Educational and Professional Experience. At Oberlin College, I absorbed myself in a wide variety of disciplines before discovering, in my final year, that neurobiology was the perfect fit. First came philosophy, which I chose as my major. I was fortunate to have found deep interest in truly everything I had studied in my first year, from modern philosophy to psychology to Japanese religious thought, and it seemed to me that through philosophy my studies could touch upon many of these more specialized fields. Midway through year two, I added an interdisciplinary concentration in cognitive sciences, which would give me access to some upper-level courses in psychology, neuroscience, and music theory that are normally reserved for majors. After taking *Human Neurobiology* and *Psychobiology of Emotion*, I became captivated by the biological basis of mind.

However, due to financial hardship I was forced to withdraw from Oberlin after five semesters. Determined to continue my education, I stayed in town for three years, working first as a house painter and then as a full-time cook. During that time, I read popular books on affective neuroscience and sat in on courses in developmental neurobiology and the evolutionary origins of life. I also began working for It's All Live, an after-school tutoring program based out of Oberlin that serves families from underadvantaged communities in the greater Cleveland area. Therefore, my time away thankfully had some **broader impacts**. Upon turning twenty-four, I became eligible for a generous financial aid package that allowed me to return to school. I was overjoyed.

In my first semester back, I began to focus more intently on the cognitive sciences curriculum, since my philosophy major was nearly complete. Although initially the mathematical component of the neurophysiology course I had chosen seemed daunting, I got up to speed and quickly developed a profound interest. Knowing that my next step should be *Studies in Neuronal Function*, an intensive laboratory course in electrophysiology, and that my only shot at it was one semester away, I successfully lobbied for a seat in the prerequisite *Neuroscience Laboratory*, which very much resembles the neurobiology lab course I am currently teaching at Yale.

Studies in Neuronal Function represented a turning point in my career goals, particularly during the latter two-thirds of the course, which required an independent research project in basic neurophysiology. I chose to follow up a prior report on depression of the crayfish neuromuscular synapse by caffeine. The results were surprising because all known mechanisms of caffeine's action were excitatory. To begin exploring the hypothesis that depressant effects of caffeine were mediated by presynaptic binding of ryanodine receptors (RyR), I performed intracellular recordings from the muscle fiber while stimulating axons of presynaptic motor neurons, and then tested whether a RyR-specific agonist could mimic the effect of caffeine. The RyR agonist induced opposite effects at different concentrations, and thus results were inconclusive regarding the mechanism of caffeine action. However, a consistent and substantial postsynaptic depolarization was observed after applying caffeine, and I used what I had learned in *Neurophysiology* to determine that most of the reduction in junction-potential amplitude could be explained by reduced driving force on the sodium ion at these depolarized potentials. The process of synthesizing book knowledge with first-hand observations of a living system in action was exhilarating.

Concurrently, I was completing an **honors thesis in the philosophy of mind**. My thesis focused on Representationalist theories of consciousness, which attempt to reduce conscious experience to psychophysical representation of external, objective properties. After surveying scholarly work in the field, I argued that leading versions of Representationalism leave essential aspects of first-person phenomenal consciousness unexplained, leading to the persistence of what

Joseph Levine describes as an “explanatory gap” regarding sensory qualia. Although pleased with the results of my effort, I felt strongly that the most important factor limiting progress in the study of consciousness was how little we know about how the brain works. I became set on making a contribution to neurobiological research. However, I was also convinced that my choice to pursue a diverse undergraduate curriculum, including a strong humanities background, would only strengthen my potential to make **broader impacts** through a scientific career.

Following graduation, it quickly became apparent that my aspirations would require grad school, and that in order to get into grad school I would need to begin work in a lab. Frustratingly for me at the time, it seemed that I could not find work in a lab without first going back to school. After securing a full-time post at a local hardware store, I began looking for coursework that would help fill the gaps in my biology background and set me on track toward a job in neurobiology. Fortunately, William Paterson University of New Jersey was only a twenty-minute drive from work, and through its biotechnology department offered some intensive methods training in molecular biology. After completing *Biotechnology: DNA*, I moved on to *Biotechnology: Proteins*. My success in these courses was encouraging, and I resumed my search for a position in research.

