**Interest**: We are living in an incredible time. There is an permanent international presence in Earth’s orbit and plans are being put in place to put humans on another planet. More than 3 billion, almost a majority, of humans have access to the internet—with unbelievable amounts of knowledge at our fingertips. Even for climate change there are beginning to be signs of a revolution in thinking, towards lower impact electric vehicles, restrictive emissions standards, and improved engineering to protect from weather changes that now appear to be inevitable. But despite these incredible technological changes I can’t help but feel that we are missing a crucial component. For all the improvement that we’ve gained there are still millions of individuals who experience major clinical depression, causing them to be unable to work, have serious health complications, and sometimes tragically to commit suicide. Autism spectrum disorder diagnoses continue to increase year-to-year, and the related focus-enhancing prescription drugs have become major drugs of abuse in university campuses around the world. Even Alzheimer’s disease, a dementia documented throughout humanity’s history, continues to be a plague on the final years of our population and there is no sign of a promising cure. It seems strange that we’ve made so much progress on one front and found so few major breakthroughs on the other.

I believe that in general our studies of the mind have fallen far behind our ability to generate new technological advances with computers. To be completely honest, we don’t understand how the mind works. We don’t understand how conscious experience is formed from neurons—and, perhaps even worse, there is a taboo against pursuing research on consciousness in psychology and neuroscience. If we want to understand depression, autism, and Alzheimer’s we desperately need a working theoretical model of consciousness. Unfortunately, there is a vast gulf of basic scientific knowledge that is missing before we can generate such a theory. Some of the missing components include pieces such as understanding how psychological processes like attention and memory link connect to perception, at what level of neural complexity (chemical, electrical, computational) consciousness operates, and models of how perceptual representations are stored in the human brain. These aren’t the flashy discoveries that will make headlines, but they are the foundational components of a theory of human consciousness. They are the basic scientific building blocks that we must pursue if we want to achieve an understanding of the mind in league with our other technological achievements.

**Background**: My long-term career goal is to become a professor. I hope to continue doing research and teaching in an academic setting. I believe this is the best environment to pursue basic research on the human mind because of the longer time scale of academic research, which reflects the slower pace at which paradigm shifts in thinking progress. My main professional objective is to continue to study cutting-edge problems in applied cognitive neuroscience, preparing the building blocks for a more major theory of human consciousness to be developed. Secondary to that I plan to immerse myself in the scientific community, publishing papers, attending conferences, and collaborating on integrative research projects that span multiple disciplines. Third, I want to develop my ability to share and generate enthusiasm surrounding my field and the study of consciousness—it is imperative that scientists combat the taboo against research on consciousness and I hope to be a part of the new wave of researchers who can look towards a future where we do have a theory of consciousness.

My interest in consciousness finds its genesis in the research and studies that I performed as an undergraduate. Over the course of four years I took classes on basic neurobiology, neuro-pharmacology, programming in Java and MATLAB, and about human visual perception. The breadth of classes was formative for my understanding of the mind, they forced me to see the mind at three entirely different levels: the “wet” level of neurons and neurotransmitters, the psychological level of human experience, but also that algorithmic level of machine computation. Although I didn’t realize it until later, my broad background at Cornell has helped me to realize that the mind cannot be understood at a single level, and solving consciousness will never be a single researcher’s success—it will have to be a collaborative and integrated effort across all of these fields.

Before pursuing graduate work I took time off to improve my skills as a cognitive neuroscientist as well as to pursue a personal interest to learn and live in a new culture. Prof. John-Dylan Haynes research group in Berlin, Germany was an ideal climate for succeeding in both of these goals. Prof. Haynes gave me the opportunity to work on an exciting and challenging research opportunity, looking at whether our intuitions about decision making are reflected in our neural processing. We experience many decisions about motor movements as final and instantaneous, but Prof. Haynes had previously shown that early brain activity could be used to predict an action 8 seconds in advance of the movement itself (Soon et al). We wanted to further study this process to understand how late a person might still be able to “veto” their movement in real time. To understand this question we devised a predictive brain computer interface, which monitored a subject’s EEG patterns in real time and fed back a signal whenever it predicted an upcoming movement. We found that up until 200 ms before movement onset participants would see the signal and then entirely cancel their movement, showing now overt sign of movement (such as muscle activity). After 200 ms though, it was impossible for them to cancel the beginning of their movement, although they were often able to stop the movement prior to completion. Comparing our results with a computational model (Schurger et al.) show strong similarities, confirming that our result may indeed be the last “point of no-return” within the brain before efferent neural activity is sent to the muscles. We have since presented this work at two conferences, OHBM 2015, and at ICON-XII in 2014, and at the time of this submission our manuscript is in revisions at PNAS. The entire process, from formulating our research question, finding appropriate technological resources to create a brain-computer interface, analyzing data, and finally creating a publishable paper, has been an enjoyable and immensely rewarding experience.

