

Engaging with the Invisible:

STS Groundwork in an Electrical and Computer Engineering Department

Annie Yong Patrick

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Matthew H. Wisnioski
Gary L. Downey
Rebecca J. Hester
Todd Schenk
Elizabeth D. McNair

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ABSTRACT

This dissertation is a study of groundwork in Engaged Science, Technology, and Society (STS) research. Engaged STS scholars reframe STS knowledge and move it beyond the traditional scope and boundaries of the field. They use various methods such as critical participation, making and doing, situated interventions, and experimentation to critically engage with their fields of study. These scholars have evaluated their work within the context of the disciplinary outsider, described their use of high-level pragmatic frameworks, and used the arts to bring critical social issues to the public eye. Yet, when I decided to use STS engagement methods to bring visibility to the lesser-known communities in the Bradley Department of Electrical and Computer Engineering (ECE) at Virginia Tech, I found a lack of work documenting the groundwork and experience of engagement. I could not locate groundwork regarding negotiation, designing the most appropriate intervention, collaboration strategies, or confronting my fears and doubts about being in the field. Therefore, in this dissertation, I identify and examine my engagement experience in three interventions within the ECE department to bring visibility to the groundwork of STS engagement.

The limited-series podcast *Engineering Visibility* was a platform to bring visibility to the less dominant communities in the ECE department. Highlighting the experiences of women in engineering, the first-generation student, inclusion and diversity, and the non-traditional student fostered a shared identity and sense of belonging within the ECE department. On the ground, this project examined the need to protect participants' visibility through invisibility. Interventionist

Protectivity conceptualizes how I combined trust, accountability, and social awareness to protect my participants' from social scrutiny.

The second project was a seminar titled "Expand Your ECE Career." The seminar exposed students to a "broader range of careers" by challenging the traditional ideas of success. The seminar featured four ECE alumni with successful careers in law, finance, and fashion entrepreneurship. Additionally, this intervention pointed out the inadequacies of traditional forms of project assessment. I describe how I measured intervention success through other assessment methods such as "assessment per mobility."

The last project was a data-driven white paper that translated the care work of the undergraduate academic career advisors and framed it to be understood by the ECE faculty. The care work done by the academic advisors was underappreciated in its connection to undergraduate student success. On the ground, I discussed the importance of identifying the advisors and the faculty's social construction to create an intervention that translated the advisors' work to be valued by the faculty.

Lastly, I conclude with a discussion summarizing the overall lessons learned from the three interventions and discussing my experience of engagement. My engaged STS experience is discussed through my framing of the concept of *self-confrontation* and the work of avoiding the term of STS being deemed as *useful*.

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GENERAL AUDIENCE ABSTRACT

This dissertation is a study of groundwork in engaged Science, Technology, and Society (STS) research. Recent advances such as critical participation, making and doing, and situated intervention are reframing boundaries between knowledge and action in STS, offering scholars new approaches for improving scientific and technological communities. When I attempted to utilize these theories and methods in a culture change project, however, I found a lack of scholarship documenting the experience of engagement. How does one design the most appropriate intervention? What strategies are required to collaborate and negotiate? How do engaged scholars confront their fears and doubts in their communities and concerning the knowledge they bring back to STS? These groundwork questions confront both novice and seasoned STS scholars and are crucial to successful engaged scholarship, but they rarely are documented and analyzed. Utilizing a matters-of-care framework and self-reflective methods, I describe how and why I sought to change the culture of a large engineering department by making visible unseen and sometimes under-appreciated stakeholders.

To do so, I created three interventions: a limited-series podcast to showcase the diversity of experiences in the department, an alternative-career seminar to redefine what counted as success in engineering, and a data-driven white paper to showcase the indispensable care work of academic advisors. I analyzed these projects' construction, application, and outcomes to highlight the complexities and significance of groundwork for STS engagement.

Dedication

Once again, I dedicate this to John and Virginia Patrick. Without your love in action and example, I would be nothing.

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There are so many people I must extend appreciation. I will try to recognize everyone.

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In no particular order to the following people-Thank you for opening your hearts, your home, and your life to me and always pushing me to just keep going: Kisha Wilson, Rabbi Alysa Stanton, Lt. Col. Jesse Hinton, Uncle Warren Copeland, Carmen Littles, Jerome James, Micheal Northcross, Dr. Katina Micheal, Dr. Bonnie Zare, Kathy Taylor, Johnnie Patrick, Bro. Artis, Rexanne Harrison, Bellinda King-Kallimanis, Amina J., Adrienne G., Patricia, D. Bork, Francesca B., Priya M., and Michal A. I apologize if I missed anyone!

Lastly, years ago, I came across the quote, “The worship of God is not a rule of safety-It is an adventure of the spirit, a flight after the unattainable.” This program has been just one stop on this adventure and walk of faith and trust with God, Christ, and the Holy Spirit.

Table of Contents

Chapter 1: Locating Missing Groundwork in STS Engagement	1
Chapter 2: Locating Invisible Identities, Careers, and Care within a Revolution	31
Chapter 3: "A Sense of Belonging: Using Podcasts to Spotlight the Unseen"	52
Chapter 4: Redefining Success within ECE Careers and Assessment.....	79
Chapter 5: Quantifying Care and Bringing Visibility and Value to Academic Career Advising.....	112
Chapter 6: A Lived Field Guide to Engaged STS.....	139
Bibliography	164

List of Figures

Figure 1. Engineering Visibility Podcast Cover Art	60
Figure 2. Whiteboard Image of Possible ECE Careers	80
Figure 3. The ECE Personas	83
Figure 4. Whiteboard Image of Successful Student.....	85
Figure 5. Seminar Marketing Poster	100

List of Tables

Table 1. Preliminary Data Analysis	42
Table 2. ECE Diversity Analysis	46
Table 3. The Importance of Image and Diversity	47
Table 4. Advisor Student Interactions Data	48
Table 5. Seminar Attendees Pre-Survey	102

Chapter 1: Locating Missing Groundwork in STS Engagement

"Knowledge is always gained through action and for action. From this starting point, to question the validity of social knowledge is to question, not how to develop a reflective science about action, but how to develop genuinely well-informed action-how to conduct an action science."-Bill Torbert

"I do not separate my scientific inquiry from my life. For me, it is really a quest for life, to understand life and to create what I call 'living knowledge'--knowledge which is valid for the people with who I work and for myself." –Marja-Liisa Swantz

Introduction

A female engineering student explained to me that the boys on her design team ignored her input and acted as though she wasn't there.¹ She paused and exclaimed, "No one should have to feel like that!" A fashion designer explained to a roomful of students how de-bugging prepared her to be an effective problem solver and contributed to her success in the fashion industry. The academic advisors carefully took the time to input over 1600 students' interactions to collect the data for a white paper that would "quantify" their care work.

This dissertation explores and analyzes my contributions to creating a culture change in an engineering department. In 2014, the National Science Foundation (NSF) launched a national, multimillion-dollar grant program titled "Revolutionizing Engineering Departments (RED)" to reform engineering departments across the United States. Recognizing the growing impact of engineering design on society's quality of life and sustainability, the NSF decided to implement an initiative to holistically address engineering students' education preparation. The NSF

¹ Teun Zuiderent-Jerak and Casper Bruun Jensen, "Editorial Introduction: Unpacking 'Intervention' in Science and Technology Studies," *Science as Culture* 16, no. 3 (September 1, 2007): 227–35, <https://doi.org/10.1080/09505430701568552>. Due to the close integration of the STS scholar within their work, engagement scholarship is typically written in first-person. Much of this dissertation will be written in first person.

challenged engineering departments across the United States to "go bold...with big ideas" to revolutionize the culture of engineering education.² To carry out this "revolution," the NSF built-in requirements for what would equate to an interdisciplinary approach. Each team was required to have Principal Investigators (PIs), including the engineering department chair, an engineering education expert, and a social scientist.

The Bradley Department of Electrical and Computer Engineering (ECE) became a RED recipient in 2016. The social scientist for the team, Dr. Matthew Wisnioski, was a historian of technology and innovation from the Department of Science, Technology, and Society (STS). As a newly admitted STS graduate student with a background in information technology and qualitative research, I became one of the grant's first Graduate Research Assistants (GRA). My first task was conducting a qualitative study to assess the climate and culture of the ECE department. The study revealed several challenges within the department regarding identity, sense of belonging, academic advising, and professional conceptions of success.³ Beyond these specific themes, the culture and climate study revealed deeper concerns about visibility in the department. After examining the themes of this study, I realized that I did not want to limit my role as only identifying these challenges; instead, I wanted to find ways to change the culture. Eventually, I would locate the tools for this culture change within engaged STS practices.

STS has always been an engaged practice. To understand STS engagement, one must understand the long-standing division within the STS discipline. STS have been divided into

² Rose Schimdt, "National-Science-Foundation-Aims-to-Change-Undergrad-Engineering-Computer-Science," accessed December 3, 2019, <https://www.usatoday.com/story/college/2015/06/24/national-science-foundation-aims-to-change-undergrad-engineering-computer-science/37404099/>.

³ A more complete description and analysis of the culture and climate study will be discussed in Chapter 2.

two sections referred to as "The High Church" and "The Low Church."⁴ The High Church approach utilized disciplines such as philosophy, history, and sociology to critique, conceptualize, and understand the facts and knowledge from science and technology.⁵ For example, Latour and Woolgar's seminal work, *Laboratory Life: The Construction of Scientific Facts*, emerged from the High Church, which aptly described the construction of facts within a laboratory at the Salk Institute.⁶ Years later, in the 1990s, other scholars would add to this position. Karin Knorr Cetina's studies at Berkeley lead to her work on epistemic cultures.⁷ Sharon Traweek published her pivotal work, *Beamtimes and Lifetimes*, detailing the social order within high-energy physics.⁸ These are only a few of the many pieces that challenged the belief of science as objective and instead presented scientific knowledge as a mish-mash of measurements and theories and social influences and political interactions.

The Low Church approach has been less prominent than the High Church approach. Low Church scholars focused on incorporating social justice reforms and democratic politics within their studied communities.⁹ These scholars often work within these communities to bring about change to truly accomplish this. For many years, the High Church approach was prominent

⁴ Steve Fuller, "Why Science Studies Has Never Been Critical of Science: Some Recent Lessons on How to Be a Helpful Nuisance and a Harmless Radical," *Philosophy of the Social Sciences* 30, no. 1 (March 1, 2000): 5–32, <https://doi.org/10.1177/004839310003000101>; Steve Fuller, "Constructing the High Church-Low Church Distinction in STS Textbooks," *Bulletin of Science, Technology & Society* 17, no. 4 (August 1, 1997): 181–83, <https://doi.org/10.1177/027046769701700408>.

⁵ Sergio Sismondo, "Science and Technology Studies and an Engaged Program," in *The Handbook of Science and Technology Studies*, Third (Cambridge, MA: The MIT Press, 2008), 13–31.

⁶ Bruno Latour, Steve Woolgar, and Jonas Salk, *Laboratory Life: The Construction of Scientific Facts* (Princeton, UNITED STATES: Princeton University Press, 1986), <http://ebookcentral.proquest.com/lib/vt/detail.action?docID=1144731>.

⁷ K. (Karin) Knorr-Cetina, *Epistemic Cultures: How the Sciences Make Knowledge* (Cambridge, Mass.: Harvard University Press, 1999), <http://swbplus.bsz-bw.de/bsz077639464inh.htm>.

⁸ Sharon Traweek, *Beamtimes and Lifetimes: The World of High Energy Physicists* (Cambridge, UNITED STATES: Harvard University Press, 1992), <http://ebookcentral.proquest.com/lib/vt/detail.action?docID=3300284>.

⁹ Steve Fuller is noted to have coined the terms "Low Church" and "High Church." He has referred to the Low Church as a social movement in the article, "Constructing the High Church-Low Church Distinction in STS Textbooks."

within STS, with the more social activist approach of the Low Church taking second place. However, years of analyzing science through the highly critical lenses of philosophy, history, and sociology and challenging the very objective foundations of science have not always sat well with those being critiqued, hence the Science Wars of the 1990s.¹⁰

Some STS scholars may claim that a pivotal moment for utilizing a practitioner approach occurred when Bruce Latour called for STS scholars to move past the "matters of facts" and to the "matters of concern."¹¹ Though STS scholars had contributed significantly to understanding the production of knowledge and identifying the social factors that complicated the production of this knowledge, Latour raised the question of if STS scholars had done enough by merely stopping at the critical analysis? In response to himself, Latour believed that scholars must move past the critique of the *matters of facts* to create new tools for the *matters of concern*.¹² Nevertheless, even as Latour was requesting new tools, the Low Church had already been doing similar work, and over time more engaged STS scholarship emerged.¹³

From the mid-to-late 1990s to now, engaged STS scholars have produced much research demonstrating engagement. STS scholars merged the arts with critical analysis to highlight the experience of those displaced by war and political unrest.¹⁴ Engaged scholars shared how their work utilizes different pragmatic frameworks.¹⁵ Additionally, as a field that works within other

¹⁰Bruno Latour, "Why Has Critique Run out of Steam? From Matters of Fact to Matters of Concern," *Critical Inquiry* 30, no. 2 (January 1, 2004): 225–48, <https://doi.org/10.1086/421123>.

¹¹Latour. 235

¹²Latour. 231

¹³ It is important to note that Latour's work on the matters of care was published in 2004 and other social scientist had already explored participatory methodologies: Action Research was being done as far back as he 1930s and Cyborg and Citadels was published in 1998. In addition, STS scholars have been taking activist approaches since the 1940s/1950s.

¹⁴ Noortje Marres, Michael Guggenheim, and Alex Wilkie, *Inventing the Social* (Mattering Press, 2018), <https://doi.org/10.28938/9780995527768>.

¹⁵ Gary Downey and Teun Zuiderent-Jerak, "Making and Doing: Engagement and Reflexive Learning in SS," in *The Handbook of Science and Technology Studies*, ed. Ulrike Felt, 2nd ed., vol. 7, 2015, 641–49.

disciplines, scholars have even theorized how they maintain their STS position within their fields of study.¹⁶

However, as I reviewed these scholars and their work, I had several questions. How exactly does one intervene on the field?¹⁷ How does one address their feelings of fear and doubt? What is the experience of participating? How does one choose the most appropriate intervention? How does one negotiate their theoretical integrity with institutional authority?

As I designed my interventions, I soon learned that deeply embedded within an intervention is a complicated web of labor, people, and politics that remain unseen in the final visible product, whether the policy, the art exhibit, the podcast, or the workshop. At the core of this, I identified that the very *groundwork* of STS engagement was missing. In other words, the essential activities and interactions, such as relationship-building, care-taking, decision-making, and planning, were missing.

This dissertation identifies the groundwork and the experience of being an engaged scholar within an electrical and computer engineering department that is crafting a culture change through a large-scale national reform incentive. Through the development of three interventions, I identify the groundwork, the detailed labor of being an STS practitioner, by critically reflecting on my experience of being an engaged STS scholar starting from my first year as both a graduate student in the ECE department and a graduate research assistant (GRA) to the reflection of my last intervention. Concurrently, in this dissertation, I draw from and contribute to theories of invisibility, care work, success, identity, and sense of belonging.

¹⁶ Teun Zuiderent-Jerak, *Situated Intervention: Sociological Experiments in Health Care*, Inside Technology (Cambridge, MA, USA: MIT Press, 2015).

¹⁷ Please note that the overall term that I use to describe myself is engagement and/or Engaged STS scholar. Engagement is an umbrella term for the activities I perform such as intervention/intervening and participation/participating.

The first section of this chapter provides a brief introduction to the NSF, the RED grant, and the ECE department. I will more thoroughly discuss these three organizations in Chapter 2. The next section explores the literature of invisibility and how invisibility shapes the culture of the ECE department. As an engaged STS scholar, I provide a history of engagement within the social sciences and STS, leading to a discussion of the primary objective of this dissertation: groundwork. I define groundwork within STS engagement and its importance to the field. Lastly, I explain the organization of this dissertation through chapters two through six.

Participating in an Engineering Revolution

The RED grant emerged from an engineering education initiative, the Professional Formation of Engineers (PFE), focused on a more innovative and inclusive engineering profession, and the Improving Undergraduate STEM Education (IUSE) framework focused on improving education within STEM fields. Together, these two initiatives formed RED in 2014 to challenge engineering and computer science departments to create sustainable, scalable revolutions by producing engineers who could address “21st-century” problems.¹⁸

RED addressed several issues within engineering education. For example, industry leaders were concerned that engineering students were not being educated and prepared to enter the workforce adequately.¹⁹ As the world’s economy and workforce became global, the industry needed engineers able to work within a more diverse world and approach design issues with a more inclusive mindset. RED provided funding and support to incentivize engineering departments across the United States to address these challenges through faculty development, institutional change, and culture change focused on the middle two years of education.²⁰ Though

¹⁸ NSF, “NSF RFP: 15.607 2016,” 2016. 3

¹⁹ NSF. 3

²⁰ NSF. 5-6

focused on curriculums and workforce development, ultimately the RED designers wanted a *culture change* within engineering education.

During the mid-20th century, engineering education focused on fundamentals such as curriculum, student development, and cognitive processes.²¹ However, as the field became more global and the impact of engineering more far-reaching, scholars began to focus on the need for a culture change to address the changing needs within and outside engineering.²² However, crafting a culture change is a complex endeavor. The NSF noted the complexity of this challenge and mandated an interdisciplinary approach.²³ The RED grant required each team of PIs include an engineering department chair, an engineering education expert, and a social scientist to ensure a successful culture change.

In 2016, Virginia Tech’s ECE department became a RED awardee. The ECE Department’s proposal titled, “Radically Re-designing the Fan-in and Fan-out of an Electrical and Computer Engineering Department” planned to transform the department’s Cold War-era curriculum into one in which students would have multiple pathways to numerous career

²¹ Maura Borrego, “Development of Engineering Education as a Rigorous Discipline: A Study of the Publication Patterns of Four Coalitions,” *Journal of Engineering Education* 96, no. 1 (January 2007): 5–18, <https://doi.org/10.1002/j.2168-9830.2007.tb00911.x>; John W. Prados, “Engineering Education in the United States: Past, Present, and Future,” August 1998, <https://eric.ed.gov/?id=ED440863>.

²² Committee on Public Understanding of Engineering Messages and National Academy of Engineering, *Changing the Conversation : Messages for Improving Public Understanding of Engineering* (Washington, D.C.: National Academies Press, 2008), <http://login.ezproxy.lib.vt.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=edsebk&AN=237728&site=eds-live&scope=site>; National Academy of Engineering, ed., *Educating the Engineer of 2020: Adapting Engineering Education to the New Century* (Washington, DC: National Academies Press, 2005).

²³ Caroline Haythornthwaite, “Learning and Knowledge Networks in Interdisciplinary Collaborations,” *Journal of the American Society for Information Science and Technology* 57, no. 8 (2006): 1079–92, <https://doi.org/10.1002/asi.20371>; Alexandra R. Costa et al., “Impact of Interdisciplinary Learning on the Development of Engineering Students’ Skills,” *European Journal of Engineering Education* 44, no. 4 (2019): 589–601; Robert Frodeman, ed., *The Oxford Handbook of Interdisciplinarity* (New York: Oxford University Press, USA, 2010); Lisa R. Lattuca, *Creating Interdisciplinarity: Interdisciplinary Research and Teaching among College and University Faculty*, First edition, Vanderbilt Issues in Higher Education (Nashville: Vanderbilt University Press, 2001).

options.²⁴ By using the engineering concept of “Fan-in/Fan-out,” the ECE proposal planned to increase the “Fan-in” (attracting a diverse pool of students through outreach). However, simply bringing in diverse students was not enough. Thus, the team planned to increase the “Fan-out” (creating a plethora of students with a broad array of career options) by restructuring the sophomore curriculum, addressing the department's culture, and K-12 outreach.²⁵

As a department of over 70 tenured track/tenured faculty members and an undergraduate student body of over 1400 students, the ECE department at Virginia Tech was primed for the challenge put forth by RED.²⁶ In addition to being the fourth largest ECE department in the United States, the department was renowned for its research.²⁷ The department had several noted researchers in power systems, remote sensing, cybersecurity, and space system.²⁸ Additionally, the department ranked seventh nationally in the NSF HERD Expenditures Report for 2019, with an approximately \$28 million research portfolio.²⁹

Yet, the department was not without its challenges. As the world’s economic workforce became more globally diverse, the engineering profession pressured the university system to produce a technically apt engineer able to work within a more socially diverse environment.³⁰

²⁴ Virginia Polytechnic Institute and State University, “IUSE/PFE: RED: Radically Re-Designing the Fan-in and Fan-out of an Electrical and Computer Engineering Department,” December 12, 2015, <https://documentcloud.adobe.com/link/review?uri=urn:aaid:scds:US:f569ff51-a5b1-4986-89fd-eb2567105a45>.

²⁵ Virginia Polytechnic Institute and State University.

²⁶ “About Our Department | Ece | Virginia Tech,” accessed December 7, 2021, <https://ece.vt.edu/about.html>.

²⁷ “VT ECE Quick Metrics,” accessed December 7, 2021, https://ece.vt.edu/content/ece_vt_edu/en/about/metrics.html.

²⁸ The Bradle Department of Electrical and Computer Engineering, “Focus on Research 2018,” 2018, https://ece.vt.edu/content/ece_vt_edu/en/research.html.

²⁹ “Bradley Department of Electrical and Computer Engineering -Research,” accessed December 7, 2021, https://ece.vt.edu/content/ece_vt_edu/en/research.html.

³⁰ NSF, “NSF RFP: 15.607 2016”; By Rhea Kelly and 06/23/15, “NSF Awards \$12 Million to Redesign Undergraduate Engineering and Computer Science Education -,” Campus Technology, accessed October 19, 2019, <https://campustechnology.com/articles/2015/06/23/nsf-awards-12-million-to-redesign-undergraduate-engineering-and-computer-science-education.aspx>.

However, the ECE curriculum of 2016 was fundamentally the same that existed 30 years ago.³¹ Likewise, the typical ECE student was the picture-perfect image of the “good engineering” student: a “boy scout” that would graduate and work within a large corporation or defense contractor company.³² Furthermore, the department’s faculty were not known for being open to change. As mentioned in several RED meetings, the current department head surpassed expectations by making it to his five-year performance review. Collectively, these advantages and challenges primed the ECE department for the objectives of the NSF and the RED grant.

A vital requirement of the RED grant was the importance of maintaining a culture change model at the forefront of each project. To aid in this charge, each PI team included a social scientist to provide critical assessments of the department’s dynamics, monitor the culture change process, and advise as necessary to maintain a culture change among the faculty, students, and staff.³³ The grant did not specify or limit the specific social science discipline.³⁴ The social scientist for the ECE team was a historian of technology and innovation from the STS department with extensive knowledge of the history of institutional change within engineering. Though RED did not stipulate the disciplinary background of the social scientists, STS scholars were primed to address the challenges of the RED grant. STS scholars have studied science and technology for decades through philosophical, sociological, historical, and anthropological lenses. One of STS’s valuable contributions to the socio-technical aspects of engineering is

³¹ Virginia Polytechnic Institute and State University, “IUSE/PFE: RED: Radically Re-Designing the Fan-in and Fan-out of an Electrical and Computer Engineering Department.”

³² Virginia Polytechnic Institute and State University. 6

³³ NSF, “NSF RFP: 15.607 2016.” 3

³⁴ However, it is interesting to note that with STS specific focus on engineering there were not many STS scholars as RED PIs. Instead many universities social scientists had more applied backgrounds, i.e psychology.

engineering studies.³⁵ Engineering studies examine the invaluable knowledge from engineering and its impacts on the world.³⁶

STS and the Identification of the Invisible

As mentioned earlier within this chapter, many of the department's cultural challenges were the traditional images of engineering: male, nerdy, bro-ish, disciplinary rigor, tech-focused, and scientific reasoning reliant. These were the department's visible and accepted images that created unseen boundaries of who and what was an ECE student. However, female and underrepresented students existed. Likewise, scientific rigor was not the only component of a successful engineer. Furthermore, ECE alumni had careers in areas other than the tech industry. These people existed; they were just unseen and invisible within the overall department.

Invisibility is complex.³⁷ Each of us exists in spaces of (in)visibility. We are (in)visible to some, and others are (in)visible to us. However, if only (in)visibility was an individual issue. Instead (in)visibility is complicated and imbued with power. It creates boundaries and limitations that frame and “others” specific populations of society.³⁸ For example, the word engineer summons images of men and masculinity. Can a woman be an engineer? Can femininity be an engineer? The short answer is yes. However, a woman pursuing engineering must overcome the lack of identity within the inherent masculine field. Sometimes, she does not overcome these barriers.³⁹

³⁵ Gary Downey, “Engineering Studies,” in *International Encyclopedia of the Social and Behavioral Sciences*, 2nd ed., vol. 7, 2015, 641–49. 641

³⁶ Gary Downey, “What is Engineering Studies for? Dominant Practices and Scalable Scholarship” 2009, 58

³⁷ To avoid typing both invisibility and visibility, I use the format *(in)visibility* where applicable

³⁸ Toni Morrison and Ta-Nehisi Coates, *The Origin of Others*, Charles Eliot Norton Lectures 2016 (Cambridge, Massachusetts: Harvard University Press, 2017).

³⁹ Of course this applies to other less dominant images: racial and ethnic minorities, first-gen students, etc.

I focused on the boundaries created by (in)visibility in this study to confront the department's culture. I examined (in)visibility's link to creating and maintaining the socially accepted images within the ECE department. One of the first approaches to understanding social (in)visibility is examining how it categorizes members of society and bestows privileges and disadvantages. Overall, the "majority members" of society are typically associated with positive images and enjoy certain privileges associated with that visible image.⁴⁰ This is partly connected to "majority members" possessing the power to create the images of who and what is good and evil in society.⁴¹ The majority members (the dominant group) maintain a culture in which anyone who does not look like them or fits their definitions is framed as inadequate, disadvantaged, unqualified, and disenfranchised.⁴² In other words, the visible, socially accepted image is framed through positive constructed images designed by those in power, and the invisible (with limited power) is framed and identified through negative images created by those in power. However, there is more to this framing. Typically, the invisible's images and identity are constructed around inaccurate and harmful narratives by the more dominant and visible members of society.⁴³ For example, the belief that women are not good in math and science. This leads to the "invisible" being overlooked or dismissed by the dominant group regardless of their actual potential, authority, and recognition. In other words, women are not even considered for a career in engineering. In so many words, they do not get opportunities. Yet, the dominant

⁴⁰ Stephanie A. Fryberg and Sarah Townsend, "The Psychology of Invisibility," in *Commemorating Brown: The Social Psychology of Racism and Discrimination*, ed. G Adams et al., 173rd–193rd ed., 2008, <https://psycnet.apa.org/doiLanding?doi=10.1037%2F11681-010>. 173; Also, consider the majority members have the power to create positive images of themselves.

⁴¹ Fryberg and Townsend. 176

⁴² Warren Smith et al., "Becoming Invisible: The Ethics and Politics of Imperceptibility," *Culture and Organization* 24, no. 1 (January 1, 2018): 54–73, <https://doi.org/10.1080/14759551.2015.1110584>.

⁴³ Sue Books, *Invisible Children in the Society and Its Schools*, 2nd ed, 1 online resource (xxiv, 258 pages) : illustrations vols., Sociocultural, Political, and Historical Studies in Education (Mahwah, N.J.: L. Erlbaum Associates Publishers, 2003), <http://site.ebrary.com/id/10227332>. 106, 155

group possesses privilege regardless of ability, values, or ethics.⁴⁴ Following this example, men are encouraged to pursue engineering.

I provided the following example to explain how ultimately, the “visible” dominant groups within the ECE department rendered the “others” of the department as invisible. This essentially kept the invisible people, ideas, and concerns at a disadvantage and deficient within the department. Subsequently, the “others” were painted in a negative image or not painted at all. Sadly, this negative image became their socially accepted (visible) representative.

Alternatively, due to invisibility, their needs and concerns were invisible. Yet, there is an upside to invisibility. Invisibility is a *social process* created through the power of the majority curating images that represent them positively.⁴⁵ Invisibility is not a naturally occurring event. Instead, what we see or do not see, is created through people and power. In other words, invisibility can be altered. Specific to the ECE department, as a social process (in)visibility could bring a culture change to the department.

Secondary theories identified the specific contexts of invisibility. Theories of belonging and identity identified how the lack of visible underrepresented minorities, students from underserved populations, and other less prevalent student populations impacted these students’ ability to foster of departmental sense of belonging?⁴⁶ Likewise, the traditional images of career success limited students’ professional goals. Eventually, this impacted potential student recruitment. Students that were not interested in tech careers or the defense sector ignored the possibilities of a degree in ECE. Thus many students did not consider ECE as an option.

⁴⁴Books. 106

⁴⁵ Darryl D. Roberts et al., “The Invisible Work of Managing Visibility for Social Change: Insights From the Leadership of Reverend Dr. Martin Luther King Jr.,” *Business & Society* 47, no. 4 (December 1, 2008): 425–56, <https://doi.org/10.1177/0007650308323817>; Smith et al., “Becoming Invisible.”

⁴⁶ Miller, “Belonging to Country-A Philosophical Anthropology,” May, “Self, Belonging and Social Change” Henry Garfinkel, *Studies in Ethnomethodology* (Englewood Cliffs, NJ: Prentice-Hall, 1967)

Within the United States, work and success are tightly intertwined through societal and cultural norms and constructed through images of failure, accomplishment, income, class, and other things.⁴⁷ Thus theories of work and success identified how the predominant jobs within the ECE department ran counter to potential students' cultural and personal ideas of success. Lastly, the academic advisors' work revealed that in addition to helping with academic challenges, they helped students achieve personal and professional success. However, the theories of care work, invisible work, and intimate labor theorized the significance of their work.⁴⁸

One would assume that the immediate answer to invisibility is visibility. Social theory has framed the invisible within the context of limited power to no power.⁴⁹ For this reason, many would argue to correct invisibility, make it visible.⁵⁰ Initially, I started many of my projects with this approach. However, I soon discovered that no community is powerless, and invisibility has power and necessity. Before I released the episodes about women in engineering, inclusion and diversity, and the first-generation student, I had to reintroduce forms of invisibility to counter the dangers of too much visibility.⁵¹ I made students anonymous, and I removed identifiers. Other times, participants took ownership of their invisibility and avoided questions or controlled the narrative through their experiences and how they shared their experiences.⁵²

⁴⁷ Robert Hoppock, "What is Success? An analysis of success in terms of guidance objectives." *The Clearing House: A journal of Educational Strategies, Issues and Ideas*. 11.5, 294-296. 1937

⁴⁸ Arlene Danies and Invisible Work, Boris and Parrenas's Intimate Labor, Annemarie Mol's Logics of care and others.

⁴⁹ Smith et al., "Becoming Invisible."

⁵⁰ Maria Puig de la Bellacasa, "Matters of Care in Technoscience: Assembling Neglected Things," *Social Studies of Science* 41, no. 1 (2011): 85–106, <https://doi.org/10.1177/0306312710380301>; Gary Lee Downey and Joseph Dumit, "Locating and Intervening: An Introduction," in *Cyborgs & Citadels: Anthropological Interventions in Emerging Sciences and Technologies*, ed. Gary Lee Downey and Joseph Dumit, 1st ed. (Santa Fe, N.M.: School of American Research Press, 1997); Sismondo, "Science and Technology Studies and an Engaged Program."

⁵¹ Roberts et al., "The Invisible Work of Managing Visibility for Social Change."

⁵² James C. Scott, *Domination and the Arts of Resistance: Hidden Transcripts* (New Haven, UNITED STATES: Yale University Press, 1990), <http://ebookcentral.proquest.com/lib/vt/detail.action?docID=3420907>.

Throughout my work, I said many times that I “brought visibility to the invisible.” However, allow me to clarify. I did not have that much power. Since I started as a qualitative researcher, I have learned to respect the power of one’s story and experience. Not to sound too sentimental, I believed and still believe in the power of the lived experience. I think that each time an experience is shared through a podcast or a viewing of the seminar, visibility shifts. Instead, let me clarify that invisibility is perhaps best revealed through *experience*, not simply visibility.⁵³

Engaging with the Invisible

Though I identified the foundation of (in)visibility within the data and the department, the decision to become engaged was not immediate. Shortly after the culture and climate study, the bureaucratic and administrative needs of the sophomore curriculum moved to the forefront. The climate and culture study shifted as time and resources ensured that the sophomore courses would be added to the checklist and that the faculty were adequately prepared to teach the classes.

Though the data remained untouched for almost a year, the invisible experiences of the ECE department remained a constant thought. I would periodically revisit the data with different ideas and theories. However, upon reading Bruno Latour's work regarding the *matters of concern* and Maria Puig de la Bellacasa's work regarding the *matters of care*, I reframed the climate study with the possibility of engagement.⁵⁴

⁵³ Maurice Merleau-Ponty, Alphonso Lingis, and Claude Lefort, *The Visible and the Invisible: Followed by Working Notes*, Northwestern University Studies in Phenomenology & Existential Philosophy (Evanston: Northwestern University Press, 1968). 136

⁵⁴ Latour, “Why Has Critique Run out of Steam?”; Maria Puig de la Bellacasa, “Matters of Care in Technoscience.”

Latour challenged STS scholars to develop new disciplinary tools beyond the critique.⁵⁵ In response to Latour's work, Puig de la Bellacasa's extended the concept of matters of concern to “the matters of care.” The matters of care directed researchers to engage the neglected [and unseen] things scholars had identified and reminded researchers of an ethical obligation to be responsible for their fields of study.⁵⁶

Latour's work brought attention to engagement; however, Puig de la Bellacasa pushed me to take a more active approach and actually *care* about the invisibility in the data.⁵⁷ In her article, Puig de la Bellacasa referenced Vinciane Despret that passion is making an effort to become interested in the multitude of problems presented to others.⁵⁸ I found myself as a sort of middleman that had come face-to-face with so many different people under one grant that could positively impact them all. In other words, I had become very interested in the department's problems. However, more importantly, the matters of care encouraged scholars taking a material form of care.⁵⁹ In other words, care by doing something. In part, the concept of *care* defined and shaped my ethical framework as an engaged scholar. My responsibility as a researcher shifted from an ethical obligation to do no harm according to the tenets outlined by the institutional review board (IRB) to an ethical obligation to respond to others' needs.⁶⁰

⁵⁵ Though Latour's work was pivotal in challenging scholars to critique themselves, Latour's call to action is not completely pivotal because parts of his motives could have been founded within the Low Church. The objectives of the Low Church has always pushed STS scholarship to be accountable to the public and promoted a socially conscience science (Sismondo, 18).