Early in 2010, I was privileged with the opportunity to join the **lab of Klaudiusz Weiss and Elizabeth Cropper** at Mount Sinai School of Medicine. With invaluable guidance from my mentors, I spent **three and a half years** studying neuromodulation in the feeding system of *Aplysia californica*. My project focused on neuromodulatory mechanisms of behavioral flexibility. Using whole-cell and extracellular electrophysiological methods, I explored mechanisms that allow the same feeding central pattern generator (CPG) to drive ingestion or rejection of food objects depending on the animal’s internal state. Previous work had identified two important sensory inputs, one signaling the presence of food (CBI-2), and the other signaling esophageal stretch (EN), that each release different complements of neuropeptides in addition to conventional synaptic transmission. I hypothesized neuropeptide-mediated reconfiguration of the local network to be a mechanism for direct encoding of recent sensory experience within the feeding CPG. After discovering a local interneuron capable of eliciting feeding motor patterns independent of sensory input, I tested this hypothesis by locally activating the CPG following stimulation of either CBI-2 or EN. I found that prior stimulation of CBI-2 or EN transformed locally driven, neutral motor patterns into full-fledged ingestive or rejection-like patterns, respectively. Bath application of the neuropeptides released by each input mimicked its effect, in confirmation of my hypothesis. Next, I recorded from local interneurons and found that subsets of these neurons showed peptide-mediated excitability changes that could explain the changes in behavioral output. Thus, the choice between two opposing behaviors depends on a representation of recent experience that is local to the CPG, and is encoded in the membrane dynamics of specific interneuronal subtypes. A report of these findings is in preparation.

My work at Mount Sinai also led to fruitful collaborations with other scientists. With assistant professor Jian Jing, and with Andrew Dacks, now an assistant professor at West Virginia, I **co-authored three reports in the *Journal of Neuroscience***. Jian has since moved to Nanjing University in China, and during my last year at Mount Sinai I contributed to an **international collaboration** with his laboratory there, for which I earned my **first lead-authorship** (see Publications). I also presented most of our results in a poster session at last year’s Society for Neuroscience meeting. In an wonderful twist of fate, Ruonan Jia, one of my Chinese collaborators whom I had never met in person, has now joined our program at Yale.

Moreover, **broader impacts** of my work in the Weiss and Cropper Lab include development of expertise with a model system that will in the future serve as an excellent teaching model: we know enough about the central nervous system of *Aplysia* to demonstrate basic principles of neurophysiology from the systems level on down to molecular transduction pathways. Yet there are still so many interesting questions left to study that such a model system can form the basis for the highest level of independent research.

Choice of Program. The Interdepartmental Neuroscience Program (INP) at Yale will provide both a solid intellectual community and ample opportunities for **broader impacts**. The student experience is extremely interactive, with bi-weekly student research talks that build valuable presentation skills, as well as keep us up do date on the progress of our peers. Opportunities for leadership are plentiful. For example, I have been moderating our journal club, which is attended by about 40 students, since the start of this year. I also took a lead role in organizing NeuroDay, which is our annual neuroscience expo, attended this year by over 300. Robert Krulwich, a fellow Oberlin Alum and science journalist, accepted my invitation to give a keynote address on communicating science to the public. Additionally, 250 t-shirts I designed for the event are now being worn all over New Haven, bringing greater attention to brain science. Since the t-shirts were such a hit, I was invited to design the banner for our recruitment table at this year's Society for Neuroscience meeting in DC. Through INP Outreach, I have also had the opportunity to give fun neuroscience related demonstrations at local schools. This year I will give out brain t-shirts!

Choice of Lab. The Kwan Lab is an ideal match for my research interests, and Dr. Kwan provides the perfect combination of insightful guidance and constant challenge. Last winter, I approached him about pursuing my interest in behavioral flexibility using some of the *in vivo* physiological methods he had pioneered in his post-doc at Berkeley. When I arrived in the lab I had no experience whatsoever with rodent behavior, was a novice with control systems, and had done very little programming. Within a month, I had succeeded in developing a simple paradigm for exploring behavioral impulse control, had wired and programmed a feedback system for detecting and rewarding specific responses, and could write enough code in MatLab to develop a computational model of response timing based on my behavioral data. Since then, I have learned to do a lot more (see Research Plan). Dr. Kwan's depth of knowledge in engineering, optics, neurophysiology, and behavior has already stimulated profound growth in my own knowledge and skill set. Just as importantly, however, his mentorship has greatly expanded my expectations for the kind of research I will be capable of accomplishing en route to a Ph.D. Moreover, through the Kwan Lab I have already been given three valuable mentorship opportunities of my own. For the past nine months, I have been training a senior pre-med student, Marc Lozano, in rodent behavior and analysis; this year's experiments will lead to his senior thesis. Last spring I also worked with a first-year economics major, Kevin Pirruccio, who has been seeking more exposure to behavioral science; he will be back again this spring. Over the summer, I taught rodent behavior to a recent Southeastern University psychology graduate, Rachel Hannibal, who is now at Harvard pursuing an Ed.M in the Mind, Brain, and Education program. In the future, she plans to teach adults with cognitive/behavioral disabilities.

Additional Outreach. In March I taught human neuroanatomy to groups of 6-12th graders as part of the Pathways to Science program's Brain Education Day. Next year, I will collaborate with my mentor, Dr. Alex Kwan, to develop and lead a new module for Brain Education Day, in which students will have their EEG recorded during a choice of activity, and will go home with a colorful spectrogram representing their own cortical rhythms.