Toward an Ethic of Queerness for Engineering Education Research

by

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A Dissertation Presented in Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

Approved November 2023 by the
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ARIZONA STATE UNIVERSITY

December 2023

ABSTRACT

This dissertation features three pieces of scholarship which showcase and demonstrate an ethic of queerness for engineering education research (EER). The concept of an ethic of queerness is introduced and constructed in Chapter 1 using tenets from the philosophy of pragmatism, systems thinking, critical theory, and the personal and collective experiences of queered communities immersed in normative spaces, such as engineering and engineering education. Chapter 2 is a scoping literature review on the state of research on the LGBTQIA+ engineering student experience compared to other relevant fields, revealing that EER is still nascent on the topic. Chapter 3 leverages arts-based qualitative inquiry to explore the opportunities and limitations of mixed-initiative creative interfaces (MICIs) when used as a tool for self care by queer(ed) subjects. Chapter 4 connects Patricia Hill Collins' insider/outsider paradox framework to recent engineering education research through collaborative autoethnographies, illuminating the ways in which normative, oppressive social discourses are embedded within the EER system. Although Chapters 2-4 feature their own unique methodology and topic of inquiry, they are united through a motivation to deconstruct and re-imagine sociotechnical systems throughout engineering and EER through the lens of radical queerness. Chapter 5 summarizes how each of the prior chapters aligns with queerness as an ethic and explores avenues of future work from this dissertation. More specifically, each chapter represents a way of queering engineering education research methodology through the embrace of ambiguity and ephemerality, particularly with regard to the ways in which the author's subjectivity and relationality to the roles of researcher, student, engineer, and engineering education researcher emerged throughout their doctoral education.

DEDICATION

Words simply cannot express how fortunate I am to be surrounded by such a wonderful support system throughout my PhD. How could I ever distill the immensity of my gratitude, love, and admiration towards those who have lent me their support within a few short pages? This dissertation is dedicated to each and every loved one, colleague, and mentor that has touched my life since my PhD journey began in 2017.

Kade, my life partner, best friend, and husband – Quite simply, I could not have done this without you by my side every step of the way. On the hardest days, you were there to comfort and support me. You never doubted my ability to see this through, even when I was convinced that I was going to leave. I am so filled with gratitude every time I look at you. Thank you for loving me. I love you more than you can ever know.

To my co-chairs and committee, Nadia, Suren, Rod and Sam — Each and every one of you have gone above and beyond your responsibilities as advisors and mentors. I am awed by the magnitude of the patience, compassion, and friendship each of you have extended to me in some of the bleakest and triumphant moments of my PhD. I simply can not thank you enough.

To my family, Jerry, Christine, Grace, Luke, Gabrielle, Marnie, Ken, Anna, Pam, and the rest of the Whitleys - Thank you for the sacrifices you all made to help me get here. Thank you for loving me and supporting me unconditionally. Thank you for being proud of everything I'm doing. I love you all.

Emi, you have been one of my greatest supporters since the day we met. You understand me better than almost anyone else. Because of this, your support, guidance, and advice has been invaluable to me throughout my PhD. Our friendship means the world to me and I love you with my whole heart.

Bala, you have been an unwavering light amidst some of the darkest days of my PhD. You did not hesitate to lend your home, food, time, or anything else I may have needed at the drop of a hat. Genuinely, I wouldn't have finished my PhD without your help. You have been a beloved friend to me since we met and I am looking forward to being your friend for years to come.

Jeanne, I am so grateful to have you as a friend and collaborator. I admire the passion you have for the people in your life and the ways you leverage your research to improve the lives of those around you. Your unequivocal support and honesty have helped me to navigate this PhD with grace and self-awareness. Thank you.

Drs. Austin and Kimberly Talley, Dr. Bailey, Sarah, Elise, Dara, Savvy, Eri, Michael, Katreena, Cecilia, Jems, Brandon, Jerry, Dan, Sue, and so many others... Let it be known that I would not have received this doctorate without the care, support, and encouragement that each of you has shown me over the years. Please know that I am eternally grateful to each and every one of you, even if you are not mentioned by name.

Oh, and I also want to thank coffee for being there for me through it all and for making life worth living. I probably should have mentioned you first.

ACKNOWLEDGMENTS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter 1

DEFINING QUEERNESS AS AN ETHIC FOR ENGINEERING EDUCATION
RESEARCH

This chapter provides an outline of the paradigms, theories, methodologies, and contexts that have coalesced to form the backbone of this dissertation. Section 1.1 provides context for this dissertation by briefly outlining engineering education and engineering education research (EER) as a complex sociotechnical system. Section 1.2 begins to construct an Ethic of Queerness by introducing the theoretical and methodological tools that it is made up of. Section 1.3.1 provides an overview of the subsequent chapters and connects each chapter back to the guiding framework. Overall, this dissertation adopts a critical systems thinking perspective to 1) define EER as a complex sociotechnical system comprising several sub-systems, 2) explore how EER methodologies and epistemologies influence other aspects of the broader EER systems, and 3) begin to construct and provide examples of an ethic of queerness as an emergent research paradigm for EER that combines the principles of systems thinking with tools offered by critical fields of study in order to address persistent issues of inequity within EER.

1.1   Engineering Education Research as a Complex System

1.1.1   Systems Thinking

Within the systems engineering discipline, systems thinking is a necessary skill in order to effectively conceptualize the scope of a problem within systems with high degrees of complexity. However, the definition and applicable scope of systems thinking is presently subject to scholarly debate (Monat & Gannon, 2015). Although there is not a commonly accepted definition of the concept, systems thinking can be conceptualized as a set of skills that one uses to understand and navigate complex technological, social, and/or biological systems that are comprised of smaller, inter-dependant parts (Ackoff, 1994). Arnold and Wade (2017) provide an outline of personality traits and skills that mature systems thinkers exhibit across four cognitive domains, including 1) one's mindset regarding how to approach issues within a system, 2) one's ability to recognize, categorize, and qualify the content of a system, 3) one's ability to comprehend the structures that comprise a system such as feedback loops and intradependent relationships between systemic elements, and 4) one's ability to understand a system's previous behavior, predict future behavior, and manipulate the system to produce a desired outcome or state. Each of these cognitive domains are made up of skills which can be developed over time and with practice. Mature systems thinkers are able to construct mental models of the system with high levels of abstraction, navigate around and through ambiguity or uncertainty, recognize the boundaries of the system and subsystems they are working within, and consider the effects of deeply abstracted systemic elements. Thus, systems thinking provides a useful framework for conceptualizing the role that EER plays within the broader

Institution of Engineering (IoE), as well as how EER methodologies can be manipulated to produce favorable outcomes for the broader system of engineering education in the United States.

1.1.2   EER as Part of the IoE

Engineering education research (EER) became a legitimized field of study in the United States during the early 2000's as a result of the nation's need to train the next generation of diverse and innovative engineering talent amidst an increasingly competitive global economic environment (Commission on the Advancement of Women and Minorities in Science, Engineering, and Technology Development, 2000; Froyd & Lohmann, 2014; National Academy of Engineering, 2004; National Engineering Education Research Colloquies, 2006; National Science Board, 2010). Overwhelmingly, however, data indicate that historically marginalized communities have been and continue to be under-represented within engineering professions despite the dedicated efforts of engineering education researchers towards a solution for this persistent issue (American Society for Engineering Education, 2020). Thus, engineering education researchers have increasingly begun adopting critical and intersectional theories to examine the broader systems that constitute and sustain engineering and engineering education, such as the human, historical, and political systems. Much of this work has revealed that the "chilly," meritocratic, and depoliticized culture of engineering is to blame for the stagnant growth rates of communities of diverse engineers, indicating a broader *systemic* issue within engineering spaces (Cech & Sherick, 2015; Riley, 2017; Seron et al., 2016).

This growing body of systems-oriented intersectional and critical EER reveals that

the philosophy and infrastructure of engineering is deeply intertwined with, informed by, and responsive to its own histories, constituting what I refer to as the IoE. More precisely, I conceptualize the IoE as the loose amalgamation of neoliberal discursive, material, and ideological systems that rely on and/or reproduce engineering technology, labor, and culture; particularly those tied to state-sanctioned imperialism, colonialism, and oppression. This definition is intentionally broad, as the IoE manifests within a variety of complex sociotechnical systems at the individual as well as global scales. Engineering education research in the U.S., for example, can be viewed as a vital part of the IoE. In fact, historians in disciplinary fields such as engineering education and philosophy of science and technology have begun to trace the history of this Westernized form of engineering and engineering philosophy (Reynolds & Seely, 1993; Seely, 1995, 1999; Slaton, 2004, 2015), connecting it to the rise of neoliberalism (Katz & Riley, 2018; Quiles-Ramos et al., 2017), particularly in the United States. Given the systemic complexity of the IoE, however, it is difficult to pinpoint and remedy any one individual issue contributing to this diversity problem. However, it is possible to isolate components of the IoE's complex system for critical deconstruction, such as the academy (e.g., universities, research enterprise, education reform), state interests (e.g., the national Departments of Security and Defense, the US military), the private sector (e.g., industry), and stakeholders (e.g., active consumers, incidentally effected public).

A systems thinking mindset – coupled with an expansive understanding of what belongs within the scope of the system being studied – is a vital component for conducting EER through an ethic of queerness. Thinking about systems through the lens of an ethic of queerness, however, necessitates that the researcher critically examine the sociohistorical development of the system they are studying, thus contextualizing

the present state of the system and enabling the researcher to predict and influence future states of the system.

1.1.3 The Philosophical, Epistemological, and Methodological Contexts of EER

There is a growing body of theoretical literature that discusses the philosophical, epistemological, and methodological underpinnings of the field of EER. This research has identified and traced at least two dominant and competing paradigms – interpretivism and (post)positivism – within EER (Beddoes, 2014; Douglas et al., 2010; Koro-Ljungberg & Douglas, 2008). Interpretivist and (post)positivist EER are often conceptualized as being methodologically qualitative and quantitative, respectively. As EER began to develop into a formalized field of study, efforts were made by leaders in the field to establish it as a "rigorous" discipline, emphasizing research methods that prioritize empiricism, contribution to existing and relevant theory, grounded and sound logic, replicability, and generalizability, among other observationally verifiable characteristics (Streveler & Smith, 2006).

The historical development of these rigorous standards for EER align with the characteristics of the (post)positivist paradigm. *Positivism* as a research paradigm is often associated with or based off of the natural sciences (e.g., physics, chemistry, biology) and centers around the verification principle of the scientific method (Strauss, 2003; Yu, 2001). Thus, the positivist paradigm asserts that a knowledge statement can only be rendered true if it can be verified as true through direct observation and sound, mathematically-based logic, thereby situating other forms of knowledge that are not verifiable through these methods as subjective (Stam, 1992). *(Post)positivism*, however, presupposes that social systems are nomological in nature, possessing an inherent,

natural, and irrefutable truth that can be studied and described much in the same way as the natural world via hypotheticodeductive methodologies (e.g., hypothesis testing; Baškarada and Koronios, 2018; Guba and Lincoln, 1994). Critiques of (post)positivism as an epistemological basis for the social sciences, and particularly psychology and education, center around the fallibility of human reason and senses in which observation and logic take place, which enable the introduction of bias/prejudice into the research (Gage, 1989). Thus, EER was initially established within the (post)positivist paradigm, as the push for instating rigorous research standards privileged quantitative methods with generalizable findings over other kinds of research.

Yet, the field of EER was necessarily interdisciplinary and drew from a variety of fields that do not strictly operate from a (post)positivist paradigm, such as women's studies and education (Beddoes, 2014; Beddoes & Borrego, 2011; Koro-Ljungberg & Douglas, 2008). Consequently, the movement towards establishing engineering education as a rigorous field of study was met with pushback from interpretivist scholars conducting research using (typically qualitative) methodologies that are largely incommensurable with EER's emergent (post)positivist paradigm (Koro-Ljungberg & Douglas, 2008). Beddoes (2014) provides a useful history of the evolution of EER from approximately 2003 to 2014, which identifies the emergence of these two paradigms within the field. More specifically, Beddoes (2014) demarcates the pushback towards (post)positivist notions of methodological rigor by noting an uptick in discourse surrounding the importance of "methodological diversity," particularly as a modality for encouraging research tailored to the needs of diverse engineers (Douglas et al., 2010). This pushback resulted in an emergence of "small n," qualitative EER that was particularly focused on the experiences of marginalized identities within engineering (Pawley, 2019; Riley, 2017).

Qualitative research, being non-generalizable in nature, centers the subjective experience of individuals embedded within complex social systems, making it a useful methodology for investigating underrepresented or minoritized communities (Guba & Lincoln, 1994). Contrary to (post)positivist values of an objective truth and observationally verifiable empiricism, qualitative research assumes that reality is experiential and individually interpreted. The interpretivist paradigm asserts that social systems do not follow any particular nomology and maintain that meaning and knowledge are subjective, deeply contextualized, and far too complex to simplify into generalizable descriptive models (Lukenchuk, 2017). Over time, however, qualitative engineering education researchers such as Borrego et al. (2009), Kellam and Cirell (2018), and Walther et al. (2017) and more began to introduce standards of validity and reliability for conducting quality qualitative research, enabling the normalization of interpretivist research within EER.

1.2   Assembling an Ethic of Queerness

Having historically contextualized the roles of philosophy, epistemology, and methodology within the evolution of EER, it is now necessary to discuss their systemic impact. Doing so, however, requires a more explicit discussion of the framing I employ to construct an ethic of queerness for EER. It is worthwhile to mention that an queerness as an ethic for EER is difficult to define by nature, as it borrows from several philosophical, epistemological, and methodological traditions to construct a *mode of engagement* with the world that is meant to *inform* EER and research design. Thus, there is no singular or correct way to operate from an ethic of queerness. Yet, the histories, paradigms, and methodologies discussed in chapter 1 work to form an "ethico-

onto-epistemology" that regards ethics, ontology, and epistemology as intertwined and responsive to each other during the production of scientific knowledge (Barad, 2007, pg. 90), upon which truly radical and liberatory EER can be designed. The following sections outline the theoretical foundations that substantiate an ethic of queerness for EER.

1.2.1   Queer Theory

Queer theory provides a useful framework for problematizing structures and systems that contribute to normativity, which is often an oppressive force against those who do not conform to normative standards. Contrary to what its name suggests, gender and sexuality are a small portion of what queer theory entails; rather, it seeks to deconstruct *all* structures of normativity, including those beyond gender and sexual normativity such as race, disability, and diaspora (Johnson, 2001; Moraga & Anzaldúa, 1981; Puar, 2005; Tompkins, 2015). As is customary with research that engages queer theory, I am obliged to define it further in order to facilitate my readers' comprehension. However, any attempt at this task feels a bit like capturing lightning in a proverbial bottle, as the nature of the theory of queerness is as ephemeral and unpredictable as a murmuration. It shape shifts and adapts when met with oppressive forces, always in flux and almost impossible to capture. How, then, might I begin to explicate what I mean by *queering* engineering education research methodology if I am struggling to define what I mean by the term *queer* in the first place?

1.2.1.1 Queerness as Being and Doing

In order to attempt to define what I mean by "queer," it is necessary to orient the reader to my own subjectivity with regard to queerness itself. First, though, I must define what I mean by *subjectivity*. I understand and conceptualize subjectivity as the ways in which one's own unique collection of experiences, contexts, knowledge, intuition, and beliefs form a single entity (that I refer to hereafter as the *subject* or the *Self*), which interacts with the various manifestations of systems of power such as social norms or law (Foucault, 1976, 2006). Power and the Self continuously interface and diffuse among each other, changing the properties of both as they continue to interact. Thus, the subject is constantly forming and adapting to systems of power, just as those systems of power form and adapt to the subject. Subjectivity is dynamic and alive, made obsolete when precipitated into static identities or faith-like beliefs. My subjectivity and its relationality to queerness, therefore, must be understood as ever-evolving and fluid; unable to be fully encapsulated, yet made painfully obsolete when somehow managed to be captured with words. I resent that it must be captured at all, as my subjectivity kaleidoscopes from one moment to the next, never to be repeated. This said, capturing one's subjectivity is a vital component of the research process, as a subject's relationality to systems of power shapes their formation of knowledge, which must be preserved statically in academic publications in order to meet the demands of academia.

