Modulating Cognitive Control

Cognitive control is defined as the process by which internal motivations govern behavior and allow us to adapt to meet the demands of each moment. It includes processes such as our capacity to restrain impulsivity, accommodate for unanticipated changes in the environment, and intentionally direct our focus and attention (Diamond, 2021). Otherwise known as executive function, cognitive control is necessary to regulate our behavior, as it allows us to complete goal-oriented tasks by informing our decisions and applying self-control. It also permits us to remain flexible when faced with unanticipated stimuli, avoiding rigidity in our responses to unexpected or infrequent situations (i.e., monitoring for pedestrians and oncoming traffic when attempting to make a left hand turn at a busy intersection).

Scientific literature suggests that cognitive control operates via two distinct modes (proactive and reactive), with the former being driven by internal factors and the latter being driven by external factors. Similarly, proactive control requires the active maintenance of goals, whereas reactive control occurs in response to changing environmental demands (Braver, 2012). Research has begun to explore whether shifts in cognitive control states can be experimentally modulated, which could have implications in a variety of domains, such as long-haul transportation, computer-human teaming, and in medical settings.

Despite recent advances in characterizing cognitive control states, less is known about their malleability. My research addresses this by investigating different experimental approaches to modulating cognitive control states in a controlled laboratory environment. If successful, we will extend our results to more applied settings and to special populations.

We test whether computerized tasks designed to promote either proactive or reactive control states can temporarily bias the use of a particular state and thus impact task performance. In particular, we use separate experimental conditions (ample or no preparation time) to assess if one context over the other leads to significant differences on a cognitive control state index. This index measures the degree to which we are in one of the two cognitive control states.

We hypothesize that the ample preparation condition will be associated with inducing a proactive control state, whereas a shorter or no preparation condition will be associated with inducing a reactive control state.

Ultimately, the significance of this research lies in its implications for human performance in a variety of domains, and applies specifically to elderly, pediatric, and clinical populations. Proactive cognitive control is crucial for successfully navigating our daily lives, yet it consumes our already limited cognitive resources. If we can leverage environmental factors, we can boost our use of proactive cognitive control, which can lead to safer decisions, especially in high-stakes settings. Our study already has IRB approval (#1607026) and is set to be published in the *Cognitive Research: Principles and Implications* journal once the data has been collected and interpreted as part of a Registered Report (https://www.cos.io/initiatives/registered-reports).

I am applying for this program because I have a fervent desire to impact people's lives in a positive way, whether it is solving a cutting edge research question, or being a support system for someone in need of a friend. I hope to diversify my life by building connections with people across all ages, cultures, and backgrounds. I am enticed by the study abroad component because this would allow me to immerse myself in other cultures, providing me with valuable insights and expanding my scope of knowledge.

I am confident that I am an ideal candidate for this program because I exert maximum effort in all I do. I am committed to excellence and perseverance, achieving distinction in my grades, despite challenging coursework. I truly pride myself on being a leader, and plan to enrich the lives of fellow students who could benefit from my experiences and findings.

Furthermore, I have been trained in the lab, earned my IRB certification, successfully collected pilot data, taken multiple STEM classes, conducted prior independent research, and gained the ultimate support of my PI. Key skills for a research scientist include patience, determination, and passion for their project. I believe that I possess these characteristics, and want to expand my knowledge base and contribute to my voracious curiosity, inspiring me to continue to ask questions and gain tools to find the answers to my inquiries.