⁵⁶ Maria Puig de la Bellacasa, “Matters of Care in Technoscience.” 94

⁵⁷ Maria Puig de la Bellacasa. 90

⁵⁸ Maria Puig de la Bellacasa. 99

⁵⁹ Maria Puig de la Bellacasa. 98

⁶⁰ Maria Puig de la Bellacasa; Leila J. Rupp and Verta Taylor, “Going Back and Giving Back: The Ethics of Staying in the Field,” *Qualitative Sociology* 34, no. 3 (July 23, 2011): 483, <https://doi.org/10.1007/s11133-011-9200-6>.

A History of Engagement

However, before I proceeded to engage with the department, I had to understand the past history and present scholarship of STS engagement. Tracing the history of STS engagement is complicated by the interdisciplinary nature of STS. Many of the participatory methods STS scholars have used have emerged from other theories and disciplines.⁶¹ For example, feminist theories have long pushed for scholarship that addresses inequalities, provides a voice for women and other underrepresented communities, and creates opportunities to remedy these inequities.⁶² Social scientists have used forms of engagement such as activist research, participatory research, and action research for years. Activist researchers take a theoretical position as they examined the cause of societal inequities and then united with these communities to create a project of change.⁶³ Participatory research is a collaboration between the researcher (the outsider) and the members of the community studied (the insider) that are studying or testing a theory. Action research emerged during the mid-1900's. Though action research offered a general approach to problem-solving, it lacked important objectives. For example, it is dismissive toward building out theories. Instead, it focused on producing practical knowledge to give back to the studied communities.⁶⁴ However, perhaps more importantly, action research has been critiqued for not considering the intricacies and complexities of people or what is noted as "human sensibilities."⁶⁵

For this dissertation, I trace engaged STS's history beginning in 2007. That year, *Science as Culture* published an issue wholly dedicated to addressing some of the critiques surrounding

⁶¹ I would dare say that STS scholars have work interchangeably with the ones discussed above, especially activist research.

⁶² Consider Donna Haraway's *Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective*, Source: *Feminist Studies*, Autumn, 1988, Vol. 14, No. 3 (Autumn, 1988), pp. 575-599.

⁶³ Charles R. Hale, "What is Activist Research?" 13, 2001

⁶⁴ Reason, Peter and Hilary Bradbury, Introduction: Inquiry and Participation in Search of a World Worthy of Human Aspiration,

⁶⁵ John Heron, "Introduction: A Brief History of Co-Operative Inquiry," in *Co-Operative Inquiry: Research into the Human Condition*, 1996, <https://us.sagepub.com/en-us/nam/co-operative-inquiry/book205168>.

interventions. "Unpacking 'Intervention' in Science and Technology Studies" featured six articles discussing the use of participatory research and deconstructing the questions around intervening within STS.⁶⁶ About a year later, Gary Downey initially theorized critical participation. Critical participation focused on five questions centered around “knowledge and personhood, alternative knowledge, alternative practices, fit with dominant practices, and 'scaling up.’”⁶⁷ About four years later, Noortje Marres' published her work regarding "material participation." Material participation explored how all human and non-human actors were involved in engagement and how participation changed the surrounding social and political context.⁶⁸ Three years later, in 2015, Gary Downey, in an interview with Zhihui Zhang, would summarize his previous work about critical participation as an approach to understanding and rearranging the components of knowledge production and knowledge travel between STS and other fields of inquiry.⁶⁹ As Downey stated, "STS scholars are not just sharing our knowledge and expertise with audiences, but rather interacting with audiences that have knowledge and expertise and are allowing us into their lives and work as critical participants."⁷⁰ Emily York used this theory when examining her experience of critically participating within a nanoengineering department. In her efforts to bring STS to this department, she recognizes the need to identify the shared benefits of such

⁶⁶ Zuiderent-Jerak and Bruun Jensen, “Editorial Introduction.”

⁶⁷ Gary Lee Downey, “The Engineering Cultures Syllabus as Formation Narrative: Critical Participation in Engineering Education through Problem Definition,” *University of St. Thomas Law Journal* 5, no. 2 (2008): 428.

⁶⁸ Noortje Marres, *Material Participation: Technology, the Environment and Everyday Publics* (Houndmills, Basingstoke, Hampshire ; Palgrave Macmillan, 2012), <http://www.netread.com/jcusers2/bk1388/112/9780230232112/image/lgcover.9780230232112.jpg>.

⁶⁹ Gary Downey and Zhihui Zhang, “Nonlinear STS, Engineering Studies, and Dominant Images of Engineering Formation,” *STS Infrastructures, Platform for Experimental Collaborative Ethnography*, 2015, <https://stsinfrastructures.org/content/nonlinear-sts-engineering-studies-and-dominant-images-engineering-formation-0>.

⁷⁰ Downey and Zhang.

work and utilize her previous academic and professional experiences for her critical participation.⁷¹

Eventually, STS Making and Doing merged into the scene. The work of Downey and Zuiderent-Jerak provided a foundation of how STS scholars could take their work and return it to the studied domain by examining how the production of the STS knowledge positioned scholars in their fields of study. STS Making and Doing focused heavily on the outcomes of participating STS scholars. With a particular emphasis on knowledge production and travel, STS Making and Doing explored how STS scholars utilized their STS knowledge through various projects within the field and examined the process of this knowledge production and travel.⁷² Furthermore, they better comprehended the identity produced and the production of knowledge, making for better scholarship. At the annual 4S conference in 2015, the first STS “Making and Doing” Program showcased the various methods and materials that STS scholars had utilized to become engaged scholars, such as policy papers, recommendations and regulations, design, and creation of products, artistic creations, and education training.⁷³ The “Making and Doing” program encouraged other like-minded scholars to share their modes of participating, engaging, and intervening in their fields of study.

Engaged scholars explored other aspects of their work besides the knowledge production directly tied to their field. Teun Zuiderent-Jerak's book *Situated Interventions* explored how his work in the Dutch healthcare system led to a more efficient system and, more importantly, how

⁷¹ Emily York, “Doing STS in STEM Spaces: Experiments in Critical Participation,” *Engineering Studies* 10, no. 1 (January 2, 2018): 66–84, <https://doi.org/10.1080/19378629.2018.1447576>.

⁷² Downey and Zuiderent-Jerak, “Making and Doing: Engagement and Reflexive Learning in SS.”

⁷³ “Denver 2015,” *Society for Social Studies of Science* (blog), accessed December 7, 2021, <https://www.4sonline.org/sts-resources/making-and-doing/denver-2015/>; “‘Making and Doing’ at 4S Meeting (Denver): Let’s Extend the Experiment!,” *EASST* (blog), accessed December 7, 2021, <https://easst.net/article/making-and-doing-at-4s-meeting-denver-lets-extend-the-experiment/>.

this work could produce valuable sociological knowledge.⁷⁴ Zuiderent-Jerak's work within healthcare identified that critical participation and situated interventions were complex and that crossing boundaries are not seamless. A challenge of participating was that the scholar might not be accepted into the domain studied; however, the more significant challenge is that once a scholar crosses into another discipline, their work may be rejected in their "home" discipline.⁷⁵

Another approach to intervening within the fields studied involved incorporating art and design approaches to the knowledge gathered from sociological-related fieldwork. The idea of "inventing the social" is a process in which its supporters stress that the social life does not simply exist but is cultivated by various forces. These scholars supported using the arts and design practices to perform social experimental interventions to better understand and interpret social life.⁷⁶

Another form of participation developed from the idea of scientific experiments. Michael Guggenheim defined "experiment" as "a setup which produces unforeseen outcomes" in a social context.⁷⁷ A "setup" is an activity in which STS scholars purposely create an intervention or a prompt that would lead to an unpredictable response by the participant.⁷⁸ Guggenheim was explicit that an STS experiment was not the observation of another researcher's experiments, nor should the research be able to predict the outcome.

⁷⁴ Zuiderent-Jerak, *Situated Intervention*.

⁷⁵ Zuiderent-Jerak.

⁷⁶ Marres, Guggenheim, and Wilkie, *Inventing the Social*.

⁷⁷ Michael Guggenheim, "Experimenting. Trying to Change the World with STS." (WTMC Series on Teaching and Learning STS, "Experimenting or trying to change the world with STS.," Deursen-Dennenburg, The Netherlands, August 26, 2019).

⁷⁸ Guggenheim; Michael Guggenheim, "'The Aspiration to Intervene: From Critique to Experiments'" (WTMC Series on Teaching and Learning STS, "Experimenting or trying to change the world with STS.," Deursen-Dennenburg, The Netherlands, August 26, 2019).

Exploring the Criticisms and Weakness of engagement

As one can tell, the field of STS is replete with various approaches to engagement. However, though many scholars embraced these forms of STS scholarship and touted the impact of these forms of scholarship, not everyone embraced these methods.

Though there are several advantages to engaged STS scholarship, this work has met quite a lot of criticism. Many argued that participation decreased our scholarship's integrity, reduced the objectivity of the work, increased the possibility of scholars going native, and has overall adverse consequences upon the normativity of research.⁷⁹ For example, some STS scholars feared that if they turn more toward engagement, the field may become bogged down into institutional constraints and lose its critical voice.⁸⁰

However, engagement increases our research's value and quality.⁸¹ Engagement directly improves many qualitative research criteria, such as a worthy topic, rich rigor, sincerity, credibility, resonance, significant contribution, ethical, and meaningful coherence.⁸² For example, a "worthy topic" is relevant, timely, effective, and engaging. Though one can argue specific points of this criteria, a researcher who employs an engaged approach directly addresses the community's active and current needs. Thus, a participatory approach attests to the community's relevance, timeliness, significance, and interest. For example, the podcast topics addressed *the department's current and relevant* issues and challenges. Likewise, participation contributes to several other aspects of this criteria. Formulating a project that emerges from

⁷⁹ Zuiderent-Jerak, *Situated Intervention*; Zuiderent-Jerak and Bruun Jensen, "Editorial Introduction"; Simon A. Cole, "A Cautionary Tale About Cautionary Tales About Intervention," *Organization* 16, no. 1 (January 1, 2009): 121–41, <https://doi.org/10.1177/1350508408098925>.

⁸⁰ Thoreau and Devinne, 221

⁸¹ Sismondo, "Science and Technology Studies and an Engaged Program"; Zuiderent-Jerak, *Situated Intervention*; Cole, "A Cautionary Tale About Cautionary Tales About Intervention"; Guggenheim, "Experimenting. Trying to Change the World with STS."

⁸² Sarah J. Tracy, "Qualitative Quality: Eight 'Big-Tent' Criteria for Excellent Qualitative Research," *Qualitative Inquiry* 16, no. 10 (December 1, 2010): 837–51, <https://doi.org/10.1177/1077800410383121>.

qualitative research and speaks to the needs of a community reveals the transferability of the initial findings beyond the initial research context, implies a practical and valuable contribution, provides a more grounded response to relational ethics, and ensures that meaningful coherence is achieved.⁸³

Secondly, participation contributes to creating theory. Research should make a scholarly and theoretical contribution to the field, whether qualitative or quantitative.⁸⁴ Research that examines another theory within a new or different context may provide new knowledge, but there must be more than that. Researchers must do more than just “test” another’s theory; but instead must challenge current knowledge to expand it, abandon it, or further enrich it.

Third, scholars criticize engagement for questioning the normative approaches to qualitative work. Scholars claim that allowing the researcher to become involved risks decreasing the research’s objectivity and increasing the chance of “going native.”⁸⁵ Others argue that when scholars intervene, their authority and power threaten the studied public.⁸⁶ Yet, an engaging scholar is a more respected scholar, and instead, engagement tends to create a more autonomous and self-advocating community.⁸⁷

However, engagement is not without its weaknesses. As a responsible scholar, I would be remiss if I did not discuss the challenges of engagement. This section discusses the need for time and resources, the loss of power, and the potential for criticism from many directions.

⁸³ Tracy.

⁸⁴ Kum-Kum Bhavnani, Peter Chua, and Dana Collins, “Critical Approaches to Qualitative Research,” *The Oxford Handbook of Qualitative Research*, July 1, 2014, <https://doi.org/10.1093/oxfordhb/9780199811755.013.009>; Luke Eric Lassiter and Elizabeth Campbell, “What Will We Have Ethnography Do?,” *Qualitative Inquiry* 16, no. 9 (November 1, 2010): 757–67, <https://doi.org/10.1177/1077800410374444>.

⁸⁵ Howard S. Becker, “Whose Side Are We On?,” *Social Problems* 14, no. 3 (1967): 239–47, <https://doi.org/10.2307/799147>.

⁸⁶ Zuiderent-Jerak, *Situated Intervention*; Becker, “Whose Side Are We On?” 241

⁸⁷ Nina Wallerstein and Bonnie Duran, “Community-Based Participatory Research Contributions to Intervention Research: The Intersection of Science and Practice to Improve Health Equity,” *American Journal of Public Health* 100, no. Suppl 1 (April 2010): S40–46, <https://doi.org/10.2105/AJPH.2009.184036>.

First, engagement requires time and resources. I would have had difficulty creating the podcast if not for the funded recording software and editing services. Likewise, each intervention commended a large amount of my time and the time of others. In general, research can be a resource-intensive endeavor. Field sites, archival research, and transcription services are just a few examples of necessary resources. However, engagement can double the necessary resources. Interestingly, I reviewed the index of several books on STS engagement and could not find indexed subjects on time, money, and resources.⁸⁸ This is one indicator of the lack of conversations about the groundwork within STS engagement.

Second, engagement is unpredictable. An engaged scholar must be prepared to reevaluate, reconsider, and even end an intervention. One of my first interventions involved a documentary theater approach of recruiting theater students to act out the experiences and narratives identified in the climate and culture study. However, I canceled the idea with the start of the Covid Pandemic. Many of my interventions depended on other people agreeing to be interviewed, waiting for final episode approval, collecting data, and just showing up.⁸⁹ I questioned the possibility of some podcast episodes when I had difficulty recruiting participants. I say all of this to say that engaged STS scholars must be flexible.⁹⁰

Third, engaged STS scholars must be prepared to face success and criticism. When I move into another field as an STS expert, I invite appreciation and criticism. STS scholars who engage with the field may think that they are only helping academically, only to find that their knowledge and identity are on trial.⁹¹ The engaged STS scholar will be the face of either the

⁸⁸ Marres, *Material Participation*; Peter Reason and Hilary Bradbury, *Handbook of Action Research: Concise Paperback Edition* (SAGE, 2006); Zuiderent-Jerak, *Situated Intervention*; Gary Downey and Teun Zuiderent-Jerak, *Making & Doing: Activating STS through Knowledge Expression and Travel* (MIT Press, 2021).

⁸⁹ Peter Park, *Knowledge and Participator Research*, 89

⁹⁰ John Gaventa and Andrea Cornwall, "Power and Knowledge" 73

⁹¹ Lynch and Cole, 296-297

intervention's failure or success. I faced this numerous times as I attempted to create a critical podcast episode that would not be banned or pulled due to departmental politics. A weakness of STS engagement is that there are times that the criticality must be blurred or completely muted for the greater good of the people and concerns of the field.⁹²

What is Groundwork?

Many of these engagement challenges can be addressed by identifying the groundwork in STS engagement. However, what exactly is groundwork? The Cambridge Dictionary defined groundwork as the "work done as *preparation* for work that will be done later."⁹³ The Oxford Language Dictionary defined groundwork as "*preliminary* or basic work."⁹⁴ The Macmillan dictionary defined it as "the work that you do in order to *prepare* for something."⁹⁵ These definitions pointed to a critical concept of STS engagement: preparation. In other words, the primary work that prepared the way for the intervention.⁹⁶ Through this lens, groundwork included the constant decision-making for every part of the intervention. It included leadership skills, teamwork, and trust-building to convince others of your idea and work with you. Groundwork occurred as I established my legitimacy with the RED grant team and the participants who agreed to participate in my projects. Groundwork was the work of designing multiple interventions and choosing the best one. The groundwork was being at a loss of *how* to negotiate authority. It included the moments when I was a recruiter, graphic designer, promoter, and marketing specialist.

⁹² I return to useful in the conclusion to expand on my experience of avoiding usefulness

⁹³ "Groundwork," accessed December 5, 2021, <https://dictionary.cambridge.org/us/dictionary/english/groundwork>.

⁹⁴ "Groundwork Noun - Definition, Pictures, Pronunciation and Usage Notes | Oxford Advanced Learner's Dictionary at OxfordLearnersDictionaries.Com," accessed December 7, 2021, <https://www.oxfordlearnersdictionaries.com/us/definition/english/groundwork>.

⁹⁵ "GROUNDWORK (Noun) American English Definition and Synonyms | Macmillan Dictionary," accessed December 7, 2021, <https://www.macmillandictionary.com/us/dictionary/american/groundwork>.

⁹⁶ This definition of groundwork connects to the weaknesses described in the previous section describing the challenges of engagement. Acquiring resources and choosing interventions are all part of preparation.

However, I have to challenge the dictionary definition of groundwork. In STS engagement, groundwork is more than preparation. Groundwork is continuous from beginning to end. However, to truly understand and comprehend the groundwork, I had to allow myself to *experience* the groundwork as a scholar, a researcher, and a person. Engaged scholars do not simply perform engagement; they experience engagement. Just as groundwork is minimal within the literature, the experience of engaging is limited too.⁹⁷ The importance of the experience is evident because many engaged scholars must write within a first-person narrative.⁹⁸ Though they may not speak directly of the experience, their experience is present all the same.

Engaging scholars *participate*. They get involved, and by getting involved, they not only *performed* engagement, but they also *experienced* engagement. However, many of the experienced things are very rarely studied or even spoken. Scholars wrote about what happened and their experience when their STS knowledge intersected with their lived experience regarding technology.⁹⁹ However, finding more information regarding the participant's internal experience was lacking. Christopher Kelty's book, *The Participant: A Century of Participation in Four Stories*, discussed the absence of the participation experience.¹⁰⁰ His work focused on the experience of participation, the language of participation, and contributor autonomy. I drew from Kelty's focus on participation as an experience. Kelty believed that the experience of participation--what does it feel to participate?--was missing from conversations about participation. From his study of the work on participation, scholars have framed participation as

⁹⁷ Christopher M. Kelty, *The Participant: A Century of Participation in Four Stories*, 1 online resource (344 p.) : 73 halftones, 11 line drawings vols. (Chicago: University of Chicago Press, 2020), <https://www.degruyter.com/isbn/9780226666938>.

⁹⁸ Benjamin R. Cohen and Wyatt Galusky, "Guest Editorial," *Science as Culture* 19, no. 1 (March 1, 2010): 1–14, <https://doi.org/10.1080/09505430903557924>; Gillian Rose, "Situating Knowledges: Positionality, Reflexivities and Other Tactics," *Progress in Human Geography* 21, no. 3 (June 1, 1997): 305–20, <https://doi.org/10.1191/030913297673302122>.

⁹⁹ Benjamin R. Cohen & Wyatt Galusky, 2010, Guest Editorial, *Science as Culture*, 19:1, 8

¹⁰⁰ Kelty's work is framed within participation, however, as stated earlier, participation falls under engagement.

"abstract, schematic, procedural, bloodless, and pale."¹⁰¹ Kelty repeatedly asked himself after reading articles about participation, "But what did it feel like?" To Kelty, this is my answer to what it feels like to participate.

However, why do we need to make groundwork visible? STS engaged scholars have produced numerous accounts of their work of engagement. However, why so little work on the preparation that happens throughout? Is groundwork irrelevant because it is simply *work*? As scholars, do we just do the groundwork without consciousness? Is groundwork invisible due to a trained focus on the critiques of scholarship? Or perhaps, as engaged scholars who are strongly focused on our communities, have we not yet taken the time to reflect on what we do and how much we do? These are all reasons to stop, pause, and reflect on how much we, as STS scholars, do. We work hard to create the policy, the art exhibit, the podcast, the workshop, or any number of interventions to speak to the needs of our communities of engagement. Additionally, bringing visibility to STS groundwork brings visibility to the STS scholar and the STS discipline. It brings visibility to our concerns, needs, care, and so much more.

STS Groundwork in Three Projects

As a background to these interventions, chapter two begins with a brief background of the history of the NSF and engineering education and the factors that lead to the development of RED's national engineering education initiative. I then outline the objectives and the team of the RED grant team for the ECE department and proceed to describe the methodology, analysis, and results of the first year culture and climate study of the ECE department. The next section details the merger of my position as a participant and ethnographer of the RED grant with my newly acquired knowledge as an emerging "STS scholar."

¹⁰¹Kelty, *The Participant*. 9

It was important to draw from numerous experiences to bring visibility to the groundwork of STS engagement. One project would not suffice to provide a rich, detailed experience of engagement. Therefore, the groundwork for this dissertation comes from three carefully chosen interventions and is described in chapters three through five. I designed my dissertation in a triad of threes. I created three projects focused on three separate segments of invisibility within the ECE department. Each project employed very different approaches and involved varying levels of participation. For example, the seminar and the podcast participants shared their experiences via a public-facing forum. However, the undergraduate academic career advisors collected data for the white paper. Likewise, the podcast and the seminar were for a broader audience, whereas the white paper was created for a specific audience: the ECE faculty. Each project positioned me to experience engagement in different ways. For each project, I discussed specific aspects of groundwork that emerged from the creation and implementation of each project

Chapter three centers around how I developed and created a limited series podcast, *Engineering Visibility* to bring visibility to the less dominant (invisible) people and concerns of the ECE department and the groundwork of this project is the need to protect the well-being of the podcast participants. The culture of the ECE department is essential because engineering education studies reveal that a student's persistence within an engineering program is linked to the student's ability to find a shared community, culture, and identity within the engineering department.¹⁰² However, the department's dominant cultural image may overshadow the smaller, less dominant cultures and communities. This led to two things. First, it dissuaded

¹⁰²Pamela Bradigan and Hartel Lynda, "Organizational Culture and Leadership: Exploring Perceptions and Relationships," in *Workplace Culture in Academic Libraries: The Early 21st Century*, ed. Kelly Blessinger and Paul Hrycaj (Witney, UNITED KINGDOM: Elsevier Science & Technology, 2013), 7–19, <http://ebookcentral.proquest.com/lib/vt/detail.action?docID=1574989>. 8

potential students from applying to the program and pursuing an engineering career. Second, current students of the program were unable to locate a sense of belonging and faced difficulties succeeding in the program. Engineering education studies have shown that the lack of shared identity and community can lead to a sense of isolation and the subtle creations of non-inclusive study groups, extracurricular gatherings, and student organizations.¹⁰³ The purpose of developing the podcast *Engineering Visibility* provided a vehicle that would bring visibility to the voices and experiences of the many unseen people of the department. Students, alumni, and other stakeholders in the department were invited to share their experiences regarding the graduate school experience, the non-traditional student experience, experiences of being an underrepresented student identity, COVID, and teaching in the ECE department. A goal of the intervention was to bring awareness to unseen individuals, promote a positive culture, and create a sense of belonging within the department. *Engineering Visibility* featured over twenty ECE alumni, students, instructors, and administrators discussing their experiences on various topics.

The groundwork of this intervention was the need to protect the participants' overall well-being. *Engineering Visibility* was public-facing platform discussing socially sensitive and polarizing issues such as women in engineering and inclusion and diversity. As the researcher, it was my responsibility to protect the participants. I explained this by reintroducing the layers of invisibility within the concept of *interventionist protectivity*. Interventionist protectivity described my work of protecting the participants at risk of abuse and threat due to the podcast's visibility.

A key aspect of the ECE RED proposal was utilizing threshold concepts to create a sophomore year curriculum of "base" classes that would allow students to explore other

¹⁰³ Erin A. Cech and William R. Rothwell, "LGBTQ Inequality in Engineering Education," *Journal of Engineering Education* 107, no. 4 (2018): 583–610, <https://doi.org/10.1002/jee.20239>. 586.

concentrations and explore non-traditional careers within engineering.¹⁰⁴ However, the success of the ECE student was firmly framed within traditional images of career success: the engineer that worked for a defense contractor or the tech industry. Yet, a career trajectory is fundamental to an engineering student's ability to matriculate through an engineering program. Engineering education studies have shown that students that are able to identify with a career path persist through the challenges of engineering education.¹⁰⁵ For students to explore and pursue non-traditional careers, non-traditional jobs had to be made visible to the student body.

To truly inspire students to move beyond these conventional images of career success, I challenged the department's cultural idea of success. Chapter four explores how I did this by first analyzing success as a socially constructed concept and then identifying how success is tightly connected to our professional identities. I invited four ECE alums with non-traditional careers to share their story to challenge this image in a seminar.

Challenging engineering career success contributed to how I approached measuring the impact and "success" of my interventions. It is essential to measure the impact of a project to gain future support, assess the impact on stakeholders, and modify future projects. However, cultural change is challenging to capture in traditional assessment modes such as surveys or focus groups. Once again, I reexamined the context and assessment milestones of success. I identified "assessment per mobility" as one form of impact measurement. Assessment per mobility considers the success of a project by the distance the knowledge of the project moves beyond its initial introduction. For example, one of the RED grant PIs shared the idea of the event with the department chair and a alumni-donor and pushed for it to be a yearly event.

¹⁰⁴ Virginia Polytechnic Institute and State University, "IUSE/PFE: RED: Radically Re-Designing the Fan-in and Fan-out of an Electrical and Computer Engineering Department."

¹⁰⁵ Asha Godbole et al., "Engineering Students' Perceptions of Belonging through the Lens of Social Identity," 2018, <https://peer.asee.org/engineering-students-perceptions-of-belonging-through-the-lens-of-social-identity>.

Chapter five explores the work of translating and legitimizing the care work of the advisors to be seen and valued by the ECE faculty. I knew that the work of the advisors, though unseen by the faculty, was pivotal to the students' success, but I struggled with how to make their work visible to the faculty. One comment, "If it isn't numbers, we don't care," made me realize I would have to translate the work of the advisors into numbers, without reducing them into numbers. For those that may minimize the work of advising, engineering education studies reveal that many engineering students leave the study of engineering due to four primary areas: advising, faculty, curriculum, and their high school preparation.¹⁰⁶ Engineering students who receive quality advisement progress through the program at a timelier rate, report increased student satisfaction, and often maintained their course track to graduation.¹⁰⁷

I created a data-driven white paper to translate the work of the advisors into a language that the faculty understood. The qualitative study revealed the significance of the academic career advisors. Having been trained that quantitative research is the normative approach to research, the engineering community can dismiss qualitative work as the results cannot be generalized.¹⁰⁸ As an ECE faculty commented, "We understand numbers. If it isn't numbers, we don't care." The challenge of this intervention was to translate the advisor's work into numbers without *reducing* the advisors to numbers. Thus during the Fall 2020 semester, the advisors collected data on almost 1700 student interactions. This data was then analyzed and used to

¹⁰⁶Susan Haag et al., "Engineering Undergraduate Attrition and Contributing Factors," *International Journal of Engineering Education* 23, no. 5 (2007): 929–40, <http://www.scopus.com/inward/record.url?scp=36348987698&partnerID=8YFLogxK>. 929.

¹⁰⁷Matthew Meyer and Sherry Marx, "Engineering Dropouts: A Qualitative Examination of Why Undergraduates Leave Engineering," *Journal of Engineering Education* 103, no. 4 (2014): 525–48, <https://doi.org/10.1002/jee.20054>. 528.

¹⁰⁸Susan E. Walden et al., "Special Session — Using Qualitative Data to Bring Positive Culture into Engineering Programs," in *2010 IEEE Frontiers in Education Conference (FIE)*, 2010, S2B-1-S2B-2, <https://doi.org/10.1109/FIE.2010.5673552>. S2B-1.

create a white paper of their work with a plan to disseminate this information to the faculty and the department through monthly faculty meetings, emails, and other options.

In my conclusion, I discuss my work, not within the confines of each project, but the overall experience of being an engaged STS scholar within three experiences. First, I summarize the three interventions and describe the corresponding groundwork that emerged. Second, I identify the limitations of positionality, reflexivity, and reflection in qualitative research. Though these three tools were necessary for my work, they were limited in helping me with my own internal doubts and fears. I introduce the term, “self-confrontation” to identify how I overcame my fears, concerns, and doubts within intervening. Lastly, I discuss the importance of avoiding the "usefulness" trap as an STS scholar in the field.

Chapter 2: Locating Invisible Identities, Careers, and Care within a Revolution

"We wanted people to really go bold or go home."—Donna Riley

A Call to Revolution

My first memory of the RED grant was attending an ECE faculty meeting in Whittemore 453 in the early Fall semester of 2016. I was sitting along the back wall conversating with faculty members, though, at the time, I had no idea who these people were as they chatted among themselves. I had even less idea of what I was supposed to be doing. I knew that I was to help collect the faculty and staff's suggestions of threshold concepts. I remember walking around the room, ensuring that everyone had a form and a pen. I remember it all being a whirlwind of words, conversation, and ideas. I remembered being overwhelmed by it all. I was a new graduate student in the STS program, new to Blacksburg, and had never heard of electrical and computer engineering. I didn't know what I was doing. I only knew that I wanted to do a good job.

That meeting was just one of the few hundred meetings that would occur over the next five years. What started as a weekly Wednesday morning timeslot that fit everybody's Fall 2016 schedule would eventually become a mainstay for the next five years. Each Wednesday morning, the team met in the Whittemore 453B conference room to discuss and ensure that the team was on track to ensure a culture change within the department.¹⁰⁹ Even in the spring of 2020, when the Covid pandemic pushed everyone indoors, the meetings continued via Zoom. We worked together to transform the department's narrow curricular path into one that "draws and

¹⁰⁹ For the first year, the meetings were held in the Moss Art Center.

retains a wider pool of students and prepare them to be T-shaped professionals for a range of careers.”¹¹⁰

However, before we decided to move forward with the curricular changes, the team decided to conduct a qualitative culture and climate study of the department. Though I knew little about curriculum and T-shaped professionals, I did know a few things about qualitative research. I had taken a two-day course in intensive interviewing facilitated by the renowned qualitative researcher, Kathy Charmaz. Additionally, I had taken workshops for both Nvivo and Atlas.ti coding software. Also, I had spent the past year working as a research consultant for a patient-reported outcome research company. My job consisted of flying across the country and interviewing patients for medical research. During my first year as a GRA on the RED grant team, I maximized my contribution through interviewing dozens of faculty members, undergraduate students, alumni, and advisors in the ECE department. In each interview, I brought visibility to the RED grant team by explaining the purpose and objectives of the RED grant. Each participant took time to listen as I explained our goals and took the time to respond thoughtfully to each question. During these conversations, I slowly learned about the work and dedication to become an engineer, the reasons they chose this profession, and the things they wished were different. Though I started the project knowing nothing about electrical and computer engineering, I came to understand engineering’s impact on the world by the end of the study.

When I accepted the GRA on the RED grant, I was still unsure of my research identity, and I was under no obligation to use the RED grant as my research project. Instead, I considered multiple different research trajectories. I considered bioethics because I was a nurse.

¹¹⁰ Virginia Polytechnic Institute and State University, “IUSE/PFE: RED: Radically Re-Designing the Fan-in and Fan-out of an Electrical and Computer Engineering Department.”

I tried to connect my background in information technology (IT) and cybersecurity to my STS policy class readings. Honestly, I knew nothing about engineers or engineering education and wasn't sure if there was a place for me. Yet, I would slowly find my "fit" in the ECE department, the RED grant, and engineering education over time. As the social scientist on the grant, I could step away from the curricular change and focus on the department's other aspects of culture change. Reflecting on the research data, I imagined a project that not only brought attention to the challenges within the department but one in which I became an active agent of change.

This chapter describes the actions leading to my decision to become an engaged STS scholar on the ECE RED grant. Instead of only advising the ECE RED team, my advisor and I combined our theoretical expertise and pragmatic knowledge to engage in the departmental culture change. In the first part of this chapter, I described my experience and positionality of coming into the ECE RED grant project as a non-traditional graduate student without any engineering experience. The next section provides a brief history of the NSF, their involvement within engineering education, and the development of the RED grant. The ECE department became a RED recipient in 2016 and commenced with a large-scale qualitative study of their department. The second part of this chapter provides an overview of this culture and climate study, its analysis, and the findings. The third section of this chapter describes the scholarship that influenced my decision to become an engaged scholar and the need for different approaches.

The STS Scholar as Outsider

The purpose of RED's mandatory inclusion of a social scientist was to provide critical assessments of the department's dynamics, monitor the change process, and advise as necessary

to maintain a culture change among the faculty, students, and staff.¹¹¹ The social scientist for this project was a historian of technology and innovation from the STS department with extensive knowledge of the history of institutional change within engineering. As an interdisciplinary field that has critiqued engineering from a historical, sociological, and philosophical viewpoint, the STS faculty member, Dr. Matthew Wisnioski, provided the project with a multi-layered historical and critical approach. By including the social scientist component and per Dr. Wisnioski's suggestion and recruitment, I joined this team as a GRA on the ECE department's RED grant project.

I became a part of this team in the fall of 2016. Reflecting on that time, I realize that I unknowingly accepted a position with a steep learning curve. I had recently completed my Masters in Network Technology, in which I conducted a qualitative study of technology adoption behaviors. Desiring a deeper and more critical approach to the social aspects of technology, I applied and was accepted into the STS program at Virginia Tech. Though I had completed a graduate degree, I didn't have a background in engineering, higher education, or STS. The learning curve was great as I tried to understand the intricacies within the ECE department and engineering education combined with attempting to understand the language, culture, and expectations of STS. For example, I was only aware of mechanical and civil engineering at the time of my admittance. I couldn't recall coming across the concept of electrical or computer engineering or meeting an electrical or computer engineer before the RED grant. As I struggled to understand ECE, I was lost within my STS coursework. The seminar format was unfamiliar to me as I struggled to discuss the readings. Though the readings were in English, they just as well had been written in Russian. That's how foreign the concepts were to me. However, instead of

¹¹¹ NSF, "NSF RFP: 15.607 2016." 3

focusing on my deficits, I turned to my assets. I was a non-traditional graduate student with years of work experience in the fast-paced and stressful environment of nursing. Up until this point, I had studied psychology, library information science, nursing, and information technology. I came into all those areas with no prior exposure and had succeeded. I recognized that my unique background was not a detriment but my best asset. I possess years of experience working with various people in numerous environments. From nursing, I had learned how to be present in conversations in which expertise and authority did not always align for equal voices. I had experience in writing, research, and a general technology background from all my disciplines that eased my transition into this challenge.