Digressing from my definition of subjectivity, however, I presently understand queerness to be independent from, yet intrinsically related to sex, sexuality, gender, race, disability, and other socially constructed subjective identities that have historically been exploited, abused, and discarded. Separated from the material conditions of

existence, I understand queerness to be an ontology of principled, intentional resistance to oppression. It changes form to subvert, evade, and sidestep normative powers that seek to capture, study, and categorize it for later exploitation. As someone who is *queered* by ideological normativity along the axes of gender, sexuality, and disability, my subjectivity is irreconcilable from queerness. Queer is who I am, and I am but one material embodiment of queerness. Queerness *is* my subjectivity, as it is to other subjects, as well. Simultaneously, queerness is a separate entity from the subject and can take the form of an ideological tool, which I conceptualize as *methodology*. I can intentionally wield queered methodology as a tool for *troubling* systems and structures that I perceive or experience as oppressively normative (Butler, 2015; Sedgewick, 1990). Incidentally, queerness as a methodological tool is also difficult to define because it can precipitate into many forms across time and space to be used subversively, be it through physical self-expression, spoken or written language, or the operationalization of theory, among infinite others. Thus, it can be said that queerness has a way of *being* (via subjectivity) as well as *doing* (via methodology), constituting a portion of what I understand to be an *ethics of queerness*.

1.2.2   The Pragmatist Paradigm

I deliberately introduce pragmatism after queer theory because I view the pragmatist paradigm as a way of disidentifying with normative or dogmatic structures of knowledge production. *Disidentification* is a concept introduced by queer theorist José Esteban Muñoz to describe the ways in which queer(ed) subjects take what is useful for them from normative structures and systems in order to survive and leave the rest (Muñoz, 2013). Similarly, pragmatism as a research paradigm operates under the

10

maxim of "do what works for the task at hand." Often positioned as a midway point on the (post)positivist/interpretivist paradigmatic and quantitative/qualitative methodological spectra, pragmatism favors an action-oriented approach to scientific inquiry that is simultaneously rooted in empiricism and subjective experience. The broader body of literature surrounding social science research paradigms situate pragmatism as a critical research paradigm that moves beyond the philosophical disputes associated with the (post)positivist/interpretivist paradigmatic binary by way of methodological plurality (Baškarada & Koronios, 2018; Gage, 1989; Lukenchuk, 2017). Pragmatism is therefore less of a philosophy and more of a "meta-paradigm," meaning it views the philosophical underpinnings of any particular research paradigm as ways of *being and doing* (Knappertsbusch, 2023).

According to sociologists of science, pragmatist research is predominantly characterized by the following philosophical assumptions:

- Reality is shaped by action, which produces change. Actions are inseparable from the contexts in which they take place, as well as the contextualized consequences they produce. Thus, scientific inquiry is intrinsically action-oriented because it is itself constitutive of the amalgam of social knowledge, experience, and other contexts by which it is conducted, which can subsequently be used to make social change (Kaushik & Walsh, 2019).

- Because knowledge is (socially and physically) contextual and consequential, criticality, skepticism, and reflexivity regarding the normative, pre-established, or collectively understood dogmas, beliefs, and knowledges that structure scientific (and other forms of) knowledge are necessary to make change (Holtz & Odağ, 2020).

- Pragmatism adopts methodological pluralism as a "meta-paradigm," which

situates research methodologies and their underlying philosophical assumptions as tools with unique and specific purposes and drawbacks, enabling the practical operationalization of methodology and philosophy according to the needs of the research at hand (Knappertsbusch, 2023).

In other words, pragmatism as a research paradigm stresses that research ought not to be conducted under the constraints of any particular philosophical or methodological norms. Rather, pragmatist research should be approached with the intention to understand the problem space as thoroughly as possible using whatever tools are at one's disposal, with the intention of operationalizing new knowledge into action-oriented and practical applications based on the findings of the research. The pragmatist research paradigm is critical, reflexive, action-oriented, and pluralist (Holtz & Odağ, 2020; Kaushik & Walsh, 2019).

As Baškarada and Koronios (2018) point out, research methodology is very much a discourse, as research is a philosophically diverse sociocultural phenomenon with a plethora of storied histories. Thus, it is imperative to develop a deeper, more critical understanding of the histories and discourses of EER philosophy and methodology so that avenues for queered EER can arise. Thus, pragmatism provides the paradigmatic structure from which to support an ethic of queerness, particularly through its insistence on troubling the normative philosophical and/or methodological assumptions and prescriptive methods that are entangled within the dominant (post)positivist and interpretivist research paradigms generally found within EER (Goncher et al., 2023; Kaushik & Walsh, 2019). However, as A. A. Waller (2006) reiterates from Fish is Fish by Leo Lionni (1970), it is our responsibility as engineering education researchers to first see and understand the philosophical water in which we plan to swim before diving in.

1.3   Toward an Ethic of Queerness as Praxis

If there ever was a unifying theme in my work, it would be an ethics of queerness. Notably, queerness as an ethic is difficult to define concretely. It lacks the structure and simplicity associated with traditional theoretical frameworks that researchers are familiar with. It also lacks a definitive definition. As I have already expressed, I am not concerned with *defining* what I mean when I refer to an ethic of queerness for EER. Instead, the objective of this dissertation is to *demonstrate* how queerness works and can be conceptually wielded as an ethic for EER, constituting a research praxis. Thus, it should be clarified that different researchers may engage with an ethic of queerness in ways that this dissertation does not demonstrate, making it a collaborative work in progress with broad applications.

For EER in particular, I argue that normative aspects of the IoE and research can be made to align with an ethic of queerness when used as a tool for collective self-exploration, precisely because doing so contradicts the methodological norms of the field (Kellam & Jennings, 2021). Separately, each chapter represents a different temporal point in the formation of my own ethics of queerness as I intentionally repurposed normative EER methodology to explore some of the mechanisms with which the IoE constituted me as a queered subject within itself. Likewise, understanding that each chapter is separated by time allows readers to trace the ways I have been disentangling my own subjectivity from the systems of power found within the IoE. Additionally, each chapter exists for the express purpose of exploring a different facet of an ethic of queerness for EER. Each chapter draws new insights about the ways in which the normative discourses embedded within engineering, education, and institutional research constituted me as a queered subject. Interpreted collectively, these works

demonstrate how an ethics of queerness – my own ethics of queerness, more specifically – evolves over time.

1.3.1 Conducting Engineering Education Research within an Ethic of Queerness

The following document constitutes a portfolio of scholarship comprising three independent articles completed over the course of my doctoral education that were guided by my understanding of an ethic of queerness. Although differing in methodology and topic of inquiry, chapters 2, 3, and 4 are epistemologically related through queerness as an ethic. More specifically, each article draws upon the prior work of critical theorists in fields such as Queer of Color critique and disability studies to examine three facets of the IoE system. Chapter 5 briefly discusses how chapters 2, 3, and 4 are conducted within an ethic of queerness, as well as the limitations of queerness as an ethic for EER and future work.

1.3.1.1 A Review of the State of LGBTQIA+ Student Research in STEM and Engineering Education

This published version of this chapter was a finalist for the 2020 American Society for Engineering Education (ASEE)'s Best Diversity, Equity, and Inclusion (DEI) Conference Paper Award (Jennings et al., 2020). Chapter 2 consists of a scoping review that examines the state of research on and with LGBTQIA+ students in STEM. It identifies massive gaps in STEM education literature regarding LGBTQIA+ engineering students and urgently calls for asset-based, critical scholarship on this topic. As the chapter discusses, EER that examines the experiences of queer(ed)

individuals in engineering is nascent compared to fields such as higher education, queer studies, and psychology. In addition to its nascency, LGBTQIA+ EER appears to be reproducing normative discourse found in the broader body of interdisciplinary literature. For example, both EER and interdisciplinary research showed a tendency to favor respondents that identified as white, cisgender, and lesbian, gay, or bisexual, often leaving out the voices of Queer People of Color (QPOC), Transgender and Gender Nonconforming (TGNC) people, and people who identified with more expansive or intersectional definitions of sexuality, indicating a broader systemic issue of marginalization and erasure of queerness within higher education that appears to be manifesting within EER, as well.

Although I did not have the words for it at the time, this chapter represents a temporal landmark in the evolution of my understanding of an ethic of queerness. In particular, this chapter represents one of my first experiences with an ethic of queerness by way of my engagement with the pragmatist paradigm. More specifically, the comparative scoping review methodology that I describe in this chapter is tailor-made to enable the contextualization of state of LGBTQIA+ EER against other fields of study. This pluralist approach allowed me to identify areas of theoretical strength and weakness within EER as compared to the broader body of literature. My engagement with pragmatism also manifests in the reflection questions that I include in the implications section. I included these questions because they are action-oriented, such that they provide researchers a pragmatic and reflective tool for exploring their own subjectivity in relation to others' when conducting EER with queer(ed) participants.

1.3.1.2 Interpreting Subjective Formations through the Lenses of Queer(ed) HCI, AI-Assisted Art Making, and Storytelling

Chapter 3 is an collaborative, autoethnographic exploration using arts-based qualitative inquiry methods to explore the opportunities and limitations of mixed-initiative creative interfaces (MICIs) when used as a tool for self care by queer(ed) subjects. MICIs, alongside other forms of computational creativity, are beginning to be mainstreamed as qualitative methodological tools in more empirical fields of study such as counseling research, as well as sites of philosophical inquiry into the future of human-computer interaction (HCI). This piece blends both methodological approaches by examining how creative technology might play a role in the formation and care of the subject. This is accomplished by focusing on the insight of one interlocutor, Kami, as she creates art with GauGAN, an open-source MICI from NVIDIA. I refer to Kami as my interlocutor because of the role she played in the generation of knowledge and theory throughout this research, as well as the ways in which she influenced my own thoughts on queerness, HCI, power, and care of the self. Thus, this work offers implications for developing a deeper understanding of the minutiae of everyday HCI and how that extrapolates to scales beyond the sole subject, as well as how the researcher themselves can leverage the fluid shifts from observer to subject as a valid form of knowledge production. Both of these implications, in my opinion, are necessary for developing radically liberatory engineering education research methodology, pedagogy, and praxis.

This chapter is precipitated from an ethic of queerness by way of explicit disengagement with the normative purpose of the GauGAN tool, which crystallizes into a collaborative meaning-making between myself at the time of writing the chapter, my

interlocutor, Kami, and myself during the interview. The methodology that I used for this study privileges the knowledge that can be derived from the subjective. The temporal component of the methodology also enabled a deeper subjective exploration for myself, what Foucault terms hermeneutics of the Self (Foucault, 2006).

1.3.1.3 Today's Grad Students, Tomorrow's Faculty: LGBTQIA+ Graduate Student Experiences Navigating the Insider/Outsider Paradox in Engineering

Chapter 4 is a collaborative auto-ethnography written by myself and two of my colleagues, Jerry Yang (Stanford University) and Brandon Bakka (University of Texas at Austin), that recounts our experiences as the queered outsiders within our doctoral engineering educations. Each of us takes equal credit and responsibility for study design, data collection, data analysis, writing, and editing. However, the appeal of collaborating was to play to each others' strengths as researchers and writers. Thus, I played a larger role in the development of our research design and literature review, as I was more familiar with auto-theoretical research methods as well as Collins (1986)'s notion of the Insider/Outsider Paradox that the broader book was based on (Cisneros et al., 2023). The chapter covers our experiences as queer(ed) subjects within engineering spaces as well as academia more broadly. We connect Hill's Insider/Outsider Paradox framework to recent engineering education research by way of our own counter-narratives, illuminating the ways in which we are oppressed by, as well as contribute to the formation of the normative social discourses and systems that we are embedded within.

I argue that this piece is a novel and valuable contribution to the field of engineering education research, as its queered methodology challenges the field's tendency towards

methodological standardization and order. Furthermore, our queer(ed) counterstories problematize several aspects of graduate engineering education, revealing several rich opportunities for further research. This selection is important when contextualizing what I mean by queering engineering education research because it further deconstructs how normativity within the IoE rendered me as a queered subject. This piece takes a much deeper dive into how my own subjectivities were constructed, both because and in spite of the normative discourses that led me to choose engineering, forced me to *disidentify* (Ferguson, 2004; Muñoz, 2009) with engineering, and ultimately, helped me form my thoughts on what an ethic of queerness might look like for engineering education research. Additionally, the autoethnographic methodology that we utilized for this chapter is a methodology is *made queer* (Adams, 2010), particularly when back-dropped against the IoE, which censors and obstructs subjective research methodologies in favor of objectivity and rigor (Kellam & Jennings, 2021; Pawley, 2013; Riley, 2017). My own subjective experience that is outlined in this chapter, therefore, demonstrates how queer subjectivity and queer methodology ameliorate to form an ethic of queerness.

Chapter 2

A REVIEW OF THE STATE OF LGBTQIA+ STUDENT RESEARCH IN STEM AND ENGINEERING EDUCATION

The purpose of this critical literature review was to generate awareness of the LGBTQIA+ engineering student experience and research on this community, while also highlighting areas that are lacking or receiving insufficient attention. This work is part of a larger project that aims to review engineering education research with respect to LGBTQIA+ students, higher education faculty and staff, and industry professionals. This literature review was conducted in two phases. First, works from non-engineering disciplines were reviewed to identify popular threads and major areas of research on the LGBTQIA+ student experience. This phase was not an exhaustive review; rather, it was meant to establish specific themes of importance derived from the larger body of literature on the LGBTQIA+ student experience. Second, a literature review identified how engineering-specific research on the LGBTQIA+ student experience aligned with these themes. We identified several themes in the first phase of the literature review: (1) Climate, (2) LGB Monolith, (3) Intersectionality, and (4) Identity Development. Engineering and engineering education literature demonstrated similar themes, although this body of work was unique in the exploration of LGBTQIA+ coping strategies and the use of the technical/social dualism framework. Overall, the engineering education literature on LGBTQIA+ student experiences seemed relatively underdeveloped.

2.1   Introduction

2.1.1   Research on the LGBTQIA+ Community

Throughout this chapter, we reference the term "LGBTQIA+," which is an umbrella acronym used to describe any person who does not identify with heterosexual and cisgender norms (Gold, 2019). Recent research on the LGBTQIA+ student experience shows a growing interest on this topic, both within and outside of the field of engineering education (Lange et al., 2019). Within this encouraging trend, the disciplines that have placed the greatest sense of urgency on understanding this community's experiences appear to have been higher education, psychology, and queer and gender studies. Research from these fields have shown that LGBTQIA+ students experience heightened levels of verbal and physical violence, harassment, and discrimination. As a result of experiencing such mistreatment on a regular basis, many students have reported lower levels of satisfaction and performance in school or the workplace, and lower levels of general wellness overall (Burgess et al., 2007; Sears & Mallory, 2011). Identity development of LGBTQIA+ college students is also different from non-LGBTQIA+ students (Bilodeau & Renn, 2005). Finally, intentional efforts from academic institutions – programs and policies that increase visibility, protection, and support for these students, along with supplying campus services and support – enhance the positive aspects of their experience (Evans, 2002; Pitcher et al., 2018).

The repertoire of literature surrounding diversity and inclusion of marginalized groups in engineering is robust and well-established. Ample research details the under-representation of women and students of color in engineering with respect to recruitment and retention, and describes the causal roles of both obvious and subtle

forms of discrimination, lack of mentorship and role models, and more (Bebbington, 2002; Ohland et al., 2011). In contrast, the perspectives and experiences of LGBTQIA+ engineering students represented in the engineering and engineering education literature reviewed in this chapter appeared to be nascent. In addition, the specific or unique experiences, benefits, and challenges of LGBTQIA+ engineering students seemed less well known. Although there has been exploratory work on the LGBTQIA+ engineering student experience (Cech & Rothwell, 2018; Cech & Waidzunas, 2011; Haverkamp et al., 2019), it was challenging to locate engineering-specific work that addressed a more holistic view of the LGBTQIA+ community. Often, research with the LGBTQIA+ engineering student community neglected the experiences of Transgender and Gender Nonconforming (TGNC) people and Queer People of Color (QPOC). This literature review explored the current status of the field of research on the LGBTQIA+ engineering student experience.