My research this past year at Stanford has focused on how attention is related to consciousness. We have an undeniable feeling that when we attend to something we are immediately aware of it. Nevertheless, in the laboratory we can easily manipulate this to induce blindness despite attentional focus. My main focus is on showing that to understand attention we must work at all three levels: neurobiological, psychological, and computational. Several decades of fruitful psychological research on attention have recently stalled because of an experimental paradigm known as inattentional blindness. In this paradigm attention to one feature, such as motion, sometimes destroys the perception of a second feature like color or scene gist. But researchers have found a number of paradoxical effects, for example attention scene contrast impedes the perception of motion, but not vice versa. Psychologists have long explained these paradoxes as effects of stimulus properties like size, but we have found an elegant neurobiological explanation. In my experiment we have shown that the physiological responses in areas V1 and MT, recorded with BOLD fMRI, are of the correct magnitude to explain the behavioral effects we observed—in other words, the brain activity in V1 and MT are likely the representations of contrast and motion perception, respectively. We also found that a simple anatomical property, the hierarchical organization of the ventral visual stream, is sufficient to account for our results. Because the representation of contrast precedes motion and therefore projects information into the representation of motion, we predicted that changes to the representation of contrast, due to attention, would corrupt the representation of motion. Our model predicted our data well, and also predicts many of the other paradoxical effects observed in the literature, that previously could not be reconciled. We are now preparing materials to present at conferences in the coming year, and we plan to publish this work in the future along with additional confirmatory experiments that will be obtained this fall. This project encapsulates the research program that I hope to develop over the next four years as I continue my research as a graduate student: working at the neurobiological, psychological, and computational levels as an integrated process, and learning about consciousness as a brain phenomenon, not just a psychological one.

**Impact**: In twenty years, in about 2035, we are expected to launch a human mission to mars. It doesn’t seem unreasonable to expect that we will have figured out depression, autism, and Alzheimer’s at that point as well. But we can’t achieve these goals if we don’t develop a basic understanding of consciousness: how does a neural system integrate information across spatial and temporal scales to generate the perception of a conscious being? I believe this goal is achievable and that the taboo against consciousness research needs to be torn down and replaced by a desire to achieve basic scientific advances—like learning about the role of attention and memory in consciousness, developing computational models to aid our theoretical understanding, and furthering our knowledge about neuroanatomy and the potential role neuron types and neurotransmitters play in computing the mind. I am committed to this goal, and I am also committed to reaching out to other scientists and future scientists and encouraging them to pursue this goal as well.

I have always had a passion for explaining things and have been working as a private tutor since undergraduate. I have continued tutoring French, programming, and statistics for high school students over the past year since arriving at Stanford, and will continue to do so for the foreseeable future. In 2016 I will TA for two courses: an introductory cognitive neuroscience class aimed at undergraduates, and a similar course aimed at graduate students. Both of these classes will be my first opportunity to encourage students to pursue similar research programs to my own. In particular I hope to encourage students who would otherwise write off the computational side of cognitive neuroscience or who are less interested in the neurobiological aspects that an integrative approach is

An NSF fellowship would further strength my position and provide me with crucial support in my goal of becoming a world expert in consciousness studies as well as an academic professor. In the end I hope to make a meaningful contribution to our understanding of consciousness and spur future scientists to pursue research on the mind. Receiving the NSF fellowship will help make this possible.