Remarkably, the RED grant caused me to reflect upon the assets connected to my identity. Up until this point, I had never considered that I was a first-generation student. However, I could connect with many of the first-generation students' experiences. When I struggled with classes and the undergraduate process during my undergraduate years, I thought I wasn't as smart as the other students. However, now I realize that I was competing with students that had come from better school districts and had family members that could advise on the college experience. I hadn't considered that as a bi-racial woman from the rural south, I was a student from both an underserved community and an underrepresented minority. As a nurse that was constantly fighting for recognition, I immediately connected with the advisors' experiences. Yet, as ECE faculty discussed the weed-out process and rigor, I could connect through my experience as a nursing student. I recalled in nursing school, after each exam, my cohort became smaller and smaller. And I remembered clinical rotations in which I was expected to spew out lab results, medication side effects, and appropriate interventions at the drop of a hat. Though I

was not an engineering student, I could connect my experiences to enrich my position as a STS graduate student and a GRA on the ECE RED grant.

More importantly, the first few years of the grant allowed me to understand the people from the culture and climate study within my multiple identities and experiences. Perhaps these things fueled my drive to intervene. I joked that I intervened in the ECE department because, as a nurse, I had been trained to intervene. A temperature spikes, I intervened. A patient becomes unresponsive, I immediately intervened. Therefore, I took my experience intervening in healthcare to the ECE department. A student wanted to know about other career options, I intervened and created a seminar. The undergraduate academic career advisors felt undervalued; I intervened and produced a white paper. Though I started my time at Virginia Tech as perhaps the most unlikely candidate, I soon learned that everything I had done had prepared me to be a member of the RED grant and to address the needs for culture change.

Making the Past Visible

The National Science Foundation (NSF), engineering education, and the engineering profession's relationship have evolved through decades of political, cultural, and economic influences. In its early years, the NSF funded and supported broad topics within science and math but contributed very little toward engineering education.¹¹² Not until the late 1980s, as other national research organizations began to focus on engineering, the NSF shifted more funding toward engineering education. For example, in 1986, the National Science Board (NSB) published the report, "Undergraduate Science, Mathematics and Engineering Education." This

¹¹² Karen Frair et al., "- The NSF Foundation Coalition Looking Toward the Future," *Frontiers in Education Conference*, 1997, 5; NSF, "NSF in a Changing World: The National Science Foundation's Strategic Plan," February 28, 1995, <https://www.nsf.gov/pubs/1995/nsf9524/contents.htm>; K. Frair and D. Cordes, "Sharing Innovation: The NSF Foundation Coalition," in *FIE '98. 28th Annual Frontiers in Education Conference. Moving from "Teacher-Centered" to "Learner-Centered" Education. Conference Proceedings (Cat. No.98CH36214)*, vol. 3 (IEEE Computer Society Symposium Frontiers in Education, Tempe, AZ, USA: IEEE, 1998), 1325, <https://doi.org/10.1109/FIE.1998.738685>.

report emphasized a national need to improve the quality of math, science, and engineering at the undergraduate level.¹¹³ Some researchers claim this report as a catalyst for a growing national dialogue regarding engineering education. About three years later, the *Belmont Conference on Imperatives in Undergraduate Engineering Education* released a series of studies urging the country to address the shortcomings within engineering education for national growth and global relevance.¹¹⁴ Eventually, the NSF heeded these reports and shifted funding to the undergraduate engineering curriculum.

The Engineering Education Coalitions (EEC) was one of the first major NSF engineering education initiatives. Recipients had three key objectives: improve undergraduate engineering education programs' quality, increase the overall number of engineering degrees awarded, and enroll more women and underrepresented minorities.¹¹⁵ Between 1990 and 2005, over 60 universities and industry partners would merge into eight coalitions. Though each coalition received between \$2-3 million for up to five years, each coalition had to match their awarded amount.¹¹⁶ Interestingly, each of the eight coalitions focused on the freshman year curriculum of their engineering program. Though the EEC contributed improvements to engineering education, engineering education scholars debated their overall success for years. One contention

¹¹³ Jack R Lohmann, "Building a Community of Scholars: The Role of the Journal of Engineering Education as a Research Journal," *Journal of Engineering Education* 94, no. 1 (2005): 1–6, <https://doi.org/10.1002/j.2168-9830.2005.tb00823.x>.

¹¹⁴ Robert Coleman, "A Progress Report: The Engineering Education Coalitions," *ASEE Prism* 6, no. 1 (September 1996): 24–31; John L. Daniels, Sally L. Wood, and Susan C. Kemnitzer, "The Role of NSF's Department Level Reform Program in Engineering Education Practice and Research," *Advances in Engineering Education* 2, no. 4 (2011), <https://eric.ed.gov/?id=EJ1076064>.

¹¹⁵ Borrego, "Development of Engineering Education as a Rigorous Discipline"; Robert C Serow, Catherine E Brawner, and James Demery, "Curriculum Reform and the NSF Engineering Education Coalitions: A Case Study," n.d., 9; N. Al-Holou et al., "First-Year Integrated Curricula across Engineering Education Coalitions," in *FIE '98. 28th Annual Frontiers in Education Conference. Moving from "Teacher-Centered" to "Learner-Centered" Education. Conference Proceedings (Cat. No.98CH36214)*, vol. 1 (IEEE Computer Society Symposium Frontiers in Education, Tempe, AZ, USA: IEEE, 1998), 177–97, <https://doi.org/10.1109/FIE.1998.736829>. Al-Holou et al., 1998; Borrego, 2007; Serow, Brawner, & Demery, 1997

¹¹⁶ Coleman, "A Progress Report: The Engineering Education Coalitions."

was that the knowledge and progress that each coalition produced never moved beyond the boundaries of the coalition and failed to impact national engineering education curriculums.¹¹⁷

Toward the end of the EEC project, the National Academy of Science published *The Engineer of 2020: Visions of Engineering in the New Century* and a later publication, *Educating the Engineer of 2020: Adapting Engineering Education to the New Century*.¹¹⁸

Another NSF initiative that began toward the end of the EEC program was the Department-Level Reform of Undergraduate Engineering Education (DLR) competition. Between 2004-2008, the DLR program built upon some of the work done by the EECs.¹¹⁹ The program directors wanted engineering departments to address the question: "starting from a clean page in 2004, what is the best possible learning experience we can provide for our students, that will prepare them for professional practice or the career they choose?"¹²⁰ Supporting twenty universities in the United States, DLR focused on developing more up-to-date curriculums that would meet the needs of the US workforce. At a workshop held in Arlington, VA to obtain feedback on the DLR program, the overall consensus was that the program had produced programs that elicited change.¹²¹ However, there was a general opinion that three to four years was insufficient to gauge the long-term effect and the NSF continued to seek ways to improve engineering education.

¹¹⁷ Borrego, Adams, Froy, Lattaca, etc 2007; [Coleman, 1996](#)).

¹¹⁸ National Academy of Engineering., *The Engineer of 2020: Visions of Engineering in the New Century*, 1 online resource (xv, 101 pages) vols. (Washington, D.C.: National Academies Press, 2004), <http://site.ebrary.com/id/10057020>; National Academy of Engineering, *Educating the Engineer of 2020*.

¹¹⁹ "The Role of NSF's Department-Level Reform Program in Engineering Education Practice and Research - AEE Advances in Engineering Education," accessed December 6, 2021, <https://advances.asee.org/publication/the-role-of-nsfs-department-level-reform-program-in-engineering-education-practice-and-research/>.

¹²⁰ "NSF Funding Opportunity Document: Grants for the Department-Level Reform of Undergraduate Engineering Education (DLR)," accessed December 6, 2021, <https://www.nsf.gov/pubs/2005/nsf05531/nsf05531.htm>.

¹²¹ "The Role of NSF's Department-Level Reform Program in Engineering Education Practice and Research - AEE Advances in Engineering Education."

In 2014, the NSF Engineering Directorate launched the Professional Formation of Engineers (PFE).¹²² This multi-year initiative addressed the need for an innovative and inclusive engineering profession. That same year, PFE partnered with Improving Undergraduate STEM Education (IUSE) and announced the Revolutionizing Engineering Departments (RED) initiative.¹²³ RED was a multi-million dollar and multi-year competition that challenged engineering departments across the nation to *revolutionize* how they approached engineering education. The initiators of the RED grant wanted to challenge the traditional and exclusive culture of the engineering profession through the engineering curriculum. Overall, most national engineering curriculums were not adequately preparing their undergraduate engineering students for a competitive global economy that required engineers that were inclusive, experientially diverse, and experienced in both soft and technical skills. The NSF RED grant urged applicants to create proposals that were “radically, suddenly, or completely new; producing fundamental, structural change; or going outside of or beyond existing norms and principles.”¹²⁴ Donna Riley, at the time the NSF director of Engineering Education, stated, “We wanted people to really go bold or go home here...we wanted big ideas that would really change how we’re thinking about engineering education.”¹²⁵ Additionally, the NSF also funded the RED Participatory Action Research (REDPAR) project to avoid the previous scalability challenges. The REDPAR team served as a resource for each university through monthly calls, workshops, and yearly consortium meetings.¹²⁶ Also, to ensure scalability and sustainability, the REDPAR team also studied each RED grant team’s change process and disseminated each into practical strategies.¹²⁷

¹²² NSF, “NSF RFP: 15.607 2016.”

¹²³ NSF.

¹²⁴ NSF.

¹²⁵ Schimdt, “National-Science-Foundation-Aims-to-Change-Undergrad-Engineering-Computer-Science.”

¹²⁶ Due to the COVID pandemic, the meetings were no longer held after 2019.

¹²⁷ “Making Academic Change Happen,” Making Academic Change Happen, accessed December 7, 2021, <https://academicchange.org/>.

Making Matters of Concern Visible

In 2016, the ECE department's RED grant proposal titled "Radically re-designing the Fan-in and Fan-out of an Electrical and Computer Engineering Department" was chosen as a RED grant awardee. One of the first tasks of the RED grant was to obtain a better understanding of engineering and the ECE department. The PIs decided that a qualitative study was the best approach to obtaining information about the current views of becoming an engineer, the body of knowledge necessary for engineering, and the ECE culture's climate. This study involved recruitment, anonymous interviews, data collection, and analysis. For this reason, the team submitted an Institutional Review Board (IRB) application before beginning the study. Upon IRB approval, the team commenced recruitment, and the interviews started.

The interview was divided into three sections. The first section explored the individual's path of becoming an engineer. The second section delved more specifically into their experience as either a faculty member, undergraduate student, alumni, or academic career advisor in the ECE program at Virginia Tech. In the third section, participants shared their thoughts on the challenges within the department and the profession that challenged the department and the industry's growth. Interviewees were recruited via snowballing techniques and in-class recruitment for students with interviews spanning over approximately nine months.

This data was analyzed utilizing in vivo coding and descriptive coding. Due to a large amount of data, in vivo coding was utilized as the first round coding to understand the participants' voices and obtain a general overview of the context of the interviewees.¹²⁸ The second round of coding utilized descriptive coding to analyze the fundamental topics that would lead to thematic development.¹²⁹ A preliminary analysis of the data provided information about

¹²⁸ Johnny Saldaña, *The Coding Manual for Qualitative Researchers* (Los Angeles: SAGE, 2013). 94

¹²⁹ Saldaña. 88

the various factors that influenced stakeholders' choice to study electrical and computer engineering, their experience within the classroom and within the job market, and their thoughts and concerns about the shortcomings of the ECE program and the engineering profession (Table 1). An overwhelming majority of interview participants shared the need for solid comprehension of math and science. This was followed by the way that engineers think about their design problems. After describing the need for strong math skills, many participants noted the need to be analytical, logical, and interested in problem-solving. However, these things did not simply describe how engineers approach problems but instead indicated that these things were a part of their identity. They did not do engineering; they were engineers. They (engineers) were analytical. They were logical. They were problem-solvers (creative).

The necessary body of knowledge and its connection to identity was just one theme of the study. The study also identified the department's challenges. Interdepartmental relationship was a broad category that branched into several subcategories. For example, silos stemmed from perspectives regarding research and teaching, tightly bounded research identities, and labor-value categorization. Lastly, as diversity has always been a point of interest within the initiative and the department, I conducted a separate analysis of diversity.

Table 1. Preliminary Data Analysis

Preliminary Data Analysis	
Body of Knowledge	<ul style="list-style-type: none"> • “The foundation of knowledge of the engineer boils down to the basics of mathematics, physics, logic, reasoning.” [faculty] • “To me engineering is a very creative process ... design at least is a very creative process.” [faculty] • “I think engineering is way more about the process and a thought process and the mindset that it is acquiring.”[alum]
ECE Identity	<ul style="list-style-type: none"> • “Of the engineering major choices, this is one of the most feared of them.” [undergrad student] • “It made me what I am today. It was an endurance but it was also it was a conditioning exercise that prepared me for life because in life you know nobody cares.” [Industry board member]
Interdepartmental -Communication	<ul style="list-style-type: none"> • “I think there is definitely a lack of communication and connection between the professor and the students.” [undergrad] • “They are not faculty [advisors] and their job is to interact with the students ...to take care of general health of academic situation of the students.” [faculty] • “I don’t know any of the professors...I’d like to grow that relationship. I mean I’d really like to know who all the professors are, what they look like, what they teach, what their interests are.” [advisor] • “There is no line, but they (the advisors) are staff. They are not faculty and their job is to interact with the students” [faculty] • “It goes around that the professors tend to be here for research and they’re forced to teach a class.” [undergrad]
Diversity	<ul style="list-style-type: none"> • “I feel everyone I know or have interacted with...I’m obviously making assumptions... they’re white, they’re middle class, upper middle class and mom and dad are paying for most of college.” [undergraduate student] • “They [women] have another way of approaching research and approaching their papers...and we don’t necessarily teach that. So maybe we teach it the male way...That’s not necessarily the right way to do it for everybody.” [faculty] • “...if you’re African-American you’re probably lonely, if you’re Hispanic you’re probably lonely.” [advisor]

The preliminary results were presented at a weekly RED meeting in the 2017 spring semester and contributed to various discussions. The diversity report was shared at the 2018

summer retreat.¹³⁰ As the data collection and initial analysis of the qualitative study came to a close, the RED team became engulfed in the administrative requirements for the revamped sophomore curriculum. Weekly meetings began to focus on deadlines, creating syllabi, and getting the new curriculum through the various levels of bureaucracy.

As the data collection ended, the RED grant became more focused on the needs of the curriculum that was a key component of the culture change. The voices of the department's culture shifted toward the background as the RED team worked to address the complexities of the project and other curricular enterprises. Though my work could have ceased at the analysis, I chose to shift myself from scholar to practitioner and become "engaged" within my studied public through three interventions.

From Documenting Issues to Tackling Them Directly

However, this shift was not immediate. Though I was no longer analyzing the data, I had not wholly forgotten the data. I took classes and worked to understand the STS theoretical approaches to technology and science. Though I found the theories valuable in critically approaching communities and topics, I was challenged to find their practical implementation. As I increased my academic acumen, I continued working with the RED grant team as a participatory member by attending meetings, providing input, and observing the change-making process.

During my fifth semester, I took a class titled, *Engaged STS* (STS 6674). Unsure what to expect, the objective of the course was to reframe STS knowledge to move beyond the scope and boundaries of the discipline into public spheres.¹³¹ In this course, STS scholars critically studied

¹³⁰ However, though they were presented, they were not discussed.

¹³¹ For this I referenced Dr. Gary Downey's syllabus for STS 6674: Engaged STS (Alternate Perspectives on Science, Technology, and Medicine)

various cultures and produced knowledge through their research, and they became involved in the challenges within these communities. As an ethnographer and an emerging STS scholar with an increasing toolbox of theories, here was the answer to my question, “Now what?” As the class progressed, I returned to the first two years of the RED project and the data and used the class as an opportunity to critically reflect upon not only the knowledge from the climate study, but how I could engage with it.

The final class project was the first step in solidifying my scholar-participant identity. My final project, “Engaging in RED and STS in Three Acts,” was a reflection upon my experience as both a researcher and participant in the RED grant. The first act, “Embodying Expertise (Being STS Now)” challenged my positionality within the grant and how my various forms of expertise had contributed to the project. The second act, “Matters of Care: Who Cares? (Framing Sociotechnical Travel)” drew from the Latour’s work regarding the matters of concern and Maria Puig de la Bellacasa’s matters of care in which I identified the people and the needs of the ECE department within the interview data. In the last act, I explored the idea of “situated intervention” and the complexity of being a scholar-participant within two disciplines and the necessary balancing act of such a task. Shortly after this class, after a discussion with my advisor, we decided to create a dissertation project that would combine the RED grant climate and culture study with methods of STS engagement.

Returning to the Interview Data

The first and second round coding provided evidence that supported the general background of engineering regarding the necessary frameworks of knowledge and the engineering identity. Though it was helpful to obtain this information, it did little to change the current culture of the department. Therefore, I revisited the data with a more focused approach.

The lack of diversity was a key component to the department's culture and was a change that many participants voiced as needed. The numbers only supported what the stakeholders already knew. During the Fall of 2020, 77.9% of the undergraduate students with the College of Engineering was male; 56.9% identified as white and 13.8% identified as Asian.¹³² From the numbers, engineering students were mostly white men. However, what did people think beyond the numbers? For this question, I conducted a deeper analysis of the topic of diversity. Of the 48 interviews, 44 discussed diversity for 157 points of data (conversations/statements regarding diversity). Eight major themes emerged from the analysis of these data points: (1) Current Perceptions of Diversity, (2) Diversity Increasing Suggestions, (3) Challenges of Increasing Diversity, (4) Diversity Self-Reported Experiences, (5) Current Diversity Incorporating Strategies, (6) Importance of Diversity, (7) Defining Diversity, and (8) Challenges from a Lack of Diversity. Table 2 lists these major themes and the number of times each them was coded. For a deeper evaluation, each theme was categorically analyzed. This analysis revealed a department that was aware of the need for diversity and interested in addressing this challenge and bridging the gap among the various aspects of diversity to create a more inclusive department, university, and profession.

¹³² Please refer to <https://eng.vt.edu/about/rankings-and-figures/undergraduate-enrollment-by-gender-and-ethnicity.html>.

Table 2. ECE Diversity Analysis

ECE Diversity Analysis	
Major Themes	Categories
Current Perceptions of Diversity (42)	Poor/Lacking/Not Good in General (19) Lack of Women (10) Improving (8) Contextual Diversity (6) Good (At present state) (6) Lack of Minorities (2)
Diversity Increasing Suggestions (29)	Representation (7) Image (7) Classroom (6) Recruitment (6) K-12 (5) Social Activity (4)
Challenges of Increasing Diversity (23)	Image (12) Retention (7) Learning Styles (6) History (2) Exposure (1)
Diversity Self-Reported Experiences (18)	Inappropriate Behavior (5) Doubt of Ability (3) Lack of Commonality (3) Discouraged (2) K-12 (2) Positive (2) Participation (1)
Current Diversity Incorporating Strategies (16)	Lab/Classroom (4) K-12 (4) Representation (3) Recruitment (2) Social Activities (2) Industry Involvement (1) Focus (1)
Importance of Diversity (12)	Broader/Improved Perspectives/Viewpoints (6) Solutions (3) Improved Workforce (2) An Improved Program (1)
Defining Diversity (11)	Race (5)

	Ethnicity (3) Personality (2) Gender (1) Sexual Orientation (1) Values (1)
Challenges from a Lack of Diversity (6)	Loss of talent (Student or Employee) (4) Hindering Growth of Profession (1) Social Norms (1)

This analysis connected the importance of image and representation within the department and engineering. Two themes, “Challenges of Increasing Diversity” and “Diversity Increasing Suggestions,” connected the concept of image as both the challenge to increasing diversity and the solution to diversity (Table 3). The department’s image ranked very high as a challenge for increasing diversity. However, representation and image were the top suggestions to address the lack of diversity. This was key to recognizing the importance of bringing visibility to less dominant images and contributed to the podcast intervention.

Table 3. The Importance of Image and Diversity

The Importance of Image and Diversity	
Major Themes	Categories
Challenges of Increasing Diversity (28)	<i>Image</i> (12) Retention (7) Learning Styles (6) History (2) Lack of Exposure (1)
Diversity Increasing Suggestions (35)	<i>Image</i> (7) Representation (7) Classroom (6) Recruitment (6) K-12 (5) Social Activity (4)

My second analysis focused on the undergraduate academic-career advisors. Reflecting on their interviews, I recognized they identified student challenges that did not emerge in my interviews with the faculty. The faculty’s student perspective focused on curriculum and other

aspects of teaching and learning. However, the advisors spoke of the students’ family relationships, financial struggles, and overall well-being. This data analysis revealed three primary areas of advisement: academic, personal, and professional advisement (Table 4). This analysis contributed to the data collection tool used to collect the qualitative data for the white paper.

Table 4: Advisor Student Interactions Data

Advisor Student Interactions	
Major Themes	Categories
Academic Student Advising (34)	Academic Struggle and Success (16) Direction (10) Faculty Interaction (6) Motivation (2)
Personal Student Advising (21)	Campus and Social Life (6) Health [Mental and Physical] (6) Parents/Family (3) Finances (3) Disabilities (2)
Professional Student Advising (16)	Language Barriers/Communication (1) Professionalism (7) Industry (4) Resumes (3) Alumni (1) Design Teams (1)

Lastly, in a shift from the interviews, the non-traditional career seminar did not emerge directly from the data. Instead, the seminar was created primarily in response to one of the ECE RED grant objectives to broaden the ECE students’ career options. Though this intervention did not directly respond to the data, three of the eighteen students interviewed shared their interests in non-traditional careers: patent law, music, and creative writing. Additionally, each student expressed disappointment that they could not locate many resources to aid them in their career

ventures. The seminar was created in response to both the proposal objective and the students' desire for more career options.

A Need for Different Approaches

The reevaluation of the data was invaluable to locating and identifying the invisible needs of the department. In addition, the places of invisibility were not simply notions or assumptions. Instead, they were data-driven. With this data in place, I proceeded to move forward, developing the best-suited intervention.

In many ways, I viewed my work as a complementary and collaborative approach to the objectives of the ECE RED grant team. The RED grant initiative was complicated, and our proposal objectives were just as complex with the tasks of implementing a culture change, restructuring the second-year curriculum, facilitating faculty-industry relationships, and creating K-12 initiatives. Therefore, when I began designing my research project, I envisioned focusing on culture and culture change. I did not have much experience regarding curricular development. Additionally, that objective had many people addressing its needs. In other words, I employed a divide and conquer approach. I self-assigned myself the task of incorporating another method. The NSF RED's Request for Proposals detailed the social science expert as a person who could "advise on strategies for developing a culture of change and on strategies for creating meaningful collective ownership of the effort among faculty, students, and staff."¹³³ From my interpretation of this statement, the social scientist was meant to embrace the role of advisor. Instead, the social science team did more than advise, we got involved in the process by designing and implementing three interventions that directly addressed the department's culture.

¹³³ NSF, "NSF RFP: 15.607 2016."

My interventions were responses to the needs, concerns, and cares of the many people I intervened and observed within the ECE department. My first project was the *Engineering Visibility* episode podcast. I invited members of the VT ECE community to come together to speak about the topics that go unseen and unspoken in the VT ECE community but exist and necessitate awareness for a true revolutionary change. My second project, a white paper, brought visibility to the underappreciated, unrecognized work of the ECE advisors that was a key part of student success. My final project highlighted disregarded engineering professionals because their career paths were not deemed “successful” by the broad engineering community. By creating a seminar showcasing the spectrum of unknown opportunities in ECE, I brought attention to students with interest in the fundamentals of ECE, but who were seeking to use their knowledge in other ways.

Conclusion

An article in the journal, *Qualitative Inquiry*, aptly titled, “What Will We Have Ethnography Do?” discussed the need of ethnographers to bring their work into the classroom and pedagogy.¹³⁴ In light of this snappy title, I asked myself, “What will I have my data do?” Or perhaps a better question is what will I do with my data? As a graduate student on the grant, I was in a position of...shall I say “power.” As a non-traditional graduate student who checked many of the categories the grant was attempting to remedy, I immediately understood the data from a scholarly and a personal perspective. I was in the position to do exactly what years of training as a nurse had prepared me to do: intervene As a graduate research assistant on a multimillion-dollar grant to revolutionize the culture of engineering, and an advisor that encouraged me to speak up and to speak out, I was in the prime position not just to study my

¹³⁴Lassiter and Campbell, “What Will We Have Ethnography Do?”

data, but to do something with *my* data. What will we have ethnography do? The answer is simple, engage.

Chapter 3: "A Sense of Belonging: Using Podcasts to Spotlight the Unseen"

"The CEED program was probably the best thing...without it...there wasn't a sense of belonging. The CEED office was a safe place...and allowed you to connect with others in a safe place...but most importantly it allowed you to venture outside that safe place with those same people and continue to build relationships...that was the best thing that Virginia had to offer me...obviously the education is top notch...but without CEED...I don't know if the experience would have been that good...the bonding [due to CEED] helped to build mental and emotional stability and had a family effect. I knew people with the same cultural beliefs. I knew I had people that I could fall back on...to support me. CEED and STEP was a glorified support system that allowed me to be the best that I could be." --Brandon¹³⁵

Introduction

The Center for the Enhancement of Engineering Diversity (CEED) was established in 1992 to provide resources to engineering students, but specifically engineering students from underserved and underrepresented communities.¹³⁶ Though increasing diversity was one objective of the Center, it also promoted the field of engineering. As a part of its outreach, it created numerous initiatives such as engineering-specific housing communities (Hypatia and Galileo); peer mentoring; and programs to ease the transition into college such as the Student Transition Engineering Program (STEP). Led by Dr. Bevlee Watford, the CEED office worked to create the type of environment described by Brandon. More than being an office of initiatives, CEED created the things that Virginia Tech and Blacksburg couldn't give him as a black male studying engineering: belonging, safety, and confidence.

¹³⁵ Brandon was an ECE alumni that agreed to be interviewed for the Inclusion and diversity episode of the Engineering Visibility podcast.

¹³⁶ "About the Center for the Enhancement of Engineering Diversity—CEED," accessed December 8, 2021, https://eng.vt.edu/content/eng_vt_edu/en/ceed/about-ceed.html.

Coming to Virginia Tech and the town of Blacksburg as a person of color or from an underserved community can be a shock to the system. A quaint mountain town positioned within the isolation of western Virginia, it is easy to understand within the first few minutes of arriving who belongs and who doesn't.¹³⁷ Sadly, some people who can't plug themselves into the landscape of Blacksburg and Virginia Tech don't make it, and others barely do. They survive. But this is the thing, no one, especially an eighteen-year-old child, should be forced to survive when they should be flourishing. And because of CEED and STEP, Brandon and dozens of others were able to do more than survive and "get the degree," but instead were able to flourish not only within Virginia Tech but were able to flourish within the ECE department and graduate to become engineers.

The ECE department is home to over 1400 undergraduate students. White and Asian men dominate the halls of the department, the classrooms, and the industry.¹³⁸ A woman, a person of color, or even a person who grew up less than 20 miles from Virginia Tech in one of the small, rural adjacent towns (i.e. Pulaski, Dublin, Pearisburg) would be hard-pressed to find a sense of belonging. When people do not see themselves in their surroundings, they doubt if they belong and due to the cyclic nature of recruitment and retention, there is no one available to tell them that they belong. As a faculty member shared, "There is something about not being represented that makes you feel as though you should not be there. If I look at my body of

¹³⁷ Per the US Census, 78.4% of Blacksburg residents identified as White, 12.6% identified as Asian, 4.8% identified as Black, and 4.3% identified as Hispanic. <https://www.census.gov/quickfacts/fact/table/blacksburgtownvirginia/IPE120219#IPE120219>

¹³⁸ US Census Bureau, "Women Are Nearly Half of U.S. Workforce but Only 27% of STEM Workers," Census.gov, accessed December 11, 2021, <https://www.census.gov/library/stories/2021/01/women-making-gains-in-stem-occupations-but-still-underrepresented.html>; "Engineering - Field of Degree: Women - Nsf.Gov - Women, Minorities, and Persons with Disabilities in Science and Engineering - NCSES - US National Science Foundation (NSF)," accessed December 11, 2021, <https://www.nsf.gov/statistics/2017/nsf17310/digest/fod-women/engineering.cfm>.

representatives and not a single one of them looks like me, I'm wondering if this is my place, if I belong?"¹³⁹

Finding belonging isn't simply locating an internal feeling or a group of friends. Belonging is the factor that creates the connection between a person's internal self and their social, relational, and material environment. In turn, this connection produces one's identity to a community, a discipline, or a career.¹⁴⁰ When a person posits the question, "If I belong?" they are seeking some type of social, cultural, and relational connection to their external environment.

So how does one create a sense of belonging? CEED addressed this problem once a student arrived at the steps of Virginia Tech. However, identity and belonging need to be nurtured before freshman year. People beyond the Hokie Stone walls of Virginia Tech need to see and know that an engineer is more than being male, nerdy, young, bro-ish, or a myriad of other identifiers.¹⁴¹

Instead of focusing on an initiative that directly addressed shortcomings of identity and belonging within the department and the college, I created a podcast to push against the cultural and institutional engineering boundaries that would go beyond the ECE department, Virginia Tech, and Blacksburg. As an alumni mentioned, "You could probably come up with a hundred reasons for why you don't see more women and minorities in engineering. Whether it's role models. Whether it's feeling comfortable. Whether it's there's too much of a bro culture. Every single one of those is probably correct." Podcasts are even more appropriate for this challenge as they are used within marginalized and underrepresented communities for social change and

¹³⁹ F_01_15

¹⁴⁰ Vanessa May, "Self, Belonging and Social Change," *Sociology* 45, no. 3 (2011): 369; Linn Miller, "Belonging to Country-A Philosophical Anthropology," *Journal of Australian Studies* 27, no. 76 (2009); 221

¹⁴¹ During the first year interviews, these were words that were used to describe the typical ECE student and professional.

increasing visibility of these communities.¹⁴² At a university and within a discipline that valued the rigor of numbers, everyone could report the dismal statistics of minorities and women in the department. As a highly respected research-intensive university department, ECE's commitment and identity to research was both its curse and blessing. Through an easily accessible public platform, I brought ECE's people together to share their stories that could transcend the numbers of the department and reach people beyond the university.

This chapter describes my efforts to craft a space for more diverse identities within the ECE department through the podcast *Engineering Visibility*. Diversity and inclusion is a long-held goal of engineering education. However, recruiting and retaining diverse student bodies partly depends on students identifying themselves and fostering a sense of belonging within the department. *Engineering Visibility* provided a voice to various student experiences. Thus, students were able to identify themselves in the department and profession through the audible narrative. On the ground, this chapter challenged the belief that visibility is necessary to remedy invisibility. Through the concept of interventionist protectivity, I carefully maintained invisibility for participant well-being.

First, I discuss the importance of creating belonging and identity among the less dominant communities within the ECE department. Second, I explain making an eight-episode podcast that shared the voices of lesser-known communities within the ECE department such as the female engineer, transfer students, underrepresented communities, the adult learner, and educators of the department. I then focus on my "revelation" that invisibility is necessary and my work of managing it. I discuss this work through an exploration of the women in engineering

¹⁴²John B. Thompson, "The New Visibility," *Theory, Culture & Society* 22, no. 6 (2005): 42, DOI:10.1177/0263278405059413

episode and the graduate student episode. Lastly, the concept *interventionist protectivity* explains the process of protecting the participants that I make visible.

"Do I belong here?" Locating the Invisible

Belonging goes beyond a "feeling" and encompasses one's ability to become part of a community, to maintain motivation within various activities, and establish an identity.¹⁴³

Internally, belonging describes the inner connection one has to the multiple aspects of their external environment, such as their job and their community.¹⁴⁴ The security and innate steadfastness of belonging manifests as motivation and resilience in challenging times.¹⁴⁵

However, this concept of belonging does require another component: identity. Belonging is crucial in creating the connection and association between a person's social, relational, and material surroundings-ultimately leading to fostering identity.¹⁴⁶ This connection is easier to understand when both are created through an individual's social norms, values, and customs.¹⁴⁷

Within an ideal situation, a person develops a stable identity early in life that makes a secure sense of self and security regarding mental, emotional, and psychological boundaries. However, this identity that develops early can be disrupted or forced to be re-evaluated regarding life-changing events such as the death of a loved one, births within one's family, marriage, or divorce. Another life-changing event can be graduation from high school and acceptance to college. In this event, a person moves from their family, community, and way of life into a place of uncertainty. For some people, college may have some resemblances to something familiar in their life regarding culture, and for some, there may be no connection. Because a key to creating

¹⁴³ Vikki Bell, "Performativity and Belonging: An Introduction," *Theory, Culture & Society* 16, no. 2 (1999): 6

¹⁴⁴ May, "Self, Belonging and Social Change"

¹⁴⁵ R.F. Baumeister and M.R. Leary, "The Need to Belong: Desire for Interpersonal Attachments Fundamental Human Motivation," *Psychological Bulletin* 117, no. 3 (1995): 208

¹⁴⁶ Miller, "Belonging to Country-A Philosophical Anthropology,"

¹⁴⁷ May, "Self, Belonging and Social Change"; Henry Garfinkel, *Studies in Ethnomethodology* (Englewood Cliffs, NJ: Prentice-Hall, 1967)

a sense of belonging is seeing oneself in one's environment, students who are unable to find identity and belonging may be challenged to be successful within college.¹⁴⁸

Of the 354 ECE graduates in 2019, 52% were white, 18% were Asian, 3% were Black, and 5% were Hispanic.¹⁴⁹ Women comprised 32.1% of that student body. Those demographics provide a brief overview of understanding the identity of the department. Though much of this chapter focuses on identities related to race, ethnicity, and gender, these are not the only identities in need of visibility. Of the over 30,000 undergraduate students, less than 20% of those students transferred from another university or community college.¹⁵⁰ As a transfer student shared, "We see ourselves as unique, we have a whole different array of problems."¹⁵¹ Additionally, there are invisible identities within the faculty. The ECE department has worked hard to position itself as one of the top research universities in the country. Though this identity has attracted numerous researchers, graduate students, and opportunities to the department, it has influenced the value of teaching. As an undergraduate student shared with me, "It goes around that the professors tend to be here for research and they're forced to teach a class."¹⁵² In a place meant to educate you, it can sometimes feel as though your questions are a hindrance and that your presence is only holding a professor back from their research.

