experimental neuroscience would make me the perfect candidate to collaborate with experimentalists and build theoretical models from their data.