I clearly remember, while I was doing a rotation through labs at the University of New England during high school, the first time I examined a small piece of brain tissue. I felt a profound feeling of awe knowing that all of our thoughts, emotions, and ability to love were embedded in this tissue. This motivated me to pursue an undergraduate degree in neuroscience at BU.

As a sophomore, I began working in the lab of the late Dr. Howard Eichenbaum and Dr. Michael Hasselmo researching learning and memory in rodents. The project used in-vivo electrophysiology to study the dynamic hippocampal representations of context. I was fascinated by the electrical language of the brain. I learned quickly that research requires improvisation and that there are no set guidelines to follow when trying a novel approach. I helped build an automated maze and implantable micro-drives. Instead of ordering these devices pre-made, they were constructed from scratch in the lab. I remember turning tetrodes deep into the brain until the hippocampus would reveal itself through its theta rhythm. The resulting recordings showed changing hippocampal representations of context, which was theorized to promote behavioral plasticity in changing contexts.

The next major influence on my research interest was taking a class with Dr. Alberto Cruz-Martín and learning that his lab was focused on understanding the genetic mechanisms underlying neurodevelopmental disorders. I contacted Dr. Cruz-Martín to let him know of my strong interest in this research and I began assisting in experiments to support the project. His lab had found that mice overexpressing the schizophrenia-associated gene C4 displayed a decrease in dendritic spines during development, and we hypothesized that microglia played a role in this. In order to study microglia-dependent synaptic engulfment, we conducted experiments that combined co-localization of molecular markers and expansion microscopy. This co-localization suggested that increased expression of the immune gene C4 enhanced microglia-dependent phagocytosis of synapses. I was awarded a grant from the BU Undergraduate Research Opportunities Program (UROP) to support my research and the findings were later presented at SFN. This experience solidified my passion for research and that I wanted to pursue a career as a scientist.

Although I knew a PhD was my ultimate goal, I believed that I would be better prepared for a doctoral program with additional experience. Therefore, after graduation, I remained at BU as a lab manager for Alberto's group. In the lab, I focused on understanding the neuronal circuits that underlie social behaviors in rodents. More than 50 years of research implicate the anterior cingulate cortex (ACC) in regulating emotional and social behaviors. However, it is not clear how local microcircuits within the ACC process emotional information. Information flowing through the ACC is shaped by patterns of excitation and inhibitory drive. Additionally, in several cortical regions, this inhibitory type regulates pyramidal cell activity through di-synaptic inhibition. Therefore, I decided to focus on Vasoactive intestinal peptide-expressing (VIP) interneurons in the ACC (VIP^{ACC}). I began leading a project that used miniaturized fluorescent microscopes (miniscopes) to record Ca^{2+} activity in cells expressing GCaMP6. Using this approach, I found that VIP^{ACC} responses were more diverse than I had ever envisioned, I identified subpopulations of VIP interneurons that responded to anxiogenic, social, and non-social stimuli. I found that these subtypes were stable within a single trial, but within hours or days, there would be a shift in the cells that represented these stimuli. This is an important finding on its own because previous research that studies unstable neuronal representations has only focused on pyramidal cells. Interestingly, recent studies suggest that this neuronal instability might be important for efficient coding of information by neuronal networks. Additionally, my data suggest that underlying stable representations and memories there might be highly unstable inhibitory microcircuits. My manuscript, titled *Distinct VIP interneurons*

in the cingulate cortex encode anxiogenic and social stimuli is currently under revision and a preprint can be found on *bioRxiv (**Johnson et al. 2020**)*.

It was important to find ways to keep the research moving during the pandemic. When I had to stay home for months, I used it as an opportunity to improve my programming skills and learn to implement complex algorithms to decode behavior from neural activity. To look at VIP^{ACC} Ca^{2+} data in different behavioral contexts, I utilized animal tracking software DeepLabCut to align our calcium activity with behavioral data. I am currently working on a second manuscript titled, *Neuronal representations of social behavior in the anterior cingulate cortex* (*Johnson et al., in progress*). As part of this manuscript, I am examining how VIP interneurons activate when both the stimulus and the experimental animal are freely moving in a chamber – studying social behavior in an even more naturalistic setting.

I view mentorship as an essential component of science. As an undergraduate, I received advice from multiple great mentors, who helped me balance work, school, and life at an urban campus. While my GPA reflects that my first year at BU was a time of transition, I am grateful for the advice I received. My academic record improved each year while I simultaneously took on more research responsibility. As lab manager I gained experience in mentoring others, teaching both undergraduates and graduate students how to perform surgeries and analysis. My time with Alberto's group best reflects my ability to successfully balance research, lab management, mentoring, and course work.

I know that earning a PhD requires resilience and a strong interest in the subject matter. The past 12 months have heightened both for me. I was diagnosed with acute lymphoblastic leukemia and then experienced a neurotoxic reaction to a chemo drug that left me cognitively aware but unable to move or speak for several days. I was determined and worked hard at my rehabilitation, which is nearly complete, learning to speak and walk again. This experience deepened my appreciation for brain plasticity and the importance of neuroscience in human health. I am currently in remission and back at work, finishing the last revisions of our resubmission and working on the second manuscript. My motivation to achieve my career goals is greater than ever and I will make the most of every opportunity presented to me.

My goal as a PhD student at Brandeis would be to continue my research on neural circuits while building the skills needed to pursue a career as a successful and independent scientist. Brandeis would provide an excellent opportunity to build on my interest in this area. I would like to rotate in the labs of Drs. Christine Grienberger and Shantanu Jhadav to further dissect the roles of hippocampal circuits. I have already been in contact with Dr. Grienberger about my interest in her research and the overall program at Brandeis.

On top of the Grienberger and Jadhav labs, I am interested in rotating through the labs of Drs. Gina Turrigiano and Stephen Van Hooser to further explore neuronal circuit formation and maintenance. I think this exploration could best be accomplished by combining traditional research with mathematical modeling. At Brandeis I would have an opportunity to further my knowledge of models of biological systems and data analysis techniques with the quantitative biology program. The Neuroscience PhD Program at Brandeis offers the combination of faculty whose research interests match mine and academic programs that include quantitative training making it my top choice for a doctoral program.

My goals as a scientist are to find and create solutions for problems in the nervous system that are affecting people today. I believe that the best way to achieve this is through multidisciplinary approaches that combine cutting edge techniques for data acquisition and analysis. The PhD in Neuroscience program at Brandeis would give me the opportunity to grow immensely in both these aspects.