Obviously, the ECE department is a myriad of identities. However, not all identities are seen the same, nor are all identities valued the same. Obviously, in a department of so many students, it can be challenging to find the other handful of students that look like you or share your experience if you are female, Black, Hispanic, or even a transfer student. However, within

¹⁴⁸ Neil Leach, "Belonging: Towards a Theory of Identification with Space," in *Habitus: A Sense of Place*, ed. Jean Hillier and Emma Rooksby (Routledge).

¹⁴⁹ "Strategic Analysis | University DataCommons | Virginia Tech," accessed December 8, 2021, <https://udc.vt.edu/irdata/data/students/enrollment/index>.

¹⁵⁰ "Transfer Experience," accessed December 8, 2021, https://llp.vt.edu/content/llp_vt_edu/en/llc/transfer.html.

¹⁵¹ H. F. the Non-traditional student podcast episode

¹⁵² US_01_14

these numbers are a few people representing the identity necessary to create the belonging needed to encourage those who do not see themselves as belonging in ECE.

Engineering Visibility: Creating Belonging and Identity through Many Voices

I did not set out to study identities and belongings, nor plan to create a podcast. I set out to conduct a qualitative study of the ECE department. As with many qualitative approaches, one does not go into the field to find an answer to a specific question. Instead, one starts from the ground with multiple levels of coding, which becomes categorical sections of data; and from which finally emerges themes and sometimes a theory.¹⁵³ Forty-four of the 50 participants discussed diversity with the ECE department and engineering. From my analysis, eight major themes evolved with a total of sixty codes (including sub-codes). Within the Preliminary RED Diversity Analysis report, the engineering image was seen as a challenge to diversity. As an alumni explained: "There's this perception that if you're talking "computers"-- you're talking to white males...and so we're trying to actively fight that as much as we can in our training and recruiting."¹⁵⁴ This quote also emphasized the image of the engineer as a potential solution. Therefore, it appeared that the ECE department had something of an image problem. However, more directly, it had an identity and a representation problem, which meant a connection problem among some people within the department and the industry. The lack of connection also affected the ability of the department to recruit and retain diversity.

I chose a podcast to bring visibility to the people who were not of the traditional image and identity associated with the ECE department. Podcasts emerged in the early 2000s as audio and/or video files that were digitally available to the public through various downloadable

¹⁵³ Kathy Charmaz, *Constructing Grounded Theory*. (2nd ed. Introducing Qualitative Methods. London: SAGE Publications, 2014).

¹⁵⁴ The *RED: ECE Diversity Trends Report* was shared with the RED team on July 24, 2018. The report presented the eight themes regarding diversity from the first year qualitative study.

platforms.¹⁵⁵ As podcasts have grown in popularity, they have become more accessible. There are currently over 700,000 active podcasts equaling to over 29 million episodes in over 100 languages.¹⁵⁶

Ironically, choosing a podcast to counter the traditional, white "nerdy" boy image within the ECE department does not go without noting the irony that podcasting was dominated by white male hosts and producers in its early years.¹⁵⁷ However, as the platform has increased in popularity, marginalized and underrepresented communities have begun using podcasts to create awareness for social issues within their communities. From a research aspect, podcasting has connected to producing more rigorous qualitative data, sharing more authentic experiences of participants, and creating a connection between research and the public.¹⁵⁸ However, negative consequences of podcasting include the challenge of ensuring complete confidentiality, the necessity of resources such as time, money, and expertise; and the challenge of answering to both the academic audience and the public community.

Engineering Visibility was developed to be a limited 6-episode podcast project but became an eight-episode podcast (Figure 1). Two episodes exploring diversity and inclusion and women in engineering addressed the prominent topics and concerns regarding recruitment and retention within the department and the field of engineering. Due to the timing of the podcast and world events, the first episode opens with the chair of the ECE department, two academic advisors, a graduate student, and the Associate Director for Professional Development of the

¹⁵⁵ Robyn Smith et al., “Like, What Even Is a Podcast?” Approaching Sport-for-Development Youth Participatory Action Research through Digital Methodologies,” *Qualitative Research in Sport, Exercise and Health* 13, no. 1 (2021): 128–45, <https://doi.org/10.1080/2159676X.2020.1836515>.

¹⁵⁶ Smith et al.

¹⁵⁷ Charley Locke, “Podcasts Biggest Problem Isn’t Discovery, It’s Diversity,” *Wired*, (2015), www.wired.com/2015/08/podcast-discovery-vs-diversity/

¹⁵⁸ Robyn Smith et al., “Like What Even is a Podcast? Approaching Sport-for-Development Your Participatory Action Research through Digital Methodologies,” *Qualitative Research in Sport, Exercise and Health* 13, no. 1 (2021): 140

Center For Excellence in Teaching and Learning, discussing the impact of COVID on themselves and their roles with the department. The second episode brought non-traditional students (transfer students and adult learners) to the foreground. In response to the undergraduate students interested in graduate school, three graduate students shared their daily experiences of being a graduate student. The last episode focused on the perspective of teaching within the department. In a research-intensive institution, teaching can become lost and lose relevance within the grand plan of education. Though this project was planned as a six episode project, the project became a community engagement project for a course (UH 3204) in the honors college. A group of five undergraduate students decided to take on the task of creating an episode focused on the first-generation college student.



Figure 1. *Engineering Visibility* Podcast Coverart. Used with Permission of Annie Patrick

Crafting Visibility Identities while Protecting Invisible Bodies

I began this project intent on creating a podcast that would be a voice for the invisible people of the ECE department. However, as I began the work of recruiting and interviewing participants for this project, I soon came to realize that invisibility was much more complicated than I could have ever anticipated. Questions soon arose from this work before I released the first episode. Is visibility purposely constructed and/or deliberately avoided? I began this

project believing that invisibility denoted a powerless and marginalized existence. However, I learned there are benefits within invisibility and crafting these projects would require me to renegotiate my understanding of invisibility.

Invisibility is not only in the voices that are not heard, but the depth and type of invisibility become even more nuanced in these projects as these voices speak (and don't speak about specific topics). The first story is about the two female ECE students that were interviewed for the podcast, but whom I made anonymous. The second story details how both of my doctoral graduate students avoided the conversation about their advisor-advisee relationship, thus choosing their invisibility. My experiences with these identities and crafting these episodes ultimately lead to examining my own subjectivity and objectivity. Ultimately, these experiences identified the work of a term I crafter to describe these moments, "interventionist protectivity."

Making Female Voices Visible While Hiding Their Female Bodies

A.H., a senior ECE undergraduate student was telling me about an experience that occurred a couple of years ago in Whittemore Hall. In the student lounge of Whittemore Hall, A. H. had been studying with some other female peers when she noticed a group of guys at another table hunched over their computers. The guys being somewhat audible and not easy to ignore, caused her and her friends to pause their studying to observe the guys more closely. A. H described the astonishment as she and her friends recognized that the guys were commenting, quite audibly, that the female students in the ECE department were only in the department to meet guys and were not serious about engineering. "This was in the student lounge and they weren't even trying to be quiet about it. It felt demeaning...I mean, this is just a few feet from where I was sitting with my friends...and these guys are openly objectifying women and putting them down." As A.H continue to describe this experience, a thought flashed through my mind

and I hurriedly made a note of it: "I am going to have to make A. H. anonymous." I appreciated A.H.'s eagerness to participate in the "Women of ECE" podcast, but I couldn't send this young woman back into her department, vulnerable to the male peers that would possibly mock and troll her. I had to protect her. At the end of the interview. I stopped the recording and I explained my concerns. I was worried that the type of guys she described in the study lounge incident would listen to the podcast, mock her in classes, and troll her on social media. Dominant images do not hold their dominance through passivity, nor do dominant communities easily negotiate to share the foreground. Challenging dominant images means challenging the identity and sense of belonging among those of the dominant and visible people of the department. Disrupting identity and belonging creates tension and uncomfortableness. Naturally, people push back.

However, then again, nothing may happen. Before I began this project, as I considered project after project, this need to protect people led me to trash some projects. Invite a faculty member to sit and observe an advisor? It would take away the "safe space" between the student and the advisor-into the project dumpster. This interventionist "protect-tivity" had had a heavy hand on my projects. This interventionist responsibility to my participants during and after my projects was a guide in choosing my projects.

A.H.'s first response was that she didn't care. These were her words and her experiences and she wanted them to be told and she wasn't ashamed and didn't care of what others may think or say. I admired her tenacity, but instead, I advised her to think about it and maybe discuss it with her parents or a mentor. A few weeks later, I received an email from A.H.... "Hi Annie, I wanted to ask if you can keep my identity anonymous for the podcast episode we recorded last

month. Thank you!" I sighed (with relief) as I replied, "Of course, I hope your semester is going well."

Did A.H. make the right decision? Yes. Honestly, before I had even received her reply, I had decided to make her story anonymous. The first time I wrote this draft, the confirmation hearings for the (possible) fifth female Supreme Court Justice are being aired (she was confirmed). As I finalized this draft, a South Asian and Jamaican woman is the Vice President. Yet, in 2021...to give a voice to a woman in engineering, I have to protect her and make her identity invisible. And this would not be the only instance of creating invisibility to protect my podcast participants. For the inclusion and diversity episode, I removed any moments in which the participants mentioned where they currently lived, where they worked, anything else that could cause or disrupt their lives. Was I paranoid? Was I overly concerned? Was my own knowledge and experience as a woman of color directing these actions?

However, I know that these moments solidified the need for these episodes. Speaking about women in engineering and inclusion and diversity stands to produce more tension than an episode on the non-traditional student. But why? This moment emphasizes, clear and loudly, the need for this podcast. This moment should indicate that the work of diversity and inclusion is not over yet. This moment reveals that all people are not ready for, nor do they want female engineers. Those male bodies were able to argue (publically) against female students within the program because they did not even "see" the female bodies a few feet from them.

"Annie, this has to be off the record..." The Invisible Advisor-Advisee Relationship

I was interviewing a grad student. So far, they were doing a great job of describing how their love for teaching led them to pursue a doctoral degree in electrical engineering at Virginia Tech. As I listened to them describe the difference between undergraduate and graduate school,

I knew that their clear, concise language and voice would sound great on the podcast. As they finished answering their question, I described how the advisor-advisee relationship was pivotal to a graduate student and would they describe their experiences. Before I had even finished the sentence, I saw them wave they fingers back and forth across his neck and mouth the word, "No." I shook my head in affirmation and mouthed, "No problem" and moved onto the next question. The graduate student smiled at me with relief and quietly replied, "Thank you."

Another graduate student happily chatted away about how they saw the circuits they studied in electrical engineering in the cells they studied as an EE doctoral student. I glanced at my list of questions and asked my next question, "Can you tell me about the advisor-advisee relationship?" The graduate started laughing and said..." I rather not." I laughed with them as I thought of the other graduate student's response to the same question. They paused and said..."Okay, Annie-but this has to be off the record." What proceeded was a conversation of a desire to change advisors and labs and the fear of having this conversation with their advisor. However, now in their fifth year, they knew they had made the right decision. Nonetheless, it was a difficult decision that was followed by a difficult conversation. At the end, the graduate student reminded me that this was entirely off the record.

For graduate students, our advisors singlehandedly control our fates. When I drafted questions for this episode, I wanted a conversation about the advisor-advisee relationship for the very fact of how pivotal it is to the life and future of a graduate student. I don't even believe one can pursue a graduate degree without an advisor (also referred to as supervisor or chair). When I began my Master's a few years ago, I remember being terrified of my advisor before meeting him. I had seen the movies where countless advisor berated their students to tears. I had read

the blogs of students who complained that it wasn't enough no matter what they did. During my first year at VT, a another engineering doctoral student told me he was trying to change advisors.¹⁵⁹ His current advisor, whom he referred to simply as, "the asshole," was constantly rude, had gone back on his word several times, and expected him to be available at all times. Another friend described how she had emailed her advisor several times with no reply and she had not been able to meet with him face to face because he had rescheduled their last three meetings. In fact, I recall an entire one-hour graduate seminar on the advisor-advisee relationship. Yet, both of my graduate experiences have been positive. And for all the stressful advisor-advisee interactions, I had met other graduate students that raved about their advisors.

To bring visibility to the graduate student experience meant getting visibility to the advisor-advisee relationship. However, when I asked my two podcast guests, they all but left the call. One just shook his head no and wouldn't even comment. Another began and ended the conversation with, "This is off the record." Even when I ensured them that I could make their comments anonymous...they still declined.

Because the graduate students refused to discuss the advisee-advisor relationship, I initially chose to let it remain invisible. However, my advisor would not allow me to do so. After much urging or advising...I was advised that I couldn't leave the topic of the advisor out of the grad student podcast episode. But what did I want to say? I critiqued my participants of avoiding the topic and here I was doing the same. I remember when I started working on my master's degree and I remember the fear of meeting my advisor for the same time. What if he or she had unreasonably expectations? What if they embodied every bad trait I had seen on television and in movies? What if they were mean? What if they were abusive? The more I think

¹⁵⁹ This engineering student was not in ECE

about this as I write, I realize that part of this comes from the hostile environment of nursing school. I can only describe nursing school as a Greek hell week that lasted two years and continued for at least the first year of working as a nurse on the floor. So from that experience, I anticipated an academic environment of soul-crushing instructors that tested your mental, psychological, and emotional limits on a daily basis (yes, this was nursing school). But my master's experience was a positive one. Even as the only girl in many classes and the only female graduate research and teaching assistant working within the department, I was welcomed and encouraged to write, research, or just work for Cisco (if that's what I wanted).

And yet...when I arrived at Virginia Tech...I once again expected advisors from hell. Mine was great...but I heard the horror stories. But what did I want to say in this episode? What could I add to this episode? What is this about? At the end, I spoke briefly about advising. But as I look back, I should have said more. I have yet to confront my own need for invisibility.

Visibility and recognition go hand-in-hand, but it is not simply a linear process. Visibility is not always the ultimate goal for the invisible, less dominant, less powerful communities. Visibility and recognition is an evolving process in which visibility is ranked and with each ranking comes the dangers of visibility and the loss of the safety of invisibility. Let's keep in mind, I made the undergraduate students identity completely invisible and I made the URM alumni partially invisible. However, the graduate students made certain parts of themselves invisible. It is of a special note that social media outlets and projects (i.e. podcasts) juxtapose subjects into varying layers of invisibility and visibility. There is a need for the image to be managed.¹⁶⁰ Was I managing images and identities? In essence, the very thing I wanted to make

¹⁶⁰ Andrea Brighenti, "Visibility: A Category for the Social Sciences," *Current Sociology* 55, no. 3 (May 1, 2007): 323–42, <https://doi.org/10.1177/0011392107076079>.

visible refused to be made visible. What does this mean? The goal of my podcast and of my dissertation is to bring visibility to topics and people that are invisible. Does the answer lie in why is it invisible? Are some things meant to stay invisible? Why did the advisor/advisee relationship remain invisible? Power? Fear? Is this another type of authority that must be analyzed?

My (In)visible Subjectivity

As I compose the "Women in Engineering" episode, I reflect on how many of the guests (mainly the alumni) speak of having no problems acclimating within the engineering department and the industry. Okay, let me clarify: they do have moments of perhaps not being "heard" when another male colleague shared their idea and received the recognition. However, there are fewer negative experiences stories than the things reported to me by the female students in the baseline interviews. Let me clarify...these are the people that made it through. This is not a podcast episode about the women that left and more importantly, why they left. That would be another podcast and one that needs to be done.

This is the thing, the researcher and the podcaster want the stories of blatant disrespect. I want stories that are the same as the first-year interviews...but I get nice stories that tell me that all women need to do is "know their stuff" and be confident. And as I was reviewing the audio recordings for the podcast, I wanted those stories of blatant disrespect. I know they exist. But is that me interjecting my subjectivity into their stories? Where is my objectivity? Do I tell the story from the interviews I have or do I tell the story that needs to be heard? Or maybe I have it all wrong? There is a need for me to become self-conscious about the specificity of my position as a researcher. Or perhaps, I was missing my purpose. As academics and researchers, are we

truly called to connect what we theoretically understand and observe to the details of the mundane everyday life via my varying degrees of power and authority.¹⁶¹

When we, as STS scholars choose to engage within our publics through interventionist approaches, we learn more about the topic in which we intervene. My anonymous interviews collectively said "yes, women are treated differently and sometimes, yes they do not feel like they belong." And then I set out to create a project that would address this feeling and the lack of belonging. But what happen? I did learn more about the importance of the sense of belonging. However, I learned that people also *need* their invisibility, especially when they are not in a place to speak up without consequences. I made my female students completely invisible by not introducing them by their names or any identifying factors. I removed the moments they shared their locations and jobs for my URM alums. Granted a person could do an internet search and find that information. However, if it means that much to a person, then they can do the work to find them. However, I will not hand-deliver anyone into the lion's den. I mean we all have an image to protect. We all have reasons. I had mine.

Two important things are happening within this project. First, I had to make the identities of the female students invisible to bring visibility to women in engineering? Likewise, I had to bring degrees of invisibility to the three men in the inclusion and diversity episode. This is because the dominant image somehow still had the power to make the non-dominant image suffer and further retreat into invisibility.

Therefore the dominant image can abuse and keep an invisible image invisible. However what power does the non-dominant image have? The non-dominant image had a voice and an experience. They needed a channel of visibility. Enter me and my podcast. This means that I

¹⁶¹ Gillian Rose, "Situating Knowledges: Positionality, Reflexivities and Other Tactics," *Progress in Human Geography* 21, no. 3 (1997): 308-310

had to consider my positionality, authority, power, and source. Do I have authority? I didn't know I had authority? A combination of power and privilege became part of my identity when I became an "academic." Numerous researchers have identified this positionality (typically within the text of feminist theories). Most notably is Donna Haraway. However, this positionality is not simply given because I am an academic, but it must be developed.

Second, the advisor-advisee relationship refused to be made visible? Both graduate students refused to discuss their advisors. Why? In a different situation, this isn't about a dominant image. This is definitely about power and authority in a different sense and how these two things create (unwilling?) invisibility. At first, I didn't believe that I had the power, authority, and positionality to bring this to visibility through this medium. Visibility travels through a maze of authority and power before it is seen. There is invisibility within the work of visibility. In one, I create the invisibility with the women and URMs in engineering to make their stories and their existence visible. In the second, the invisibility is the refusal to discuss the advisor-advisee relationship. Could I have forced the topic? Yes, but would that have been ethical? I was naïve to think that I would simply show these people and their experiences and all would be well. Invisibility must be understood and respected. Visibility must be done carefully and with much consideration with all its good intention.

"Don't worry, Squadcast doesn't record video, just audio"--Creating 'INTERVENTIONIST PROTECTIVITY'

I have done a lot of interviews. A Lot. I interviewed fifty people for the baseline interviews. All anonymous conversations in which people easily spoke for almost an hour about why they choose engineering, what they enjoyed about engineering, and what they would change. I pre-interviewed about twenty people for the podcast project. I interviewed about 12

people for the ECE Faculty Profile project. And this doesn't count the countless people I have interviewed for other projects. I have spoken to a lot of people.

However, tell a person that you are recording them for a public facing project and things change. They change. The people in pre-interviews for the podcast projects talked easily and easily shared their thoughts and opinions. These same people become guarded as soon as the record button was activated. Their voices changed. Their words become stiffer. They become stiffer. I noticed this during my first interview and I confirmed it by the second interview. What to do? This was affecting the quality of the interviews. People spoke in stifled voices. People gave the "safe" answers. Was I the only one aware of this? No, my participants were aware of their vulnerability as soon as I pressed record. Their posture stiffen and so did their words.

I take my job as the interviewer very seriously. Ever since my master's graduate supervisor told me that my interviews were important because it was my data. Ever since the director at the research company in which I was a consultant told me that people heal in the speaking.

This can make creating visibility with things such as podcast and other public mediums challenging in several ways as evidenced by my female undergrad students, graduate students, and alumni speaking about inclusion and diversity. The thing about a podcast that will be shared with the public is that it is a podcast that *will be shared with the public*. Whatever is said is out there in the world and for people to either enjoy, relate, judge, or hate. And judge they will. The Pew Research Center reported that over 60% of internet users have been called an offensive name; 25% have been physically threatened; 35% have witnessed sustained harassment, and

19% have experience sexual harassment.¹⁶² Even without those numbers, I recognized early on that I could not allow my female undergraduate participants (or any participant) to experience any of those activities. I made them anonymous to protect them from those forms of abuse. These projects do not only bring visibility to the person, but to their associations (family, work, employers, etc). As I review the interviews about inclusion and diversity, I removed each moment in which the participants mentioned their employers or where they lived. Visibility leads to identification through at least two avenues: social identification and individual identification.¹⁶³ Visibility brings recognition. Recognition sometimes brings trouble. I took it upon myself to protect my participants. I defined the phrase, *interventionist protectivity* to describe my efforts to protect my participants.

What is interventionist protectivity? Interventionist protectivity is the awareness of protecting my participants' emotional, psychological, mental, physical, professional, and public well-being. Emotional, psychological, mental, and physical well-being is well known and we are accustomed to protecting it constantly. However, a person's public well-being is just as important and perhaps just as important as the other things because detrimental acts toward the public well-being can leak in to the emotional, psychological, mental, and perhaps even the physical well-being.

Public well-being is even more important in this age of social media. Podcasts are a form of social media. Podcasts are the voices of people telling stories, sharing experiences, and touting their opinions. Naturally, there are people that will not agree with these opinions,

¹⁶² To note on April 23, 2021, an incident was shared in which a Virginia Tech undergraduate student of Asian descent receive abusive comments on her Instagram account from another Virginia Tech Student after posting about the rise in Anti-Asian violence. After reporting it, she was told that hate speech is free speech and nothing could be done. This incident is an example of what I was concerned regarding A. H. and other participants.

¹⁶³ Brighenti, "Visibility."

experiences, and stories. Every day, I read of celebrities and non-celebrities pausing their social media, deleting their social media, or "just taking a break" from their social media accounts due to countless and vicious trolling. Children take their lives from the constant stream of bullying that follows them home in the form of social media posts, DM's, and harassing messages. Let's face it, people can be very mean. Let's also face it, in today's use of social media, it is easier to be mean. Bullies of yesteryear had to look you in the eye or at least past you in the hallways and typically their scope was limited to the parameters of your school and neighborhood. However, the bullies of today can hurl their insults behind avatars and cleverly selected social media names and identities. Protecting my participants from the possible viciousness of the public was my job and responsibility.

Interventionist protectivity starts with trust. Before I can protect my participant, they must trust me. I think I am a trustworthy person. I know I am a trustworthy person. But my participant does not know that. Do you (my participant) trust me to respect you, your words, your story, and your image? Do you trust that I will not sensationalize you for my own ratings or desires? Do you trust that I will provide the most complete, honest, and respectful story? My first step was to create trust in what I was doing and in who I was. Trust was somewhat established by my position. I was a graduate student. I was a graduate research assistant on the RED grant within the ECE department. Sometimes trust is implied. Sometimes trust is associated with a title and a position. However, that trust can only get you so far. It may get you through the door with some people. It may get your foot in the doorframe, but there is so much more work to do. Therefore, I prepped my participants as much as possible. I explained their options: sending questions prior to the interview; having a choice to withdraw from the project at any time; and final approval before episodes were released.

Interventionist protectivity is the work of being reflexive and anticipating ways to protect your participant. When I was choosing a recording software, there were many companies that offered both video and audio recording (similar to Zoom). However, for some reason...my gut...told me to keep it simple and simply record the audio. I didn't realize how important this would be until the first two interviews. I noticed the relief of one participant when I told him that I was not recording video. Another participant explained how she was worried that I would be recording video prior to our interview. After these first two meetings, I prepared a set of instructions and informed participants specifically that they would not be recorded. So the question: to protect an individual...do I need to decrease the identifiers? Instead of audio and video-only audio? Instead of a face and a voice, just the voice? Has this always been a concern?

It is here that I must discuss the third component of interventionist protectivity: responsibility, more specifically my responsibility to others and not just the research. As I read Christopher Kelty's *The Participant*,¹⁶⁴ I come across the word "responsibility." And there it is for me to chew on, to pause, and reflect....what do other researchers and scholars say about responsibility. Responsibility is a combination of determinism (free will and the problem of causality) with issues of accountability (the subjective experience of both guilt and blame, attitudes toward oneself and others. Free will? My participants have varying degrees of free will. They are free to participate. They are free to represent themselves and their stories in any form they choose. They are free to withdraw from this project at any time. But after a certain point, their will is no longer theirs, it is mine. I create the story and I weave it together as I

¹⁶⁴ Kelty, *The Participant*. 20-22

choose. Do I have more free will? I believe I do and that connects me to greater causality and responsibility.

Recognizing the need to protect the less dominant identity is the work of being reflexive as a researcher and as a person to others. Being a scholar-interventionist means that a researcher is not only reflexive of themselves as a researcher, but reflexive and reflective for their participants and the community in which they work. Interventionist protectivity didn't emerge during the production of the podcast. It emerged semesters before as I worked to create three projects. Recall, I chose not to have faculty members spend time with an advisor due to its possible effect on the student and academic advisor relationship. Entering into the podcast project with a general knowledge of the need to protect led to the work of protecting my participants in the stages I could anticipate and those that I couldn't have imagine.

"Thank you for taking the time to listen..."

Did I enhance belonging among the ECE department? The short answer is I don't know. Impact is measured in many ways. A survey, a scale, and numbers are the traditional markers of success. I attempted that method and created a survey. However, attempting to measure the impact of the podcast listeners through a survey was futile. People listen and move on with life and other activities.

The success of this type of project can't be measured in the same way that we count success within markets, dollars, and so forth.¹⁶⁵ What I know is that at the time of this writing there has been 400 downloads as noted by the Buzzsprout site that holds the podcast. After I released the podcast describing the experience of being a woman in engineering, it was reported as one of the top sites on the ICAT website. Are people listening? Yes. Enhancing belonging

¹⁶⁵ I address success more in the next chapter.

cannot be measured weeks after a project is released or even months. Though I cannot discuss the belonging associated with the podcast, I can discuss its impact on understanding invisibility and the work of creating this project as an STS scholar.

This project has become its own vehicle and in becoming that vehicle, I deem it a success. It provided students with a creative approach to address the experiences of first-generation student experiences. Over a dozen invisible voices are now visible. And this podcast will continue to live (though I will probably need to return to it and keep it alive). It became a vehicle to share the work of the RED grant. Is that success? Yes, it is. It became a point of discussion to bring forth topics of invisibility. One voice at a time, one more person made visible is success for me.

This chapter was initially purposed to explore my attempt to negotiate the politics, authority, and maintain the boundaries of other parties that may wish to control the voice and direction of the podcast (and other projects). I am negotiating politics, authority, and maintaining boundaries. However, I am not negotiating the politics, authority, and boundaries I anticipated. I anticipated negotiating with Dr. Lester. This experience is from the ECE profile project in which he removed two or three faculty members for departmental reasons. As the department head, maintaining the image and protecting the department seems to be his objective and rightly so. I anticipated negotiating his authority, his politics, and his boundaries. But that wasn't the case. He fully approved this project.¹⁶⁶

However, these projects were still fraught with challenges of authority, power, and politics from the most unlikely places. These places of authority, power, and politics came instead from the dominant images. It came from the people that I couldn't see, yet could create

¹⁶⁶ At the June 22, 2020 meeting in which I presented my projects to Dr. Lester and Dr. Martin, everything was approved. I haven't received any pushback to date from anyone in administration concerning these projects.

discomfort and threats to my participants.¹⁶⁷ Is this what happens when one intervenes? Is there anything that I could have done differently to prepare for this? As I was creating the podcast, the places of authority, power, and politics emerged as a variety of questions and ideas:

1. The authority and politics of the dominant image create invisibility with inherent power that maintains invisibility upon the less dominant identities.
2. How does a scholar-participant protect the invisible (less dominant) people from the power and influence of those that embody the dominant image.
3. How does the scholar participant negotiate their own subjectivity and (in)visibility within intervening?

The irony of my research and this project is that I am working to bring visibility to the hidden voices, people, and concerns of the ECE department. However, to bring visibility to the female students of the ECE department requires that I make their identities and bodies invisible. Is this the ultimate oxymoron? If anyone were to deny that there is a problem of misogyny within engineering and the world, I would ask them to understand that to protect these young women from the possible trolling of their male peers, I had to make them anonymous. One of the female students that has classes with these students and will count them as her future co-workers asked me to make her anonymous because she knew what could happen. To protect the men who participated in the inclusion and diversity episode from pushback from their employers, peers, and strangers, I removed mention of the employers and locations. It isn't simply ironic, it's sad and it indicts that there is still a huge problem of how people treat bodies that they don't even see. Or more importantly, this indicates how people treat bodies that are different.

¹⁶⁷ At the time of this writing, an incident occurred of VT students making offensive comment regarding race and issues of justice. Another student screenshot these conversations and posted them on social media. This incident was reported in an April 2, 2021 0830 email titled, "A Message to the Virginia Tech community."

A STS friction is when the dominant image loses its smoothness and becomes multiple.¹⁶⁸ This is about visibility. At the end of it all...it is making those other images visible. The dominate image didn't lose its "smoothness" and become multiple...the multiple other images were always there...hidden by the dominant image. As an STS scholar, I cause friction, I shake things up and ta-da---here are all these other images. If we as STS scholars go into our projects thinking that we are causing an image to lose it smoothness and become multiple...what are we missing. What will we miss? And as I read on...the question is posed...is this friction about boundaries, subordination, demarcation, presupposition, invisibility, multiplicity, and obligation....wait....invisibility? And there it is...the invisibility. Which brings me to the next point. When STS knowledge enters a domain, what happens? What happens to this friction? For myself...I bring visibility (at least I try). What happens when STS knowledge enters into an engineering department to create a sense of belonging?

Is creating visibility the best route and option? There is an absolute need for institutional visibility, but not always a need or possibility for individual visibility. Invisibility naturally has negative connotations as something that is undesirable or sufferable by an underserved, marginalized group, community, ethnicity, or gender.¹⁶⁹ In that regard, the way to remedy this form of infringement is to bring visibility to those communities, concerns, and populations. However, is this the best approach? The only way? I ran into this project in this mode of thinking. But instead I learned that there are reasons to become invisible to escape the trap of identification, thus invisibility is a strategy and purposely chosen and sought. To

¹⁶⁸ Gary Downey and Teun Zuiderent-Jerak. "Making and Doing: Engagement and Reflexive Learning in STS." *The Handbook of Science and Technology Studies*, 4th Edition. Ed. Ulrike Felt, Rayvon Fouche, Clark A. Miller, Laurel Smith-Doerr. 2017 (The MIT Press)

¹⁶⁹ Warren Smith, Matthew Higgins, George Kokkinidis, and Martin Parker, "Becoming Invisible: The Ethics and Politics of Imperceptibility" *Culture and Organization*, 24, no. 1 (2018): 57

maintain a positive relationship with their advisors, my graduate students refused to speak publicly about their advisors. However, any graduate student who listens to that podcast would agree with their reasons.

Let us not forget that within the invisibility is the fact that in another reality that what the normative see as the invisible is quite visible. But visible as what? For the women in engineering as a student...they were invisible as engineers, but they were visible as women that were in ECE for reasons beyond an education and career. However, as a female student told me, "I am in ECE for me!"

At the time of this writing, I had just released the seventh episode of the podcast. I have composed countless emails sharing this podcast and believe that I will compose countless more. The purpose of this podcast was to bring visibility to invisible voices, concerns, and people. To create a sense of belonging through visible voices. However, at ten months into this project, this podcast has done more than just reveal hidden invisibilities, it has uncovered the "hidden" layers and complexity of social (in)visibility. It has revealed that all invisibility isn't bad and sometimes is necessary. It has revealed that power and politics reside in hidden places that (sometimes) can't be anticipated and it has revealed that to uncover visibility means protecting the very ones you seek to make visible.

Chapter 4: Redefining Success within ECE Careers and Assessment

“Our vision is to transform Virginia Tech’s Dept. of Electrical and Computer Engineering from a department with narrow curricular paths that attracts and produces traditional engineers to one that draws and retains a wider pool of students and prepares them to be T-shaped professionals for a range of careers.”-The ECE RED Grant Team¹⁷⁰

Introduction

In the early years of the RED grant, the ECE team’s efforts proposed to prepare the students for a broader range of careers. Traditionally, graduates of the ECE department obtained a job within the defense sector or the tech industry near the North Virginia region. However, the ECE department promised to revolutionize the curriculum and undo decades of occupational tradition. Electrical and computer engineers graduated and accepted positions with Lockheed Martin, Northrop Grumman, and other engineering companies. In one of the earlier weekly RED meetings, the RED team listed the current and potential professional destinations of the ECE students (Figure 1). A “Big Co[mpany]” led the list with a corresponding note that this path was one of safety and structure. The next four careers included academic research and teaching; start-ups with an added word of “excitement;” a small company; and patent law. What started as a proposed list of ten career options ended as a list of fifteen possible career options ranging from obtaining an MBA, the entertainment industry, Non-Governmental Organizations (NGOs), design, and even number seven: “something completely different.”

Throughout the years of the grant, the future of the ECE graduates and their professional future came up in numerous meetings. Though the topic was ever-present within the spirit of the

¹⁷⁰ As noted in the Overview section of the ECE’s department NSF RED proposal titled, “IUSE/PFE: RED: Radically re-designing the Fan-in and Fan-out of an Electrical and Computer Engineering Department.” The objective of broadening the career options for students is mentioned numerous times throughout the proposal.

grant, direct work toward broadening the careers was an intermittent topic.¹⁷¹ In the beginning, these meetings focused on the big picture of “fan-out,” however, due to a strict deadline regarding approving and rolling out the new curriculum, the team's focus shifted heavily to the curriculum and the “fan-in.” Discussion regarding envisioning and identifying the non-traditional career options drifted in and out of the conversation throughout the next few years of meetings.

