



# GRAND CHALLENGE SCHOLARS PROGRAM PORTFOLIO: BECOMING A NEURAL ENGINEER

GRAND CHALLENGE: REVERSE-ENGINEERING THE BRAIN

This portfolio is submitted in partial fulfillment of the Grand Challenge Scholars Program.

## BECOMING A NEURAL ENGINEER/INTERDISCIPLINARY EXPERIENCE

When I was applying to colleges four and a half years ago, I decided I wanted to major in neural engineering. Inspired by a class in philosophy, I wanted to understand the basis of human thought, behavior, and consciousness at the most fundamental level possible. I wanted, specifically, to make a human brain from the bottom up by understanding human brain signaling. So when I came to Olin College, I took advantage of the Engineering: Concentrations major, which allows students to architect their own engineering-related majors with the help and approval of professors. Leveraging Olin's partnership with Brandeis to take advanced neuroscience classes as well as the expertise of Olin's engineering professors, I designed my own interdisciplinary concentration in Neural Engineering.

Even before I arrived at Olin, a bit of basic research revealed that reconstructing the human brain was a much bigger project than I had envisioned: brain circuitry is neither fully understood nor generalizable as a set of specific circuits. Regardless, I bravely set out in all directions at once: designing my major based on a combination of other universities' curricula, I took cognitive neuroscience, systems engineering, signals and systems, programming, circuit-based classes, various math courses, and modeling courses. In each of these classes, I sought connections between the disciplines: in modeling courses, I thought of circuits that produced similar curves. I tried to draw my knowledge of brains into projects for my engineering classes. However, by the end of the first semester of my senior year, I felt that my major was too disparate and disconnected: I had engineering knowledge; I had brain knowledge; and I had little crossover.

However, in my last semester, I started taking a course on Biomedical Materials, and chose for my review project to study neural prosthetics for vision. And as I read through paper after paper, I saw the concepts I'd learned over the course of my time at Olin starting to come together: circuit concepts, knowledge from the anatomy of the brain, the electrical shape of neural signals I'd modeled. I realized suddenly that my major had been cohesive after all, and that I had come much closer over the course of my study to being able to reconstruct brain signals and components of the human brain.

For the next few years, I plan to read more scientific papers on neuroprosthetics while working at an engineering job, saving up money: in a few years, I hope to go to graduate school to further my exploration of brain reconstruction, particularly in the area of neuroprosthetics. I have the grounding now to know where to start.

## ACTIVE PARTICIPANT'S REFLECTION

Over the course of my Olin career, I have been extremely involved in various aspects of student life: chairing and being an active member in the Student Activities Committee;

directing, costuming, and acting in student theater productions; founding Orienteering and Fiber Arts clubs. However, the community involvement which I am most proud of in my Olin career has been as Editor in Chief of Frankly Speaking, Olin's unofficial, unaffiliated student newspaper.

Frankly Speaking was begun in September of my sophomore year, with the intention of starting conversations within the Olin community, and it has been an incredible success in its mission to start conversations. At first we had to make the argument that a newspaper was necessary. The following quote is from an article I wrote for the paper over a year ago, entitled "Do Something with Frankly Speaking":

Most of Olin's written communication takes place over email. Important issues are brought up and discussed on [Olin student email distribution lists] ThinkTank, Radical Notion, even Therapy and Sexuality. But there are two major problems with these email lists as public forums: they are self-selecting, and they are not fully developed as pieces of writing.

Frankly Speaking reaches a broad audience. It's not just students who read our paper, but faculty and staff, administrators, some of the general public, and even students from other colleges. I know they read it up in OSL [the Office of Student Life], because they sent me corrections from last month's issue (see the Errata). And that's just the paper version. If you're looking for reach, the newspaper will get there.

Discussions such as the value of the scholarship [Olin provides a substantial scholarship towards every Olin student's tuition], gender issues, and course requirements have all been discussed on mailing lists. And it's good that discussion happens there; information is shared and opinions are formed.

But list discussions are transient, and the outcomes of long and involved discussions, more often than not, recede to the backs of people's minds and list archives rather than being acted upon. Publication in the newspaper is the final step: if you reason out an argument, it's time to get the broader community in on the discussion. And that's what this newspaper is for.

The other benefit to a published medium is that an author must think arguments out and figure out how to communicate the idea to other people. You have to think hard to write. And if you [the author] get it, as roughly as necessary, out of email or out of your head, send it to us. We'll help you think about how to phrase your thoughts so that you are writing good, clear English and expressing yourself.