2.1.2 Research Questions

We were interested in determining how the body of literature on the LGBTQIA+ student experience in engineering compares to literature and research on the LGBTQIA+ student experience from other interdisciplinary higher education fields. To accomplish this, we conducted a thematic review on interdisciplinary higher education research conducted on and with the LGBTQIA+ community. Following this stage, we conducted a systematic literature review to compare the existing literature on the LGBTQIA+ student experience within the field of engineering education to that of the interdisciplinary higher education literature. The following research questions informed this review: 1) What are major, overarching themes on the LGBTQIA+

student experience present in a broader body of interdisciplinary higher education literature? 2) How do the overarching themes found in the broader body of literature manifest (or not) in the engineering and engineering education research literature?

2.2   Methods

2.2.1   Theoretical Framework

Borrego et al. (2014) discusses the purposes and procedures involved in conducting a systematic literature review. In more mature fields of study, systematic literature reviews are often conducted to evaluate or crystallize theory from a body of work. Systematic literature reviews also can be written to capture the historical development of a research trend. Within engineering education research, however, systematic literature reviews are most often conducted to outline the state of a body of literature, or to point to gaps in a body of research. Systematic literature reviews are often needed if a body of work informs policy, or if future research efforts need direction from the synthesis of existing work. Research questions and carefully scoped search criteria typically guide qualitative systematic literature reviews (Borrego et al., 2014). Resource analysis is guided by an "appraisal" process, involving a protocol of questions designed to determine the content and quality of a study. Each study is synthesized, and the reviewer evaluates within and between studies to establish links, evaluate quality and content, and draw conclusions. We relied on other literature reviews to provide us a sense of where interdisciplinary higher education disciplines focus their efforts with regard to research with the LGBTQIA+ student community. However,

we utilized the systematic literature review framework for engineering education to inform the literature review for engineering and engineering education works.

2.2.2   Data Collection and Analysis

The literature review for this project was conducted in two stages. During the first stage, literature from several fields, which we refer to as interdisciplinary higher education research, was surveyed on the LGBTQIA+ student experience. Examples of these diverse fields included psychology, higher education, sociology, anthropology, art education, public policy, and business management. All disciplines were considered in the search; however, much of the work we found surrounding the LGBTQIA+ student experience had been conducted in higher education, psychology, and gender/queer studies. Therefore, these disciplines were heavily drawn upon to inform the first stage of this review. A non-systematic, general thematic review was conducted using databases such as Google Scholar, ERIC, and PsychINFO. Searches contained keywords in the Boolean input function for these databases (e.g., ("LGBT" or "lesbian" or "gay" or "bisexual" or "transgender" or "queer" or "gender nonconforming" or "homosexual") AND ("student" or "college" or "university")). Results from this search were extensive; we thus focused our attention on existing literature reviews and similar publications to capture the most representative themes and patterns of the broader body of interdisciplinary higher education literature.

During the second stage, a systematic review located all relevant engineering-specific work on the LGBTQIA+ student community. This search considered refereed engineering or engineering education-specific journals or conference proceedings, and focused on publications that explicitly examined the LGBTQIA+ engineering student

experience. Search databases included Google Scholar, EI Compendex, ASEE Peer Document Repository, IEEE Transactions on Education, Journal of Engineering Education (JEE) and Advances in Engineering Education (AEE) archives. Additionally, we obtained engineering-related content appearing in education, gender studies, and related journals and conference proceedings.

Our search yielded a large volume of works (over 1,900 in EI Compendex and over 11,000 in Google Scholar) that were only marginally or not at all related to our search criteria. Works that best fit our search criteria from the first 350 results from these two databases were collected. After obtaining relevant publications resulting from these searches, we inspected their references to reveal additional sources. Because our specific focus was LGBTQIA+ engineering student experiences, we did not obtain works pertaining only to LGBTQIA+ engineering faculty, faculty, or others.

Each publication was evaluated with respect to inclusion and exclusion criteria (e.g., peer reviewed journal article or conference proceeding on relevant topics), and then integrated within the broader analysis. For both stages of the literature review, an online form was implemented to annotate each publication in a systematic, streamlined, and transparent manner. Annotations recorded (a) the stated purpose of the study, (b) major findings, (c) key contributions to the literature, (d) potentially unique features of the research, and (e) readers' interpretation of the themes addressed in publication. These annotations were then analyzed to identify the overarching themes reported in this chapter.

Overall, twenty-two engineering or STEM-specific papers were included. Six of these publications were published in peer-reviewed journals, and fifteen publications appeared in refereed conference proceedings. One publication did not appear to be peer-reviewed. We included it because it met our other search criteria and

represented a topic that had not been discussed in other works. Of the entire data set, eight publications implemented primarily quantitative methods and nine publications emphasized qualitative methods. Two of the remaining publications were classified as mixed methods, and three others were classified as "other." The data set for this chapter is included in Appendix A. For clarity, we adopted APA formatting guidelines (rather than IEEE formatting) to assist readers with identifying cited research.

2.2.3 Limitations

Research on the LGBTQIA+ engineering experience is more expansive than this review represents, as this literature review only examined the state and status of the research surrounding the LGBTQIA+ engineering student experience. As such, we intentionally left out literature on LGBTQIA+ engineering faculty and industry professionals. We also left out much of the literature on efforts to improve the climate of engineering for LGBTQIA+ students through faculty training efforts. We intend to address works on LGBTQIA+ faculty/staff and industry professionals in later works.

Our methods for reviewing literature are heavily interpretivist. The lead author on the chapter identifies with the LGBTQIA+ community, and is becoming familiar with feminist, queer, and race theories that they feel have been absent from engineering and engineering education research. This interpretivist lens was informed by the lead author's own experiences as a queer engineering student. This interpretivist lens also enabled analysis and recommendations with QPOC and TGNC experiences in mind.

We felt that the body of research with the LGBTQIA+ engineering student community was relatively small. As such, we did not synthesize this body of literature. Instead, we organized the themes within the literature to gain an understanding of

certain authors' spheres of influence and popular topics of investigation. We also chose to conduct a thematic analysis of the engineering and engineering education research so that we could more easily highlight the absence of themes such as intersectionality and queer theory, which were themes that were more easily detectable in the interdisciplinary higher education literature.

2.2.4 Positionality Statements

The lead author on this chapter, Madeleine Jennings, is a white, middle-class, queer graduate student at Arizona State University. They are interested in restructuring the engineering institution to become less hostile to marginalized groups using tenants from queer theory, feminism, and anarchism. Madeleine prefers qualitative methodologies when working with "small numbers (Slaton & Pawley, 2018)" and believes that quantitative research on "small numbers" communities such as the LGBTQIA+ community serves to marginalize these communities further. They view this literature review as a call-to-action for engineering education researchers to engage in work with LGBTQIA+ students using these frameworks, methodologies, and epistemologies.

Dr. Rod Roscoe is an associate professor in the Human Systems Engineering program at Arizona State University, and serves as Madeleine's advisor for their MS in that program. He studies education and learning from the perspectives of self-regulation and sociotechnical systems. Dr. Roscoe is deeply interested in inclusion and equity issues in human-centered engineering and design.

Dr. Nadia Kellam is an associate professor in the engineering education program at Arizona State University, and serves as Madeleine's advisor for their PhD. In general, Dr. Kellam is interested in using research approaches that encourage us to listen

more deeply to the data. While she appreciates the value of this literature review in developing a pulse of the current state of research around LGBTQIA+ engineering students, she is looking forward to conversations with LGBTQIA+ engineering students that will help us begin to develop understandings of their experiences in engineering education and how their experiences reflect broader structural and societal inequalities present in engineering education.

Dr. Suren Jayasuriya is an assistant professor in the Arts, Media, and Engineering program at Arizona State University, and serves as Madeleine's mentor on multiple projects. His background and research are in electrical engineering and computer science, although he has new research projects in engineering education, including epistemologies and student experiences in interdisciplinary engineering and the arts/humanities programs. His subjectivity in this project mostly focused on the application of queer theory and philosophy in the works collected in this literature review, including analyzing how effectively those ideas and methods are incorporated throughout the literature.

2.3 Findings

2.3.1 Interdisciplinary Higher Education Research Findings

Much of the research presented in this section on LGBTQIA+ students originated from higher education, queer studies, and psychology research. Consequently, this interdisciplinary higher education literature review relied heavily on work from this area. The themes that emerged in this first stage were (1) Climate, (2) LGB Monolith, (3) Intersectionality, and (4) Identity Development.

1. Climate – As Renn (2010) mentioned, climate is a large theme within the body of research conducted on LGBTQIA+ students. Research on this topic often asked heterosexual, cisgender students about their attitudes towards students within the LGBTQIA+ community via survey. For example, Woodford et al. (2012) conducted a quantitative study which sought to determine predictors in heterosexual students about their attitudes toward the LGBT community as a whole, as opposed to asking about certain sub-communities within the LGBTQIA+ community. Works of this nature were most often quantitative, but can also be qualitative in nature. For example, Evans and Herriott (2004) conducted an ethnographic study to explore how heterosexual students' perceptions about the LGBTQ+ community changed when they were exposed to the community. Work that followed this theme could also take the form of asking LGBTQIA+ students about the climate of their university to assess attitudes surrounding the LGBTQIA+ community. The campus climate for queer-identifying and TGNC students, according to Greathouse et al. (2018), remains chilly or violent. This same study indicated that 72.4 percent of trans-spectrum students and 42.3 percent of queer-spectrum students reported that they witnessed discrimination on campus, as opposed to 27.6 percent of heterosexual, cisgender students. LGBTQIA+ students were also more likely to be victims of violence and discrimination than their cisgender, heterosexual peers. Queer and trans-spectrum students were also significantly more likely to report "below average" mental health compared to cisgender, heterosexual peers.

2. LGB Monolith - We termed this theme as the LGB Monolith, as it largely focused on the experiences of primarily white, cisgender, middle-class, and homosexual men and women. There were some exceptions belonging to bisexuals in the same demographic groups. Largely, this theme described older works (late 1990's to early

2000's), and this body of work constituted the foundation of what researchers know about the experiences of the LGBTQIA+ community (D'Augelli, 1992; Dilley, 2013). Privileged members of the LGBT community are largely white, male, cisgender, and middle-class. Ongoing research on this group is likely enforced by sampling. As Renn (2010) mentioned, "there is no longer a gap in the literature" with regard to LGB research in higher education. This trend seems to be reflected in other disciplines. Renn did, however, mention that as of 2010, there was still a gap in the literature with regard to work with the TGNC and QPOC community. Lange et al. (2019) further confirmed with their more recent literature review that there is still a gap in the research with regard to the TGNC and QPOC experience in higher education. It would seem that other fields to tend agree that the TGNC and QPOC population has been neglected, as well (Johnson, 2001).

3. Intersectionality - More recent work discussed the intersectional nature of the LGBTQ+ community, and provided a welcome challenge to the LGB monolith. Specifically, work in this area deals with the TGNC communities, as well as the larger queer community in general, with respect to racial/ethnic, class, disability, and other identities. Both Renn (2010) and Lange et al. (2019) mentioned in their literature reviews that not enough work has focused on this topic. Newer research appeared to be focusing more on the TGNC and QPOC communities, however. For example, Marine and Nicolazzo (2014) conducted a discourse analysis of the language used by LGBTQ Centers, which analyzed the inclusion of TGNC people in these centers, and, thus, challenged the LGB monolith. Duran et al. (2019) systematic literature review of QPOC in higher education and higher education research highlighted the importance of acknowledging the intersectionality of QPOC by providing examples of the diversity of QPOC research participants from research studies.

4. Identity Development - Models that serve to map out LGBTQIA+ students' identity development in college or university settings were prevalent in interdisciplinary higher education research. These models, as defined by Bilodeau and Renn (2005), vary in nature and epistemology. Often, older models were designed from positivist and linear perspectives, which expected the student to "arrive" at their fully developed identity. Other more constructivist and postmodern models were grounded in queer, critical, and feminist theory and explored how one's LGBTQIA+ identity develops alongside other identities, as demonstrated by Abes and Kasch (2007). In addition to LGBTQIA+ identity development, this theme also included the identity development of non-LGBTQIA+ people using queer identity development models (Evans & Herriott, 2004). An emergent research theme was the creation, characterization, and/or validation of LGBT identity development models for LGBTQIA+ or non LGBTQIA+ students.

Climate, LGB Monolith, Intersectionality, and Identity Development were the major, overarching themes that emerged in the broader body of literature, as summarized above. However, there were trends that we found somewhat frequently, but could not necessarily classify as themes. For example, there was a roughly chronological evolution of trends in LGBTQIA+ student research in the broader body of literature (Renn, 2010). This trend began with the LGB Monolith, which is defined by research that primarily represents the experiences of white, cisgender, middle- to upper-class, homosexual men and women (D'Augelli, 1992; Lopez & Chims, 1993). This body of work constitutes the foundational research that lays out the LGBTQIA+ student experience. This period of research is followed by works that discuss LGBTQIA+ student identity development, which were initially positivist and linear in nature (Bilodeau & Renn, 2005). Later, research on LGBTQIA+ students evolved to take on

a more intersectional lens, and identity development models became additive or cumu-lative in nature. The latest evolution of LGBTQIA+ research adopted a post-modern interpretation, which rejects identity as additive, and instead examines the experience of LGBTQIA+ individuals through the lenses of queer theory, critical theory, critical race theory, and feminism (Duran et al., 2019; Lange et al., 2019). Other, more critical works also addressed the apparent gap in the literature with regard to researchers using queer theory that focus on race and ethnicity, known as "quare theory," as a framework for exploring LGBTQIA+ student experiences (Johnson, 2001; Means, 2017).

2.3.2 Engineering-Specific Research Findings

The first paper breaking ground on LGBTQIA+ student issues in engineering was published in 2009 at the annual ASEE conference (Cech & Waidzunas, 2009). Since this flagship paper on the topic, Cech has arguably been the most influential researcher in this space, having been an author on seven out of the twenty-two works we reviewed. Waidzunas and Farrell were also prolific researchers in this space, having been lead or co-author on five and four publications, respectively. Below, we discuss the themes that were most prominent within the body of work on the LGBTQIA+ engineering student experience, which often overlapped with each other within individual papers. These themes were (1) Climate, (2) Coping Strategies, (3) Policy Change, (4) LGB Monolith, and (5) Technical/Social Dualism.

1. Climate – Much of the groundwork that was conducted on the LGBTQIA+ student experience within the field of engineering education has focused on the climate within engineering programs and the attitudes of heterosexual engineering students

toward their LGBTQIA+ peers. Climate, as defined within the context of engineering education, is perceived by marginalized students, and is reflective of the broader, dominant culture that operates within the program (Cech & Rothwell, 2018; Cech & Waidzunas, 2011). The climates within engineering programs and classrooms are perceived as "chilly" by LGBTQIA+ students. This chilliness is often driven by a range of behavior and attitudes from heterosexual and cisgender students and faculty, including subtle indications of disapproval about one's sexual orientation or gender identity (Haverkamp et al., 2019; Linley et al., 2018), to outright and explicit verbal and/or physical violence (Cech & Rothwell, 2018).

The flagship works discussing the LGBTQIA+ engineering student experience demonstrated specific instances of chilliness within the engineering academic climate for LGBTQIA+ students, as told by LGBTQIA+ engineering students through qualitative data (Cech, 2013; Cech & Waidzunas, 2009, 2011; Trenshaw et al., 2013). They revealed that engineering, being an apolitical space, often forces queerness out, and that people belonging to the LGBTQIA+ community are often seen as less than. A quantitative study conducted by Cech and Rothwell (2018) on LGBTQ inequality in engineering revealed that across eight different universities, LGBTQ students reported heightened levels of marginalization and discrimination as compared to their non-LGBTQ peers, which corresponded to more health issues for these students, such as insomnia, depression, and anxiety (Cech & Pham, 2017; Cech & Rothwell, 2018). Additionally, LGB students are reported to persist in STEM fields 7 percent less than non-LGB students despite more engagement in undergraduate research, likely because of issues with marginalization in their programs (Hughes, 2018).