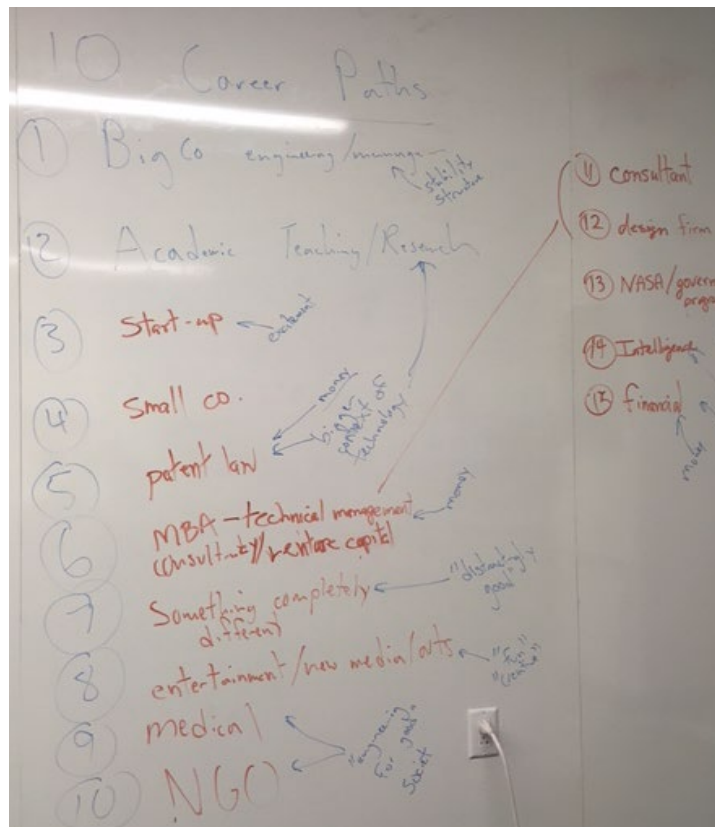


Figure 2. Whiteboard Image of Possible ECE Careers. Used with permission of Tom Martin and Matthew H. Wisnioski

¹⁷¹ Reviewing the RED meeting notes on my file and the notes on the RED folder on the Google drive resulted in 10 meetings in which the topic of careers were discussed. Success resulted in five meetings.

Though these conversation topics were about careers and job options in the simplest sense, it wasn't that simple. The RED Grant addressed a culture that was at best stifling. Broadening the career options for ECE graduates wasn't as simple as listing the potential careers because this wasn't simply about obtaining a job in the tech industry or the defense sector. Instead, the challenge of broadening the ECE career option was changing the general perspective on success and what has deemed a successful engineering career within the ECE department.

In general, most students entered engineering with some combination of wanting to create something, make an impact, and have job security.¹⁷² I was challenged to address the non-traditional career options because I was not technically addressing a challenge that emerged from the climate study. However, I was managing an objective of the ECE RED grant team. As an STS scholar, I had to contend with the decision to move from scholarship (issues that arose from the study) to a place of practicality (addressing one of the needs of the grant). I wanted to do and be both. I wanted to be a scholar, yet I wanted to be a "useful" scholar.¹⁷³ Additionally, as I challenged the idea of success within the ECE graduates' career choice, I had to challenge how success is defined and measured within projects of engagement. How would I know if I was successful?

This chapter explores the culture of success within the ECE department and engineering careers. I also examine how the social construction of success has institutional and individual impacts. In the first part of this chapter, I examine the institutional notion of success through its connection to labor. I further explore success within America and its impact on individual and institutional identity from this intervention. Then, I describe the relationship between success

¹⁷² This is also evident with the non-traditional seminar surveys that students complete prior to attending the seminar.

¹⁷³ I address this further in the conclusion.


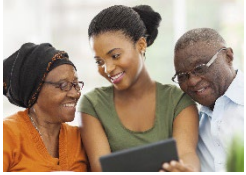



and an engineering career within the ECE department and the need to create a seminar to challenge these traditional and limiting notions of success. I then detail how that impacted the creation of the non-traditional career seminar and how I had to think of non-traditional methods of measuring success. Lastly, I discuss the groundwork of positioning myself as a scholar with critical knowledge creation versus being useful as an academic scholar.

Moving from the “Brad”

The typical and successful ECE student was dubbed a “Brad” or a “Boy Scout.” This student was male, white, and from an upper-class Northern Virginia community in which both parents were probably engineers or had at least gone to college.¹⁷⁴ The team developed five personas, including the typical “Brad” to challenge the Brad stereotype and bring visibility to other potential students who would benefit from an ECE degree, the team developed five personas, including the typical “Brad” (Figure 3). Personas are typically used in usability engineering (UX) design. The persona is a profile that is created with specific characteristics and behaviors to help designers create the most appropriate product.¹⁷⁵ These student personas varied regarding their educational background, socioeconomic class, ethnicity, and career goals. For example, “Gabrielle” was assigned a photograph of a young Black female and described as a first-generation college student interested in geriatric care. However, she was unsure if she should study gerontology, architecture, or engineering. These personas were used at several faculty meetings to emphasize the RED grant objectives of increasing the diversity of incoming students and increasing the career options of ECE graduates.

¹⁷⁴ This was noted during several of the first year interviews in which participants described the typical ECE student as white, male, nerdy, and “bro-ish.” Furthermore, an international student described the general ECE student as white, middle to upper middle class, in which the parents were probably engineers and pay for college.

¹⁷⁵ Rex Hartson and Pardha S. Pyla, *The UX Book: Process and Guidelines for Ensuring a Quality User Experience*, 1 online resource (xxxiv, 937 pages) : color illustrations vols. (Amsterdam: Morgan Kaufmann, 2012), <http://site.ebrary.com/id/10525048>.

	<p>Brad is from northern [State X] and wants to work at a defense contractor after getting a master’s degree. He would like to use his math and physics skills. Both his parents are engineers. He is an A/A- student, but he’s not comfortable with ambiguity.</p>
	<p>Gabrielle is a first-generation college student from [Capital city in State X] and wants to help older people live better lives by designing smart homes for assisted living. She’s not sure whether she should major in gerontology, architecture, or engineering to be able to pursue her interests.</p>
	<p>Bethany is from rural [State X]. She had a great science teacher in high school who inspired her and helped her to develop an interest in biomedical research, particularly for veterinary applications. However, she did not have a good math teacher, so her preparation is uneven.</p>
	<p>Steven was born overseas but has been in the U.S. since middle school. His parents told him to be an engineer. He likes to work in teams and wants to work at Google, Facebook, or some other trendy company after graduation.</p>
	<p>Mackenzie is from northern [State X]. She is interested in electronic music, has the initiative to double-major in arts and engineering, and is comfortable with ambiguity. In high-school, she</p>

	<p>built a Theremin from instructions found on the internet and played it in her band. Mackenzie feels unfulfilled by the available choices for pursuing a degree at [State University] and is unsure whether understanding the fundamentals underlying the technology is essential to her professional goals.</p>
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Figure 3. The ECE Personas¹⁷⁶

However, the ECE faculty did not quickly accept the personas. In a first-year team meeting, it was noted that the faculty had a specific idea of a successful student and the attributes fit the description of “boy scout” (Figure 4). Furthermore, it became apparent that many people within the ECE department had firm ideas of what success looked like regarding people, backgrounds, and careers through the years. Many judged the jobs that did not place students within the tech industry as not being associated with success and, consequently, these were not “successful” graduates.¹⁷⁷ If the team wanted to truly broaden the range of career options for its graduates, updating the curriculum would not be enough. As it stood, there was a culture that framed success within the boundaries of being a “Brad.” Challenging Brad would mean challenging the currently accepted image of success within the department and society.¹⁷⁸

¹⁷⁶ Desen Sevi Ozkan et al., “Using Personas as Curricular Design Tools: Engaging the Boundaries of Engineering Culture,” in *2019 IEEE Frontiers in Education Conference (FIE)* (IEEE, 2019), 1–7. Please note that the personas were developed by the RED team and this table and information was presented at numerous meetings.

¹⁷⁷ This is indicated from meeting notes and recordings from October 24, 2018; June 5, 2019; November 12, 2019

¹⁷⁸ Drawn from meeting notes for December 6, 2018, February 6, 2019, and February 13, 2019.

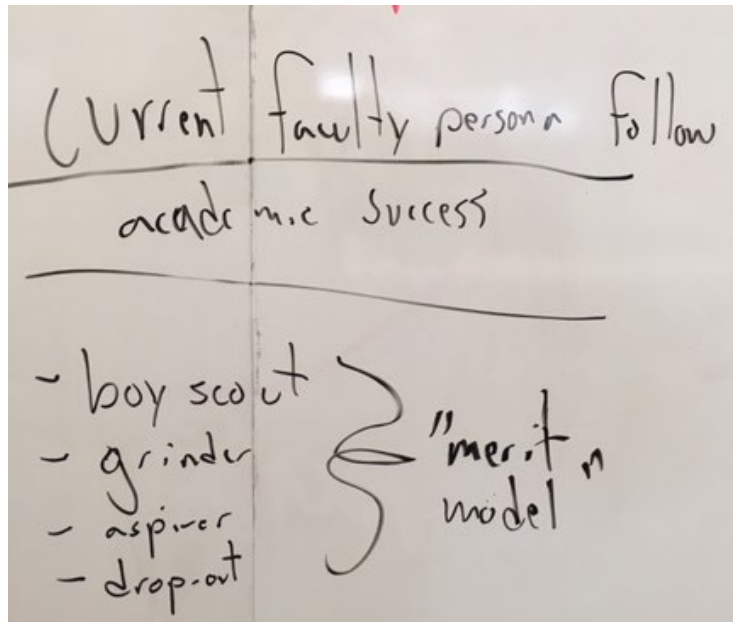


Figure 4. Whiteboard Image of Successful Student. Used with permission of Tom Martine and Matthew H. Wisnioski

What is Success?

A challenge of discussing success and work is that though they are separate entities, they are tightly intertwined. It is easy to assume that when one speaks of success, the general association is career success and the factors that identify this type of success. However, it is essential to note that career success is not the only type of success, nor is a career path the only avenue in which a person may garner success. However, success will be examined for this chapter and corresponding intervention through its connection to the cultural relevance of a career within the United States.

Examining work and success within the United States is unique because of the nation's political, economic, and cultural connection to capitalism..¹⁷⁹ Success is an activity that is

¹⁷⁹ An example is Nugin and Onken's study of Estonia's culture during its transition from a communist to a democratic regime. The generation that came to adulthood during the rise in democracy faced the challenges of understanding and embracing the new concept of an individual success.

compared and judged through a multitude of lenses, such as one's work and career, in addition to things such as accomplishment, failure, income, class, and other variables. Concurrently, work-associated success has become a powerful indicator of not only one's professional success, but work success is also an indicator of personal and societal success. For that reason, it is complicated to explain work and success separately. This section will focus on defining the factors that construct individual and institutional success, illustrating the similarities and differences among the terms work, profession, career, and labor; and then examining how one's identity is connected to success. From an examination of work, I move to a discussion of success and how the traditional and normative definition of success has become embedded within the individual and collective identities.

What is success and what does it mean to be successful?

The definition of success can vary according to a professional field, an academic discipline, and a culture. Traditionally, success is defined through several frames: the result and outcome of a given activity; the acquisition of wealth, fame, or position; or by bestowing positive recognition onto a person.¹⁸⁰ However, a dictionary definition does not truly explain the complex nuances of success. Instead, it reduces success to simply a list of accomplishments and outcomes. This definition makes it easy to become enamored with counting the associated images of success without considering the many factors that create an image of success. Exploring the cultural composition of success provides an understanding of an organization or society.

Success Defined by the Institution

¹⁸⁰ Webster's Dictionary, 1964

What we understand as a measure of success is often dictated by institutional forces. The institution determines the measure of success for a community.¹⁸¹ Additionally, what society deems as success can change across cultural, professional, demographic, and individual boundaries. Success is identified for some people and communities through measurable milestones such as living situation (moving from parent's home), education attainment (which can differ from obtaining a high school diploma in some communities to obtaining a graduate degree in other communities), and employment. However, for others, success can be tied collectively or solely to ideas of a family (marriage, children, etc). Some refer to success within a more holistic manner, influence, or intellectual achievement.¹⁸² Yet, for others, success is closely connected to financial security and accomplishing a set of personal and professional goals.¹⁸³ However, this does not mean that the institution's definition is right, nor does it indicate the factors for success are meant for everyone or can be attained by everyone.

Take, for example, homeownership in the United States.¹⁸⁴ One of the foremost "American Dreams" institutionalized as a moniker of success is purchasing a home.¹⁸⁵ For many people in the United States, a sign of success is to move from renting to homeownership.¹⁸⁶ For the most part, renting is not indicative of a "successful" person. Yet, some studies have indicated that renting may be more financially beneficial than purchasing a home dependent on

¹⁸¹Mark Iutovich, "The Sociology of Success: Fact or Fantasy" *Journal of Applied Sociology*, vol. 5, pp. 1-14; 9

¹⁸² Raili Nugin and Eva-Clarita Onken, "Defining Success in a Changing Society: Self-Evaluation and Social Reflections of a Coming Elite in the Baltic States," *Journal of Baltic Studies* 41, no. 4 (December 2010): 449–71, <https://doi.org/10.1080/01629778.2010.527129>.

¹⁸³ Anderson and Williams, 653.; Nugin and Onken, "Defining Success in a Changing Society."464

¹⁸⁴Salsich, Peter W. "Homeownership—Dream or Disaster?" *Journal of Affordable Housing & Community Development Law* 21, no. 1 (2012): 17–71. <http://www.jstor.org/stable/24389815>.

¹⁸⁵ Huntington, S. P. *American Politics: The Promise of Disharmony*. Cambridge, MA: Harvard University Press, 1981.

¹⁸⁶Di, Zhu Xiao, and Xiaodong Liu. "The Importance of Wealth and Income in the Transition to Homeownership." *Cityscape* 9, no. 2 (2007): 137–51. <http://www.jstor.org/stable/20868621>.

several factors.¹⁸⁷ Still, the institutionalized image of success as homeownership dismisses any other option.

The Functionality of Success

Success is an indicator of one's ability. The previous section details how society constructs images and ideals of success. Success is an indicator when it functions as a representation of the collective thoughts, beliefs, and values of the dominant powers of society. The ability of success to be utilized as a representation of the *needs* of society provides the foundation that success is also a marker of the *values* of a society.¹⁸⁸ For some communities and during some periods, a woman's success was measured by her functionality as a caretaker. Her success as a caretaker also translated to her value within society. A successful woman had a marriage and children (a family). A spinster was not a moniker of success because she never fulfilled her functionality to indicate success. However, what is deemed as a success for a woman has changed throughout the years. Today, a woman with a career (sometimes added with a family) is considered successful. Lastly, success is not static. Instead, success is a dynamic facet of society. Success serves as a vehicle to continue to advance the values of a society or community. Once again, if a traditional family is the utmost moniker of success, then people will work hard to have a family and encourage others to do the same. The needs of society highly control the image of success. Thus, institutions use ideas of success to control society.

¹⁸⁷Ironically, some studies have shown where renting can actually be more financially beneficially. Please see Beracha, Eli, Alexandre Skiba, and Ken H. Johnson. "A Revision of the American Dream of Homeownership." *Journal of Housing Research* 26, no. 1 (2017): 1–26 <https://www.jstor.org/stable/26393458>. and Beracha, E. and K.H. Johnson. Lessons from over 30 years of Buy versus Rent Decision: Is the American Dream Always Wise? *Real Estate Economics*, 2012, 40:2, 217-47

¹⁸⁸Michael Edmondson, *Success: Theory and Practice* (New York, UNITED STATES: Business Expert Press, 2016), <http://ebookcentral.proquest.com/lib/vt/detail.action?docID=4429829>.

Success Defined by Markets

As described above, people, communities, and institutions create the boundaries that form the socially accepted image and the idea of success.¹⁸⁹ Collectively, what is seen as success, especially within a capitalist society, greatly frames a society's individual and collective identity and value. In a study of success in Estonia, the definition of success shifted from a communal and collective identity of success within a communist region to more individual markers of success such as property-ownership and individual income as the country moved to a democratic government.¹⁹⁰ Within capitalism, individual success is significantly connected to a market economy, financial competition, and institutional restructuring. Success is assessed through one's position (i.e. class) within a society.¹⁹¹ In the United States, class mobility or immobility is impacted by one's income, or in other words, their job.¹⁹² In this framing, a person's success (and value) is connected to their career.

“What do you want to be when you grow up?”

“What do you want to be when you grow up?” It is a question that most children have been asked. As an adult, the question shifts to “What do you do?” And though the question could reference a dozen situations, it is generally accepted that one's response should identify a

¹⁸⁹Robert Hoppock, “What is Success?: An analysis of success in terms of guidance objectives.” *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, 11(5), 294-295

¹⁹⁰ Nugin and Onken, “Defining Success in a Changing Society.” 450

¹⁹¹ Nugin and Onken. 450

¹⁹²Peter Heslin, Conceptualizing and evaluating career success, *Journal of Org. Behavior*, 26, 113-136.

job title. However, the underlying question within these questions is “How do you and your work contribute to society?” In referencing the earlier definition of success, what do you do that contributes to the needs of society? The simple fact is that the work that we do, whether we refer to it as a job, a career, a profession, or even a gig, constructs a significant part of our value and identity within society.¹⁹³

However, what exactly is work? And before proceeding to define the term *work*, one must acknowledge there are many terms that refer to the activity of work such as labor, a career, an occupation, a profession, and a job that vary according to culture and context. A job typically refers to a position within an organization that depends on one’s relationships with others within the organization. An occupation refers to a group of people and their activities and conduct. It can even include their social and political identities.¹⁹⁴ Still, a career is a more individualized concept regarding work. A career refers to an individual’s activity within a profession over a specific timeframe and within a specific societal context.¹⁹⁵

The definitions for job, occupation, and career defined the internal and superficial activities that encompass work. These definitions do not address the societal and personal implications of work. With the exception of the very rich, a person’s job is at the center of one’s psychological, social, and material life.¹⁹⁶ Scholars have spent years exploring the connection of work to one’s identity and value. Work within capitalistic societies is much more complicated

¹⁹³ Nadya A. Fouad and Angela M. Byars-Winston, “Cultural Context of Career Choice: Meta-Analysis of Race/Ethnicity Differences,” *The Career Development Quarterly* 53, no. 3 (2005): 223–33, <https://doi.org/10.1002/j.2161-0045.2005.tb00992.x>. Marcia J. Ghidina, “Social Relations and the Definition of Work: Identity Management in a Low-Status Occupation,” *Qualitative Sociology* 15, no. 1 (1992): 73–85, <https://doi.org/10.1007/BF00989714>; Daniels and Invisible Work

¹⁹³ Khleif, 1985: 1010

¹⁹⁴ Everett C. Hughes

¹⁹⁵ Everett C. Hughes

¹⁹⁶ Peter L. Berger, *The Human Shape of Work: Studies in the Sociology of Occupations* (New York: Macmillan, 1964).

than in non-capitalistic institutions globally.¹⁹⁷ In the mid to late 19th century, Marx began to bring awareness to work and production and its association with a person's value.¹⁹⁸ A person's work did more than produce value and material means. Labor connected people to their external world and provided a way to be identified and categorized within society.¹⁹⁹ In Marx's world, this included food, shelter and clothing. In today's world, that connection of labor does a similar thing, though perhaps not as closely as Marx's assessment. Second, a person's work is a self-affirming activity. When laborers see their work and labor used and appreciated, they receive that affirmation within themselves.²⁰⁰ Lastly, a person's value is connected directly to the value of their labor.²⁰¹ Even today, numerous scholars still discuss work within the context of Marx's understanding of work, identity, and self-worth.

Max Weber examined labor in the United States through the Protestant lens.²⁰² Through an examination of Calvinism, Weber identified that one's work was a calling within the Protestant world.²⁰³ A person's calling thus becomes their toiling (work) within a material world that would eventually manifest within heavenly rewards and purpose.²⁰⁴ Therefore, work possessed a spiritual value.

¹⁹⁷ Berger; Marcia J. Ghidina, "Social Relations and the Definition of Work: Identity Management in a Low-Status Occupation," *Qualitative Sociology* 15, no. 1 (1992): 73–85, <https://doi.org/10.1007/BF00989714>; Andrea E. Abele and Daniel Spurr, "How Do Objective and Subjective Career Success Interrelate over Time?," *Journal of Occupational and Organizational Psychology* 82, no. 4 (2009): 803–24, <https://doi.org/10.1348/096317909X470924>.

¹⁹⁸ Karl Marx, "Economic and Philosophic Manuscripts of 1844,"

¹⁹⁹ Specifically, his description of work is used to define and understand organic and mechanical solidarity. Within organic societies, one's work determines their place in society as opposed to kinship.

²⁰⁰ I do not use laborer in this section to denote manual labor, but anyone that works. This includes teachers, doctors, engineers, etc.

²⁰¹ Morrison, Marx, Durkheim, Weber: Formations of Modern Social Thought, 92.

²⁰² Max Weber, Talcott Parsons, and R. H. (Richard Henry) Tawney, *The Protestant Ethic and the Spirit of Capitalism*, [Student's ed.], Scribner Library, SL 21 (New York: Scribner, 1958).

²⁰³ Weber, Parsons, and Tawney.

²⁰⁴ Morrison, 254, 255

Emile Durkheim's scholarship contributed significantly to the connection between work and labor with numerous writings. For example, Durkheim argued that work was a critical factor between segmented (rudimentary) and advanced societies. Durkheim identified segmented societies as being more family-focused. These societies were composed of several "tribes" nearby in which they worked cooperatively.²⁰⁵ Additionally, these segmented societies were connected by social, familial, and religious bonds. However, advanced societies were unique in that their connections were through work and individualism. As civilizations advanced, a division of labor developed. Division of labor refers to the separation of skills and labor from increased personal and collective productivity. In the search for the most efficient way to meet the needs of many, labor becomes separated and specialized. However, this division does not solely impact production and efficiency. As people become more specialized by their professional expertise, their beliefs, social connections, and values become more connected to labor.²⁰⁶

Work and Identity

These early sociologists identified the unique connection between work and a person's identity and value. Contemporary scholars still study these theories.²⁰⁷

²⁰⁵ Craig Calhoun et al., *Classical Sociological Theory, 3rd Edition* | Wiley, accessed November 22, 2021, <https://www.wiley.com/en-us/Classical+Sociological+Theory%2C+3rd+Edition-p-9780470655672>. 139

²⁰⁶ Please note that this connection of work to value, needs, and social connections was discussed within the section explaining success. Drawing from Durkheim's work, one can see how the connection to work and success are even more deeply connected. Another consideration: the division of work and identity. This can be identified within engineering: electrical engineers, civil engineers, mechanical engineers, etc.

²⁰⁷ Arlene Kaplan Daniels, "Invisible Work," *Social Problems* 34, no. 5 (1987): 403–15, <https://doi.org/10.2307/800538>; Ruth Schwartz Cowan, *More Work for Mother: The Ironies of Household Technology from the Open Hearth to the Microwave* (New York: Basic Books, 1983), <https://babel.on.worldcat.org/oclc/424292319>; Eileen Boris and Rhacel Salazar Parreñas, *Intimate Labors: Cultures, Technologies, and the Politics of Care* (Redwood City, UNITED STATES: Stanford University Press, 2010), <http://ebookcentral.proquest.com/lib/vt/detail.action?docID=683243>.

Consider that a single job title can identify many parts of a person. Prior to the emergence of industrialization, a person's social identity was closely linked to their race, gender, marital status, and a slew of other characteristics.²⁰⁸ However, as societies became more advanced and people began laboring outside of the home, they became identified by their occupation.²⁰⁹ Though a person's job may identify them, it does not indicate an individual's complexity. A person's work can position them within a spectrum in which one is fulfilled through their work to the other extreme in which their work is oppressive and a hindrance to one's identity and personhood.²¹⁰ In this place, Weber's belief that work is a "calling" becomes challenged beyond the spiritual connection and instead reveals social obstacles. Everyone's work is not a calling. A caveat of the modern labor theory, *intimate labor* identifies that many jobs are not a calling.²¹¹ Few people would aspire to do these forms of work identified and associated with impoverishment, marginalized ethnicities, and women. In these situations, people do the work, but they don't identify with it.

Instead, people that do fulfilling work, tend to identify themselves through their work.²¹² For example, a person that does respectful and esteemed work may readily identify themselves through their work—"I am engineer." However, people whose work is oppressive and lowly will create a psychological distance between themselves and their work—"I work at XYZ Factory." Thus work identity goes further than self-identification, but also is a moniker for status identification within society.

²⁰⁸ Ghidina, "Social Relations and the Definition of Work."

²⁰⁹ Everett C. Hughes, *The Sociological Eye: Selected Papers*. 1971, Aldine Atherton, Inc. Chicago Illinois.

²¹⁰ Peter Berger, "The Human Shape of Work: Studies in the Sociology of Occupations" 1964. MacMillan.

²¹¹ Boris and Parreñas, *Intimate Labors*. 5

²¹² Ghidina, "Social Relations and the Definition of Work."

Work and identity connect one's work with individual and societal value. Earlier researchers referred to this as "occupational prestige."²¹³ Some jobs are afforded more value and prestige than others through factors such as the required amount of education; the number of managed employees, and the income associated with it. Occupational prestige connects to success. The perceived importance of work and the people who perform it are valued according to how that job fulfills the needs of society. Society needs doctors for obvious reasons. Is it no surprise that a physician is the epitome of success within most countries? Additionally, consider that many engineering education initiatives cite global and societal needs.²¹⁴ Some careers are deemed successful due to their value in society or the preparation necessary to enter that profession.

However, there is the other consideration of being successful within one's field. Career success is similar to overall success because both are greatly influenced by cultural context and change. Additionally, career success and personal/overall success are tightly connected. Traditionally, career success is identified as a sense of accomplishment associated with achievement in one's career or occupation. This type of success has typically been measured through promotions, financial achievements (raises, bonus, income, etc), responsibilities, and number of people one supervises. Other measurements of career success include positive evaluations and the value of one's job against the standards of one's community. However, in recent years, career success has shifted to include flexibility, continuous learning, and a work-life balance.²¹⁵

Disrupting Success

²¹³ Beeghly, Leonard, "The Structure of Social Stratification in the United States," 1989, Simon & Schuster.

²¹⁴ NSF, "NSF RFP: 15.607 2016"; NSF, "NSF in a Changing World: The National Science Foundation's Strategic Plan."

²¹⁵ Which is a long way of saying that success is a socially constructed process.

Which brings this chapter back to the primary audience: the ECE students. What the ECE students generally accept as success, personally and professionally, is shaped by many factors. Their idea of success is impacted by their personal interests, family and friends, and the image of a successful engineer.²¹⁶

However, the 2019-2020 Final Destination Report may tell us something differently. Thirty percent of CpE and 31% of EE graduates responded that they would have done something different in response to the question, “If you could start over in college, is there anything you would do differently related to career planning?”²¹⁷ Sixteen percent of CpE and 14% of EE would have chosen to learn more about career options in reply to these questions.²¹⁸ Though these statistics represent a small number, they point to a need of some students wishing to know about other careers, which was highlighted by the RED grant proposal. Bringing visibility to non-traditional career options for ECE graduates was not simply the work of showing other career options, but it was the challenge of changing the traditional idea of success.

Choosing, Recruiting, and Bringing Different Forms of Success Together

A key aspect of the ECE RED proposal was utilizing threshold concepts to create a sophomore year curriculum of “base” classes that would create more flexibility for students to explore other concentrations that would lead to an exploration of non-traditional careers within

²¹⁶ Rachel E. Friedensen, Sarah Rodriguez, and Erin Doran. “The Making of an ‘Ideal’ electrical and computer engineers: A departmental document analysis.” *Engineering Studies*, 12(2), 104-126; Deneen M. Hatmaker, “Practicing Engineers: professional identity construction through role configuration,” *Engineering Studies*, 4(2) 2012, 121-144; and Reed Stevens, Kevin O’Connor, Lari Garrison, Anrew Jocuns, and Daniel M. Amos. “Becoming an Engineering: Toward a Three Dimensional View of Engineering Learning.” *Journal of Engineering Education*, 97 (3), 2013, pp. 355-368

²¹⁷ First Destination Report: 2019-2020 Undergraduate Degree Recipients for Computer Engineering: <https://fds.career.vt.edu/Results/Details?id=1173> and First Destination Report: 2019-2020 Undergraduate Degree Recipients for Electrical Engineering: <https://fds.career.vt.edu/Results/Details?id=1183>

²¹⁸ For this survey 80 EE and 127 CpE graduates responded to this survey. There have been several discussions that it is difficult and complicated to collect data and track graduates. It is also important to note that to this question of doing things differently, 28% of the EE graduates and 30% of the CpE students did not answer the question.

engineering.²¹⁹ While the importance of the curriculum cannot be invalidated, the curriculum alone cannot broaden the career options for the students.

The NSF RED grant designers knew that actual change would necessitate a culture change. This point has rung true throughout the five-year process. Broadening the range of careers within the ECE department was not simply modifying the courses and adding concentrations. The culture of success had to change. The fact was that non-traditional students and non-traditional careers were not examples of success within the ECE Department.

Additionally, there was limited information regarding engineers and non-traditional careers. The engineering education literature pointed toward an increased trend of engineering students exploring social justice and occupations close to engineering (design).²²⁰ However, there was little research about engineers that moved from the traditional applicable use of their engineering expertise to wholly different fields. Instead, most studies focused on undergraduate students changing their majors from engineering.²²¹ Thus, other career options were rendered culturally invisible by the more traditional career route.

However, regardless of the feedback from faculty and advisors and the literature, students wanted different career options. Of course, a majority of the ECE students wanted a career in the tech industry and within the defense sector. However, this was not the case with all the students. Of the nineteen students interviewed, three shared that they were interested in non-traditional careers. An EE student with hopes of becoming a patent attorney shared the following: “I have a

²¹⁹ Virginia Polytechnic Institute and State University, “IUSE/PFE: RED: Radically Re-Designing the Fan-in and Fan-out of an Electrical and Computer Engineering Department.”

²²⁰ Kaitlin Litchfield and Amy Javernick-Will, “I am an Engineer AND”: A mixed methods study of socially engaged engineers.” *Journal of Engineering Education*, 104 (94), 2915, 292-416 and James N. Magarian, “Characterizing engineering work in a changing world: Synthesis of a typology for engineering students’ occupational outcomes.” *Journal of Engineering Education*, 110 (2), 2021. 485-500

²²¹ Greg Rulifson and Angela Bielefeldt, “Motivations to Leave Engineering: Through a Lens of Social Responsibility.” 9(3), 2017, 222-248

pretty unique background in the fact that I still am thinking about going to law school. I don't know if I've met someone as interested in seeing the other side of ECE. I have one friend in computer science, who's double majoring in music technology. That's like the closest.” To triangulate my data, I shared this finding with other ECE students. Though not every student was seeking an alternate career choice, several students did agree that they would like to learn more about other career options.²²² One student expressed interest by sharing that the “The zoom seminar series sounds very interesting! Especially if you have alumni who have jobs that most ECE students didn't realize were career options. I personally have been looking for jobs that may not fall into EE, but still value the skills that I learned from my degree.”

However, for students to explore and pursue non-traditional careers, the non-traditional careers had to be made visible to the student body and the department. Students interested in a non-traditional career found resources within the department sparse. An ECE student from the first year interviews that was interested in music informed me that there wasn't anyone in the ECE department to help him with developing a music-focused career because it didn't directly help him find a job within the traditional career paths.²²³ Another student double majoring in ECE and creative writing had some help from an ECE faculty member, but most of his guidance came from the English department.²²⁴

Therefore, to truly broaden the career options for the ECE graduates, the department needed to challenge the culture of success by presenting alumni that had pursued non-traditional careers and alumni that were *successful* within these non-traditional careers. Success is highly

²²² From a June 3, 2020 email from an ECE Student.

²²³ US_01_18

²²⁴ US_01_16

contingent upon the values of the audience.²²⁵ In this case, the audience includes the students, faculty, and academic advisors of the ECE department.²²⁶ Presenting alternative careers during their college years was pivotal. Whether traditional or non-traditional, a career trajectory is very important to an engineering student's ability to matriculate through an engineering program.²²⁷ Engineering education studies have shown that students that are able to identify with a career path are more successful at persisting through the challenges of an engineering education.²²⁸ A student who may enjoy their engineering education may find it challenging to continue through the academic challenges if the careers presented to them do not appeal and motivate them. Presenting successful, non-traditional careers not only broadens the occupational scope, but it adds a layer of recruitment and retention through expanding the idea of who can become an engineer and what an engineer is and does. This can contribute greatly to attracting and retaining invisible students, such as women and URMs who may possess the technical skills, but may be dissuaded from pursuing a career in engineering because of the traditional, dominant image.²²⁹ Because the perceptions and experiences of practicing engineers are key to the public perception of engineering, it is vital to bring visibility to the engineers that have successfully opted for a non-traditional career track and do not reflect the traditional, dominant image.

The Seminar: Disrupting the Idea of Success

²²⁵ Mark Iutovich (p. 6) in his work regarding success points out that fame and success is determined by the people of a community or the audience. The audience determines if an action, a person, or an artifact has value, thus the audience gives it the recognition of being associated with the idea of "success."

²²⁶ Furthermore, what a community or society deems as success changes constantly in regards to context and the time. Therefore, it is not surprising as we look throughout history that the themes of success change according to the present circumstances and its cultural relevances (Iutovich, 1988, p. 6).

²²⁷ Godbole et al., "Engineering Students' Perceptions of Belonging through the Lens of Social Identity."

²²⁸ Godbole et al.

²²⁹ Diana N. Bairaktarova and Mary K. Pilotte, "Person or Thing Oriented: A Comparative Study of Individual Differences of First-Year Engineering Students and Practitioners," *Journal of Engineering Education* 109, no. 2 (2020): 230–42, <https://doi.org/10.1002/jee.20309>. 231

The grant proposed to create a curriculum that would prepare the students for a “broader range of careers.” But, what exactly is a “broader range of careers” and how were students to become aware of other career options in a department that valued the traditional engineering career? The premise of this intervention was to create a non-traditional/alternative career seminar series to expose students to a “broader range of careers” through making visible those engineers employed in non-traditional engineering positions. Seminar series’ have shown to help influence a student’s career choice.²³⁰ The alternative career seminar series would feature electrical and computer engineers that are not currently employed in the traditional engineering fields. Realistically speaking, within the field of electrical and computer engineering, there are both engineers in traditional roles and those in non-traditional roles; however, the non-traditional roles are not visible because they do not embody the definition of a “successful” engineer. The purpose of this seminar was to legitimize non-traditional engineers by giving voice to their experience, expertise, and exposure to others. Additionally, this series would also encourage students to consider the socio-technical implications of their degree outside of the traditional role of the technical.

