

Statement of Purpose

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I want to pursue a Ph.D. to contribute to our understanding of the human mind and how it processes information to make decisions. Through my undergraduate research, I have come to appreciate the importance of mental models and how it relates to the decision making processes and the power of computational techniques in many aspects of research ranging from coding experiments to conducting statistical analysis. During my graduate training, I hope to continue my line of research while becoming more proficient with computational tools, that can involve Bayesian and machine learning elements, and in the use of brain imaging tools. As such, I believe continuing my training in this institution with its faculty members is invaluable to fulfilling my career goal of becoming a professor.

Currently, I am working on my undergraduate thesis project¹ under the supervision of Dr. Britt Anderson. This project explores the relationships between changes in an internal model, confidence and pupil diameter. My participants were tasked to infer whether the shape or the color of the visual stimuli was relevant when making a decision to go ‘up’ or ‘down’, and indicate how confident they feel that one or the other factor is at play. After making their choice, they received a stochastic audio feedback where there was a small chance to be wrong regardless of making the correct choice. I manipulated the participants belief by alternating the relevant factor while I looked at their pupil responses when they made prediction errors. Of interest was comparing pupil response after experiencing an informative or an uninformative prediction error. I hypothesized that informative errors will elicit a greater pupil response. A secondary hypothesis I explored was whether confidence positively correlated with greater pupil response and belief change. This was done by manipulating the stochasticity of the feedback where, during certain blocks, the chance of an unreliable feedback was increased.

In the process of working on my thesis project, I developed a variety of technical skills. I became more skilled in the use of Python and the Psychopy library to code my experiment. I became more proficient with R programming to transform, visualize and analyze data. I applied parallelization to some of my Python codes to run tasks concurrently or to expedite a task. I learned to use an unfamiliar eye tracker (CRS LiveTrack), applying its code library and resolving bugs. And, I became more proficient working in the Unix environment and a variety of its tools to troubleshoot hardware issues and maintain a backup pipeline. I believe the skills I developed will be of value to both research and teaching assistantship. Although I'm most familiar with Python and R, I am confident I can efficiently adapt to different programming languages, such as MATLAB.

Although my interest in the human mind persisted since my childhood, my research experience only started during my third year at the University of Waterloo. Before that, I was on a two years leave to fulfill the South Korean military service requirement. I used this period as an opportunity to consider many career options (both academic and non-academic) and I invested time to read on topics ranging from military psychology, history, computer science, philosophy, behavioral economics, biology, and neuroscience. Ultimately, I decided to return to my undergraduate study with a galvanized will to continue a career path to become a scholar in the field of cognitive science. When I returned, I entered Dr. Britt Anderson's lab as a research assistant, and I enrolled in a directed studies course on statistics, supervised by Dr. Anna Dorfman, to prepare for my future endeavors.

In the lab, I assisted in two graduate student's projects, both involving eye-trackers (SR Eye-

¹https://github.com/sjp117/Undergrad_Projects/tree/master/mentalModelUpdatingPupil

link) and probability learning (PL). The first project investigated whether the manipulation of involuntary spatial attention can influence voluntary spatial attention. This was done by biasing participants to a region of a display with a spatial PL task and analyzing their voluntary attention tendency using the Tse illusion. The second project investigated what eye movements can reveal about mental model updating. It involved participants learning the distribution shape of how stimuli dots appeared on the surface of an invisible circle. We monitored eye behaviors such as dwell duration (time spent fixated on a stimulus) and saccade latency (time between stimulus onset and saccade initiation) when stimuli appeared in 'low' vs 'high' probability locations and when the stimuli distribution shape was changed ('wide' \leftrightarrow 'narrow').

Through a directed studies course, I strengthened my ability to work independently and I became more familiar with R programming through cleaning, mutating, visualizing and analyzing a diary data set. This data set was originally used to explore how people internalize events when writing a diary in either a self-immersed (first-person) or self-distanced (third-person) perspective. I used this data set to conduct my own exploratory analysis with my own post-hoc hypotheses. I learned to use packages to conduct quantitative discourse analysis, linear mixed effect modeling, and visualization. Alongside my final write up, I created a supplementary document walking through my analysis and visualization process; which is openly accessible².

It would be my pleasure to continue my training with faculty members such as Dr. Samuel D. McDougale and Dr. Ilker Yildirim. To this point, I explored how people use prediction errors to inform what contingent to attend to when making decisions. With Dr. McDougale, I envision exploring how we can computationally model motor action in the purview of reinforcement learning or other machine learning techniques. It would be fruitful to compare models focused generally focused on cognitive tasks with those that involve motor activity. With Dr. Yildirim, I envision conducting research into how we inform our mental representations (physical or not). What mechanism is involved in differentiating one physical object from another? And what it takes to change our representation of an object? Although I am interested in belief updating, I am not fixated on it. I am willing to take on a variety of projects, and I am willing to modify my research interest if suggested by a potential mentor.

²https://github.com/sjp117/Undergrad_Projects/tree/master/mixedEffectModelDiary