Between Cech and Waidzunas (2011) and Cech and Rothwell (2018) journal publications, there were a number of works that examined the engineering climate

for LGBTQIA+ students through different lenses. Specifically, the climate within engineering programs was measured quantitatively by surveying forty-seven engineering deans about their feelings toward LGBTQIA+ inclusion in their programs, how they perceived their faculty's and student's feelings about LGBTQIA+ inclusion, and if they felt that there were issues with inclusion within their programs (Cech et al., 2016). They found that a majority of engineering deans supported LGBTQIA+ inclusion initiatives in their programs, but believed that their faculty, staff, and students did not. Additionally, engineering deans appeared to underestimate the amount of problems with LGBTQIA+ inclusion that were present within their programs. Trenshaw (2018) investigated how the representation of LGBTQIA+ people in engineering spaces affected LGBTQIA+ engineering students' perception of engineering climate, as well. Linley et al. (2018) examined the LGBTQIA+ STEM student experience through qualitative data. They relied on ecological, climate, and social dualism frameworks. They found that LGBTQIA+ STEM students in socially-oriented STEM fields perceived a more friendly climate, whereas students enrolled in technical, applied majors perceived a chillier climate. Haverkamp (2018) also theorized that many of the issues that TGNC students face in engineering are caused by biological essentialism, which is the belief that assigned sex dictates gender identity and that there are only two genders, which are male and female. This belief is associated with apolitical leanings.

Interestingly, Rohde et al. (2017) investigated the differences between self-identified cisgender engineering students and engineering students who identify themselves as either male or female and do not identify as cisgender. They found that those who identify as cisgender are more likely to care about or aim to utilize their engineering degree to address social justice issues. Although this study is about allied engineering

students, we still believe it is relevant to the study at hand, as it provides context for both measuring and understanding the climate for marginalized engineering students, including LGBTQIA+, through queer language.

There has been recent work regarding TGNC students, which is a sub-community within the broader LGBTQIA+ group that has not explicitly been studied previously. While these students belong to the broader LGBTQIA+ community, their experiences are not always translatable when compared to the experiences of cisgender members of the LGBTQIA+ community. For example, an auto-ethnographic, qualitative study conducted with two transgender queer women both confirmed researched trends of the marginalization of LGBTQIA+ students in engineering, and brought to light that TGNC engineering students often face unique challenges, such as introducing name and pronoun changes to peers (Haverkamp, 2018; Haverkamp et al., 2019). The students in this study also discussed the issues relating to the lack of community for them within engineering spaces, and often found this sense of community within online spaces. The lack of in-person communities within engineering spaces further sequestered TGNC students from the broader engineering community. The result of this finding was one student leaving engineering altogether, which they reported vastly improved their mental health. The lack of community for LGBTQIA+ engineering students stems from the embodiment of heteronormativity within the culture of engineering (Riley, 2013). In addition to health issues, the culmination of the "chilly" climate within STEM spaces has also been shown to have an effect on LGBTQIA+ retention in computing, meaning LGBTQIA+ computing students that report a lower sense of belonging within their programs are more likely to leave their programs (Stout & Wright, 2016).

On a brighter note, Boudreau et al. (2018) explored how engineering spaces may be

becoming more inclusive to LGBTQIA+ engineering students. Cultural changes had begun to make younger people more accepting of LGBTQIA+ students on campus. Additionally, incorporating humanities and social sciences into engineering programs made engineering spaces less apolitical, thus improving the climate for students. Openly queer or visible faculty allies also improved the climate for LGBTQIA+ students. Another study cited that, although other students were a main source of stress for LGBTQIA+ STEM students, having faculty allies made these students' experiences much more manageable (Linley et al., 2018).

2. Coping Strategies – As discussed prior, the climate for LGBTQIA+ engineering students is generally perceived as "chilly" (Cech & Waidzunas, 2011). LGBTQIA+ students in engineering were shown to adopt coping strategies to help them navigate this climate. A qualitative study by Cech and Waidzunas (2011) explored the experiences of the LGBTQIA+ engineering community in general. They found that these students navigated the heteronormative and "chilly" or hostile environment by covering their identities, passing as straight, and compartmentalizing their social and academic/professional lives. The implications of these coping strategies were diminished mental health, dissatisfaction or anxiety with their career choice, and increased levels of isolation from peers. This study, however, focused only on cisgender members of the LGBTQIA+ community.

TGNC students have the added challenge of "deadnaming," or being consistently called by the name and pronouns that align with the gender that they no longer identify with. TGNC students also face confusion or even violence from peers in the event that they are physically transitioning. This, according to Haverkamp et al. (2019), required TGNC students to downplay or hide their gender identities and isolate themselves from their engineering and university community. Often, this meant

skipping class or group work to prevent being identified as TGNC. Haverkamp et al. (2019) mentioned also that these students find solace and community in online spaces rather than on-campus spaces. This need for community was so intense for one participant in this study that they dropped out of school altogether, which they said vastly improved their mental health.

3. Policy Change – An interesting trend that we found in the engineering-specific body of literature is the focus on policy change to help protect the LGBTQIA+ engineering population. The uptick in works relating to the LGBTQIA+ engineering experience has created a rise in literature that introduces ideas for policy change to improve the experience of LGBTQIA+ engineers. Policy improvements that were reported ranged from the ratification of diversity and inclusion statements of engineering organizations to include LGBTQIA+ (Bowman & Madsen, 2018), to the implementation of SafeZone trainings for allies (Farrell et al., 2017; Guerra et al., 2016), to a broader call-to-action to change the culture of engineering to be more gender inclusive and less heteronormative (Cech, 2013; Haverkamp, 2018). The policy changes that were suggested most often include faculty training, protections for LGBTQIA+ students, and the addition of social sciences and humanities to fight the meritocratic, apolitical climate within engineering spaces.

4. LGB Monolith – Despite an increasing amount of work on the topic since 2009, research on the LGBTQIA+ student engineering experience is still nascent. Though researchers undertake efforts to recruit a diverse sample of research participants, much of the work that we reviewed was focused on the gay, lesbian, and bisexual perspective and is also very heavily focused on the cisgender perspective (Cech & Rothwell, 2018; Cech & Waidzunas, 2009; Hughes, 2017, 2018). Often, this was not the researchers' fault. Students who reside at more than a few intersections of marginalized identity

often "fell out" of quantitative analysis, due to small numbers of representation within engineering. This same issue of representation was still persistent in qualitative research, as well. The result of research that was conducted on primarily cisgender members of the LGBTQIA+ community — however valuable it actually is — is work that is only generalizable to the cisgender portion of the community, which could result in further alienation of QPOC, TGNC, and a-, bi-, demi-, or pansexual engineering students (Marine & Nicolazzo, 2014).

5. Technical/Social Dualism in Engineering – There was a frequent utilization or mention of the Technical/Social Dualism framework by Faulkner (2000) throughout the broader body of literature regarding LGBTQIA+ engineering students' experiences in engineering. Publications that Cech has co-authored often incorporated this framework. Since many of Cech's papers on the LGBTQIA+ engineering student experience were heavily cited, this framework often appeared in some way in much of the research. This framework theorizes that dichotomies within the social systems of engineering disenfranchise marginalized groups by associating them with the "lesser" dualism. For example, gay men are stereotyped as being feminine. Since women are often associated with more socially-oriented areas of study or occupation, gay men are often shut out of engineering in ways similar to women (Cech & Waidzunas, 2011). This framework has been used to analyze the experiences of LGBTQIA+ engineering students in the most impactful and seminal publications (Cech & Rothwell, 2018; Cech & Waidzunas, 2009, 2011; Linley et al., 2018). It has also been mentioned in other journal and conference articles to varying degrees with regard to the LGBTQIA+ community (Farrell et al., 2017; Hughes, 2017; Leyva et al., 2016).

2.4 Discussion

This literature review examined the state of engineering and engineering education-specific literature regarding the LGBTQIA+ student experience compared to interdisciplinary higher education fields. Compared to research on LGBTQIA+ students in the broader body of literature, engineering and engineering education research is far less developed. Although there has been an increase in interest in the LGBTQIA+ experience in engineering since 2009, we feel that the body of current work on engineering students is still nascent and fundamental. In general, more research with this community is vital in order to claim that we, as engineering education researchers, understand the experiences of diverse LGBTQIA+ engineers. In addition, we identified a fairly small community of scholars who have worked on research with the LGBTQIA+ engineering community. We understand that this phenomenon is a function of the nascency of this thread of research. However, we believe that an increase in the number of scholars that conduct research in this area will benefit the LGBTQIA+ engineering community by increasing the diversity of thought within the body of research on this topic, as well as normalizing this community's presence within engineering. The severe lack of research on the TGNC and QPOC communities in engineering is likely due, in part, to the lack of researcher diversity. Other factors could be the inherent difficulty of conducting research with the LGBTQIA+ population, due to the diversity of the community and the lack of LGBTQIA+ people in engineering, in general.

Our findings indicated that a majority of engineering and engineering education research focuses on what the climate is like for LGBTQIA+ students. This research is a vital first step into understanding how this community experiences engineering programs. Research on the climate for LGBTQIA+ engineering students also provides

substantiation for culturally relevant pedagogy, refining policy changes, and revising inclusion and diversity strategies in academia and industry. It is also useful because it further confirms the toxicity within engineering programs that has been shown to affect women, students of color, students from low socioeconomic backgrounds, and other marginalized groups. However, much of the research exploring the climate within engineering is heavily focused on groups that belong to the LGB monolith. We felt that the erasure of the 'TQIA+' portion of the community was partially unintentional. There are many sub-communities within the greater LGBTQIA+ community, some of which can be fairly small and difficult to represent in large-scale studies. For example, we could find no studies that specifically examined the experiences of TGNC QPOC. However, there have been studies which we have included in this review that have successfully represented some of the smaller sub-communities within LGBTQIA+. For example, Haverkamp et al. (2019) broke the silence on the TGNC engineering experience in a collaborative auto-ethnography with two engineering students who identified as such.

We noted also that there was little to no application of queer theory with regard to researching the LGBTQIA+ engineering student community. The exception was work having to do with TGNC students, and to some extent, queerness as a state of being in engineering (Haverkamp, 2018). However, it is worth mentioning that we were able to find some queer theory-inspired work in engineering spaces, which did not necessarily discuss the LGBTQIA+ population. Rather, these works utilized queer theory and critical analysis to critique the culture of engineering and engineering education (Riley, 2013, 2017; Slaton & Pawley, 2018). This is paradoxical, according to Renn (2010), who cites a similar trend in the higher education literature – that is,

the queer experience is not often analyzed or understood through the framework that has been established to understand queerness.

In addition to the lack of queer theory represented in engineering education research, there was little discussion on identity development in engineering education as opposed to other bodies of literature. Only one paper that we reviewed from the engineering education literature explored the engineering, queer, or other identity development of LGBTQIA+ engineering students (Hughes, 2017), though this topic has been explored at length in other disciplines. Proportionally, however, there seemed to be more explicit discussion surrounding coping mechanisms within engineering education than the broader body of literature (Cech & Waidzunas, 2009, 2011; Haverkamp et al., 2019; Lange et al., 2019), though this work tended to focus on the ways that LGBTQIA+ students navigated toxic systemic structures as opposed to changing these structures to be more inclusive.

Finally, research seemed to be more representative of the diversity within the LGBTQIA+ engineering community when it was conducted in qualitative settings with a smaller handful of diverse students. Engineering education research often tends to value larger, systematic, quantitative studies that are generalizable to a wider population (Riley, 2017). These studies are valuable for making generalizations about larger populations, including the LGBTQIA+ engineering community. However, we note that the climate within the engineering education community seems to be changing to value "small numbers (Slaton & Pawley, 2018)" research. This type of research is especially valuable and important for capturing voices that "fall out" of these large-scale, quantitative studies. Particularly within the LGBTQIA+ student community, "small numbers" studies are useful for understanding the experiences of TGNC and QPOC, who often find themselves as the "only" in their programs.

2.4.1 Implications

Engineering education research has, we feel, sufficiently established a baseline understanding of the LGBTQIA+ student experience through both qualitative and quantitative methods. However, there is less work on the TGNC and QPOC experience. This review demonstrates that more research must be conducted with the LGBTQIA+ engineering student community in order to claim that engineering education as a discipline understands their experiences. Although we are especially excited about qualitative, "small numbers" research with this community, we recognize that there is a need for more responsible, thorough, and thoughtful research in general. Because of this, we offer some answers to potential questions that engineering education researchers may have when considering conducting research with the LGBTQIA+ community. In addition, we ask a few questions without answers that researchers may consider when conducting engineering education research that may involve LGBTQIA+ students.

Who can conduct research with the LGBTQIA+ engineering community? We believe that anybody can conduct research with this community, so long as they have responsibly educated themselves about this community's struggles and victories. This helps to establish trust with the community. Researchers that are interested in becoming familiar with the LGBTQIA+ community can complete SafeZone training, available on most campuses and online. They can also seek out LGBTQIA+ media such as podcasts, blogs, or TV shows, which often examine LGBTQIA+ issues and current events.

How can researchers conduct responsible research with the LGBTQIA+ community? The LGBTQIA+ community has been subject to unique and particularly violent

forms of harassment, discrimination, and erasure within society, including within the engineering institution. Within the LGBTQIA+ community, TGNC people and QPOC have shouldered the brunt of societal abuse. Examining one's own reflexivities and biases about the LGBTQIA+ community is a necessity if the work is to remain ethical.

We pose some questions for all engineering education researchers to consider when doing research that may involve LGBTQIA+ students:

- Do I have some understanding of the LGBTQIA+ community, so that I can empathetically navigate an interview with someone from this community?
- How does my positionality as a [describe yourself here] influence my interactions with the LGBTQIA+ community?
- Do I have any unexamined biases around LGBTQIA+ communities?
- Do my demographic surveys ask questions that are inclusive of QPOC and TGNC identities?

2.5   Conclusions

We conducted a literature review to uncover gaps and future directions for research around the LGBTQIA+ engineering student experience. First, we identified themes within the interdisciplinary higher education literature, including the following: 1) Climate, 2) LGB Monolith, 3) Intersectionality, and 4) Identity Development. In the next phase of this work, we conducted a systematic literature review of engineering-specific research on the LGBTQIA+ experience. Using thematic analysis, we found that Climate and LGB Monolith aligned across interdisciplinary higher education and engineering education research. Differences included a focus on coping strategies,

policy change, and technical/social dualism in engineering and engineering education research. We concluded this chapter with questions for consideration when conducting research specifically focused on an aspect of LGBTQIA+ engineering students and when conducting research that may include students from this minoritized population.

Chapter 3

INTERPRETING SUBJECTIVE FORMATIONS THROUGH THE LENSES OF QUEER(ED) HCI, AI-ASSISTED ART MAKING, AND STORYTELLING

This qualitative study utilized a novel, arts-based elicitation using NVIDIA's Gau-GAN in conjunction with interpretive narrative research methods of one interlocutor's interviews to explore how queer(ed) hermeneutics are influenced by technology and power in their lives. We utilize Foucault's theories of Technologies of the Self and Power to interpret how Kami, our interlocutor, constructed and performed aspects of their subjectivity. GauGAN served a dual purpose in providing a creative mode of expression, as well as provoking thoughtful discussions between Kami and the researchers about the role that technology plays in the hermeneutic process. Using Foucauldian Technologies as an analytical lens, we present Kami's story (as told from the perspective of R1) with her accompanying art pieces to elucidate nuanced ways that we conceptualize algorithm and technology alongside our subjectivities and hermeneutic processes.

3.1 Introduction

Computational creativity has received significant attention within the fields of human-computer interaction (HCI), science and technology studies (STS), and sociology (e.g., Colton et al., 2011; Liapis et al., 2016; Rohrmeier, 2022; Wiggins, 2006). In particular, there has been an increasing focus on AI tools that foster human creativity for its own sake (Compton & Mateas, 2015) by generating a feedback loop

between the user and system during the creation process. AI tools that support this *mixed-initiative co-creativity (MICC)* feedback loop are called *mixed initiative creative interfaces (MICIs)* (Yannakakis et al., 2014). MICIs can potentially expand the possibility space of human creativity (Deterding et al., 2017; Galanos et al., 2021; Kreminski & Mateas, 2021; Kreminski et al., 2022).

Autotelic creativity provides a unique way of expressing complex or nuanced thoughts and emotions (Compton, 2019; Compton & Mateas, 2015). MICIs and other computationally-driven creativity tools can be interpreted as tools for self-care amidst structures of power. Emergent interdisciplinary scholarship has examined the impact that MICIs have on formations of power within social formations (e.g., Mirsky and Lee, 2021; Turtle, 2022). These findings implicate AI MICIs as sites of both empowerment and dis-empowerment, simultaneously embodying normative discourses while enabling radical, imaginary creation.