Defining One’s Own ECE Success

Part of the work of creating the non-traditional career seminar was understanding who and what constitutes a non-traditional student. Even for myself, I found that understanding what a non-traditional career in ECE was challenging. There were the prominent non-traditional careers such as a patent attorney. But then there were the ones that I wasn’t even sure constituted a non-traditional career. One alumni I spoke to explained how his job in

²³⁰ Pamela Cantrell and Jacque Ewing-Taylor, “Exploring STEM Career Options through Collaborative High School Seminars,” *Journal of Engineering Education* 98, no. 3 (2009): 295–303, <https://doi.org/10.1002/j.2168-9830.2009.tb01026.x>. 299

management within a tech/engineering design company was “non-traditional.” I told him I would follow-up with him. Not many people replied to this recruitment, but alumni emerged through recruitment and word-of-mouth one by one. First were two patent attorneys. Then another alumni reached out to me and described how her work in finance was a non-traditional job for an ECE alum. Lastly, I spoke to an ECE alumna who shared how she was creating her own fashion design company.

patent attorney
entrepreneur
financial analyst
fashion designer

EXPAND YOUR ECE CAREER

 Sal Bezos Director of Electronics Practice Group at Sterne, Kessler, Goldstein & Fox, P.L.L.C.	 Daniel Cho Patent Attorney and Associate at Espin & Associates	 Paige Kassalen Analytics Solutions Associate at JPMorgan Chase	 Shemeka Neville-Watson Founder and CEO of Chief Complex
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an event with electrical and computer engineering alumni

Thursday, March 25
5:30pm - 7:00pm
all students welcome!

<https://bit.ly/3sPxcw6>
to register

questions? Ask Annie Patrick, anyapa16@vt.edu

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Figure 5. Seminar Marketing Poster. Used with Permission of Annie Y. Patrick

In the end, the seminar was a one-day virtual event on a Thursday evening on March 25, 2021 (Figure 5). The event lasted ninety minutes. In total, thirty-two undergraduate students

registered for the event, and eight people that were designated as either faculty, staff, or graduate students registered. Each student that registered was emailed a survey inquiring about their definition of success and why they were interested in the seminar—a total of 20 people signed in for the event. My interview consisted of four questions exploring their initial plans and how their ECE education contributed to their current careers. Afterward, the students could choose an alumni to chat with in a break-out room.²³¹

What is Success post seminar?

Nine months of recruiting alumni, pre-interviewing them, scheduling them, creating an interview guide, creating a flyer, distributing a flyer, and distributing a flyer even more, the non-traditional career seminar was done. Was the seminar a success? Did it change the student's beliefs about success?

Prior to this seminar, I invited all the registered participants to share their thoughts on success. Specifically, they were asked to answer the following question: "In a few words, please describe what "success" within engineering means to you?" I received 15 responses to this question and, like the qualitative researcher that I am, I coded them (Table 5). I identified two primary branches of success from the student responses: the personal (inward) association of success and the outward association of success in how they contribute to society. Personal success was identified as a connection to one's own personal fulfillment in life. These categories were further divided into individual, occupational, monetary, and knowledge.

²³¹ The recording can be viewed at <https://icat.vt.edu/projects/red.html>

Table 5: Seminar Attendees Pre-Survey

“In a few words, please describe what "success" within engineering means to you?”	
Code	Quotes
Outward: Contribute to Society	<ul style="list-style-type: none"> • “Make the world better with engineering knowledge.” • “To continuously grow, learn and contribute to the community while enjoying the process.”
Inward: Individual	<ul style="list-style-type: none"> • “All this also goes side by side with the feeling of realization of an individual, where he or her would feel that they are achieving what they always wanted to or doing things that are getting them closer to reach their goals.”
Inward: Knowledge	<ul style="list-style-type: none"> • “Success within engineering means to apply your knowledge of the field and solve problems.” • “Obtaining good knowledge in the field of work, keeping up to date with the latest advancements.”
Inward: Monetary	<ul style="list-style-type: none"> • “High-paying engineering salary.”
Inward: Occupational	<ul style="list-style-type: none"> • “Getting your dream job.”

I emailed a post-attendance survey to all the attendees. However, I only received a response from one participant. This is the challenge of measuring the impact of these projects. This student reported that they “Learned about options I had other than a typical engineering career. I was particularly interested in the route of creating my own business and learned a bit about what that might entail.”

In the end, some of the students may respond by going deeper into the traditional careers and other attendees may be inspired to seek other careers. Of the sixteen students that replied to the survey 75% chose to attend the seminar because they were curious about other career options

with an engineering degree. Obviously, this seminar filled a need for the students, but measuring its success was another challenge that brought me back to defining “success.”

How does a scholar go about defining and measuring the success of an intervention?

When I was asked how I would measure impact, was I being asked how I would measure success? I assume that I was being asked to measure success. We rarely ask about impact in anything but in regards to the notions of success. We don’t care to know the failure, we only want to know the success. Can I claim success if only a few people attend the seminar? Is success in the number of attendees? Can I claim success if only five students show up, but it changes the course of their career? Is the success noted if it changes the culture and attitude of the department?

Earlier in this chapter, I discussed the social construction of success in regards to culture, identity, and society. However, how success is measured within metrics of project success is also greatly influenced by outside factors. The parameters in which we measure project success is as complicated and nuanced as the boundaries in which we define personal and professional success. Success is associated with a person and a society, but success is also associated with an endpoint. In another language and discipline, perhaps my measurement of success was a wicked problem.²³² Wicked problems are typically used to describe modern social problems that are “ill defined,” interlinked, and dependent on judgments rather than objective, scientific measurements.²³³ Though the three challenges (problems) I identified in the data were not wicked problems in the strictest sense, perhaps the measurement of their success was a wicked

²³² Brian W. Head, “Wicked Problems in Public Policy,” *Public Policy*, 3(2), 2008, 101-118, 102.

²³³Horst Rittel and Melvin Webber, “Dilemmas in a General Theory of Planning,” *Policy Sciences* 4 (1973): 155–69.

problem? Nevertheless, some of the ten primary characteristics of a wicked problem were useful in framing the complexity of measure my projects. For example, “Solutions to wicked problems are not true-or-false, but good-or-bad in the eyes of the stakeholder.”²³⁴ Instead, I considered that “*Assessments* of wicked problems/social problems are not true-or-false, but good-or-bad in the eyes of the stakeholder.” Likewise, “There is no definitive formulation of a wicked problem, even the definition and scope of the problem is contested.” For this I considered, “There is no definitive assessment of a wicked problem/social problem, even the definition and the scope of the assessment is contested.” Though I did not have a strict wicked problem, its literature gave me permission to challenge and explore the use measurement and impact.

Measuring the impact of projects such as seminars, podcasts, and others is important. However, how we measure and why we measure are important questions to measuring project success.²³⁵ Typically, success or failure is measured in numbers. However, the interpretation and communication of success and failure strictly through numbers can quickly become political fodder and weaponized.²³⁶ As a society, we embrace numbers as they reduce our social complexity.²³⁷ When I wrote this proposal, I was asked how I would measure impact. And that is a good and necessary question. My initial thought was to survey participants. However, I recognize that the survey is easy in theory and within some practical formats, but it wasn’t the best way.²³⁸ Only one student responded to the post survey. Therefore, it is obvious that I have

²³⁴Rittel and Webber.

²³⁵ Deborah Stone, “Numbers” *Policy Paradox: the art of political decision making*, 2012, 183-205

²³⁶ Porter, Theodore M. 1995. *Trust in Numbers*. Princeton, NJ: Princeton University Press; Desrosières, Alain. 1990. "How to Make Things Which Hold Together: Social Science, Statistics and the State." In P. Wagner, B. Wittrock, R. Whitley (eds.), *Discourses on Society*: Vol. XV, 195-218.

²³⁷ Theodore M. Porter, *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life*, New edition. /, 1 online resource (344 pages). vols., Princeton Scholarship Online (Princeton, New Jersey: Princeton University Press, 2021), <https://dx.doi.org/10.23943/princeton/9780691208411.001.0001>.

²³⁸ Zeki Simsek and John F. Veiga, “A Primer on Internet Organizational Surveys,” *Organizational Research Methods* 4, no. 3 (2001): 218–35.

to measure success in other formats. Within this chapter, I not only challenge the notion of success in regards to one's profession, but I also challenge how we measure success in projects.

Much of the literature in regard to project success was from the perspective of project management.²³⁹ However, let's consider success from a social aspect. Success in its many forms drives people, it drives society. However, there are limitations to how researchers have studied "success. As discussed previously in this chapter, there exists the common concept of success within the obvious indicators such as income, social position, and social mobility and class. When I interviewed undergraduate students, I observed this drive to stay on a path that indicated success: graduate in four years, get a good job, and get rich. Typically, we create an image of success depending on what our environment indicates as success.

The traditional notion of success that builds the image of a successful ECE graduate, bleeds into how I evaluate the success of all my projects. A challenge of this work is that the true impact may not be noted for years and can't be measured with numbers or a survey. Policymakers face challenges of measuring the impact of policy changes and implementations.²⁴⁰ Within the notion of *project management success*, the traditional measurements of success are considered in regards to the project against cost, time, and quality.²⁴¹ Time is a huge factor because the project's effects can take years for impact. Another impact of time is that things change. Funding shifts, people change positions, other more pressing issues take precedence. However, though some interventions may be able to be measured by a survey, others will not. The podcast was challenging. Instead of surveys, I leaned toward download numbers. However,

²³⁹ Terry Cooke-Davies, "The 'Real' Success Factors on Projects," *International Journal of Project Management* 20, no. 3 (April 1, 2002): 185–90, [https://doi.org/10.1016/S0263-7863\(01\)00067-9](https://doi.org/10.1016/S0263-7863(01)00067-9).

²⁴⁰ Bent Greve, "How to Measure Social Progress?," *Social Policy & Administration* 51, no. 7 (2017): 1002–22, <https://doi.org/10.1111/spol.12219>; Brian W. Head, "Wicked Problems in Public Policy," *Public Policy* 3, no. 2 (n.d.): 101–18, <https://doi.org/10.3316/informat.662880306504754>; Deborah Stone, *Policy Paradox, The Art of Political Decision Making*, accessed November 22, 2021, <https://wnnorton.com/books/Policy-Paradox>.

²⁴¹ Cooke-Davies, "The 'Real' Success Factors on Projects."

the numbers couldn't relay the impact of the participants' stories and experiences. It is hard to track who is listening and collect data with a moving target and moving population.

Then there is the separate factors of *project success*. This includes the criteria in which success is measured against the overall objectives to the project. Project success and project management success do not account for the success criteria (how the project will be judged as a success or failure) and the success factors (the inputs to the management system that lead directly or indirectly to the success of the project or business.²⁴²

STS scholars have discussed the measurement and assessment of success in numerous ways. One way to frame success is to measure the stability of an organization and the subsequent relationships during the project implementation and changes.²⁴³ This is a creative and contextual way to approach assessment and builds from work regarding boundary objects and boundary organizations.²⁴⁴ However, measuring assessment through the stability of the boundaries and relationships does not indicate success outside the stability of the relationships. Granted the RED grant team that was the center of the grant and the projects may continue in relationships of stability, the undergraduate student body could be very upset about something that was said in a podcast. Another interesting approach to success assessment is through justice-assessing for a fair distribution of goods, procedures, and functions within a community. In a project in which success or failure is complicated to measure, environmental justice (EJ) was used to critically assess the success of NGO assistance in the rebuilding of neighborhoods devastated by Hurricane Katrina.²⁴⁵ In the end, I found several approaches to measuring success,

²⁴² Cooke-Davies, 2002

²⁴³ Peat Leith, Marcus Haward, Chris Rees, and Emily Ogier, "Success and Evolution of a Boundary Organization" *Science, Technology, and Human Values*, 41(3), 375-401, 2016, 394

²⁴⁴ Guston, David H. "Boundary Organizations in Environmental Policy and Science: An Introduction." *Science, Technology, & Human Values* 26, no. 4 (2001): 399-408. <http://www.jstor.org/stable/690161>.

²⁴⁵ Barbara L. Allen, "Justice as a Measure of Nongovernmental Organization Success in Postdisaster Community Assistance" *Science, Technology, and Human Values*,

however, none were able to completely measure the success of my projects. Though my projects were not a wicked problem, their measurement was starting to become a wicked problem.

Redefining Measurements of Success

*Hello Annie,*²⁴⁶

I received the above email on April 9, 2021, two weeks after the seminar. Is this an indicator of success? Is this a form of impact measurement? I would say yes, yes it is. Dr. Martin, one of the PIs of the ECE RED grant team attended the seminar and recognized the value of the seminar. Though I could not measure the success in regard to the students and their future careers, I can recognize this project's success within the parameters of the RED grant team and within the department. This email communicates several aspects of success. On one level, it was recognized and deemed a success by an ECE faculty member. It was then shared to the chair of the department and potential donor alumni of the ECE department. That communication indicates a level of recognition and success of the project. Recognizing the value of the seminar, Dr. Martin brought it to the attention of the chair and a potential donor. Another indicator of the program's success is Dr. Martin's plan to make the seminar an annual event within the department. In this place, the initial objective of the seminar to challenge the traditional image of the engineer will continue to challenge this image.

Instead of measuring success regarding numbers and surveys, I had to consider other ways to describe the success that was occurring. Though I was challenged to measure the success numerically or through traditional assessments, I was not challenged to identify the occurrence of success. One indicator of success was how the seminar traveled outward and became visible within places of power, authority, and other resources. I term this as a form of "assessment per

²⁴⁶ Unable to share email.

mobility.”²⁴⁷ The seminar gained its own traction when it was picked up and shared with both the chair of the ECE department and an ECE alumni-donor, thus indicating a high degree of successful mobility. On the contrary, if the seminar had simply stayed within the confines of that one evening, it may have moved by word of mouth among the participants. This would indicate a small degree of mobility and a small degree of success. However, the seminar was deemed valuable by Dr. Marin (a PI on the RED grant and an ECE faculty member), and it was taken to places of authority and power (the ECE chair and the ECE alumni-donor). Thus “assessment per mobility” can be measured in (1) distance from the original event, (2) new and increasing visibility within structures of power, and (3) desire to repeat (indicated by wanting to make it an annual event). Consider “assessment per mobility” regarding the podcast. I would deem it a high degree of success. Per the demographic statistics, it had been listened to across the globe. It was a service-learning project. And what started as a six-episode podcast increased to eight episodes. Lastly, the podcast was chosen by a very small media production site in the UK as one of the “20 Best Electrical Engineering Podcasts of 2021.”²⁴⁸

STS is more than Useful

This is a seminar that says, “Hey, there is more to engineering than tech jobs and defense sector jobs.” As I read Gary Downey’s article about critical participation, he remarks about a consulting project with two engineering school senior administrators. The questions that were asked in the analysis of this project were: What is at stake? Knowledge? Identity? Commitment? What counts as engineering knowledge? What does it mean to be an engineer

²⁴⁷ Please note that this is a concept that I am still attempting to unpack and identify other places of assessment and measurement.

²⁴⁸ <https://welpmagazine.com/20-best-electrical-engineering-podcasts-of-2021/>

Please note I am not sure the validity of this social media publication, Welp Magazine (obvious it is not Wired Magazine) However, this is a degree of success!

and for whom? ²⁴⁹ Though Downey confronts these issues in his conversation with two senior administrators from an engineering program, I encounter similar issues with this project. However, my question is not what counts as engineering knowledge, but instead what counts as STS knowledge? This in turn brings forth my own question: How was this seminar for STS knowledge? As a scholar-practitioner who travels into other fields, there is a thin line between being an expert and just being useful. ²⁵⁰ I do not want myself, nor my expertise to just be useful. In other words, I do not want just to be used to do the things that the engineers don't find relevant enough to do themselves. I don't want to be a fad of expertise. I don't want STS and the social scientist to be forgotten when RED is over. This is also a project that says, "Hey, there is more to STS than the critique."

Conclusion: The Risks of Pursuing the "Other" Success

This work has shifted...it has changed. And what am I discussing? How we celebrate the traditional definition of success? And how that definition of success has limited us and created invisibility of those that have "failed." And allow me to add that what is deemed "failure" is socially constructed. What is judged as a failure by society, may be success for another culture or individual or another historical moment. Today, many things that judged to be successful would have been a failure years ago. Today, I am an independent woman. Years ago, I would be a spinster-useless and pitied. Additionally, a failure at one thing does not imply an overall failure. ²⁵¹ Failure and success are subjective and objective at the same time. They are all encompassing at one point and absolutely nothing at another point. We define success on an individual level, an institutional level. These are very different, yet important and real things.

²⁴⁹ Gary Lee Downey, "Critical Participation: Inflecting Dominant Knowledge Practices Through STS," 221

²⁵⁰ Please note that I address the idea of use and usefulness more fully in the conclusion.

²⁵¹ Stefan Timmermans, "The Joy of Science: Finding Success in a "Failed" Randomized Clinical Trial" *Science, Technology, and Human Values*, 36(4), 2011, 549-572, 567

Obtaining a non-traditional form of success is not an easy feat. It is not guaranteed. A question from the audience asked the panelists would they have had any regrets if their non-traditional path was not successful. And in this moment, I would like to make my own personal observation: the failures are harder to find, harder to celebrate. Would the non-traditional, unsuccessful alumni have replied to this call for participation? Would I have featured them if they had contacted me? In this sense, I am tied to a certain type of success. I should create a panel of those who were not successful within the ECE program and within the non-traditional path. For that matter, I should create a podcast episode for the people who did not make it through the program. For those women for whom just “knowing your stuff” didn’t work. Those underserved and underrepresented people who didn’t find their community or sense of belonging left the engineering program. Those people who went down the path least traveled and wish they never did. At this point...at least for me...I am tired of speaking to the people that succeeded...I want to meet the people who “failed,” the people who didn’t make it, the “quitters.” Where are you? And if I found you, would you talk to me? I want to make you visible. Your story is valuable. You are valuable. Because the other side of the coin of success is failure. Far too often we judge the failures as a lack of intelligence, drive, persistence, and dedication. The weed-out courses. If you didn’t cut it, too bad. It was your fault. But for those that “failed” within ECE, did you succeed somewhere else? Failure is judged through personal and institutional criteria-same as success.

But back to my question. What would have happened if they failed? The panelists were aware of that risk. Some minimize their risks by working as an engineer while in law school until the correct position arises. However, all in all...there were no regrets...because for these people it worked out for them. Take the leap...just jump in. What is the worst that can happen?

And these were engineers. They were still engineers. They had a back-up because if all else failed, they would have their degree in engineering. Are engineer's level of risk low? They have a set of needed and wanted skills. And these alumni went into pretty secure fields. They didn't go into the culinary arts. They didn't move to New York City to pursue a Broadway career. All of which are riskier ventures. They followed their passions, but even their passions were fairly secure. Taking a chance is good. However, taking a well calculated chance is better. A student from the first year interviews was aware of this: "I've always loved writing, but I knew it wasn't a promising career. Those [writing] careers are kind of hard to come by and if they do, they might not always pay as high as I need. So engineering was kind of the way to like support myself while I also pursued what I love doing." Is to succeed in engineering a way to succeed in other things?

Chapter 5: Quantifying Care and Bringing Visibility and Value to Academic Career Advising

“You could be in Kroger and you would see them, they would see you and they don't even know that you work in the same department.”--Academic Career Advisor²⁵²

Introduction

This chapter is about the invisibility of the academic advisors within the department and their connection to student success. The students see the advisors. However, the people that most need to recognize not only the work of the advisors, but the advisors themselves, were the faculty. It is a horrible feeling for one's contributions to go unnoticed and underappreciated. However, this invisibility goes beyond appreciation and acknowledgment, but to the lack of communication between the advisors and the faculty that impacted the students. Advisors were unsure of who to communicate with regarding student's professional and academic needs. Advisors repeated how knowing the faculty could help them in answering students' questions. Yet, many of the faculty were unsure of what the advisors' responsibilities were. The invisibility went beyond communication and awareness. When the faculty spoke of the students, they discussed them within the context of the classroom, homework assignments, and projects. They discussed the work of motivating students and their learning capability. However, when I spoke to the advisors, I learned of another part of the student-the student as a person. In my conversations with the advisors, I learned of the student's loneliness, of the financial burden to finish on time because of a younger sibling about to enter college, of parental pressure to pursue engineering despite the student's desire to do otherwise, and the day-to-day stress of college

²⁵²This was a quote/comment from one of the academic career advisors during the culture and climate study.

life.²⁵³ In seeing the advisors, I saw the student as more than a student and as a person. In essence, to see the academic advisors is to also see the whole undergraduate ECE student.

The previous paragraph describes two dynamics of invisibility. The first is the advisors' covert contribution to student success. The second is the hidden challenges of the undergraduate student experience. However, this chapter will focus primarily on the academic advisors' invisibility and the work to make them visible to the ECE faculty. David Wellman, a sociologist of labor said, "How people work is one of the best kept secrets in America." However, many of the ways that people work is not cloaked in secrecy. Instead of secrecy, some work is simply invisible, undervalued, and underappreciated. For whatever reason, society is not aware of certain types of work or does not care about the work because it does not have a place of visibility in regards to perceived value, its relation to the definitions of success, or associated factors related to gender, class, education attainment, and race. For example, during the COVID pandemic, the grocery store person became an essential worker. However, the store person and their work was not cloaked in secrecy. Instead, no one cared. It was a low-paying job with no status until people couldn't access toilet paper and canned goods. Then the world saw them and praised them as essential workers. Work is not cloaked in secrecy. Instead, it is cloaked in factors such as status, gender, race, perceived monetary value, and its contribution to society.²⁵⁴ Unfortunately, it can take a world changing event (pandemic) or an organized effort (labor strike) to bring both visibility and value to undervalued work and workers. Or it can take an STS graduate student.

The first section of this chapter explores the relationship between professional academic career advisors within higher education with a specific focus on engineering education. For

²⁵³These are all actual concerns shared by the academic career advisors.

²⁵⁴Ghidina, "Social Relations and the Definition of Work"; Berger, *The Human Shape of Work*.

many years, undergraduate advising was conducted by faculty. However, over the past XX years, undergraduate academic advising has shifted toward professional academic advisors. Though research has supported their impact upon student well-being and department culture, their position has been undervalued. The second section explores the concept and history of care work. Understanding academic advising means understanding that care work is not limited within the boundaries of gender and housework. Instead, it is to push beyond these academic boundaries and identify care work in everything. In this chapter, care work is discussed in engineering education and student success. I draw from theories of care work to understand the work of the advisors. However, why is their work unseen? For this, I draw from theories that examine the gendering of work and theories that explore the impact of class, race, socio-economic status, education, and other factors upon the value and visibility of work. The third section explores the choice of a white paper. This section examines the importance of considering the social construction of stakeholders, the direction of knowledge transportation, and the importance of knowledge translation within intervention development. The last section will discuss the impact of the white paper project after its presentation to the department and after my discussion with the academic advisors.

Academic Advising in the ECE Department

The undergraduate academic career advisors can be found in Whittemore Hall on the Virginia Tech Blacksburg Campus. These four women are responsible for advising over 1600 undergraduate ECE students in addition to fielding questions from students in other majors that may be interested in majoring in Electrical and Computer Engineering. However, these four women do more than advise students on class schedules and checklists. On a given day, they must be prepared to advise students on personal issues regarding family and finances or

professional issues such as preparing for an interview or negotiating a job offer.

But what exactly is professional academic advising? The National Academic Advising Association (NACADA) defines *academic advising* as “a series of intentional interactions with a curriculum, a pedagogy, and a set of student learning outcomes. Academic advising synthesizes and contextualizes students’ educational experiences within the frameworks of their aspirations, abilities and lives to extend learning beyond campus boundaries and timeframes.”²⁵⁵ Academic advising is an important component of the undergraduate experience that brings together students, faculty, and the curriculum.²⁵⁶

Within the ECE department, the advisor’s official job description includes over forty responsibilities and duties ranging from advising current and future ECE students to serving on numerous departmental and university committees.²⁵⁷ However, their daily interactions with students, faculty, and administrations encompasses so much more. However, the responsibilities of the academic advisors is best summarized by one of the academic career advisors, Kimberly Johnston:

“Professional advisors act as a partner to our faculty and both assist our students in valuable and meaningful ways. We navigate the curriculum, keep them on track to graduate, explain all of Virginia Tech’s policies and procedures whether it is academic dates and deadlines, appeals, or academic integrity. We work as a liaison with all the other offices on campus and determine what a student’s need is at that particular time.

Often we are a sounding board for how to address a problem with a roommate, faculty, or

²⁵⁵NACADA, “Pillars of Academic Advising,” 2017, <https://www.nacada.ksu.edu/Resources/Pillars.aspx>.

²⁵⁶A. W. Astin, “Student Involvement: A Developmental Theory for Higher Education.,” *Journal of College Student Personnel* 25, no. 4 (1984): 297–307; J.D. Greenwood, “Academic Advising and Institutional Goals: A President’s Perspective.,” in *Developmental Academic Advising*, ed. R.B. Winston, et al. (San Francisco: Jossey-Bass, n.d.), 64–88.

even their parents/guardian. We assist with major, minor and career options and create academic plans (for Policy 91 & SAP appeals or graduation). We assist if a student needs to disallow credits, wants to study abroad, needs tutoring, food or medical assistance, is looking for an internship, or tips for a job interview. The professional academic & career advisor is the point of contact for any student that doesn't know who to ask or where to go for a resource.”

Why is Advising Important

Professional academic career advisors are important in assisting students with their integration into higher education.²⁵⁸ Dedicated academic-career advisors are generally hired and trained to address the larger and complicated scope of the undergraduate student's needs, included but not limited to academic and curricular management, career guidance, recruitment, and developmental activities.²⁵⁹ Having a team of professional advisors allows faculty to have more time to focus upon research, service, and instructional activities. They are institutional representatives who guide students in the areas of academic, social, and personal matters.²⁶⁰ Much of their duties entails curriculum guidance.²⁶¹

To understand success for a successful student means that we recognize students and their challenges are not located to one aspect of their life. A challenge in the classroom may not be solely attributed to an academic issue, but can be connected to a range of issues outside of the classroom experience.

²⁵⁸NACADA, “Concept of Academic Advising,” 2006, <https://www.nacada.ksu.edu/Resources/Pillars/Concept.aspx>. “NACADA > About Us > Vision and Mission,” accessed December 12, 2021, <https://nacada.ksu.edu/About-Us/Vision-and-Mission.aspx>.

²⁵⁹ C. Self, “Advising Delivery: Professional Advisors, Counselors, and Other Staff.,” in *Developmental Academic Advising*, ed. R.B Winston, et al. (San Francisco: Jossey-Bass, n.d.), 64–88.

²⁶⁰ T.L Kuhn, “Historical Foundation of Academic Advising,” in *Developmental Academic Advising*, ed. R.B Winston, et al. (San Francisco: Jossey-Bass, n.d.), 64–88.

²⁶¹ Self, “Advising Delivery: Professional Advisors, Counselors, and Other Staff.”

Though most research supports the general importance of academic advising, engineering education studies have further supported the need for quality academic advising. Increasing the number of engineering graduates is an important national and global imperative. The effect of quality advising is connected to retaining students in general, but is even connected to increasing the matriculation of women and members of underrepresented minorities.²⁶² Additionally, as university administrators recognize the value and importance of advising, they have directed more resources into it.²⁶³ Advising is key to helping students integrate successfully in to the new and challenging environment of college and graduate on time.²⁶⁴ Additionally, though students may master their classes, many may be at risk of withdrawing from the program without advising that helps them to develop self-confidence in their academic studies while fostering social support.²⁶⁵

The general research revealed that academic advisors tend to address three primary segments of students' lives: academic, personal/social, and professional area.²⁶⁶ Data from the culture and climate study correlated with this research.

Academic student advising is a significant activity of the advisors. However, the analysis reflected that the advisors' work was not simply focused on coursework, but counseling students through academic struggles, academic and major choice, and how to interact with faculty.

- “I had a student who picked electrical engineering and she's like ‘Oh, I didn't really know

²⁶² J. Hudesman et al., “The Effects of Academic Contracting and Semistructured Counseling Sessions,” *Journal of College Student Personnel* 24 (n.d.): 278–79; M Lopez et al., “Intrusive Advising with Special Student Populations” 25, no. 3 (1988): 195–200. 3

²⁶³ W. R. Habley, J.L. Bloom, and S. Robbins, *Increasing Persistence: Research-Based Strategies for College Student Success*. (San Francisco: Jossey-Bass, n.d.).

²⁶⁴ NACADA, “Concept of Academic Advising”; Christian Guillén, “Undergraduate Academic Advising and Its Relation to Degree Completion Time” (2010), <http://hdl.handle.net/2148/672>.

²⁶⁵ Lotkowski, V.A., Robbins, S.B. and Noeth, R.J. (2004), “The role of academic and non-academic factors in improving college retention”, ACT Policy Report, available at: www.act.org/research/policymakers/pdf/college_retention.pdf (accessed 28 September 2008).

²⁶⁶ Terry O’Banion, “An Academic Advising Model,” *NACADA Journal* 14, no. 2 (1994): 10–17.

a lot about it, so I thought maybe I major in it and find out about it.' But what she found out was that it wasn't for her...we're here to help them learn what is involved in their major and understand what they're getting into.”--*Advisor 01-03*

- “The ones I found struggling a lot...they're trying to get used to the university setting, they have study skill issues, they just aren't focused. They hang out with their friends way too much. They're people pleasers....We try to reach out to them and say is there something we can do to help get you back on track?”--*Advisor 01-02*

However, the students’ **personal** challenges were almost unspoken within the RED grant and would have remained invisible if not for the academic advisors. From these interviews, it was revealed that the students personal lives greatly impacted their academic life and ability to be successful.²⁶⁷

- “I have one student, he’s not performing. And the family doesn't get that the pressure they put on him and him carrying a certain course load means a poor performance. He's better off taking a slower pace and really focusing on a couple of classes and doing well. That will make him a stronger candidate to go on the job market in the long run than rushing through.” --*Advisor 01-05*
- “Letting them know about different organizations to join...They're lonely and they just need somebody who's like them. If they have trouble making friends, they can join IEEE and they meet other people like them...we can tell them about those type of resources.” -
-*Advisor 01-04*

In addition to counseling students through academic and personal topics, the advisors are

²⁶⁷R. Harper and M. Peterson, “Mental Health Issues and College Students: What Advisors Can Do.,” NACADA Clearinghouse of Academic Advising Resources, 2005, <http://www.nacada.ksu.edu/Clearinghouse/AdvisingIssues/Mental-Health.htm>. 1

also a source of professional career counseling. The advisors are a bridge connecting the students to recruiters in industry, alumni, and design teams. Also, the advisors serve the additional role of educating the students in professionalism and resume building. It is interesting that the academic advisors are also referred to as “academic-career counselors,” they all shared that they are not engineers and are limited in professional engineering advising. This is part of the reason they wanted increased visibility and communication with the ECE faculty.

- “I’ve had students come in and say ‘I don’t have anything to put on a resume.’ And I ask, ‘What do you do in your free time?’ ‘I am building this motor for my 1966 Mustang.’ OK. So that’s a really good thing to put on a resume.” --*Advisor 01-01*
- “I know a lot of students sometimes obsess over [their] GPA and yes, employers will look at that. But I believe from what I’ve seen with other employers, they might be way more interested in a lower GPA if that student has a lot more projects or a lot more things that they’re involved in as a person and more personal growth within their education. That’s something that we’re trying to get across to students as well.” --*Advisor 01-03*

The academic advising literature correlated with the analysis of the interviews. On the surface, the advisors addressed a multitude of student concerns that are just simply categorized within the heading of “advising.” However, a deeper analysis of the interviews revealed that the advisors were doing more than simply advising. The advisors highlighted the significance of *care* within the ECE department. Whether an academic advisor is helping an ECE student find a support system or helping them to create their first resume, care work was prevalent within the department. However, how we as academics and laypeople understand care requires clarification.

To care is not to feel, but to do!

The way that we understand care is affected by several factors. The understanding of care is dependent upon the individuals and groups that are examining and performing it. Laypeople will approach and understand care differently from researchers. Researchers will understand and approach care differently depending on the discipline. However, the importance of understanding care and care work hinges on the fact that we have all been and will continue to be care givers and care receivers. This section will examine the complexity of care as a feeling, a skill, a public and private activity, and as a form of labor.

One of the first interpretations of care is care being limited to a feeling or sentiment.²⁶⁸ When a person exclaims, “I care about you,” it is received as a feeling they hold for the person hearing. This is especially true within the popular culture. The statement, “I care for you” evokes feelings of love, safety, and compassion within the recipient. In another context-“They are a caring person.”-may indicate that the person has a caring spirit or demeanor thus continuing the understanding of care as a feeling, attitude, or sentiment. These are popular definitions of care and have a place within the lexicon, but this limited idea and image of care damages and devalues the actual work and skill that is necessary for care and care work.

Much of the literature regarding care and care work examines it through a bifocal lens that is situated strongly with masculinity and femininity.²⁶⁹ For example, the words and ideas used to understand care work almost exist in an opposing dichotomy: work that exist within the public versus work that is done in private; work that is paid and valued versus work that is unpaid and thus has no value; care is innate and natural versus work that requires skills and

²⁶⁸ Arnlaug Leira, “Concepts of Caring: Loving, Thinking, and Doing. *Social Service Review*, 68(2), 1994, 185-201-189; Bowden, P. (1997), *Caring. Gender-sensitive ethics*, London: Routledge

²⁶⁹ A. Leira; Susan Himmelweit, “Caring Labor” *Annals of the American Academy of Political and Social Science*, 561, 1999; Michael D. Fine, *A Caring Society?: Care and the Dilemmas of Human Service in the 21st Century*, 2007

training; and care as a feeling versus work that requires thinking.²⁷⁰ Each of these opposing viewpoints share another dichotomy in that the characteristics of care are identified and associated with femininity and the work characteristics are masculine. Additionally, as care work has become strongly associated with markers of femininity it has become invisible within the context of work and value. Part of bringing visibility to care work is bringing visibility to the many inaccurate assumptions of what it means to care. In this following section, I will discuss care primarily through its opposing dichotomies as a skilled or unskilled form of labor and within the definitions of work and labor.

