Thesis Project Portfolio

A Novel Encapsulation Device for Mouse Neural Stem Cells

(Technical Report)

Developing a Techno-Selective Framework for Analyzing the Implementation of Emerging Technologies

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

Feeling eager yet slightly nervous, I walked out of the capstone project fair at the start of my fourth year excited about the opportunity to work on a technical project where I would be designing a novel device to encapsulate stem cells. I was enthusiastic about starting the technical design and optimization of the device; however, like many other aspiring engineers, I viewed my role as an engineer as merely a technical problem solver. It was not until I started my STS 4000-level courses and my STS research that I began to realize that the role and responsibilities of an engineer should encompass much more than I had initially considered. I learned that, in addition to taking an active role in the problem definition and solution process, engineers should consider the relationship between technology and society, as they are uniquely equipped to address the ethical implications of their work in the context of a sociotechnical system.

After coming to this realization, I decided to take a deeper look into my capstone technical design project to determine what I could contribute to the field of STS research. As my technical project was focused on developing a cell encapsulation device for mouse neural stem cells, I initially decided to write about the ethical implications of stem cell research. My prospectus outlined a number of concerns that had been raised regarding stem cell research and discussed possible methods for addressing these concerns while moving forward with the research and its technological applications. When considering what topic to address for my final STS research paper, however, I decided to take a step back from the specific ethical concerns associated with the progression of stem cell technologies and address the bigger picture of technological progression more broadly. Using the ethical considerations of stem cell technology development as inspiration, I focused my STS research on examining differing viewpoints about technological progression as well as developing a specific framework in order to achieve a greater understanding about the implementation of emerging technologies.

From this research for my STS paper, I ultimately synthesized a "techno-selective" framework for analyzing the implementation of a new technology based on societal goals and values. Following an opening discussion about technology's rapid and unchecked progression, I make the claim that society is unable to selectively manage the progression of technology, and emphasize that we need to come to a greater understanding of how to view the problem and address it effectively. Through conducting a thorough analysis of the Amish approach toward the implementation of emerging technologies, I came to the realization that, in our Western society, we often subscribe to the view that technology must be controlled through a binary approach. In this binary approach, we are quick to accept or reject an emerging technology without thoroughly considering the multiple implications of that particular technology in regards to our societal goals and values. Rather than taking this simple and inadequate approach, I discovered that we should take a more thoughtful, nuanced approach—a techno-selective approach—based on the principle that technology is, as Karen-Johnson Weiner so eloquently states it, "an outcome of particular decisions that favor one way of life over another" (Johnson-Weiner, 2014, p. 21).

In the technical portion of my thesis, my capstone group and I present an optimized design for cell encapsulation device to coat mouse neural stem cells. Cell encapsulation is of critical importance for many biomedical research applications including stem cell technologies, as the coating that encapsulates the cell is necessary to prevent immune rejection in cell transplantations. However, the current layer-by-layer cell encapsulation technique is tedious, and the necessary centrifugation process for this technique is time-consuming and energy-intensive, and places strain on cells leading to significant cell death. Therefore, through an iterative design process, our capstone group developed a cell encapsulation device to aid stem cell researchers by providing improvements over the traditional process. While the COVID-19 pandemic prevented

our capstone team from assembling and testing our final design iteration, we expect our device to reduce the time necessary to complete the encapsulation procedure, reduce the amount of material lost during the procedure, as well as reduce both monetary and energy costs associated with the centrifugation process.

Through the process of completing both my technical and STS research, I have realized that they profoundly influence each other. While my technical project initially served as a starting point to examine the specific ethical considerations regarding the progression of stem cell technologies, it eventually became a source of inspiration for conducting research on the complex relationships between technology and society, thus influencing my decision to focus my STS paper on synthesizing a framework for analyzing any type of emerging technology. Similarly, my STS research influenced my technical work as it promotes not just the consideration of how a technology adheres to societal goals and values after it has been invented, but how these considerations can be incorporated into the design iteration process. Ultimately, this thesis provides a foundation for a novel encapsulation device to aid stem cell researchers in the coating of stem cells and, if utilized by engineers, government-officials, policy-makers, etc., a proposed techno-selective framework with the potential to allow for the selective management of technological development based on societal goals and values.