To understand how MICIs can operate in this space, we turn to the social theories of Michel Foucault. Foucault theorized power formations as imminent and inescapable (Foucault, 1963, 1975, 1976), yet malleable to one's own negotiations with discourses, artifacts, and Technologies of Power. Foucault calls the process of an individual's negotiation with broader power formations a hermeneutic of the self (Foucault, 2006). Similarly, Technologies of the Self are the embodied tools at one's disposal that are useful in one's hermeneutic practices (Brey, 2008). MICIs have the potential to embody dis-empowering discourse, yet still contribute to one's hermeneutic practices as shown in prior literature (Cheatley et al., 2022; Kou et al., 2019).

This study adopts Foucault's theories of power formation and hermeneutics of the self to examine how one queer(ed) subject, Kami, leveraged NVIDIA's GauGAN, an open-source generative MICI, to negotiate her own power. We chose to conduct our

analysis with the data from a singular interlocutor, as it aligned with the ethnographic methods that we utilized by helping us to center Kami's story in our analysis (Pellicone & Ahn, 2018). GauGAN can be considered a MICI with implications for casual creation, we did not find prior literature that analyzes GauGAN in this lens. Thus, our contribution to the literature surrounding queer HCI and computational creativity examines the MICI GauGAN as a site for empowering the hermeneutic practices of our singular interlocutor, Kami. We intentionally call Kami our interlocutor rather than our participant because she was an active participant in the production of knowledge rather than passively providing us information that we asked for. Given that our findings are specifically relevant to Kami, however, we include a discussion surrounding this study's implications for further research and design.

3.2 Relevant Literature

3.2.1 Foucault in HCI

(Computational) Technologies of Power

Foucault's body of work anthropologically examines the ways that power behaves by excavating the discourses embodied within technological systems across time and societal contexts. Foucault argues that power cannot exist without resistance, which are similarly embodied within technology and discourse. Several scholars further postulated how technological artifacts are integral to formations of power. Science and technology studies scholar Steve Matthewman situates Foucault as a technological theorist in addition to a social theorist, arguing that Foucault's work often

attributed power formations to the technological artifacts that developed alongside them (Matthewman, 2013). He writes, "Technologies like stethoscopes are designed to do specific things, to allow certain actions. That is, there is a morality to artefacts [*sic.*] which affect decisive transformations (Matthewman, 2013, pg.19)." In other words, daily objects that we interact with are materializations of power forces because they are, by design, embedded with meaning and purpose (Brey, 2008). Thus, interactions between computers and humans become deeply implicated as formative discursive sites of (dis)empowerment. Indeed, critical HCI research has focused on the formation of power within techno-social systems. Increasingly accessible data-driven computational technology, such as smart home devices and employee productivity trackers, have contributed to oppressive formations of state, institutional, and interpersonal power by surreptitiously monitoring and exploiting trends within user-generated data (Monahan, 2016). Research documenting the use of data-driven computational systems as Technologies of Power is commonplace, particularly at the nexus of AI ethics (Crawford, 2021; Hong et al., 2020; Mirsky & Lee, 2021; Noble, 2018). In Foucauldian terms, data-driven computational systems constitute Technologies of Power, specifically because they are designed to subjectify (or identify) and exert control over their users via their data.

(Computational) Technologies of the Self

Critical and queer(ed) HCI research, however, has identified the collaboration between humans and computers as a site for developing a hermeneutic of the self. Much of this work conceptualizes power relations similarly to Foucault, placing empowering and dis-empowering forces in concert with each other. Scholars advocate

47

for an embrace of existentialism within HCI research to theorize how computational systems contribute to one's understanding of ones' self (or more broadly, humanity's understanding of itself), particularly from a post-humanist perspective (Kaptelinin, 2016, 2018; Light et al., 2017). This existential approach to HCI aligns well with Foucault's hermeneutic strategy, as they both consider how one might negotiate with power forces beyond one's control. For example, Kaptelinin (2016) considers the ways in which social sites like Facebook constitute the notion of "existence," even after the death of a user. From a Foucauldian perspective, Facebook becomes a Technology of the Self for those negotiating with discursive notions of death following the death of a loved one as they interact with their loved one's profile.

It is useful, however, to return to a discussion surrounding autotelic creativity tools as Technologies of the Self. As their names suggest, autotelic creativity tools exist to aid in creation for the sake of creation (Compton & Mateas, 2015; Steels, 2004). Paraphrasing from Kate Compton's dissertation, being creative for the joy of it is a part of what defines humanity (Compton, 2019, pg. 6). In the face of what, at times, seem like insurmountable formations of oppressive power, creation for the joy of it is an act of resistance. Thus, the tools we use to create become Technologies of the Self, alongside all of the discursive formations of power embedded within them. With this in mind, much of the work within HCI on computational creativity (Colton & Wiggins, 2012), autotelic creativity tools (Epstein et al., 2020), MICC/MICIs (Yannakakis et al., 2014), and other computationally-driven creativity platforms (Faller, 2016; Mateas, 2002; Turtle, 2022) can be interpreted as Technologies of the Self when used to empower ones' self.

3.2.2 Queer(ed) HCI

HCI scholars have recently examined how algorithms and AI are used and experienced by racialized, gendered, and otherwise marginalized communities (Jaroszewski et al., 2018; Noble, 2018; Scheuerman et al., 2020; Spiel, 2021; Spiel et al., 2019). This work also explores how HCI shapes complex sociological phenomena such as human sexuality (Hobbs et al., 2017; Kannabiran et al., 2012), as well as the discourse surrounding technosexuality within the broader HCI community (Irvine, 2014; Kannabiran et al., 2011). By calling for this community to examine their prejudices about sex and sexuality (Kannabiran et al., 2011, pg. 702), technosexuality research facilitated new opportunities for research on LGBTQIA+ HCI. Much recent queer HCI stems from this work, comprising a growing body of scholarship dedicated to exploring the diverse ways that the LGBTQIA+ community engages with and challenges HCI (Spiel et al., 2019).

Within queer HCI, technosexuality comprises a large portion of the work that places HCI in conversation with queerness (Chan, 2017; Miles, 2017; Spiel et al., 2019). However, queer theory is useful beyond exploring how AI and technology impact the LGBTQIA+ community alone. Queer theory is, by nature, a difficult framework to define. However, it can be described as a "troubling (Butler, 2015)" of normative ideologies by exploring radically alternative *possibility spaces*. To gain access to these radical possibility spaces, we must travel through time and develop linguistic tools to describe a yet-to-exist reality. Thus, *temporality* and *discourse* are important methodological tools when using queer theory, imagining radical queer Utopian futures while still being temporally and discursively situated in a present that is informed by the past. As José Esteban Muñoz puts it, "We have never been

queer, yet queerness exists for us as an ideality that can be distilled from the past and used to imagine a future. The future is queerness's domain (Muñoz, 2009, pg. 36)."

This work operationalizes queer theory beyond examining the ways in which AI and the queer community interact. Queer HCI research utilizes queer theory to examine and problematize essentialism and normativity within the field's historical foundations. Using queer theory as framing for her analysis, Light (2011) deconstructs how the field of HCI reifies normative, "technocentric" ideologies within an increasingly technological world by aligning itself with the security and funding that comes from the technology industry under global capitalism. She suggests that the field engage with queer theory as a tool for examining itself from an "off-centre" and "self-analytic" perspective that enables radical visions for the future of HCI and technology as an extension of humanity (Light, 2011). Thus, queer theory is useful when designing, conducting, and disseminating research focused around the development of day-to-day technologies like algorithms, deep learning models, and user interfaces.

For example, Dinan et al. (2020) utilize queer theory to examine online gendered discourse as a site of reproduction for normative gender ideologies when training natural language processing (NLP) models. In doing so, they imagined a queered future where NLP models resist and subvert normative gender ideologies rather than reproduce them. Their queered imaginary future informed the development of a multi-dimensional framework that decomposes and measures gender bias in online discourse. Their study resulted in an operational model that is publicly available to conduct research on gender-normative ideological bias in the online discourse used to train NLP models (Dinan et al., 2020). This paper is but one example for how queer theory critically examines the normative impacts of day-to-day HCI and builds practical technological solutions.

3.2.3 Computational Creativity & AI

Computational creativity is a relatively well-established field of study, which explores the ways that algorithms can be creative (Colton & Wiggins, 2012; Colton et al., 2011; Wiggins, 2006) as well as the ways that humans perceive and place value upon algorithmically-generated creative artifacts (Mazzone & Elgammal, 2019; Rohrmeier, 2022). A ubiquitous definition of "creativity" is challenging to succinctly define from the literature due to its socially constructed nature (Parkhurst, 1999). However, several computational creativity scholars commonly ground their discussion in positive psychology, namely the work of Csikszentmihalyi, who has written extensively about the psychology of creativity in humans (Csikszentmihalyi, 1996). Computational creativity scholars reference his work on flow and autotelic activities in relation to co-constitutive human-algorithmic systems dedicated to the creation of some artistic artifact (Compton, 2019), or otherwise refer to the model of creativity put forth by Csikszentmihalyi (2014) to theorize about computational creativity (Jordanous, 2016).

Since the advent of AI technology like generative adversarial networks (GANs), variational autoencoders (VAEs), and diffusion models, computational creativity scholarship began focusing on how these technologies *redefine* notions of creativity for both AI and humans (de Vries, 2020). Mazzone and Elgammal (2019) essay on the reception of AI Creative Adversarial Network (AICAN)'s creative artwork, for example, explores whether AI can create socially legible art. The authors conclude with the ambiguity that AI brings to socially constructed concepts such as creativity and autonomy. Ultimately, they argue that creative AI ought to be considered more than a simple tool, but less agentic than a human artist. They *redefine* creative AI as an artistic medium, which pays respect to "the range of possibilities and limitations

inherent to the conditions of creation in that area of art (Mazzone & Elgammal, 2019, pg. 8)." Their conclusions suggest that AI ought to be used for mixed-initiative co-creativity (MICC), defined as collaborative creation between a human user and a computational system (Yannakakis et al., 2014).

Deterding et al. (2017) argue that MICC occurs on a spectrum of human-computer engagement, with one end of the spectrum being human-driven with the computer as passive helper and the other being computer-driven with the human as passive observer (e.g., Pagnutti et al., 2016). The resultant midpoint between these two extremes are *mixed-initiative creative interfaces* (MICIs) (Deterding et al., 2017), which Mazzone and Elgammal (2019) frame as "artistic mediums" that blur the line between creator and tool. MICIs are characterized by a substantive feedback loop between the human-computer creative team where each builds upon the other's work (Kreminski et al., 2022) in proactive and generative ways (Liapis et al., 2016). This feedback loop engages the user in *autotelic creativity*, or creativity for its' own sake. Thus, AI tools that facilitate autotelic creativity can be considered *casual creators* (Compton, 2019; Compton & Mateas, 2015), which are technologies that afford users the ability to delve deeply into the possibility space they are exploring by allowing them to bypass the time it takes to acquire the technical skills needed to create from scratch (Liapis et al., 2016).

3.2.4   Queer(ed/ing) MICIs

M. H. Huang et al. (2019) theorize *mixed-initiative co-creativity* (MICC) from an economic perspective. They theorize three forms of machine intelligence: mechanical, thinking, and feeling. Mechanical and thinking intelligence are characteristic of the

narrow AI that we are familiar with today, whereas feeling intelligence is theorized to be a feature of a nascent general AI that, arguably, does not yet exist. Thus, the evolution of AI has driven a shift towards a *feeling economy*, where humans are still relied upon for labor that requires having feeling intelligence, such as the creation of socially relevant artwork. Therefore, AI with thinking and mechanical intelligence allows humans to bypass the time and energy that mechanical and cognitive intelligence demand (e.g., learning to paint) to explore the "feeling" possibility spaces of the task or activity more deeply. Thus, certain creative possibility spaces would require substantial effort to explore without the affordances from casual creators, perhaps rendering those spaces inaccessible to those who can or will not acquire the mechanical and cognitive skills needed for certain modes of creation. Put another way, MICIs are casual creators which afford users access to novel emotive possibility spaces by allowing them to easily outsource their mechanical and cognitive labor to AI. In these ways, autotelic MICC tools have already contributed to radical reimaginings of emotive (Cheatley et al., 2022; Pease et al., 2022) as well as artistic (Compton & Mateas, 2015; Kreminski et al., 2022; Liapis et al., 2016; Mateas, 2002) possibility spaces.

Considering how quickly and radically AI has shifted the world to a feeling economy by allowing humans to "outsource" mechanical and thinking labor to machines, it becomes reasonable to conceptualize MICC and MICIs through queered notions of temporality and discourse. Thus, MICIs become technological, temporal, and discursive sites where queer Utopias can be imagined through novel autotelic creativity (Compton, 2019; Muñoz, 2009). Exploratory work examines this radically queer possibility space by leveraging MICIs as methodological tools. In their report on an autotheoretical experiment with StyleGAN (Karras et al., 2019), Grace Turtle

imagines how gender normativity and conceptualizations of their own gender might shift if humanity began conceptualizing AI as its own dynamic gender variation (Turtle, 2022). Turtle explores this queer futurity by training a StyleGAN model on photos of their own face and then examining StyleGAN's discursive and artistic output. Their experiment reveals that StyleGAN classifies their stylized portraits as "hairspray" and "toy poodle." This outcome, they argue, explodes the legitimacy of the classificatory discursive methods that designers rely upon when building AI, leaving space to imagine how radically queer(ed) AI might work. In fact, their report draws on notions of queer temporality to advocate for a reality in which categorization and the normativity it breeds relinquishes its hold on how we conceptualize the world. In other words, Turtle is working with their MICI in order to advocate for an embrace of the "indeterminate" when designing for HCI.

3.3 Conceptual Framework

3.3.1 Foucauldian Power Formations

Networks and Artifacts of Power

For clarity's sake, Appendix B contains the main Foucauldian concepts that we use throughout this chapter in addition to contextualized examples in the following sections. This study is framed within the the work of Michel Foucault, a post-modern historian and philosopher whose work largely focused on how *power* forms within society. Borrowing from his own description of the "microphysics of power Foucault (1975)," we conceptualize Foucault's theory on the formation of power as somewhat

akin to the study of physics. For example, the effects of gravity can be observed in the material world, but the force of gravity itself cannot be directly observed. Similarly, Foucault's theory situates power as an immutable force that cannot be directly observed, but can be understood by studying the ways it manifests within the observable world. Just as gravity behaves differently between atoms and celestial bodies, power behaves differently at the scales of the individual and society. Likewise, power forces are constantly acting and reacting with each other at the individual scale, magnifying the effects of the force as we zoom out to the societal scale, which respond in kind. Thus, the effects of power can be studied vis-á-vis the crystallization of these forces into observable phenomena, which Foucault describes as *discourse*. Importantly, Foucault conceptualizes discourse much more broadly than written and spoken word, although he is careful not to define it too closely. More specifically, discourse refers to the ways in which power, over time, becomes conceptually embodied within the material world around us through the manifestation of knowledge, which can be anthropologically excavated and studied. As discourse is written onto the individual, the individual gains *subjectivity*, becoming an embodiment of the formations of power which constitute subjects as empowered or dis-empowered.

Foucauldian Technologies

Foucault's own work on the histories of sexuality (1976, 1984a, 1984b), the prison system (1975), and clinical response to madness (1963) take an anthropological approach, citing discourse that contributed to normative knowledge on these topics. Foucault describes sociological "Technologies of Power" as the humanization of penal systems (via "panopticism") and the sterilization of medicine (via the "clinical gaze"),

among other things, in several of his works (1963, 1975). In short, Technologies of Power operate by generating humanizing discourse about systems of domination and discipline. According to Foucault, educational systems also serve as a disciplinary Technology within a capitalist society which seeks to control bodies through the installation of socially normative or "default" ideologies, such as heteronormativity or ableism (Foucault, 1961). Educational institutions within dominant Western societies have been critiqued by critical scholars as sites of power-Technology, in which the reproduction of power hierarchies manifest vis-á-vis the collaborative efforts of normative pedagogy and the constant threat of (real or perceived) surveillance to monitor social compliance (Bazzul, 2017; Simons, 2006). Foucault conceptualized the manifestation of constant surveillance, in part, through peer-to-peer interactions, wherein individuals constantly and (un)consciously govern each others' actions in accordance to dominant norms, expectations, and ideologies and enact social consequences on each other when deviations from those norms occur (Peters, 2007). Foucault introduces the concept of *Technologies*, which he describes as discursive tools that manipulate power forces. He outlines four major modes of Technology, being that of production, sign systems, power, and the self (Matthewman, 2013). Examining how these first three modes of Technology contribute to oppressive formations of power constitutes much of Foucault's work.