Care as Skilled versus Unskilled Labor

As explained previously, care is typically understood as a feeling of empathy and concern that one has for another. When we think of care as a feeling, we limit our ability to understand care as a series of active decisions that require many skills. The first step toward increasing the visibility and value of care work is shedding the notion that care is a feeling. Multiple scholars have provided evidence that care (also known as care work) goes beyond a feeling or sentiment and includes different skills.

The value and importance of care have been damaged and devalued by its public perception as a feeling and a sentiment instead of the work and skill necessary to efficiently and effectively perform the activity of care. Care as a feeling and sentiment is connected with the belief that care is an innate nurturing capability that does not require work. The detriment of care as a feeling or a sentiment is that it cannot be judged valuable as a skill, but instead remains situated as an innate feeling that has become closely associated with femininity. Consider that everyone has the ability to care and performs care work within different contexts and different

²⁷⁰ Amy Amenia, "Care as Work: Research and Theory" *Handbook of the Sociology of Gender*, 2018

levels, however care has a strong association with things such as housework which is strongly associated with women's work and a feminine identity. For this reason, care or care work has been at its best devalued and at its worst rendered invisible by traditional masculine notions of work and skills. Early in this chapter, the academic advisors were identified as four women, thus creating the image of academic advising as seen as a feminine occupation.²⁷¹ Indeed, advising cannot be that hard, right? It doesn't involve computations, hardware design, or coding. However, advising does require intuition, empathy, interpersonal skills, problem solving, resourcefulness, attention to detail, and technical skills among many other skills.²⁷²

For example, care necessitates the ability to cultivate not a simple, superficial relationship, but instead an interaction that is complex not only in its creation, but additionally within its ongoing maintenance, if it is to remain efficient. For many scholars, the notion of relational care is founded on necessary skills of building trust, maintaining a vulnerable, yet safe space, and an environment of dependency. One does not build trust and vulnerability within feelings and sentiment, but instead these things are built upon actions.²⁷³ Additionally, healthy and effective relationships depend on effective communication, emotional labor, and cognitive work. None of these skills are innate, natural abilities, but instead are skills that one must constantly work and improve upon for an optimal outcome. Understanding care through the need of relationships is very helpful for moving care from the idea of a feeling. There is a misunderstanding that relationships are founded upon feelings (worry, love, consideration,

²⁷¹Though I was unable to locate identity statistics on professional academic career advisors, the United States Bureau of Labor Statistics identified that almost 80% of educational, guidance, and career counselors and advisors were women. <https://www.bls.gov/cps/cpsaat11.pdf>

²⁷²Arnlaug Leira, "Concepts of Caring: Loving, Thinking, and Doing," *Social Service Review* 68, no. 2 (1994): 185–201. 188.

²⁷³Paula England, "Emerging Theories of Care Work," *Annual Review of Sociology* 31, no. 1 (2005): 381–99, <https://doi.org/10.1146/annurev.soc.31.041304.122317>. 389

etc).²⁷⁴ However, when we study relationships through the skills needed for a productive and healthy relationship, we can identify the relationships that necessitate communication skills, cognitive effort, and psychological adaptation and effort.²⁷⁵ Limiting care within natural and nurturing notions of relationships limits the actual skills (work) that is integral of care.

Theories that explain care work beyond natural and nurturing greatly explain the complexity and skills necessary to care. The theory of intimate labor successfully identifies the various skills necessary for care work.²⁷⁶ Though many examples of intimate labor are connected to work within the sex industry (hence the intimate notation), intimate labor can help to distinguish the skillful nature of care. However, what is intimate labor? Describing the “what” of intimate labor includes identifying its characteristics.. First, intimate labor includes a relationship in which a professional would be privy to the very personal details of a person's personal, physical, mental, and environmental life.²⁷⁷ For example, a housekeeper would be very familiar with their employer's day-to-day activities, arguments that may occur between family members, and other things that would be unknown to family and close friends. Another case would be those in the healthcare industry such as nurses or nursing assistants. Though there are the obvious intimate labor scenarios that involve bathing and other forms of bodily upkeep, there is the additional work of understanding and negotiating complex family dynamics; technology competency, knowledge of complex medical information; and providing emotional, psychological, and mental care. Overall, intimate labor requires that the person be attentive to the physical person (bathing or feeding a person whom is unable) and/or attentive the objects of

²⁷⁴Kirstein Rummery and Michael Fine, “Care: A Critical Review of Theory, Policy and Practice,” *Social Policy & Administration* 46, no. 3 (2012): 321–43, <https://doi.org/10.1111/j.1467-9515.2012.00845.x>.

²⁷⁵ L. Lloyd, L. LLOYD, “Caring about Carers: Only Half the Picture?,” *CRITICAL SOCIAL POLICY* 20, no. 62 Part 1 (2000): 136–50.

²⁷⁶ Eileen Bois & Rhacel Salazar Parrenas, *Intimate Labors: Cultures, Technologies, and the Politics of Care*, 2010, 4.

²⁷⁷ Boris and Parreñas, *Intimate Labors*.4.

that person (the home and meals if one is a housekeeper or cook). In addition, intimate labor necessitates vulnerability between the employer and the employee.

These occupations provide tangible examples of intimate labor, but what is intimate labor and how does it apply within the context of identifying the skills necessary for advising. First, intimate labor indicates that another person is privy to private information that reveals some vulnerability about the other person.²⁷⁸ For example, a housekeeper during their cleaning of a home would be aware of drug use that the homeowner has kept secret for obvious reasons from family and friends. Academic advisors are also privy to information that students may not want revealed to others. Advisors reported students coming to them with food concerns, financial issues, and mental health challenges. These are issues that many students may not feel comfortable sharing with faculty or other students. Overall, an important thing to note is that intimate labor promotes the physical, emotional, affective, and *intellectual* (emphasis mine) needs of others and aids in the development of the “human capabilities of the recipient (for example-being a successful student).”²⁷⁹ In this sense, sentimental feeling is but a small component of care work and advising.

We don’t pay for care, therefore it isn’t work, right?

Care has always been work, but it wasn’t until the 1970’s that researchers began to study care as a form of labor. One of the challenges of recognizing care work as a form of labor is that it does not have an obvious form of production. As far back as the mid-1800’s, Marx identified work and labor as something that exists within a system of production. To complicate matters even more, a person’s worth and value was closely tied this system of production that existed

²⁷⁸Boris and Parreñas. 2.

²⁷⁹Boris and Parreñas. 3.

outside of the home.²⁸⁰ What was valued by society, both monetarily and socially, was work that produced a tangible product and occurred outside of the home. This valuation of work as something that is connected to production and done outside of the home is a strong characteristic of American culture. Like Marx theorized, labor in the United States has been shaped by tangible identifiers such as productivity (number of widgets produced), sales (how much money do we make from the widgets), and time (how do we make as many widgets as possible in a specified time).²⁸¹ Needless to say, all of this was done outside of the home. Unfortunately, care is not able to be counted in either of these forms and for these reasons care is invisible. Instead of care being seen as a primary source and contributor of productivity, at best it exists within the peripheral of the labor market.²⁸² Even if care is acknowledged at all, it is minimized as a form of work that helps others to be more productive.²⁸³

Arlene Daniels's research regarding "invisible work" identified how these invisible activities that have been done within the home and out of the public scope of productivity have been overlooked as work. Invisible work identified the activities such as maintaining the home, childcare, and personal grooming that were not acknowledged as work because most importantly it did not receive financial validation and was not done in the public.²⁸⁴ This work that existed behind the closed doors of one's home was invisible in regards to traditional parameters of work.

²⁸⁰Karl Marx, *Economic and Philosophic Manuscripts of 1844*, 2013, <https://www.simonandschuster.com/books/Economic-and-Philosophic-Manuscripts-of-1844/Karl-Marx/9781627931755>. 147.

²⁸¹For example, Kurt Lewin's work with action research focused on how factory workers could be more productive. Additionally, Taylor's *Principles of Scientific Management* has greatly shaped how this country has measured, viewed, and look to increase productivity.

²⁸²Rummery and Fine, "Care"; England, "Emerging Theories of Care Work"; B. Aulenbacher, E. Gutiérrez Rodríguez, and B. Liebig, "Care Work – International Perspectives and Reflections," *Österreichische Zeitschrift Für Soziologie* 43, no. 1 (March 1, 2018): 1–5, <https://doi.org/10.1007/s11614-018-0291-0>. t

²⁸³This connects back to parts of intimate labor of how care helps other to reach their full capabilities. 385

²⁸⁴Daniels, "Invisible Work." 403.

Not only was it invisible, it was insignificant within society.²⁸⁵ However, to clarify, this does not mean that the activity is not valuable. The necessity of this invisible work would be obvious in its actual absence.

Though all this research has done much to bring visibility and value to care work, it has also limited our ideas of what is care and where it is located. Care work is still discussed within feminine contexts such as teaching, healthcare, elder care, and disability care.²⁸⁶ Additionally, dichotomies of care further position and explain it through feminine versus masculine contexts.²⁸⁷ For example, care and work as a “public: private” dichotomy furthers the belief that work done in the public is rewarded, legitimate work that has traditionally been done by men. Work that is done in private isn’t considered to be legitimate work. Additionally work that is done in private is done within the home and has been shaped by feminine images of homemakers and caregivers. Which brings us to another challenge. Care work is not considered work requiring skills. Work that is done within the public at a job is characterized by the need of a set of skills. Private and unpaid work such as care work is thought to be an innate natural ability and desire of women and therefore cannot be valued within the traditional concepts of work that is for a paid skillset and education. Within all of these is the additional boundary of paid versus unpaid work. The payment of work is what legitimizes it and gives it value. Once again, paid work is characterized as a public activity.

²⁸⁵Daniels. 404.

²⁸⁶ From my literature searches, much of the research regarding care and care work focuses on care within healthcare and childcare. I was challenged to find anything regarding care outside of these environments.

²⁸⁷ Amy Armenia, “Caring as Work: Research and Theory,” in *Handbook of the Sociology of Gender*, ed. Barbara J. Risman, Carissa M. Froyum, and William J. Scarborough, Handbooks of Sociology and Social Research (Cham: Springer International Publishing, 2018), 469–78, https://doi.org/10.1007/978-3-319-76333-0_34; Susan Himmelweit, “Caring Labor,” *The ANNALS of the American Academy of Political and Social Science* 561, no. 1 (January 1, 1999): 27–38, <https://doi.org/10.1177/000271629956100102>; Micheal D. Fine, *A Caring Society?: Care and the Dilemmas of Human Services in the 21st Century* (Macmillan International Higher Education, 2018).

The notion that care work is a private, unskilled form of work done mostly by women is an inaccurate assumption that has limited our ability to identify the many locations of care work. Furthermore, these assumptions have made care invaluable and invisible within society. Care scholars have revealed that care work is skilled work. However, because it is not immediately seen as a physical skill, the emotional and mental skills necessary to do this kind of work go unseen. Additionally, there are contextual and relational skills necessary to care for those that may not be able to verbalize their needs or who are even unaware of those needs. All of these things require skills. In fact, many caregivers whether unpaid family member or paid caregivers will need some type of training if care involves complex procedures (dressing changes, equipment use, etc) or special needs (communication needs, etc).

My argument is that the domains that care has been studied within (healthcare, teaching, etc), in addition to the feminist approaches to care, have limited our understanding of care and our ability to see the care that is all around us and how it contributes to our social, individual, and institutional well-being. It doesn't help that many models of care are framed around the unpaid work of women in some form of household labor and familial ties. Obviously, the traditional model of care sees a female individual (wife, mother, daughter, etc) within the home as the unpaid caregiver. Postmodern theories of care continued to center on the female form. Even models of cold modern and warm modern frameworks of care added additional help in the forms of care centers or sharing the work with men, women still remained a part of the model and typically the primary caregiver.²⁸⁸ In essence, feminists' focus on critiquing care within feminist spaces and a feminist lens alluded the fact that care is everywhere. Ironically, this dug care deeper into feminist ideas and languages.

²⁸⁸Fine, *A Caring Society?* 13, 12

The value and visibility of care rests in the need to explore the other contexts in which care is used and how care exists at varying levels and degrees in almost every aspect of life. The problem is that care has been limited by scholars that have repeatedly focused on its feminine foundation and the traditional occupations of care work. Considering care outside of women's work is difficult because we have been culturally and historically trained to see care and care work through women's actions and female bodies. However, care is like air. We all depend on it and would perish without it. Yet we never think of it until it is contaminated, compromised, or missing. I argue that care exists in every part of our make-up whether as a direct consequence or an indirect consequence. Care is not a feminine, care is human. Examining the academic advisors identifies care in one of the most unlikely places: engineering. It is ironic to locate care in one of the most masculine occupations, but this proves the importance of care. Engineering students become engineers because of care, not in spite of it. It exists in a multitude of forms whether coming from a faculty member, a GTA, or an advisor. However, if we continue to examine care work through female dominated occupations (though advising is heavily female), we will miss identifying it in everyday life. Additionally, we will miss the very fact that everyone does it!

Choosing the White Paper

The last project that I developed out of this research was a white paper. The podcast, described in the third chapter, was the first project, and the seminar, discussed in chapter four, emerged from the initial idea to host a non-traditional career job fair. However, I struggled with ways to make the advisors and their work visible. Someone suggested that I set up lunch meetings between the advisors and some of the faculty. However, this would only reach a few faculty members and frankly, having lunch with someone you barely know can be

uncomfortable. Another person suggested that I have a faculty member sit in the office with an academic advisor. However, what if the faculty visit happens on a slow day? Once again, this intervention would be limited to the few faculty that would be able to visit the advisors. Additionally, I was worried that this would affect the student's ability and comfort of confiding with the advisors. Sometimes students discussed faculty members with the advisors and I didn't want to impede that relationship. I consulted others. An administrator in the College of Engineering suggested that I have them all call in sick one day in the semester. In their absence, the department, notably the faculty would notice their absence and then become aware of the advisor's impact. In other words, a short-term strike. I knew that the person was joking, however, the implied meaning behind that statement didn't go unnoticed. Labor strikes have been used throughout history by the working-class to leverage power and bring attention to their work. However, I would not be responsible for this. I was left at an interventional pause. What was another way in which the ECE faculty could see and value the work of the academic advisors?

Around the spring of 2019, I found myself in a conversation with an ECE faculty member. Though the purpose of the conversation was not my dissertation, the topic of my three projects came up. As we discussed identities, non-traditional careers, and the work of the academic advisors, he paused and said to me, "You know, we (the ECE faculty) get numbers. If it isn't numbers, we don't care." In that moment, I realized that if I wanted to get ECE faculty to understand the work of the academic advisors, I had to quantify the academic advisors work with the students and within the department. I decided that I needed to translate the advisors and their care work into data and numbers. Remembering the white papers that were popular during my brief time in the tech world, I decided to create a white paper about academic advising and care.

The Groundwork of Creating the Right Vehicle

Why did I choose a white paper and why did I decide that it was important to “quantify” the work of the advisors. Before I started this project, I was warned of the dangers of quantifying and minimizing the advisors and their work. However, there are two factors that shaped this intervention. The first was the direction of the knowledge of this project. In this particular project, I was bringing the knowledge and the expertise of the academic advisors to the faculty. In this situation, I was not bringing knowledge of the faculty to the advisors. Additionally, though this white paper could be shared with other stakeholders, the faculty were the primary audience. The direction and the final destination of this project (the faculty) greatly shaped the intervention. The second factor was how I delivered the information. Efficient communication is a very important to share findings across disciplines, stakeholders, and within the public. As I was told, “We get numbers.” The faculty would not understand or accept the qualitative data, but they would understand and accept the numbers.

However, why did I focus on the ECE faculty for this project? Couldn't I have focused on leadership and administration? Perhaps, but the data revealed a direct disconnect between the advisors and the faculty. The advisors shared that having a more direct and visible relationship with the faculty could help advise the students regarding their research interests, choosing classes, and professional decisions. As an advisor stated, “We aren't engineers.” Additionally, some of the faculty were not fully aware of the responsibilities of the advisors. As a faculty stated, “I'm not sure what they do...take care of the health of the student?”

Social Construction of Stakeholder

Creating the suitable interventions means that people are always at the center of my work. However, there are many ways to approach people. Earlier I spoke of how I used the

matters of care to consider the matters of people. Even care work is focused on people. However, for this particular project, I drew from literature regarding policy making and stakeholders.²⁸⁹ One of the first steps in policy making is identifying the different stakeholders that are potentially impacted by a policy. Policy makers tend to identify and consider stakeholders within the effects of the policy or in my case, the white paper. Within policy making this tends to be identifying the primary stakeholder and the secondary stakeholder.²⁹⁰ Identifying the stakeholders requires one to consider who will potentially be impacted by the white paper. Within this project, the primary stakeholders were the advisors and the faculty and the secondary stakeholders were the students and members of leadership, such as the chair.

However, the scope and breadth of the audience was different for each project and this of course contributed to which project was developed. The primary stakeholders for the podcast was the overall ECE department. However, due to the broad and far reaching scope of the podcast, the secondary stakeholders were everyone and anyone. The IP addresses for locations of listeners went as far as Europe, Asia, South America, and Africa. However, primary and secondary stakeholders could shift according the episode, too. A female ECE student may be more impacted by the women in engineering episode than a male stakeholder. The stakeholders for the seminar included any student that was interested in a non-traditional career. However,

²⁸⁹ Please not that I used the term loosely in regard to public policy. Per Kerry Lee's "Who are the Stakeholder's?" a stakeholder has some kind of claim on the service of the organization or those who can influence the workings of the business in some way (5). However, R. Reeman's *Strategic Management: A Stakeholder Approach* (1984) identifies a stakeholder as anyone affected by or can affect an organization's objectives. In this sense, the academic advisors are stakeholders that can be affect by my objectives for the department's culture. Also, Mitchell, Agle, Wood's "Toward a theory of stakeholder identification and salience: Defining the principle of who and what really counts" discusses the power and legitimacy of stakeholders which contributes to identifying direction and translation of the project.

²⁹⁰ R. Brugha and Z. Varvasovszky, "Stakeholder Analysis: A Review," *Health Policy and Planning* 15, no. 3 (September 2000): 239–46, <https://doi.org/10.1093/heapol/15.3.239>. 242

this project was different. Unlike the other two projects, the stakeholders were very specific and directly linked to each other.

Another aspect of a traditional stakeholder analysis is the power structure. It is important to acknowledge and understand the varying levels of power that is held by various stakeholders. Most of the literature directs people to consider the relevance of the stakeholder's within the organization and their responsibilities and duties. However, understanding the power structure within these two stakeholders means understanding the group dynamics: how they do or do not work together, their behaviors, their intentions, and their agendas. However, these traditional aspects of stakeholder analysis can only do so much. Another factor that must be considered are the social factors that shape them as people and as a group. This means thinking about the stakeholders beyond a title within the department and their listed job responsibilities. Considering the social network and their social construction of these stakeholders means considering the faculty consist of over 100 faculty members compared to four advisors.²⁹¹ The faculty are mostly white and Asian men and the advisors are all women (three that are white and one that is Black). The greater majority of the faculty have PhDs and are educated in engineering. The advisors have a Master's degree in a social science. This creates a socioeconomic difference based in education attainment and professional difference. And lastly, the faculty hold in high esteem the notions of rigor, analytical thinking, and math, whereas the advisors work in areas of less "rigor" and they aren't teaching. This leads to a perception of less difficult, less importance, and less value.

²⁹¹ Cristina C. Costa and Paulo Rupino da Cunha, 's "Who are the players? Finding and Characterizing stakeholders in social networks." *Proceedings of the 43rd Hawaii International Conference on System Sciences*, 2010 IEEE makes an argument that a stakeholder's position in the social network of an organization is important to identify the cultural and social factors that affect behavior, choices, interests, etc. This was helpful to consider the social dynamics of gender, class, education, etc that separated the advisors and the faculty.

Taking the time to consider stakeholders through their social positionality forces one to reconsider their power dynamics and shapes how an intervention is developed and how it moves among/between stakeholders. Though the advisors and the faculty were not stakeholders in the true definition of the word, understanding the traditional dynamics of a stakeholder was one step toward creating the most appropriate intervention. Understanding the faculty and the advisors as stakeholders provided a framework to understand their connection to each other. This led to further understanding the importance of direction and translation across stakeholder boundaries.

Where is this going? Understanding the Importance of Direction

The second aspect of understanding the relationship between the faculty and advisors is understanding how their dynamics affect the direction of knowledge. Understanding that projects and interventions move in directions is another key aspect to intervention formation. Direction comes from the idea that within STS interventions there exists a component of travel that is constantly occurring as knowledge travels back and forth between STS scholars and the communities where they are studying and working, in addition to knowledge that is traveling within other groups.²⁹² Knowledge may move in multiple directions impacting multiple people. It may move in a dual direction in which it is directly impacting two parties. Perhaps this work of knowledge travel direction is one of the more important components of intervening. Travel is complex and involves many stakeholders and just as many destinations.²⁹³ Downey acknowledges that travelers of knowledge must consider the points of beginning and end and the roadblocks that will be met along the way.

However, the white paper further explored the importance of direction that carries knowledge. The direction of travel is very important when choosing an intervention. There are

²⁹²Downey and Zuiderent-Jerak, "Making and Doing: Engagement and Reflexive Learning in STS."

²⁹³Downey and Dumit, "Locating and Intervening: An Introduction." 9

times when the knowledge may move within a circular pattern or it may be bidirectional. It is important to stop and consider all of these options that shape the intervention. For this project, knowledge was a one-way street. The care work of the advisors was moving toward the faculty. However, I was not bringing information of the faculty to the advisors. Additionally, direction influences the type of intervention. For example, if I was bringing visibility of the faculty to the advisors, a white paper would not be the best option. For one, there are over 100 faculty members in the ECE department. This could very much complicate the scope of my project. This large number of individuals means that the advisors at best could understand minimal information about the advisors as a group and almost no information of them as individuals. As knowledge travels on the road, it is imperative that the right vehicle is chosen.²⁹⁴

Intervention Translation: It's not just for languages.

I had two stakeholders, but the knowledge was only going in one direction: the care work of the advisors to the faculty members. So I chose the white paper because it is a medium of communication that is popular with engineering and technology disciplines.²⁹⁵ I had to choose a vehicle that could properly reach the faculty in a language they not only understood but also valued. A white paper is noted to be research driven, supported by data, concise, and created for a particular audience.²⁹⁶ The white paper would address and bring visibility to care within engineering education through data-driven evidence. In a department that values rigor and data,

²⁹⁴Downey and Zuiderent-Jerak, *Making & Doing*. 226.

²⁹⁵ What Is a White Paper (in Technology)? - Definition from Techopedia,” Techopedia.com, accessed December 29, 2021, <http://www.techopedia.com/definition/5579/white-paper>; “The Ultimate Guide to Writing Technical White Papers,” Compose.ly, April 9, 2020, <https://compose.ly/strategy/technical-white-paper-guide/>.

²⁹⁶Robert W. Bly, *The White Paper Marketing Handbook: How to Generate More Leads and Sales with White Papers, Special Reports, Booklets, and CDs* (Mason, Ohio: Thomson, 2006), <http://catdir.loc.gov/catdir/toc/ecip0517/2005021939.html>; Michael A. Stelzner, *Writing White Papers: How to Capture Readers and Keep Them Engaged*, 1st ed (Poway, Calif.: WhitePaperSource Pub., 2007), <http://catdir.loc.gov/catdir/toc/fy0711/2006924256.html>.

this care work was quantified to bring visibility to the academic advisors. In the Fall of 2020, the academic-career advisors collected data on approximately 1,700 student exchanges and addressed over 2,400 student concerns. Though the majority of these concerns were academic, students also discussed numerous questions regarding their mental health and physical well-being to resumes and app development. As the ECE department grows and student needs become more complex, increased collaboration and communication between the academic-career advisors and faculty are key to student and departmental success.

Do Your Best and Then Do Some More: Bringing Visibility to Failure in STS Engagement

On October 27, 2021, I presented the White Paper at the bi-weekly RED grant meeting. I prepared a list of slides outlining the formation and the purpose of the white paper. At the meeting of nine team members, at least three had seen the document and had contributed by editing or content. After I finished the presentation, one person disagreed with the first statement of the document. “Academic advisors are essential to the Bradley Department of Electrical and Computer Engineering (ECE), but their work remains unseen and underappreciated.” He continued that they are invisible not because they are unseen, but because they do their job so well. What I assume would be at the most a thirty minute conversation, instead took the whole hour time-slot.

The meeting was, in some ways tense. Afterward, I received an email from another RED team member stating their support of the document and offering to help in whatever way they could. Another person emailed to share that they would be happy to discuss the paper and the events of the meeting. Another person shared that one of the newer members of the team was slightly taken aback by the event. However, my overall impression of the meeting was that it and the white paper were successful. It had done exactly what I wanted it to do: create a

provocation. A discussion ensued in which people defended the importance of the project and others defended a need to tone down the wording for it to be better received by the faculty. However, no one dismissed the importance of the paper or the advisors. Was it uncomfortable? For some, it appeared to be. For myself? No, I expected it. After five and a half years of working on this project, I knew my audience. I believe that it would have been worse if no one had responded. Instead, where some may have seen some criticizing the document, I saw him wanting to adjust it to be fully received by the department.

Success is not always smiles and acceptance. Success can be contention and disagreement. Sometimes care work continues in so many ways. The department head cares about the project and his faculty. The following suggestions were requested:

1. Clear indication that this work was about the undergraduate academic advisors.

Unbeknownst to me, there were graduate academic advisors and he wanted it clear in the document that the white paper pertains strictly to the undergraduate academic advisors.

2. Rewriting the first sentence of the executive summary: “Academic advisors are essential to the Bradley Department of Electrical and Computer Engineering (ECE), but their work remains unseen and underappreciated.”

3. Defining the care and care-work.

A couple of weeks later, I met with Tom Martin and Scott Dunning and we made the applicable changes. The document was shared with Luke and approved to be shared to the ECE faculty. On November 19, 2021, I presented the white paper at the monthly ECE Faculty Meeting in which about 70 people were present. They had received the white paper the previous day. I judged my presentation to not be my strongest presentation. I received a couple of

questions, and some went directly to the advisors. Overall, the meeting was quiet. My presentation, including questions, lasted about twenty minutes. Afterwards...well that was it.

In this section, I will critique my responsibility to the intervention and the advisors. I will not discuss the assessment of the faculty as I had hoped I would. I do not have time to measure impact as I expected. Instead, engagement, being a wise teacher made me address failure (or perceived failure).²⁹⁷ Up until this point, everything was a success: the podcast, the seminar, and the white paper. However, my presentation did not go as planned. And as I completed this chapter, I am forced to reflect on what went wrong and the next steps.²⁹⁸

My first challenge was time. Perhaps, I ran out of time. I presented a week before Thanksgiving and just as the department entered the last few weeks of the semester. Strategically, this is not the best time of the academic year to present anything new. However, it was the only time allowed. My second challenge was myself. When I was completing the final edits and preparing to present it to the department, I was furiously and tirelessly writing and updating my dissertation. And no, I did not followed up with the academic advisors because I was unsure what to say or what to do. I do not know what happened? I chose the right vehicle. I pointed it in the right direction. Yet, I somehow missed my destination.

This situation bothered me tremendously because it impacted the academic-career advisors. It meant I failed them and their hard work. Some would say that since I am about to graduate, “Oh, well, it happens. Move on.” However, I could not allow myself that approach. What happens when there is a failure? When I failed. How do I care in the places of failure, my

²⁹⁷Cole, “A Cautionary Tale About Cautionary Tales About Intervention.”

²⁹⁸ Ironically, in chapter four, I discuss wanting to interview and bring visibility to the people who transferred out of engineering. In other words, I wanted to discuss the so-called failures. Instead of discussing theirs, I will discuss mine.

failure? There is care for people and care for the objects that care for those people.²⁹⁹ I am attempting to do both.

What next? An abstract about the white paper was accepted to an ASEE conference. I invited the advisors as co-authors and they were happy to be included. There is a discussion of finding space for it on the ECE website. And I will follow-up with other resources even after I defend and leave. Is that enough? I do not know, but I know that it is something.

This is now a conversation of when does engaging end? Interventions have to be finite. No, allow me to reconsider that thought. The podcast can possibly go on forever (it has infinite agency). However, I do not. The engaged scholar, must at some time, stop engaging. Sometimes the end is definite. At the end of a “Expand Your ECE Career” seminar, it occurred when I ended the zoom call. For the podcast, it will be with my last episode. However, all interventions are not that simple, and some need extra care. This is one of them. I wish I could tell you what happens next, but I can’t. For future engaged STS scholars: You do the best you can. And sometimes, after you do your best, you will do some more.

²⁹⁹Maria Puig de la Bellacasa, “Matters of Care in Technoscience.” 99

Chapter 6: A Lived Field Guide to Engaged STS

"I could not myself experience participation in all the forms and modes that I sensed were indicated by this diverse literature. For every article I read, I asked myself: 'but what did it feel like?'" -Christopher Kelty

And in the End...

Here we are at the end. Five and a half years as a GTA on the RED grant conducting over 75 interviews, attending approximately 300 weekly meetings, and taking thousands of pages of notes. Then, of course, are the three interventions spanning over two years. *Engineering Visibility* brought the experience of various communities to the forefront of the ECE department. From the transfer student explaining how they felt lost in the classroom and on campus to the first-generation student sharing how their family's legacy and future depends on them, the department had to contemplate the diversity and inequalities of its student body. The "Expand Your ECE Career" seminar presented four ECE alumni who explained how their ECE degree led to successful careers in law, finance, and fashion. "Engineering Care: The Vital Role of Academic Advisors in ECE Undergraduate Student Success" was the white paper that translated the care work of the undergraduate academic career advisors. Translating the qualitatively derived themes of personal, professional, and academic care work into quantitative data was necessary to communicate the significance of the advisors' work to be valued by the ECE faculty. The podcast, white paper, and seminar brought visibility to its respectful audience and respectively challenged the department to see the invaluable diversity within its community, the unacknowledged contributors to student success, and success beyond the parameters of the "Brad" persona.

Though these interventions brought visibility to several places within the ECE department, my primary focus on groundwork aimed to fill a gap in the Engaged STS literature. After reading the literature, I understood the benefits and challenges of engagement. Furthermore, I was familiar with the impact of various interventions. However, I found limited research describing the invisible on-the-ground work that brought these projects to fruition. I believed it was essential to bring this work to light for several reasons. So much of engagement work occurs in a grey area with no firm foundation. This is not the case in other methodologies. The qualitative methodology is overloaded with literature to aid the researcher in the big picture questions and the more minor nuances. For example, qualitative work has well-defined instructions, examples, and frameworks to aid the scholar in developing research questions, recruitment methods, conducting a focus group or individual interview, and analyzing data.³⁰⁰ Yet, engagement and similar methods do not have as much research. Second, this lack of instructions could potentially impact the future of engagement scholarship. Future engaged STS scholars may desire some well-defined directions for their work. I believe that the future of engagement is dependent on documenting and studying groundwork so that other scholars will have some essential background and guidance. Some scholars may not feel comfortable or

³⁰⁰ J. W. Cresswell, *Research Design Qualitative and Quantitative Approaches*. (Sage Publications.); Norman K. Denzin and Yvonna S. Lincoln, *Handbook of Qualitative Research*, 2nd ed (Thousand Oaks, Calif.: Sage Publications, 2000), <http://catdir.loc.gov/catdir/enhancements/fy0658/00008104-t.html>; David L. Morgan and Margaret T. Spanish, "Focus Groups: A New Tool for Qualitative Research," *Qualitative Sociology* 7, no. 3 (1984): 253–70, <https://doi.org/10.1007/BF00987314>.

confident in engagement if they cannot locate some “rules” or a guidebook. Third, some scholars may question the validity and legitimacy of our methods if we cannot provide some reproducible knowledge and framework of engagement.³⁰¹

Therefore, I contributed to this scholarship through three interventions. Three different interventions provided a fuller account of my experience as an engaged STS scholar and provided at least three accounts for other scholars to compare and contrast. The podcast, white paper, and seminar were unique vehicles in framing and delivering STS knowledge. For example, the podcast demonstrated sharing knowledge to a broad audience. Yet, the white paper was most appropriate for a more narrow audience (i.e. communicating the advisors and care work to the ECE faculty). Furthermore, I pulled different aspects of groundwork from each intervention that I would not have been able to do with one intervention. In the podcast, I learned the importance of protecting participants. With the seminar, I experienced a different way to measure success. And writing the white paper forced me to address the differences within stakeholders that dictated the intervention I developed. In other words, conducting three projects demonstrated the significance of groundwork and its complexity.

In this last chapter, I review my lessons learned from my time on the RED grant and from the three interventions. Next, I explore my positionality and reflect upon my own position as a *participantworkerscholarcaretaker*. Lastly, I return to STS and describe how I pushed against framing STS as *useful*. Then I conclude this chapter and my dissertation with a discussion of my next steps of engagement.

³⁰¹ Jerome Kirk and Marc L. Miller, *Reliability and Validity in Qualitative Research*, Qualitative Research Methods, v. 1 (Beverly Hills: Sage Publications, 1986), <http://catdir.loc.gov/catdir/enhancements/fy0654/85002412-t.html>; John W. Ratcliffe, “Notions of Validity in Qualitative Research Methodology,” *Knowledge* 5, no. 2 (1983): 147–67, <https://doi.org/10.1177/107554708300500201>; Sam Porter, “RESEARCH METHODOLOGY: Validity, Trustworthiness and Rigour: Reasserting Realism in Qualitative Research,” *Journal of Advanced Nursing* 60, no. 1 (2007): 79–86.

Project Grounding: Lessons from RED

The NSF created RED to incentivize engineering departments across the United States to create sustainable and scalable changes. The grant urged awarded engineering departments to develop proposals that would remove departmental barriers to inclusivity, develop curriculums that would connect to the industry's technical and professional needs, and produce engineers that would become leaders in a global economy.³⁰² In essence, the NSF created RED to elicit a culture change within engineering education and the profession.³⁰³ This was not the NSF's first time to attempt to change engineering education. The NSF had learned from previous grants and these lessons were reflected within the RED grant. A drawback of the DLR program was that experts were unsure if long-term change had occurred. Therefore, RED required an engineering education PI to ground each team's work within academic scholarship. A downside of the EEC was that changes and improvements never moved beyond the individual coalitions. REDPAR was created to serve as a resource to keep the universities communicating about each other's work.³⁰⁴ Additionally, RED required the department chair as a PI to obtain and maintain faculty buy-in. However, to ensure that each team never strayed from the ultimate goal of culture change, the RED grant required a PI who was a social science expert. The social scientist was to advise and monitor the culture change strategy. It would appear that the NSF had covered all its bases.

