Daniel Strouse **Personal Statement**

My goal is to become a university professor and combine my quantitative background and collaborations with experimental neuroscientists to model the biophysical mechanisms of learning and memory in human brains. This was not always my goal, however. As a child, I fell in love with mathematical problem-solving but had no idea that it formed the basis of science. My conception of science involved men in lab coats, dutifully and unthinkingly carrying out the precise, reliable, and logical "scientific process." I wanted to solve problems that required creativity, ones that no one knew how to solve and that would have an impact on society.

As I entered college, I discovered such a problem – the unavailability of clean drinking water in many countries outside the US. From fall 2007 through spring 2008, I co-led a team of engineering students in designing and implementing a water pump in a Honduran village through the Engineers Without Borders program. Excited that I could apply my love of problem-solving to make an impact in the lives of others, I sought to expand our efforts and organized an interdisciplinary team of engineering and health sciences students to perform a similar project in India. After successfully securing a grant through the new USC Global Impact Program, we spent the summer of 2008 in the Hubli-Dharwad district of Karnataka. The engineers and I assessed, acquired, and distributed appropriate water filtration technologies while the health sciences students designed a supplementary sanitation education program. The rapidity with which our project progressed convinced me of the value of interdisciplinary work. Our diverse set of interests and skill sets, united under a shared goal, allowed us to tackle just about any problem we encountered. The project also turned out to have even more of an impact than I had expected and hoped for. Since 2008, our sanitation education program has spread to five additional schools, our water filter distribution efforts have expanded into a microfinance program with access to over 3000 self-help groups serving thousands of women in hundreds of rural villages, and additional community-level water systems, including a rainwater harvesting unit and reverse osmosis system, have been constructed to supplement the household filters.

Upon returning to USC that fall, my naïve stereotypes of science were shattered by what, in retrospect, was the most important class I ever took – an introductory electricity and magnetism course with Professor Paolo Zanardi. Using only a few simple principles and the creative mathematical problem-solving that I had fallen in love with as a child, we explored the physical mechanisms behind coaxial cables, Faraday cages, and magnets. Moreover, the ideas we encountered provided the basis for just about every piece of technology I could name – from the water filters and pumps I had watched change lives in India and Honduras to my personal laptop. It finally became clear to me that science was not only highly creative but also offered a powerful way to improve society. I had found my calling. Professor Zanardi invited me to join him for research the following summer,[1] and engaging with problems that *no one* knew the answer to only confirmed my growing intuition – science was the career for me.

My fascination with problem-solving and appreciation for physical mechanisms led me to wander how my brain actually works. When I think about math, which molecules wiggle? How are the things I learn embodied in my brain? Is it possible to understand the mechanical basis of the human mind just as we had done with cables and magnets in my physics course? I had never felt so consumed by a series of questions and searched for a neuroscience group at USC who might have need of a physicist. Working with Professor Ted Berger's synaptic modeling group[1] confirmed to me that (1) it was indeed possible to understand the physical basis of the brain, (2) a background in physics and mathematics was quite useful in doing so, and (3) seeking the biophysical mechanisms of learning and memory was exactly the science I wanted to pursue.

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[1] See "Previous Research Experience" for further details.

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Research had become my passion, but there was more I wanted to do. My project in India and collaboration with the biologists in the Berger lab had demonstrated to me the value of interdisciplinary problem-solving, and I wanted to encourage such collaborations in science. Also, my initial naivety about the process of science drove me to want to convey the excitement and creativity of research to students and the public. In pursuit of both of these goals, a friend and I built an online suite of project management tools called CoLab[2] to promote open, collaborative science on the web. More specifically, we aim to support online discussion around any piece of scientific content, including data plots, experimental protocols, published papers, papers in progress, and code. I believe that relocating the daily discussions of science to the web will make it easier to maintain current collaborations as well as form new ones. Online science can also increase the participation of minority researchers and those in less-developed nations by decreasing the geographic barriers to research collaborations. Furthermore, Colab presents an interesting new form of publication. Whereas journals focus on sharing the highly polished results of science, CoLab encourages sharing the ongoing process. Doing so can provide researchers with a more complete and real-time picture of their fields. In addition to helping scientists, online open science gives students and the public direct access to a live record of the scientific process, which could revolutionize science education and the public understanding of how science is actually done. We launched CoLab this summer at the Open Science Summit 2010,[3] received plenty of feedback, and are currently working to improve the site (which is, appropriately, open source). That we already have over 150 users and have received dozens of requests to help with development conveys to me that many scientists are just as excited as I am to promote collaboration and public outreach through online science.

While I look forward to a future in which students and the public follow live feeds of activity directly from their favorite labs, I currently communicate my own research projects and lessons about doing science through a personal blog.[4] I have shared my thoughts on the future of open science, the connections between physics and neuroscience, how to navigate a scientific paper, my strategies for teaching myself new things, and plenty more. I also began experimenting with "progress reports" during my time at IQC this past summer,[1] and the comments and questions I have received from friends (both in and out of science) has encouraged me to continue. During my graduate studies, I plan to expand my blog to include short video lectures on my thesis research, lessons about doing science, and topics in physics and neuroscience that I feel are not addressed well in standard textbooks.

Though my focus is on research, the science I want to do and the life I want to lead are inseparable. I would like to become a professor and share my passion for discovery with eager young minds. Through collaborations with experimentalists and training in physics and math, I want to further our understanding of the brain, capture it in quantitative models, and apply these models to understand and treat learning and memory disorders.[5] Through CoLab and other open science efforts, I hope to have an impact beyond my own research by improving how science is done, shared, and communicated to the public. The NSF fellowship would grant me the freedom to pursue my interdisciplinary research without the constraint of funding from a single home department or advisor. Moreover, the freedom from earning funding by other means will enable me to continue promoting open science and public outreach through CoLab and my blog.

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[2] www.colabscience.com
[3] See http://fora.tv/2010/07/29/DJ_Strouse_and_Casey_Stark_CoLab for a video of our presentation.
[4] www.djstrouse.com
[5] See "Proposed Plan of Research" for further details.