 Power Relations and the Self

Foucault's earlier work on power formations is critiqued a nihilistic because it insinuates that there is no escape from oppressive formations of power. However, lectures delivered at the Collége de France shortly before his death introduced his

56

emergent theory on a personal politic of power subversion, which he refers to as *hermeneutics of the Self* (Foucault, 2006). Foucault rejects the notion that there is an absolute solution to the problem of power that subjects might access through science, philosophy, or religion. Rather, a subject should practice a hermeneutic of the self, which relies upon the individual determining for themself their own interpretation of "truth" through a process of self-realization made up of both knowledge and spirituality. Notably, "spirituality" is an agnostic concept that is separate from religion (although, at times, related), referring to a "self-mastery and self-constitution (Westerink, 2019)." In other words, a hermeneutic of the subject operates at the abstracted intersection between philosophy, spirituality, and the subject's own relationality amidst formations of power. Hermeneutics are, therefore, a deeply subjective and nuanced practice that help subjects care for themselves amidst power forces, while simultaneously enabling them to negotiate their own power within the broader network of power formations. Foucault's notion of a hermeneutic of the self introduces the fourth mode of Technology to his theory of power formations. Technologies of the Self are discursive tools that individuals incorporate into their hermeneutic practices, which they utilize to govern their own behavior and negotiate with the networks of power they are embedded within (Foucault, 1988). Within this study, we explore the utility of one MICI, GauGAN, as a Technology of the Self for our interlocutor, Kami, as she processes the ways in which power manifests throughout her life.

3.4 Methodology

3.4.1 Data Collection and Interview Process

We utilize pre-existing qualitative data for this research, which was approved by institutional IRB at Arizona State University (Appendix C). The data for this study was collected via Zoom over the summer of 2020 and comprised 18 semi-structured interviews and several pieces of digital art generated by the collaborative efforts of the interviewers, nine interlocutors, and NVIDIA's novel open-access AI art making tool, GauGAN, detailed in a previously published work-in-progress (WIP) methods report (Jennings et al., 2021). Prior to this manuscript, that WIP methods chapter was the only work generated from this data set. It detailed how GauGAN was used in interviews and began examining our interlocutors' reactions towards GauGAN with *in vivo* quotes from each interlocutor's second interview.
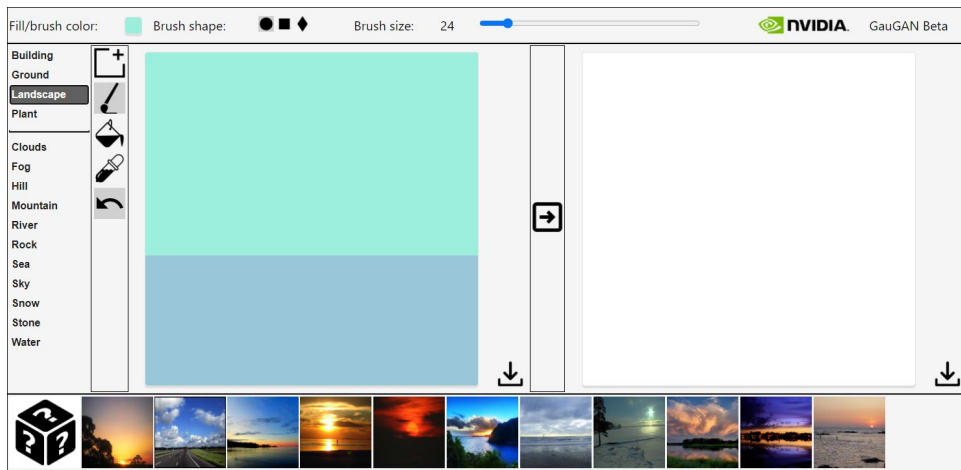

Figure 1. User Interface for GauGAN v1 Tool Depicting Brush Options (leftmost ribbon), Drawing Panel (left), Output Panel (right), and Output Style Options (bottom ribbon)

GauGAN

GauGAN is a MICI that is powered by an unsupervised conditional GAN. GauGAN is trained to transform user-generated input into convincingly realistic renditions of natural landscapes. The user annotation provided in the input pane generates a semantic map where pixels are classified to a particular object category (e.g., building, sky, water) according to the pixel color (Park et al., 2019). The network then uses this map to help condition the generated photorealistic output which matches the real-world image statistics of landscapes it has been trained on. Figure 1 shows GauGAN's user interface. Since its introduction, the GauGAN tool has received numerous awards at vision and graphics conferences, and has spanned further interest in generative AI models. It is currently on its second version, which incorporates multimodal image synthesis (X. Huang et al., 2021). The updated version of GauGAN allows the user to iterate on the output using a combination of textual input, segmentation maps, fine-line sketches, and style choices. GauGAN's original version was not multi-modal; users could only provide visual input to be converted into a segmentation map and change the style of the output. The initial version of GauGAN was somewhat clumsy and prone to absurd output, and the style feature had little effect on the output image's segmentation map. As a result, GauGAN2 is a much more sophisticated MICI, capable of generating shockingly realistic visual output. Unfortunately, NVIDIA archived GauGAN v1, which is the version we used for this study, when they introduced GauGAN2 in 2021.

There are several limitations with using a generative AI tool in our study. Generative models are known to suffer from technical issues such as mode collapse (Thanh-Tung & Tran, 2020) where the output is limited to a fixed sample of a distribution (e.g.,

the same image or type of image) without variation. While GauGAN v1 and v2 did not suffer from extreme mode collapse, these models still offer limited out-of-domain generalization (i.e., they cannot generate images for semantic categories that they have not been trained on like people or animals). Indeed, this limitation is built into the user interface itself, as the discrete set of categories are built into the menu. The limits of out-of-domain generalization could be seen in our study where our participant struggled to make GauGAN interpret squiggly or abstract swirls in the input, which presumably was not statistically common features in the training data.

Interview Protocol

The interlocutor for this study, Kami, was one of several interlocutors recruited from solicitations posted to social media. She embodied several nuanced intersections of subjective experiences across various axes such as sexuality, gender, ethnicity, age, education, class, nationality, and more. In other words, she is a complex individual with a unique perspective that we were interested to learn from. In line with our guiding framework, we opted to forego providing identity-based descriptors for Kami unless she explicitly discussed her subjectivity as central to her experiences or world view. With this in mind, we note that Kami's subjectivities as multi-lingual, immigrant, and neuroscience graduate student with hermeneutic objections to "human brain as computer" discourse made her interviews particularly relevant for the purpose of this chapter. Additionally, Kami was already somewhat familiar with Foucault, which gave Kami the option to answer our prompts within the framework of the study.

Madeleine and Jorge's first interview with Kami was semi-structured and designed to elicit thoughtful responses about queerness, technology, and academia. Madeleine

led this interview while Jorge listened, occasionally interjecting with his own comments or questions. We made sure that Kami knew that she had complete agency over the topics of discussion, inviting her to let us know if we were encroaching on topics that she was not comfortable discussing. The interview protocol was designed to explore Kami's understanding of and relationships with power structures in her life, her experiences with technology, the ways that she navigated power structures, and the ways that she interacted with and cared for herself day-to-day amidst the structures of power that she was immersed in. The semi-structured interview protocol did not specifically elicit conversation surrounding queerness or other essentialist or identity-based topics. Instead, we allowed space for these topics to come up organically. If and when these topics came up, we invited deeper conversation around these topic by asking Kami clarifying questions based on her responses. We video recorded Kami's first interview with her consent and used it to transcribe our conversation verbatim. Transcribing Kami's interview enabled us to become more familiar with her and her data prior to her second interview, as well as to prepare it for later analysis. In addition to completing a verbatim transcription, the research team reviewed the video recording of Kami's first interview and met via Zoom to more deeply discuss the dialogue between Kami, Madeleine, and Jorge. This meeting also helped us to identify subject matter from the first interview that piqued our individual interests and related back to the Foucauldian framework. We video-recorded our discussion so that the meta-data that we produced on Kami's first interview was not lost.

The second interview that Madeleine and Jorge had with Kami followed our team's discussion on her first interview and was recorded with Kami's permission for analysis purposes. We designed the second interview to be semi-structured and to include an AI-assisted art-making activity. Jorge led this interview while Madeleine

listened, periodically interjecting into the conversation with their own questions or for clarification. We used GauGAN for our art elicitation prompt to encourage more explicit commentary on the role of technology and computing in Kami's personal life. Kami's second interview was informed by the data and artifacts (e.g., meta-data) produced by our first interview with Kami. This approach empowered Kami to revisit topics of conversation that she was particularly focused on throughout the first interview while also allowing her to bring up new, tangential topics. The semi-structured format of the interview also enabled us to ask for elaboration or clarification on the data that she provided during her first interview. As we talked, Kami made artwork using NVIDIA's GauGAN tool. Periodically, Madeleine or Jorge asked Kami about her creative decisions in GauGAN, her evolving relationship with the tool, as well as any insights or reflections that her art making process inspired for her. The data from the second interview was not transcribed into a textual format because it was necessary to preserve the art-making process alongside the flow of conversation. The video data also aided in producing a richer analysis by preserving nonverbal discursive cues, as well. These discursive cues arose as body language changes, tone of voice, and/or emotional arousal, which provided context and texture to our analysis (Leistyna, 2001).

3.4.2 Data Analysis

Our goal with this analysis was to bring to light the nuance embedded within creative human-computer collaboration, as well as to explore how MICC might shape the discursive and social fabric of queer(ed) subjectivity for Kami. Additionally, we felt it necessary to conduct our analysis with respect to how things have changed for

the researchers since Kami's interviews in 2020. Thus, our analysis methods were chosen to embrace Kami's unique subjective experience as well as to honor Madeleine's own subjective growth during the time between the interview and completing the analysis.

The first round of analysis comprised iterative viewings of the video data by Madeleine, alongside reflective memoing. The purpose of this first round of analysis was to prioritize Kami's voice, ensuring her insights were not lost during the second, auto-ethnographic round of analysis. This technique was partially inspired by the *The Listening Guide*, a voice-centered, feminist, and relational methodology for examining qualitative data (Gilligan et al., 2003). In particular, we borrowed the focus on multiple viewings and readings of the data, as well as listening for Kami's voice. Where we depart from The Listening Guide, however, is our focus on auto-ethnographic analysis and aligning Kami's data with Foucauldian theory. For example, one of Madeleine's early viewings involved watching sections of the video in chronological order while also descriptively documenting what Kami was communicating through her words, actions, gestures, and art. In the second round of analysis, Madeleine wrote interpretive, analytical memos that connected Kami's data in relation to Foucauldian Technologies. Due to the inter-relational nature of Foucauldian Technologies, Madeleine made sure to capture their own auto-ethnographic data using memos that captured their real-time reactions and emotions in response to Kami's interview video. This approach enabled them to make deeper connections between the data and the conceptual framework by scaffolding their own experiential knowledge to the insights generated from Kami's own voice as well as the Foucauldian analysis.

Finally, Madeleine combined the insights, memos, and artifacts that had been generated from the first and second rounds of analysis to construct an interwoven

storied narrative featuring the insight and knowledge from the Kami, Madeleine, and Jorge of 2020, as well as the Madeleine from the summer of 2022 (Grant, 1997). The temporal and subjective aspects of the resultant tapestry of knowledge paints a more holistic picture of how Kami negotiates her subjectivities at the intersection of HCI, how engaging in this research shaped Madeleine's own subjectivity, and how one narrative led to more complex and nuanced understandings of Technologies of the Self. Keeping with the Foucauldian tradition, this methodology honors the ways in which subjectivity fluidly shifts with respect to temporally and contextually situated dynamics of power. Phrased more philosophically, our approach to this research draws upon the epistemological assumption that reality is socially constructed within the context we experience it in, making reality subjective in nature and rooted to the temporal, social, and material realities and contexts of the moment.

3.4.2.1   Our Position on Positionalities

We believe our individual experiences to be unique and subjective as a collateral effect of our independent social positions, which are informed by our politicized identities. As researchers, these subjective experiences are drawn upon when designing, collecting, and interpreting our research. Thus, we share our positionalities to our research here in the hopes that knowing more about us helps our readers understand our motivations for this work more thoroughly and facilitates an ethos of trust (Besley & Peters, 2007; Hampton et al., 2021; Secules et al., 2021). Because Madeleine's voice is centered in this chapter, we are providing a more detailed description of their positionality. The remaining authors' positionalities are also included to provide context and information about their motivations, which were influential to the design

and execution of this research. However, their positionalities do not include the same level of detail as Madeleine's because they were less involved in the analysis for this chapter.

I (Madeleine) facilitated and led this research as a part of my doctoral dissertation with much guidance, support, and advising from my coauthors. I am a doctoral student in a STEM-focused education program with a background in human factors engineering. I am also privileged, yet marginalized within normative spaces as a white person who is also queer and disabled, so my interest in this research stems from a desire to more deeply understand my own personal experiences in relation to others'. During my doctoral education, I have taken classes and developed expertise in domains such as Queer of Color Critique, Critical Education, Data Visualization, Cognitive Science, and more. To that end, I tend to gravitate towards research that blends critical and queer(ed) methodologies with STEM. I have leveraged my experiential knowledge from being queer and disabled in STEM and academia with my developing domain expertise in critical methodologies, queer theory, critical theory, and education research to inform the design and implementation of this research. My educational background in human factors and manufacturing engineering also informs my perspective towards HCI. This chapter embodies my interest in exploring the moral, ethical, and philosophical ramifications that arise when queering HCI (and particularly AI).

The remainder of the authors include a postdoctoral researcher, a PhD candidate, and three professors. They have motivations that include supporting equitable change, developing critical understandings of the culture of engineering education, and using AI and computer vision technology to support educational research. They include insiders and outsiders to the queer community. They also embody subjective experiences across

65

various axes such as sexuality, gender, ethnicity, age, education, class, nationality, discipline, and more. They were involved in varying degrees with the design of this project, the conceptual framing of the project, data analysis, and pursuing funding to support this project. This team has learned from each other and the dialogues with the interlocutors, but they also learned about themselves and their own subjectivities as a result of their involvement in this project.

3.5 Findings

3.5.1 GauGAN as Foucauldian Technology

Kami experiments with some brushes and starts exploring the tool's logic. Her reactions to how GauGAN interprets her input convey genuine interest, curiosity, and enjoyment, so we give her a few moments to process the experience. She is baffled by the output, I notice that she keeps bringing up her curiosity about how GauGAN makes "semantic interpretations" of her input and translates them to a landscape painting (see Fig. 2). After a beat, Kami explains that as a neuroscience PhD student, she has become well-versed in data science as a tool to conduct her own research, which is dedicated to exploring the machinations of the human brain. As she plays with GauGAN, Kami begins talking about research on creativity and the flow state. Kami explains the flow state as a combination of time distortion and intense focus on a task, but she makes a point to differentiate types of flow state that she experiences.