As the fourth largest ECE department in the United States, the VT ECE department was the ideal RED grant candidate. The department chair was interested in inclusion, diversity, and bringing a culture change to the department. Additionally, the department had approved fourteen

³⁰² NSF, "NSF RFP: 15.607 2016."

³⁰³ NSF.

³⁰⁴ "Making Academic Change Happen," Making Academic Change Happen, accessed December 23, 2021, <https://academicchange.org/>.

majors to increase career options for students. Overall the RED grant team and the ECE department's leadership was on-board to cultivate a departmental culture change. To understand the department's culture, one of the team's first tasks was the department's culture and climate study. Though supported by the entire RED grant team with recruitment and other necessary resources, the team's social scientists supervised the majority of the study. The study reiterated the significance of math, analytical design, and the overall engineering identity. Yet, more importantly, the study revealed the department's significant yet less visible culture within three points. One included the undergraduate academic career advisor's work that contributed to the student's successful matriculation. However, their work was undervalued due to a focus on the classroom and faculty. Additionally, the data revealed that many of the department stakeholders viewed diversity as lacking. Yet, the interviewees shared their thoughts on improving diversity. They believed that addressing the department's image and representation could improve diversity within the department and the profession. Third, though not a primary theme within the interviews, three students vocalized the lack of resources to aid them in their non-traditional career trajectory. These three data points supported the objective of the ECE RED grant proposal to broaden career choices.

If one looked at these challenges individually, one would miss the overall connection of these challenges to the department's culture. At the foundation of these challenges was the current culture of the department. The department's culture preserved the dominant image of the engineer as predominantly white, male, and situated within the "bro" culture. The department's culture dismissed the connection between the advisors and student success, and instead, student success was linked to the faculty. The department's culture associated any career choice not within the tech industry or defense sector as unsuccessful.

The social scientists conducted the study, analyzed the data, and presented the findings. However, instead of continuing in the advising role, the social scientists became engaged with the themes, the invisibility, and the department through three interventions. From a theoretical stance, invisibility was at the center of the cultural challenges. The dominant, visible images of engineering regarding identity, success, and work had created barriers to those who were not male and white, those who were not interested in careers in tech or defense, or work that was not judged as rigorous. Challenging the culture meant challenging these dominant images with visibility of diverse identities, successful non-traditional careers, and the impact of care work in engineering. As an engaged STS scholar, I took the knowledge from the study, drew from theories of invisibility, and combined them with pragmatic STS knowledge to create three interventions. In each intervention, I studied the groundwork of STS engagement as I created and implemented each intervention. Likewise, I challenged theories of identity, success, and care work while I challenged the dominant culture of the ECE department.

Diversity of gender, ethnicity, background, and other factors had been a goal of engineering education for decades.³⁰⁵ Many scholars studied the importance of diversity, and just as many attempted to correct this discrepancy. In our climate and culture study, interviewees believed there was room for improvement regarding diversity. Interestingly, many believed that the current dominant images were the top reasons for both the problem of diversity and the solution to increasing diversity. There were not many images of diversity within the ECE department. However, it wasn't that the department or the profession did not have

³⁰⁵ Emily Blosser, "An Examination of Black Women's Experiences in Undergraduate Engineering on a Primarily White Campus: Considering Institutional Strategies for Change," *Journal of Engineering Education* 109, no. 1 (2020): 52–71, <https://doi.org/10.1002/jee.20304>; NSF, "NSF RFP: 15.607 2016"; Rachel E. Friedensen, Sarah Rodriguez, and Erin Doran, "The Making of 'Ideal' Electrical and Computer Engineers: A Departmental Document Analysis," *Engineering Studies* 12, no. 2 (May 3, 2020): 104–26, <https://doi.org/10.1080/19378629.2020.1795182>.

diversity. Instead, these people and their experiences were invisible within the overall department's image and did not have a prominent place of visibility within the department. I created the *Engineering Visibility* podcast as a platform to bring these identities and their experiences to the forefront of the department. The podcast brought visibility to the female students' experience of being ignored in team meetings. The podcast stressed the importance of programs such as CEED for creating the necessary community and sense of belonging for underrepresented students. Also, we learned of the first-generation student struggling to balance classwork with the work of being their family's translator. However, each episode was carefully crafted on the ground to bring visibility to these hidden identities yet protect each participant from the potential danger of online abuse. For the more socially sensitive topics of women in engineering, inclusion and diversity, and the first-generation student, I reintroduced invisibility to protect the participants from opposing opinions. I identified this work as *interventionist protectivity*. Interventionist protectivity encompasses all the work that an engaged researcher performs to protect participants. Another example of interventionist protectivity was declining the intervention of having faculty spend a day observing the undergraduate academic advisors. I wanted to maintain the advising space as a safe place for students to discuss any concerns, including faculty interactions. Interventionist protectivity includes the work of building trust with participants, possessing social awareness, and maintaining engaged researcher accountability.

The "Expand Your ECE Career" seminar featured four ECE alumni with successful law, finance, and fashion entrepreneurship careers. An objective of the ECE RED grant proposal was to broaden students' career choices through a revamped sophomore curriculum and increase industry relations. Yet, non-traditional careers were not culturally relevant. There were few

examples of ECE alumni in non-technical careers. Furthermore, three students seeking non-traditional careers stated there were few resources or people to assist them. I created the seminar to showcase not only non-traditional ECE career options but to challenge the limitations of the current image of success. It was important to not only feature ECE alumni in non-traditional careers, but they needed to represent another form of success. For almost ninety minutes, two patent attorneys, a financial analyst, and a fashion entrepreneur shared how their ECE degree contributed to their careers. Challenging career success within the department contributed to challenging traditional measurements of project success. Interventions are difficult to measure with focus groups, surveys, and other assessment formats. However, assessment is necessary for future support and use of the intervention. Instead of assessing the interventions through traditional formats, I reexamined success through other forms of impact such as distance, mobility, and dissemination. I used the phrase “assessment per mobility” to describe how the seminar was shared with the department chair and an alumni donor to be supported as a yearly event. Measuring the impact of the podcast through the location of the various IP addresses was another form of assessment per mobility. Though the podcast was shared primarily with the Virginia Tech community, there were IP addresses across the globe. This indicated that these students' experiences were being shared around the world.

Lastly, the white paper “Engineering Care: The Vital Role of Academic Advisors in ECE Undergraduate Student Success” translated the care work of the academic advisors into data that could be understood and valued by the ECE faculty. The qualitative study identified that the undergraduate academic advisors did more than help students plan their courses. The advisors helped students with faculty interactions, resume building, finding a community, and listened to the students’ concerns with family and finances. These conversations and concerns were rarely

spoken of in meetings and other discussions regarding student success. Yet, the most significant concern was advisors' lack of visibility among the ECE faculty. As an advisor commented, the faculty would not recognize the advisors in passing at the local grocery store. I chose a data-driven white paper to concisely translate and communicate the significance of their work to the faculty. The academic advisors collected data on their student interactions during the Fall 2020 semester. Almost 1700 student interactions were analyzed and combined with the current literature presenting the undergraduate advisors and care work as invaluable to student success. Social construction is a prominent theory in STS. However, analyzing the social construction of the advisors and faculty identified the barriers between them. Furthermore, this "deconstructing" mandated the need to translate the advisors into a language the faculty understood and respected. In each intervention, knowledge is traveling. For some interventions, knowledge travels in multiple directions; in others, the knowledge moves back and forth. However, for the white paper the knowledge of the advisor was on a one-way street to the faculty. Alternatively, the white paper would not have been appropriate to move information to the advisors.³⁰⁶ Engaged scholars must be able to translate knowledge and understand its direction to build the most effective intervention.

Each intervention was carefully developed as a direct response to the needs and concerns of the people within the ECE department. Developing three interventions showcased the ability of the engaged STS scholar to intervene in various ways and to address various concerns. More so, each intervention contributed valuable groundwork to STS scholarship to be used by other STS scholars.

³⁰⁶ Please note, white papers are popular formats of communication within the government and the tech industry. For this reason, I assumed the faculty would be familiar with them. In my communication with the advisors, many of them were unfamiliar with white papers.

Self-Grounding: *participantworkerscholarcaretaker*

The lessons learned are only half of understanding the groundwork of STS engagement. To fully understand engaged STS research, it is necessary to reflect on the *experience* of being an engaged scholar.³⁰⁷ This section explores and discusses my experience as an engaged scholar. Engaged scholars are forced to not only confront their professional and academic identity but additionally, their personal identity. Instead of being a participant, a work, a scholar, and a caretaker, one becomes the *participantworkerscholarcaretaker* (hyphens purposefully omitted).

The first part of this section opens with the importance of the well-known qualitative research tools of positionality, reflexivity, and reflection. Though these tools were invaluable to me as an engaged STS scholar, these tools were limited in their ability to guide me through my internal fears and doubts of engagement. Instead, I introduce the concept of *self-confrontation*. I explain self-confrontation as a tool to address and resolve my internal doubts.

"But now that I think back to the first episode [of Engineering Visibility], being an outsider is the only way to do this project. I think when you are embedded and it [engineering] is all you know, you can only look at it from one perspective. But coming with this STS background, I was able to step outside of the engineering box and see that it isn't just engineering and engineers. I was able to see that they [ECE stakeholders] are having a lot of different experiences. Also, it kept me grounded, as an outsider [to the ECE department], I am responsible to both [ECE and STS]. It took time and work to situate myself in both...I was constantly playing this duel role."--Annie³⁰⁸

Scholars are encouraged and forced to confront positionality. In other words, what are the things and the factors specific to us as scholars that allow or don't allow us to do our work,

³⁰⁷C. Wright Mills, "On Intellectual Craftsmanship" 54

³⁰⁸ This is from an interview of me for the Final episode of Engineering Visibility

whether it is strictly scholarly research or the work of intervening? For many scholars, positionality is associated with fostering a self-awareness of the privilege and power that is bestowed upon researchers at all levels.³⁰⁹ Analyzing the significance of my professional and personal positionality within the RED grant and for my projects was vital. However, identifying positionality wasn't enough. For this reason, scholars discussed how other well-known approaches such as reflexivity and reflectivity in consideration of our positionality. I have used the tactics throughout my research career. Yet, engaged STS scholarship revealed that these approaches did very little to aid the internal complexities of my engaging experience.

My position was complex. I was a STS graduate student on a NSF funded grant in an electrical and computer engineering department at a research-intensive university.³¹⁰ First, I was in a well-funded position and quickly obtained the resources and support for my different projects. During the first year, I was allocated funds for the best computer-assisted coding software, \$25 Amazon gift cards for undergraduate student recruitment, and transcription services. I asked and received funds for the podcast editing and the recording service. From a material standpoint, I was better equipped to participate than other researchers and interventionists who may have to take time to locate sufficient funds and resources.³¹¹

Second, I was a graduate student.³¹² As a graduate student, I was rewarded for taking a different approach. I had the time, permission, and the mental resources to develop three

³⁰⁹Audrey Kobayashi, Melissa Gilbert's, Lynn Staeheli, Victoria Lawson, and Sarah Radcliffe are just a few scholars that have written on the power and privilege of researchers. Granted many of these studies of positionality, power, and privilege emerge from feminist scholars.

³¹⁰Please note that much of this section will be written in the first person. The work of reflexivity regarding positionality is done through first person language. Please reference Roni Berger's "Now I see it, now I don't: researcher's position and reflexivity in qualitative research." *Qualitative Research*, 15:2, 2013, p. 222.

³¹¹ This connects to one of the challenges of engagement: locating resources

³¹²Additionally, at the time of my intervention development, I was not considering an academic career. Therefore, publishing was not at the forefront of my mind. I saw this to indicate that mentally, I had the mental energy to focus on three projects. I am not sure if I was actively seeking publication opportunities how this would have changed. I was able to produce two publications and present this work in six conferences.

interventions.³¹³ Often, graduate students may feel powerless because they have to answer to their academic advisor and countless other people and situations. And though I was just an STS graduate student, I was a part of a grant within the ECE department with the department's chair as the PI who supported my endeavors. My academic advisor supported and encouraged me to tackle these challenges through pragmatic approaches. What my direct power structure lacked, my indirect power structure provided. When I entered a space, I entered as a graduate student with the backing of a large-scale national grant and leadership support.

However, the title of graduate student was double sided. On one side, I was just a graduate student. I was no longer an undergraduate student, but I wasn't a post-doc or a faculty member either. However, I was a *graduate student* conducting *research*. There is an implication of expertise and authority within my position's title and purpose. I had the power of methodology choice, analysis, and the final interpretation. I chose the questions for the baseline interviews and for the podcast. I chose the interventions with little to no input from the ECE department stakeholders. For example, before I finalized the white paper, I discussed it with the academic advisors for their thoughts and feedback. All except one had heard of a white paper. However, after my explanation, they all agreed to this choice.³¹⁴ I chose the podcast topics, the guests, and I chose their words.³¹⁵ I decided on the panelist for the non-traditional career seminar. I had power under the guise of leadership and being a graduate student. Allow me to

³¹³Gillian Rose acknowledges that as researchers we have not only academic knowledge, but greater access to the material resources and the people of power to conduct research (Positionality, reflexivities and other tactics, 1997 Progress in Human Geography 21:3, p 307.)

³¹⁴Allow me to add that there is a caveat that many people want you to bring the project. In some community settings there is a push for the community to become more involved. However, in this large department, I had to make executive decisions. As far as the academic advisors, they are extremely busy and did not have the time to brainstorm ideas. However, because I needed their help for data collection and the end product with have direct consequences and connection to them, I knew it was important to incorporate them into the process.

³¹⁵ Note: the podcast participants approved the final podcast episode that featured them

interject that being a researcher comes with power.³¹⁶ However, how did I use my power? I truly believed that I used it most productively. I recognized my position as a graduate student with the resources to do something and I did something.

Besides my researcher positionality, there was my cultural and personal positionality. This positionality can include various personal identifiers such as gender, race, age, sexual orientation, immigration status, personal experiences, language, religious beliefs, and affective responses.³¹⁷ My personal positionality was that of a cis-gendered woman, a woman of Black and Asian ethnicity, a non-traditional graduate student, and a first-generation student from rural Southeast America. All of these things affected how I approached problems and how people responded to me, whether within an anonymous research interview or a public-facing podcast interview. As researchers, who we are and how we outwardly present are the first steps toward building trust, whether in a research project that will expand for years or a 30-minute interview. Would female ECE students have been as willing to share their experience of being ignored by the guys on team projects if a man had been sitting across from them?³¹⁸ Possibly. In the first-generation interviews, undergraduate students interviewed undergraduate students. I noted more "openness" in some conversations and more openness in discussions of the same gender. However, my experience has taught me that practice and skillfully building trust, empathy, and understanding during the first few interactions (i.e, recruitment) does much to overcome hindering perceptions associated with researcher identities.³¹⁹

³¹⁶Rose refers to power of the researcher as "transparent reflexivity" and emerges from the conscious awareness of the intersection of our choices in reference to our power

³¹⁷There are countless scholars that have discussed personal positionality: C. Bradbury-Jones, L. Finlay, M. Z. Hamzeh and K. Oliver to name a few.

³¹⁸Roni Berger, "Now I see it, now I don't: researcher's position and reflexivity in qualitative research." *Qualitative Research* 15;2, 2015, 220

³¹⁹C. DeTona, "But what is interesting is the story of why and how migration happened." *Forum: Qualitative Social Research* 7:13, 2006

How did I resolve my positionality? There are several methods for scholars to examine their positionality. A common practice among qualitative researchers is **reflexivity**. Reflexivity describes the work and effort for researchers to explore the power structures of authority that are inherent within researchers as they enter the field.³²⁰ However, reflexivity does more than just explore and hold us accountable to our position as an expert. More and more researchers are using reflexivity to explore their identity and how it impacts data collection, analysis, and the final product.³²¹ Reflexivity is a two-way street of inward and outward reflection. The scholar must consider one's relationship to the public and simultaneously examine their own identity to the community at large.³²² Reflexivity serves the larger purpose of ensuring just and objective work. However, objectivity is fraught through philosophical frameworks and the objectivity of any research is debatable. Therefore, reflexivity serves to examine and extract as much subjectivity as possible. This is even more important in regards to intervening in which there is a constant tension of involvement and detachment. Allow me to explain; regarding the white paper, it was easy to frame the faculty as villains in the department that just didn't care about the advisors and their work. However, that wasn't the case. The faculty were inundated with teaching in a department of over 1400 undergraduate students, advising graduate research students, obtaining and managing grant funding, and a myriad of other responsibilities. However, this is my moment of vulnerability. I had moments when I channeled the relationship between the advisors and the faculty to my own experience as a nurse struggling to be seen and heard by the physician. I recalled moments that my fight for the advisors' visibility was a

³²⁰R. Wasserfall, Reflexivity, feminism, and Difference. IN R. Hertz Reflexivity and voice pp. 150-168, 1997. Thousand Oaks, CA: Sage

³²¹Wanda S. Pillos, "Confession, catharsis, or cure? Rethinking the uses of reflexivity as methodological power in qualitative research." *Qualitative Studies in Education*, 2003, 16:2, 176

³²²Gillian Rose, "Situating Knowledges: positionality, reflexivities, and other tactics." *Progress In Human Geography*, 21:3, 1997, 309

personal fight reflecting on my moments of feeling invisible as a nurse. I used reflexivity to assess those internal feelings of invisibility. I monitored these innate responses to my work because I stopped to consider my past career identity, and I reflected on how that was shaping my vision of the faculty and that I produced a fair assessment and intervention.³²³

Though reflexivity is a popular approach toward positionality, there are other methods. Self-awareness and cycles of "action and reflection" are also forms of self-checking. "Action and reflection" is used within action research. A researcher engages through an immersive action and then reflects on what has occurred within the experience and how the scholar feels.³²⁴

However, let's be clear that reflexivity is not reflection. Reflection is the process of simply thinking back toward the past with little or no action or cognitive processing.³²⁵ Later scholars define reflection as an activity of revising their past with the ability to extract some intellectual worth to contribute to future endeavors.³²⁶

STS scholars implementing 'making and doing' employ both reflection and reflexivity. Reflection is a tool to understand not only the work that STS scholars perform, but to also understand their identities.³²⁷ Reflexivity defines what we learn from our publics and the practices we enact.³²⁸ Reflexivity and reflection is one way to address ourselves as researchers. However, and perhaps unfortunately, these two things are limited in their capability to address the experience of intervening and participating.

³²³Wanda S. Pillow, "Confession, catharsis, or cure? Rethinking the uses of reflexivity as methodological power in qualitative research." *Qualitative Studies in Education*, 2008, 16: 2, 181.

³²⁴Judi Marshall, "Self-reflective Inquiry Practices" *Handbook of Action Research*, eds. Peter Reason and Hilary Bradbury, 335-342, Sage Publications

³²⁵In this sense, reflection has ties to Enlightenment philosophers who believed that man (humans) had the ability to think upon their past and consider the impact of that past upon their future

³²⁶John Dewey, *Experience and education*, 1938 Collier Books: New York.

³²⁷G. L. Downey and T. Zuiderent-Jerak, "Making and Doing: Engagement and Reflexive Learning in STS" 223-251

³²⁸G. L. Downey and T. Zuiderent-Jerak, "Making and Doing: Engagement and Reflexive Learning in STS", 225

Though positionality, reflexivity, and reflectivity are methods to ensure trust, fairness, and some modicum of objectivity within research, these methods are limited for intervening scholars. These methods direct researchers to consider their professional and personal identities in connection to their relationship with participants and in consideration of creating objective data collection, analysis, and interpretation, but not intervening. To a certain degree, Wanda Pillow moved toward recognizing this absence. She concisely summarizes most theories of reflexivity into four categories: recognition of self, recognition of the other, reflexivity as truth, and reflexivity as transcendence.³²⁹ However, Pillow challenges these four categories of reflexivity as too superficial to the emotional and mental taxation of involving oneself within a different community. She proposed the idea of "reflexivities of discomfort" to bring to the forefront the uncomfortableness of thinking within a different language and culture; of embodying a different shape and identify; the work of engaging and disengaging with a community; and the work of not "othering" those that are studied.³³⁰

In a close framework, STS making and doing not only explores creating an intervention but also how the scholar is shaped during the making and doing.³³¹ Becoming an involved scholar required that I do more than acknowledge and understand my positionality. I read about positionality, reflexivity, and reflectivity. These frameworks were quite helpful to a point, but they ceased to be beneficial at a certain point as I was forced to contend with my own inner research demons. And for this, I am going to speak of the dreaded f-word...**fear**. I had to acknowledge and face down something bigger than objectivity and my professional and personal position. I had to address my innate discomfort, primarily my fears. Dear fellow scholars, am I

³²⁹Pillow, 181-186

³³⁰Pillow, 187

³³¹Gary L. Downey and Teun Zuiderent-Jerak, "Introduction: Activating STS through STS Sensibilities"

allowed to say fear? Perhaps hesitation or apprehension is a better word. No, both are more polite words that soften the discomfort I experienced. I was scared of "breaking" the ECE department. I was afraid of failing. I was scared of putting people in harm's way. I was also scared of what I did not know and did not understand. Do participating scholars discuss hesitation, apprehension, or doubt?³³² Yes, though it does not come across as strongly as fear. Therefore, I shall discuss my fear.

All fear is not bad fear. I experienced fear about the podcast to the point that I contacted my advisor with another project to address identity and a sense of belonging. The plan would recruit ECE undergraduate students to post pictures of themselves and items that described them on the ECE Instagram account. This project addressed identity. But more importantly, I did not have to host. Obviously, I did not receive the green light and resolved that I would be the host of *Engineering Visibility*. It isn't that I didn't think the podcast was a good idea. I think the podcast is (and has been) a great idea, but I didn't want to be the host. I didn't want to be a heard voice. I didn't want to listen to my voice. I didn't want to be seen. So there you have it—the person fighting invisibility wished to remain invisible.

The thing about being a scholar-participant is that rarely can the scholar-participant remain invisible. Vehicles of knowledge are created and must be driven by someone. Typically, the best driver is the one who built the vehicle, is accustomed to the vehicle's strengths, and is familiar with the route. Knowing one's positionality is barely a first step for the interventionist. Overcoming fears and putting yourself out there is a huge step. If you love the limelight, great! However, if you are like me and you would rather remain invisible while starting a revolution, this can be challenging work. If you don't address the positionality of your fears and your

³³²Zuiderent-Jerak, *Situated Intervention*. 185.

character, you will do a disservice to yourself and your public. If you rather steer the ship unseen, then this may not be the work for you.

Self-examination and self-awareness are necessary for engaging. Perhaps self-examination is connected to reflexivity and reflection. Self-awareness is an awareness of oneself, and maybe this links to an innate positionality. Positionality refers to outward institutional context of oneself and self-awareness refers to one's innate proportionality. However, I was doing more than self-examination and self-awareness. Self-confrontation. I had to confront myself. So let's re-evaluate that. Self-examination and self-awareness are the beginning, but the actual work is self-confrontation.

If we address and acknowledge the "reflexivities of discomfort," we have to address discomfort within ourselves. Did I confront myself? Yes, I had to. Either I confronted my fears or my projects confronted me. Let me say this is all positive. In the final podcast interview, three people interviewed me. And in each episode, I repeat: "I did not want to be the host." But toward episode five, I accepted that only I could have been the host. Likewise, I had to host the seminar, and I had to present the white paper. In my self-confrontation, I grew as a person, as a researcher, and as an interventionist. What is self-confrontation? Instead of listing our identities and considering the reflexivities of discomfort, I walk into them, and I experience the discomfort.

In the self-confrontation, I had to face my doubt. Scientists develop a testable hypothesis. They approach the gods of the grant money with a well-written proposal. We bring our findings to the conference and we fight for them. In academia, there is no visible place for doubt or, at the very least, the image of doubt. Even in nursing, I was told to hide my doubt and enter the patient's room and "Fake it until you make it." However, doubt is always present and it

does not indicate weakness. When we are free to doubt, we can create space for more thought, more experimentation, more attempts of trial and error, and more conversation.³³³

What does engaging address that non-participating studies do not? I would have had a good dissertation and made quality contributions to the field of STS and engineering education if I had reported my findings from the baseline interviews. I would have discussed invisible identities and the lack of a sense of belonging. I would have discussed the invisibility of the academic advisors and how theories of care work, intimate labor, and invisible work contributed to them. I would have noted that students seeking non-traditional careers didn't have examples of success and were limited by traditional images of engineering success. And I would have had a good dissertation with less hassle, less stress, and half the work.

I conducted countless interviews as a qualitative researcher. My master's thesis was a qualitative study of 10 Baby Boomers. I have interviewed terminally-ill oncology patients. I had some nervousness but quickly overcame it. However, I have never had to confront myself so critically and severely until I became an engaged scholar. The work of engagement is not that you intervene within the field but that you intervene upon yourself. And just as you work to address the frictions within that field, you work to address your frictions of doubt and fear.

STS is not simply, *useful*--Protecting STS in other Fields

The challenge of doing this work is the total immersion required and the necessity to engage and ensure that interventions are done correctly. In earlier chapters, I discussed the importance of interventionist protectivity. Protecting people who are in less dominant positions is challenging. Not in an IRB way, but in an "I genuinely care." type of way.

³³³Teun Zuiderent-Jerak, *Situated Intervention: Sociological Experiments in Health Care*. 180

I didn't forget STS. STS was a tool within intervening. We see the newly built home, but we never consider the tools that built the house and that without the tools, the house would never exist. Working as an STS scholar is similar. An STS scholar uses a toolbox of theories to build the interventions, but typically we only celebrate and/or critique the end product. We listen to the podcast and hear the voices of the ECE department, but we don't consider the theories of invisibility and identity that shaped each interview. Students are so excited to learn how the alumni utilized her computer engineering expertise to create a fashion start-up; however, the engineering undergraduate students do not know that the celebrated traditional images of success meant to provide encouragement and professional direction are limiting their career options. Lastly, the white paper perfectly highlighted the importance of the undergraduate academic career advisors. However, theories of care proved the importance of their work and why it remained unseen. Engaging STS scholars must be careful that their work is not confiscated by the people in the field attempting to define what the project is without any knowledge of the theory behind it.³³⁴ This leads to the danger of positioning STS knowledge as a tool. To the STS outsider, the significance of my work is in the “doing.” However, it isn't that simple. It is crucial to explain how and what I “know.” When I refer to “knowing,” I am identifying the knowledge I am using and, perhaps more importantly, the knowledge I am bringing back to STS.

However, this is the danger of only seeing the end product: the podcast, the seminar, and the white paper and thinking that what engaged STS scholars do isn't complex. Many are unaware of the many tools needed to create these projects, the tools' complexity, and the training necessary to use them efficiently. The danger is that STS is not seen for its theoretical complexity and instead seen as only being *useful*. Though the idea of *use* has implied positive

³³⁴Teun Zuiderent-Jerak, 186

connotations, use also has politics. *Use* may define the employment of a person or object, the consumption of something, or the work to manipulate in an exploitative manner or habituate.³³⁵ The danger is that useful can eventually lead to something being *used*. In this sense, useful is negative. To be used is associated with abuse. In another context, to use and discard. Therefore, it is essential that STS knowledge is not simply used or found to be useful by other disciplines and consequently used up. Instead, our work and our knowledge must be carefully presented to be valued because STS is valuable. Therefore it is vital to consider these things of use, used, and valuation within our own discipline. However, the reality is that when we cross into other disciplines, we become the outsider and we are judged. Therefore, there is a danger of being used.

When STS scholars engage, they are not only protecting participants. They are protecting STS knowledge from being bastardized through *use* and *usefulness*. As an intervening STS scholar, my work, my field, and myself must not be used and found useful. I had to remind myself that I was not to become a "worker/problem-solver" within the ECE department but I am a scholar and researcher. I admit I fought the desire to be seen as "useful" or in other words, valuable within the ECE department.³³⁶ I had to resist the urge to display the value of STS knowledge through usefulness.³³⁷ In some ways, this ties into the "feeling" and assumption that because I wasn't an engineer, I wasn't as smart, rigorous, or valuable to the department and in general within engineering. In other words, I judged myself as not useful within the department.

³³⁵Sara Ahmed, *What's the Use?* 2019, Duke University Press, 23

³³⁶The idea of use and value can be traced as far back as Karl Marx. In *Capital*, Marx goes into detail of production, labor, and material goods eventually come into value based on their use.

³³⁷Simon A. Cole's "A cautionary tale about cautionary tales about intervention" discusses the usefulness of Cole's expertise of fingerprint identification and DNA forensics for the *People v. Hyatt* trial. He considers the usefulness of his STS expertise. Though his first legal witnesses resulted in some viewing STS as useless and the judge describing him as a "junk scientist," he went on to testify in eight jury trials and was permitted to do so in several others, but declined. The other experiences were positive toward the value of STS.

Though being useful has some benefits, as a scholar it is detrimental to go into the field with the desire to be "useful."³³⁸ To do so is to position oneself as a "helper." Not only do I become subservient, but so does STS. My field is valuable, and my knowledge is valuable.

However, how does a STS scholar prevent STS bastardization? An engaged STS scholar said, "Surely an awareness of the importance of material interventions is arguable among the most important things that STS has to offer to the wider field of sociologically inspired intervention research."³³⁹ Once again, drawing from such tools as positionality, engaging scholars must consider how their research will return to their "home" discipline.³⁴⁰ I performed forms of disciplinary reflexivity and reflection to examine and remain mindful of my academic and field positionality. Another form of self-check for engagement is to take every opportunity to share one's work within the STS community. Submitting my work to STS-related conferences remedied the lack of STS situated reflection. Not only did I build my CV, but I confronted my interventions as an STS scholar, and other STS scholars challenged my work. What I am saying to my engaged STS scholar, as you engage in other disciplines, do not forget to stay in close proximity to your STS community. The fact remains that one day the intervention will end. The grant will end. The team that you worked with for years will disband and everyone will return to their offices and seek other challenges, grants, and revolutions. However, if you have done your best, and I trust you will, you return to your field not used, but instead with a plethora of experiences. And it is at this point, you engage with your STS scholars, share your experiences, and show others the beauty and power of engagement.

³³⁸Some STS scholars argue that as STS scholars move into other spheres of work such as the courtroom, there is the danger that we lose our radicalism. (Cole, 131)

³³⁹Teun Zuiderent-Jerak, *Situated Intervention, Sociological Experiments in Health Care*. p182

³⁴⁰Pamela Moss, *Embeddedness in practice, numbers in context: the politics of knowing and doing*. *Professional Geographer* 47, 442-449.

Conclusion

Earlier I stated that my work of engagement encapsulated about two years. However, I am wrong. I was engaging since day one. Perhaps, even as I conducted the climate study interviews, I was thinking of how to help. I started this dissertation believing that there was a need to analyze and document the groundwork of STS engagement. If this were a quantitative study, I would say that my hypothesis was correct. Groundwork in STS engagement was missing. Furthermore, this work was necessary for the field of STS, for other scholars who wish to engage, and for myself. The most surprising thing about this work is how I predicted the groundwork that I would examine and once in the field, something completely different happened. For example, in my research proposal, my questions regarding the groundwork for the podcast were:

- How does a scholar maintain the disciplinary boundaries of an intervention?
- How can providing a voice to non-dominant images influence departmental invisibility?
- How does an STS scholar negotiate institutional authority and departmental politics?

However, this project challenged theories that believed visibility corrected invisibility. And instead of learning about boundaries and departmental politics, I realized the importance of protecting participants and managing invisibility. As I stated earlier, through protecting my vulnerable participants, I learned that visibility is not the answer to invisibility. Instead, invisibility is a tool that must not be thrown aside but instead slowly and strategically maintained. Analyzing the advisors through lenses of care work challenged care work scholars that had primarily defined care work through the feminine lens of housework, elder care, child care, and private and unpaid work. Instead, I argue that care work is everywhere and explain how care work exists in one of the most masculine professions: engineering. For the first few

weeks after the non-traditional career seminar, I was challenged to measure its impact. Only one student had returned the survey. However, an email sharing a desire to make it a yearly event reframed how I understood success for interventions and similar projects.

At the end of it all....what is engagement? What is an intervention? What is an experiment? What is making and doing? Is it participating? I engaged with culture. I intervened in a problem. Did I participate in a revolution? Once we have stepped away from the minimizing definitions of engagement, then and only then can we see and understand the power and the significance of engagement. Engagement is powerful. It contains power and contains the potential to be a political-social weapon. All of these things make participation a very human activity. Putting aside the arguments regarding human, non-human actors, and agency, human actors are the only ones who genuinely participate.³⁴¹

Donna Haraway stated that "situatedness is not given; it must be developed."³⁴² Any scientist who wants to understand society must become involved enough to have a true perspective of it.³⁴³ Observing the community and interviewing its members only gets you so far as a scholar. If you truly want to understand a community, whether it is a neighborhood or an engineering department, get involved. Do your interviews, but really, really listen. Then after you have listened and identified their invisibility, get involved and make them visible. Perhaps, you will make yourself visible too.

As a dissertation student, I am expected to contribute (in the form of knowledge) to the field of STS. However, this expectation evaded me for some time until I reviewed a chapter

³⁴¹Participation has been considered by numerous scholars (Noortje Marres, Javier Lezaun, Chilvers, etc. Participation is very much a human activity. Marres argues that participation is ever-present in our society. We are participants when we vote when we purchase something. We can't avoid participation, therefore, we just as well do it.

³⁴² Donna Haraway, "Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective," *Feminist Studies* 14, no. 3 (1988): 575–99.

³⁴³Howard Becker, "Whose Side Are We On?"²⁷

from the *Handbook of Action Research*. The introduction chapter began with several quotes from participating scholars. The scholars discussed their pragmatic methods and their purpose within the concept and language of knowledge. On the page were phrases such as living knowledge, practical knowledge, and alternative paradigm research.³⁴⁴ At that moment, I realized that I was ignoring the fact that in the midst of podcast episodes, white paper data collection, and seminar hosting, I was also producing knowledge.

³⁴⁴This was from the introduction of “The Handbook of Action Research.”The introduction opens with quotes from several participatory researchers and I noted that these scholars did not focus as much on the doing, but emphasized the knowledge production of their work.

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