Since then, Frankly Speaking has become a living organization: we have four monthly columns, specialized editors for layout and content, regular writers- and better yet, new authors nearly every month. I love distributing at midnight as each new month starts; I walk around the dorms and students take copies of the fresh newspaper from my hands and immediately start reading. The next morning, in the Dining Hall, I overhear arguments and conversations sparked by words written by classmates, articles I worked on, curated, and published. And each month, my peers reach out to me and ask: "Can

this go in Frankly Speaking?" The newspaper is a place for students to speak frankly to the community at large- and as an unofficial and unaffiliated organization, we can edit for clarity and phrasing without censoring even inflammatory issues. Through Frankly Speaking, I have brought to life a vital piece of Olin's communication culture.

## ENTREPRENEURIAL EXPERIENCE

My primary entrepreneurial experience over the course of Olin has been my work with the short-term startup The Midnight Bakery, supported by the Olin College Foundry program. Although the Bakery was actually founded by Hannah Sarver and Samantha Becht, I was a part of its conception. Near the end of our first year at Olin, Hannah and I were looking for work experience over the summer, and particularly excited about the idea of using skills and interests we had already cultivated and turning them into a profitable venture. Hannah and I spent a lot of late nights in the kitchen, baking experimental cookies and cupcakes and then running around the dorms handing them to whomever was still awake and working. That passion for cooking and for bringing baked goods to stressed, studying students were what drove the mission of the Midnight Bakery. I went in a different direction for that summer, but Hannah and Sam began the startup, based around anytime delivery of delicious baked goods. I was involved in initial communications with health regulations representatives, and then joined the Bakery in September. There were around seven of us involved in the Bakery over the two years that it ran, and we were all bakers. Over the course of the project, we learned about scalability and bulk goods purchasing, shipping constraints regarding perishable and breakable foods, state and federal regulations, customer service issues, even taxes. However, I learned that although starting a business seems like a gigantic and frightening venture, it isn't really far out of reach to take the first steps. The experience demonstrated to me that (despite the example of almost every previous Olin startup), entrepreneurship does not require the invention of a novel concept or the design of a new product. It requires a purpose, passion, and a willingness to work.

## GLOBAL AWARENESS/SERVICE LEARNING

In the fall of 2012, I took a leave of absence from college to go abroad to Chile. I went to learn about my own self-sufficiency, but also to discover what it meant to live in another country: both to be a foreigner, and to understand a different pace of life. Together with my father, I spent three months backpacking, hitchhiking, and farming down the length of Chile, from Santiago to south of Punta Arenas. And I lived through service: when I could, I work-stayed, providing rural Chileans with labor and some building expertise. I spent my time doing physical labor with the working people of the countryside. The places I lent my services were small: a vegetable garden outside of Marchigue, a new woodshed designed and built near the Argentinian border, trees felled and stacked on the coast of Chiloé. I really enjoyed my time: breathing clean air and working to physical exhaustion alongside people- new family- I had met only days before. Because I had nothing to do but work on my hosts' projects during the time I spent with them, I made

appreciable differences in their lives. And for many, I was the first person they had ever met from the United States. I came to know people from completely different backgrounds, of completely different ages, than I would otherwise have encountered. The kindness, the closeness, and the openness of these people are what stand out to me when I think of myself as a citizen of the world: it didn't matter where I was from or who they were, but rather that we were fellow humans who treated each other well and worked together for a space of time. Through this travel and service, I learned to see the human population as a real community of people.

## CONCLUSION

My time at Olin has been invaluable in shaping who I am as a person, largely because Olin's teaching methods embody the values of the global grand challenge scholars program. At Olin, I have been an active community participant, particularly inspired by our Honor Code value of "Do Something" and by the sense of community, both of which motivate me to actively reach out to and help people.

Through Olin, I have learned how to connect knowledge across disciplines, and nowhere has this been more evident than in my undergraduate research projects: with a professor, I conducted research in CAD modeling of prostates from MRI scans to better improve radiotherapy for prostate cancer. For a class, I am building an apparatus to simulate and measure electrical power generation from the pumping motion of human arteries. As an independent study, I am working on a blanket designed to improve sleep based on temperature regulation, with feedback from EEG brain signaling.

Throughout my time at Olin, I have embodied the values of the Grand Challenge Scholars Program, and this time in my life has empowered and educated me so that I both can and want to create positive change in the world.