While she talks about flow state, I recall Kami's first interview. She talked about how she was a "serious amateur" pianist when she lived at home in a post-Soviet nation. I recall how she explained that piano was a hermeneutic tool that produced

complex emotions for her. On one hand, piano served as one of only a few gateways into her emotional self because as an adult, she played as a creative outlet and to self-soothe. On the other, it was culturally expected of her as a child growing up in a post-Soviet country to master an instrument, so she saw piano as a source of her unhealthy perfectionist tendencies. Despite her trauma surrounding playing the piano, she continues to be a proficient player. But as an adult, she is relearning how to use it as a hermeneutic tool for herself rather than succumb to piano as a material metaphor for capitalist notions of perfectionism, work ethic, and discipline. Her relationship with piano and creativity was something that we had wanted to explore deeper, so I am excited that she brought this up on her own.
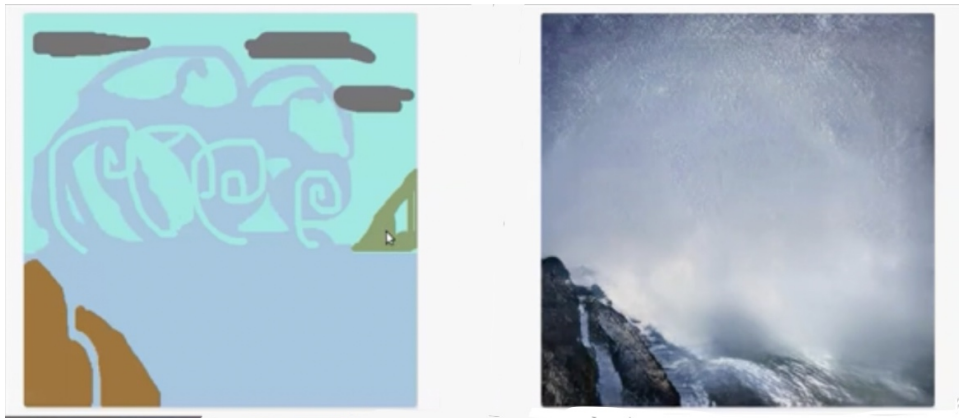
Figure 2. Kami's First Rendering using GauGAN

I listen as Kami describes the types of flow state that she experiences. Her "cognitive" flow state is tapped by her research, and she explains that her computer is the conduit between flow and research. She notes that playing her keyboard piano and typing are "mechanically" similar in terms of finger movements, perhaps indicating that this action is responsible for triggering her flow state. However, she is quick to specify that the flow state she reaches when she is playing piano compared to when

she is doing research is very much not the same. To her, the flow state that she experiences when playing piano is more organic and "emotional" flow. Her creative flow differs from her cognitive flow with regard to how they are triggered, the nature of the flow state, and what she gets out of her flow state. She reaches cognitive flow when she is doing research, which she describes as more structured, algorithmic, and computational. As I listen to her describe her creative and cognitive flow states, I start to wonder which state GauGAN taps into for her. But as I continue my analysis, I realize that GauGAN taps into both her creative as well as her cognitive flow states and that these states may not necessarily be mutually exclusive.

As a scientist, she hermeneutically engages with GauGAN in an investigative manner in order to make sense of its behaviors. To me, this is evidenced by the fact that she adopted an algorithmic approach to figuring out GauGAN's "semantic" patterns when she realized that she was not interpreting clouds in the same way that GauGAN was. She wanted to create a sunny island beach landscape with waves on the water, but GauGAN was interpreting her input as a wave crashing over rocks. I watched her try to correct the semantic discrepancy between her and GauGAN by constructing an adaptive algorithmic process. First, she selects the brushes that she understands as aligned with her vision. She was trying to hand-draw wispy clouds against a blue sky, back dropped against wavy ocean. Instead, GauGAN created a picture of mist from a wave breaking over a rock with very little sky in the background, so she responds to its output by selecting the "sky" brush. Next, she identifies the place in her drawing that she thinks GauGAN is interpreting differently and makes slight changes that she believes will correct the discrepancy. I watch as she tames her waves, drawing them closer to the horizon line but still trying to preserve some of their wildness. When she is finally satisfied with the changes that she has made to her input drawing,

she renders GauGAN's output to see how its interpretation has changed. She then updates her tactics based on this new information and starts the process again. From her algorithmic approach, she quickly learns that GauGAN has trouble interpreting her "swirls" as waves, which she notes as strange as she associates waves with swirling water. GauGAN, on the other hand, seems to render more legible output when her input is more generic and simple, or less stylized (Fig. 3).
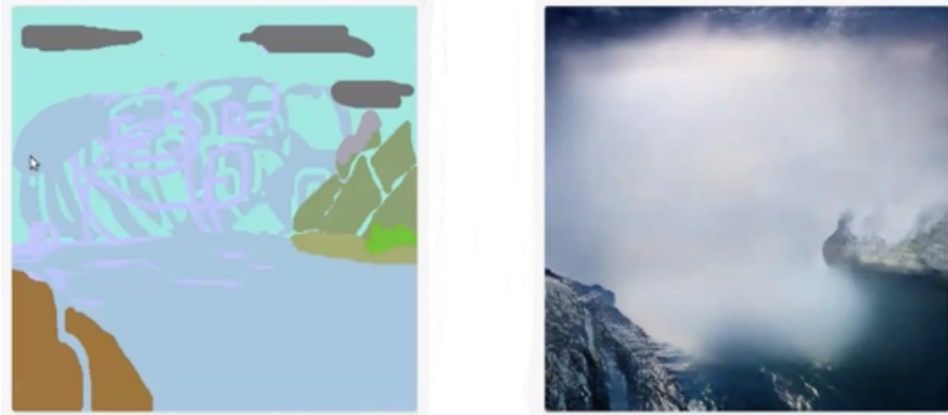
Figure 3. Crashing Waves Against a Sunny Island?

Watching as she goes through this algorithmic process, I realize that Kami appears much more comfortable and open compared to her first interview. At the time, I recall attributing this change in her demeanor because of an increased familiarity with us. Now, it occurs to me that Kami has used GauGAN to tap into her creative flow. It is clear that she has a vision for how she wants the output to look, and she is approaching the limitations of the tool by using language, logic, and reasoning that it understands. At the same time, she is testing GauGAN's creative boundaries and is also much more fluent in how she describes complex emotions and interpretations that arose from the intersecting topics of creativity, flow state, and technology. As she maps out GauGAN's semantic reasoning and relates it to her own, she effortlessly

bridges the conversation from flow state to her own sexual, ethnic, and cultural subjective formation. I am in awe of the ways that Kami understands her own subjectivities in relation to the rest of the world, and am pleased that this creative exercise seems to have helped her verbalize her hermeneutics more fluidly. None of our first interviews were this rich, as none of our interlocutors were able to put words to the rich theorizations that they had about their own subjective experiences. I note that Kami is utilizing GauGAN as a Technology of the Self in this moment, despite its limitations to her stylistic creativity, by using it to reach this hybrid flow state that is facilitating this insightful discourse.

3.5.2 Semantic Technologies of Power and Self

Kami has referred to GauGAN's brush interface using the term "semantic reasoning" several times by this point in our interview, but I notice that she has replaced this term with "language" a few times in the past few minutes. She has stated that she is trying to figure out GauGAN's language so she can make what she is envisioning. After a brief silence spurred by Kami's focus on GauGAN, she explicitly makes the connection between semantics, language, and her own subjective formation.

Kami explains how her sexuality takes on different forms between these different contexts as a function of language, discourse, and ideology. In her Russian speaking culture, she tells people that she is a lesbian because there are no Russian words to fully describe her sexuality and gender. Bisexuality, she says, is still a foreign concept to most without introducing genders outside of the binary. Within the contexts of her home country, she explains that being constructed as a lesbian inculcates her into certain communities and roles within those communities. During her first interview,

she talked about how she was understood and treated as a lesbian woman at home by the gay men that she spent time with. According to her, they looked down on lesbian activism as unimportant women's work, which placed her in a second-tier status in relation to these gay men that she hung out with. Now, Jorge is asking Kami about how the notion of community changes between here and home. Kami explains that at home, the type of marginalization that people experience constructs communities that share experiences with the same types of marginalization. Here, identitarian politics govern the community dynamics, resulting in what Kami calls "higher-level segregation." This results in the identity-based community being very "tightly knit" because "[their] Venn diagrams overlap much more." This identitarian construction of community that Kami is describing as common in the U.S. is thus responsible for the "tightness" of the community while simultaneously acting as the mechanism with which the community gatekeeps who has access. At home, advocacy is not as predicated on identitarian politics, but on the common good of marginalized groups. Here, Kami has to "choose" who to advocate for, based on identitarian politics. She resides at the intersection of "immigrant" and "queer" in the U.S., complicating her ability to access identity-based communities due to the semantic complexity of her subjective experiences.

After explaining how her sexual subjectivity is constructed differently based on two different semantic cultural practices, Kami tells us that she identifies as pansexual in the U.S. because the cultural contexts and language have adapted to shifting norms surrounding gender and gender roles, making American semantic cultures more accommodating to genders beyond the binary. Despite language and culture in the U.S. accommodating how she understands her own gender and sexuality more holistically than her native language and culture, Kami problematizes this seemingly liberating

semantic reasoning as an alienating tool in its own right. She explains that there is a much greater emphasis on finding or constructing identity-based community in the U.S. compared to home. Although she has used language as a Technology of the Self to explore and define her own sexuality and gender autonomously, the semantic meanings embedded within the language she uses to describe her subjectivities often obfuscate her ability to form community with other LGBTQIA+ people in the U.S. This is because, in addition to being discursively formed as a pansexual woman, she is constructed as "immigrant," making queer communities in the United States feel exclusionary, as well.
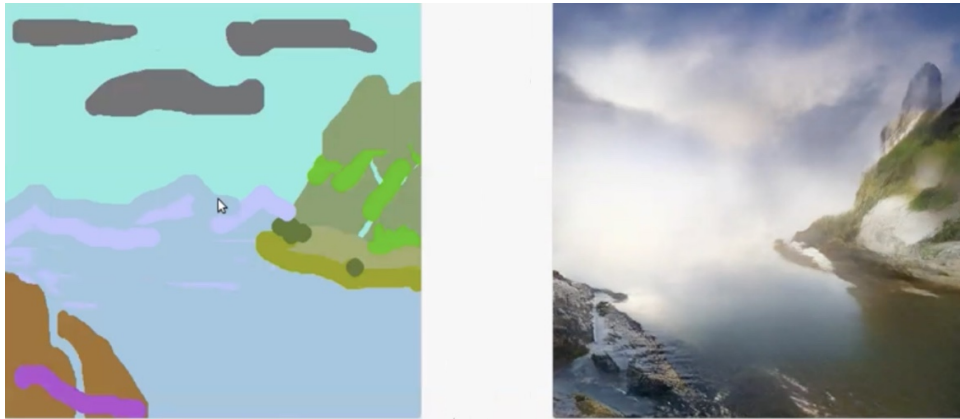
Figure 4. Revising Input to Remove a Persistent Fog Cloud

I notice the parallels between what Kami is explaining and how Kami is engaging with GauGAN. Kami has the language and semantic experience to construct heuristics that she uses to differentiate sea from sky or wave from cloud, regardless of her stylistic choices. GauGAN, however, processes categorically. It compares what it sees to what it knows with little attempt to construct accommodations for semantic input that defies its conventional means of categorization, and it resists (or even destroys) attempts to establish common semantic cues. So, when Kami provides

input that straddles categories as she did when she drew large, stylized, swirly waves, GauGAN sees her ambiguity and resistance to categorization, shrugs its proverbial shoulders, and tosses Kami's stylized input into one of its pre-established conceptual bins anyways (Fig. 4). It then offers Kami no opportunity to teach it about the semantic heuristics she has developed from her unique experiences, demanding instead that she adapt her interpretation of a sunny island scene to its own. I am struck by how similar Kami's experience with queer community in the U.S. seems to be.

Kami begins to focus more on her art again as I talk. It is interesting to me that she creates while we are talking, and I wonder if this is a bit of a self-soothing behavior in response to the topics that we are talking about and the things that she is saying. Perhaps she is feeling anxious about the conversation? At any rate, she begins to answer my question about experiences with biphobia here and at home. She states that at home, biphobia is less of an issue because people are "unaware" of it; therefore, they don't necessarily have the language for it with which to marginalize others. She says that her society does not have the bandwidth to care about it, necessarily. "People are aware that LGBT people exist, but people aren't aware of the different struggles between the L vs. the B vs. the G vs. the T." Here, the dialogue has progressed farther because it's been longer. Romantic minorities being a topic of conversation here in the U.S. is an example that she uses to contextualize what she means.

She abruptly changes the conversation to GauGAN's interpretation of her input (Fig. 5). "The AI tries to... I feel like the... this is what it's kind of perceiving to be the road, even though I am trying to actively discourage it from that... The road is being, like, perpendicular to the ground... "Let's try to replace it with gravel. Let's see if that... Interesting... Maybe it's not the- the road? Maybe it's... Okay, maybe... Let me try this, maybe... Oh, maybe it's seeing stones and it's just

73

creating stones. Maybe the dark gray thing is the stone... It also does not help that the colors of the brushes are not the same of the colors of the- whatever the semantics they're entailing." "I kind of like this. I dig the, um... whatever is happen- Oh look, oh no! The fog is- The fog is so, like, white! I only drew a little bit of fog and it creates just this huge-" She undoes the fog input and makes the tool brush smaller in an attempt to make it less foggy (Fig. 5). "Oh here look, there you go! It just needs a very thin brush to create, like, a little bit of fog... There we go."
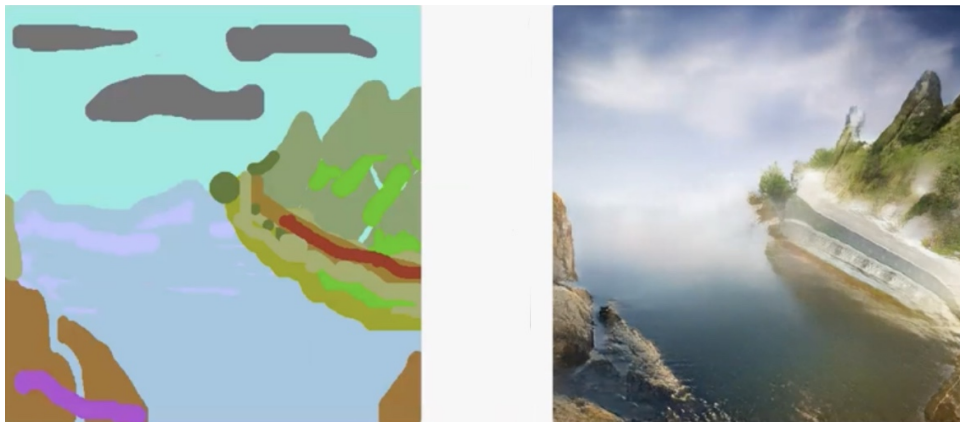
Figure 5. Still Trying to Preserve the Waves

Jorge asks Kami how she adapts to the ways that language and semantics shape her subjectivities. She responds that her pet theory about empathy and emotional connections between other people are useful in this adaptive process. She thinks of empathy as a copying of a mental state for the one who is empathizing as another. For example, an empathetic response to someone who is crying is to feel sad, as well. However, she explains that this connection is deeper for her than a simple mirroring of emotions. As she tries to explain this concept, she struggles to translate it to English. She says that we are just a collection of mental states of other people that we unconsciously copy, who are also unconsciously copying us. This explanation

makes me think about my belief in a collective consciousness, which has served as an important hermeneutic for me in particularly tumultuous periods of my own life. As I'm thinking about my own hermeneutics, this recording of Kami seems to read my mind as she reflects a similar sentiment. She explains that this empathetic mirroring theory of hers has played a vital role in her life for processing grief and trauma with regards to her relationships with others. Jorge brings up Erin Manning's thoughts on collective affect Manning (2010), in which she discusses our interrelated emotional states as a semi-intuitive "tango." Kami resonates with this, and they start talking more deeply about this topic. Again, she mentions how this theory brings her comfort specifically because she knows that she cannot experience feelings and emotions that haven't already been shared by others. Rather, her memories allow her to access these states, which she then uses to synchronize her emotions with others.

3.5.3 Antirepresentationalism and Immanence

This term access spurs another conversational tangent that relates to queered HCI. I ask about what is meant by access, and Kami responds by saying that she is a "staunch anti-representationalist" when thinking about the human brain. Initially, I am confused as to why she answers this way. I don't understand how her response is meant to answer my question. But she goes on to explain that the brain is a "black box." In other words, we aren't sure how it works, we just know that it does. For this reason, Kami is vehemently opposed to the metaphor of the brain being a computer that renders representations of the world. She explains that our "wetware" does not work like that, and does not work the way that we often want it to. I find this conversational tangent as jarring now as I did when we recorded

this interview. I believe her when she says she is an anti-representationalist when it comes to understanding the human brain, and I recognize some of the issues with the brain-as-computer metaphor. However, I find myself tripping over her description of the human brain as a "black box," because this term is often used to describe the process behind deep learning, which we also know very little about.

