I’ve always been fascinated about the brain and the incredible computations it performs. While most of the brain’s computations remain elusive, we know a lot about what the circuitry of the early visual system is and what computations it performs. The early visual system therefore provides us with a unique opportunity to design and test theories about how neurons process information. One such theory is the efficient coding hypothesis, which postulates that neurons should adapt to natural stimuli to efficiently encode information. For my PhD research, I want to use this opportunity and investigate how much of the known retinal circuitry can be explained by computational models built from efficient coding principles.

To do so, I will draw upon my research experience in both visual and computational neuroscience. My first real research experience was in the last year of my undergraduate degree in honors psychology at McGill University, where I was able to work on my own research. In my project entitled “**Modulating episodic memory alters risk preference during decision-making**”, we found that probing episodic memory in human participants reduced their aversion towards risky decisions. I’ve published this work as a first-author in the Journal of Cognitive Neuroscience.

Because I wanted to better understand the brain at the circuitry level, I then pursued my Master’s degree in visual neuroscience under the supervision of Dr. Curtis Baker at McGill University. In my research, entitled “**Model-Based Approach Shows ON Pathway Afferents Elicit a Transient Decrease of V1 Responses**”, I built a custom machine learning algorithm to analyze how recorded primary visual cortex (V1) neurons respond differently to light and dark patches within natural images. Using these methods, we showed that V1 neurons have weaker inhibition to dark than light stimuli in their early, but not late, responses. I’ve published this work as the first-author in the Journal of Neuroscience.

During my Master’s degree, I’ve also worked on a psychophysics project entitled “**Visual perception of texture regularity: Conjoint measurements and a wavelet response-distribution model**”. As the statistical expert within the team, my role within this project was to create an extension to an advanced statistical m https://www.overleaf.com/read/qvckdpgrnzzyethod to analyze our experimental data. I’ve published this work in PL0S Computational Biology as the second-author.

I am excited to now take my academic career to the next level by pursuing my PhD at Duke University under the supervision of Dr. John Pearson. We believe that the retina is built to efficiently encode natural images, and collaborate with experimentalists (Dr. Greg Field at UCLA) to investigate how much about the retina can be explained by efficient coding principles. More specifically, I am currently working on using efficient coding to explain how color is encoded by Long, Middle and Short wavelength cones in the retina. In the future, I would also like to use information theory to understand why it is optimal for neurons to be separated into excitatory and inhibitory subclasses (Dale’s principle; Osborne, 1979), a prominent feature of neuronal circuitry efficient coding has yet to explain. With my strong background in both visual and computational neuroscience, I believe I am in an excellent position to utilize information theory to shed light on why the early visual system is wired the way it is.