I listen as Kami explains her reasoning. "[M]emory is the process of reverting to the closest approximate representation of a memory, given that the brain is different at any given moment." She contextualizes her statement by explaining that our brain physically changes, meaning the atoms and neurons that captured a memory in the first place are not the ones that are used to store or recall the memory at a later time. Thus, memory is not perfect or representative of the world as we observe it in the present. This is interesting to me, and I ponder whether the ephemeral omnipresence of human memory is what differentiates our brains from AI. Again, as if reading my mind from the past, Jorge in the video brings up the Plane of Immanence, a Deleuzian notion residing within the realm of metaphysics, which refers to what exists of consciousness independent of material reality (Deleuze, 1997). Kami is familiar with this work and suggests that she has used Immanence to conceptualize her own understanding of human memory.

As Kami expresses a desire for fewer computing analogies and more artistic and philosophical representations to describe the metaphysical aspects of the human brain and the nature of consciousness, I begin to realize why Kami resents representationalist discourse in neuroscience. Perhaps the distinction between human consciousness and AI resides at the defiance of logic that human memory seems to occupy. Unlike machines, we are unable to carbon-copy our memories to new brain matter as old brain matter dies out, so we settle for approximations; yet our memories persist. The

memories that define us rarely leave us, although they evolve over time in response to the physical and emotional contexts in which our corporeal forms reside. And when we die, our memories die with us unless they are preserved in writing. However, the memory that is preserved is the original memory multiplied by the aggregate sum of our lived experiences. Our lived experiences, including our emotions, constitute our memories, which constitutes our consciousness. AI, on the other hand, can modify its "memories" as it gains experience. However, it cannot ascribe its own contextualized emotional meaning to its memories, nor can the context of time and re-remembering alter the original memory.

As Kami makes explicit that she has no desire for the human brain to be equated to a computer, I become aware that this insistence is an artifact of Kami's hermeneutics. She understands consciousness and memory to be unique to each person and impossible to simulate. I understand her insistence against representationalism as an artifact of the way that she makes sense of her own reality and her own worth. Specifically, the individuality and mutability of memory, interpretation, and experience is unique to human intelligence, and is something that a computer cannot reproduce. In other words, if human memories could be recalled in their unaltered state and copied to a new brain as they are in AI, then the uniqueness of the human mind ceases to exist, losing its Immanence. I idly wonder if it could be argued that emergent behaviors in AI are suggestive of Immanence, as well.

3.5.4 A Hermeneutic of Curiosity

I jump slightly, startled by my own voice as it interrupts my internal pontificating. I watch myself interject into their conversation to ask Kami about her art. She

explains that her process is guided by what she learns about the semantics of the tool as she engages with it, selecting her brushes based on what they produce in the output. I get the feeling that she is working with the tool in a way that it was "meant" to be worked with by NVIDIA, in that she seems to be suspending her own semantic interpretations of each brush in favor of GauGAN's. Despite the semantic limitations that GauGAN imposes, Kami insists that she does not feel limited in her creativity. I realize that the suspension of her own semantic assumptions allow her to explore the boundaries of GauGAN's semantic interpretations more fully, giving Kami access to the full scope of GauGAN's creative potential. She also appears reluctant to erase her progress and start over, despite GauGAN's occasional confounding output. I watch as she erases much of the background to see if she can remove the fog cloud that GauGAN is interpreting from her input.

Kami has spent a significant portion of the conversation trying to remove the fog cloud from the output and is finally successful. Although Kami has expressed that she is not feeling creatively stifled by her and GauGAN's semantic differences, she comments on her impression of the tool so far: "The logic that it follows is a little bizarre to me." At this point in the interview, she has realized that GauGAN has difficulty processing input that contains "swirly" lines or multiple levels of abstraction. GauGAN generates a photo-realistic version of a "realistic" input (or as realistic as what you can make on Microsoft paint), which necessitates sharp distinctions between sea and sky or mountain and shoreline. So, Kami starts providing her input using straighter lines and distinctive boundaries.

When I see how Kami changes her behavior in response to what she has learned, it occurs to me that Kami's creative process does not derive from her input. Rather, her creative process is embedded within the algorithmic approach she took to decipher
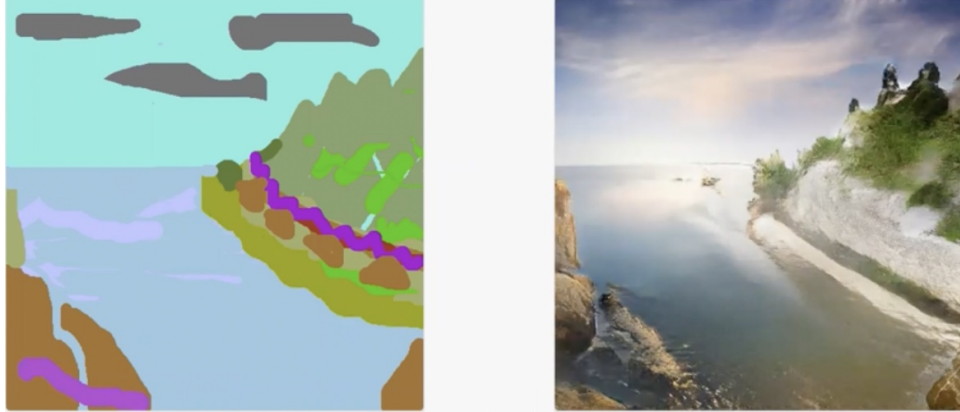
Figure 6. ■White Blob■ Continuing to Frustrate Kami

GauGAN's semantic logic. She has created her own hybridized meanings, resulting from what she has learned from her translational algorithm as her own cache of memories that she uses to define each brush (e.g., sea, sky, gravel, flowers). She has, in essence, created a hybrid semantic structure, which she is now using to construct meaning with GauGAN.

Through her creative approach, Kami learns that the tool is quite literal. She states that she does not think that the algorithm discriminates by layer; rather, it contextualizes all of the input as one picture. By following its logic, she is able to manipulate it to produce something closer to her desired picture. I mentioned that my understanding of the tool was that it operates similarly to the human brain. There is a pause, followed by "Interesting... My brain does understand swirls." She proceeds with exploring the semantic differences between the pens; namely the "sea" and "water" tools. I ask Kami how she is feeling at that moment as she is trying to navigate this program. "It is not very temporally aware of the changes that I am making." She states that she is a bit frustrated with the way that GauGAN is conceptualizing her drawing, and that she wishes that the horizon was a bit more defined than it is. Despite her frustration, however, she explains that her main reaction to GauGAN is

avid curiosity, as if she is a "little kid that got a new toy." She uses this as a jumping off point for a conversation about how she has "always enjoyed these more complex toys." The story that she tells following this disclosure is about her and her sister as children. They both enjoyed "free-form structure puzzles" versus toys that were more limited in scope or narrative. As she explains this, she stops drawing. However, she does mention that she likes where the piece has arrived, and she shares her realization that the tool "likes" straight lines more than more abstract input. After a beat, Kami modifies some of the clouds she has drawn in order to define the horizon (Fig. 6). Instead of making them more subtle like she wanted, GauGAN adds more clouds, causing Kami to exclaim "Why does it want this big white blob in the middle! Like, why?"

3.5.5 Examining Linguistic (De)colonization

Kami's semantic creativity has me thinking again about the role that language plays in the meaning making process. When we were talking about Deleuze and the plane of immanence, I remember Kami mentioning that Deleuze's understanding of "Nomadism" in his work is problematic. I decide to press her further on this opinion, asking what she meant when she problematized Deleuze's use of Nomadism in his work. She responds by explaining that she is part of a Nomadic culture which has a rich and storied history. However, Western interpretations of Nomadic cultures are bastardized, paraphrased, and steeped in xenophobia. She notes that she wasn't necessarily offended by the way that Deleuze used the concept of Nomadism in his work. Instead, she saw it as an example of the need to decolonize language and resist Western appropriation of Indigenous and marginalized discourse. Kami tells us that

colonial semantics have warped the collective understanding of Nomadism. Contrary to Deleuze's meaning of the word, Nomadism is a highly organized and systemic way of life. Deleuze, however, contextualized Nomadism as unenlightened and disorganized. This incorrect interpretation and contextualization of Nomadism is an artifact of European and American colonialism, and with this in mind, Kami audibly wonders if the word can ever be re-appropriated, or if her culture should let the word go and collectively create new linguistic and semantic meanings to describe their ways of life. Kami explains to us that she feels that the answer to this question may reside in developing an understanding of how colonialism "progressed" in different parts of the world. She states that she perceives Africa to be farther along in their decolonial journey than post-Soviet nations because her nation is only just beginning to grasp the concept of sovereignty. Neither Jorge or I quite know what to say to this observation, so we stay quiet in case Kami has more to say. I watch as Kami begins drawing again during the lull in conversation. A few moments later, I ask Kami about the pervasive nature of American-centrism and colonialism within her advocacy and her education and the conversation moves on. As I watch this now, however, it strikes me suddenly how little I understood about what Kami has just talked about. I do not and will never share her experiences with colonialism as a citizen of a colonizing nation-state. Thus, my semantic interpretation of what she has just told us will always remain incomplete, as we will never share a truly common language with which we might describe these complex concepts and understand each other fully.

At this time in the interview, I ask Kami why she seems to avoid structures in her landscape. She responds that she does not associate buildings with landscapes. She also explains that she is trying to work within the limitations of the tool. Given our prior topic of conversation, I cannot help but wonder if human-made structures

Figure 7. Finally Sharpening the Horizon Line

might be representative of colonization. Within an artistic rendering of a natural landscape, the presence of certain human-made structures would certainly insinuate the domination of nature. From my prior experience with GauGAN, I know that the structural brushes produce renditions of modern bridges, buildings, and suburban homes. In my mind, these structures discursively represent the colonial urge to dominate and control nature, and I idly wonder if Kami feels similarly. Unfortunately, however, I did not have the foresight to ask her about this during the interview.

3.5.6 Technologies of the Self

Jorge asks Kami about how she takes care of herself. She states that she watches a lot of anime, not for the story line, but because she gains a lot of cognitive rest from immersion into other languages. Anime in particular depicts the nuances of certain Japanese hierarchies, which Kami says appeal to her Nomadic cultural background and experiences. She explains that these hierarchical depictions are "closer" to her own lived experiences than American shows. Similarly, shows produced from the context of her own culture tend to be "low quality," making it hard for her to relate to them,

as well. She also plays Dungeons & Dragons (D&D), a fantasy tabletop role playing game. When she cannot play, she watches D&D campaigns online. She explains that D&D appeals to her need to care for herself because the unscripted, improvisational nature of the game facilitates "pure human interactions," which she finds extremely comforting and relatable. She also reads and listens to audio books "inordinately," and explains that books are her escapism tool.

Talking about reading and listening to audio books spurs a conversational tangent about an audio book anthology that Kami has recently finished, containing short stories written from the perspectives of marginalized peoples. One story in particular resonated with Kami, and she describes a short story about a lesbian graduate student who time travels to the past to gather an artifact from a woman physicist. The graduate student falls in love with the physicist in the past and stays back in time in order to be with her loved one. As I observe her talking about this story, I can see how much it means to her. Her face and voice are full of emotion as she describes how healing this story is to her. She explains that she was able to relate her own experiences to the story, which is something that she "craves."

As Kami talks about the craving to be represented in fiction, she is adding to her art. Suddenly, she interrupts her own monologue and exclaims, "Ooh, I love this!" after she has added grass to her coastline. Her and Jorge start discussing how beautiful it is that GauGAN can generate such landscapes out of her "squiggles" when it occurs to me that Kami has found a way for her vision and experiences to be represented within the semantic limitations that GauGAN imposes. As I watch her continue to create in GauGAN, I am surprised to see Kami select a structural brush for the first time. On the horizon, far away from the deserted island she has been creating to this point, she adds a human-made brick structure (Fig. 8). As she draws, she explains

that she is aware that the self-care activities that she chooses are very insular, which comes as a result of the ways that she was raised.

Figure 8. Kami's Final Creation

Similarly, her art depicts an oceanic channel cutting through rocky, mountainous terrain that is covered in lush, green vegetation. The land looks rugged and uninhabitable as the sun burns off the last remaining patches of fog, revealing a human-made structure along the horizon line. As she adds some final touches to the structure that she has drawn on the horizon, she expresses that she likes this addition because her art now represents her perspective that other humans are present, but simultaneously "very, very far away." As we finish the interview with Kami, I am aware that she has used GauGAN to create an artistic representation as she sees herself in relation to others.

3.6 Discussion

3.6.1 GauGAN as Queer(ed) Hermeneutic

Examined through the lens of Foucauldian power formations, Kami's engagement with GauGAN helps to map out the politics of power that are embedded within MICIs. At the end of our interview, we asked Kami what her thoughts were on using GauGAN's MICC interface as a tool for self-reflection. She told us that the process of deciphering GauGAN's "semantic structure" helped her to more fluidly and naturally verbalize complex thoughts and concepts surrounding the ways that she cared for herself. Borrowing Freudian terms, Kami succinctly explained that GauGAN "occupie[d] her id with something very semantics-based [which] let the ego speak." In other words, her id – the part of her concept of Self relating to pleasure – was occupied by the satisfaction derived from successfully negotiating with GauGAN and reproducing the image of an island that she had in mind. As her id was occupied with GauGAN, her ego – the conscious, unconscious, and emotional Self which governs the id – was temporarily relieved of its responsibility to form the creative semantic structure that would have been necessary with analog modes of creation (such as learning proper form and theory when, say, painting a picture). Despite GauGAN's semantic authority that governed the mode of co-creation, Kami was able to use GauGAN as a Technology of the Self, enabling hermeneutic engagement with the self (e.g., Kami's "ego") via the act of creation.

Most evidently, the impact that GauGAN had on Kami appears to be consistent with Huang et al.'s (2019) theory that AI is ushering in the era of the "feeling economy." As we have already discussed, GauGAN enabled Kami to explore her own

hermeneutic practices more deeply by taking over the mechanical and thinking labor necessary to create photorealistic art. Finding herself bound within a pre-determined logic, creating with GauGAN allowed Kami to leverage GauGAN as a Technology of the Self, as she was able to devote her energy towards the "feeling labor" that is necessary for engaging with one's hermeneutic practice. Simultaneously, the pre-determined logic that GauGAN forced on Kami acted as a Technology of Power, which limited her creative options.

GauGAN's AI uses semantic mapping to translate user input based on which brush was being used, what size the brush was, where the input was drawn with relation to the horizon line, the shape that the input was drawn in, and input that had already been rendered as output. These heuristics comprised a semantic structure that was specific to GauGAN but not visible to the human user. This meant that Kami was forced to decipher the logic within GauGAN's semantic maps in order to effectively communicate with the tool, forcing Kami into a state of dis-empowerment. However, Foucault points out that power cannot exist without resistance, which is a hermeneutic strategy for personal empowerment. At the start of the interview, GauGAN's semantic laws represented a Technology of Power that demanded Kami suspend or modify her own semantic understandings of the world that were derived from her lived experiences. Her experiences are marginalized by the semantic authority that GauGAN has in the interaction, given that the tool has an extremely limited structure of logic. Thus, GauGAN is constituted as a Technology of Power, as its discursive structure forces users into limited modes of creation. As Kami continued to use GauGAN, however, she found ways to resist the power forces that GauGAN exerted on her by translating her Self into compatible semantic logics. As we learned at the end of her interview, Kami's final image acts as a metaphor for the ways that

she negotiates her own subjectivities amidst manifestations of subjectifying discourse. Throughout the interview, however, Kami focuses on deciphering GauGAN's semantic logic so that she could manipulate the output to her satisfaction. Kami learned and adapted to these laws, enabling her to subvert them and express her creative vision the way that felt right to her. This negotiation is embodied in the final image rendered in GauGAN's output pane, as it is a representation of the Self, portrayed within the limited semantic structure that GauGAN provided. Thus, Kami's interaction with GauGAN embodies the ways in which networks of power, comprising Technologies of Power and of the self, are in a constant state of development.

3.6.2 Implications for HCI Research & Design

As several HCI scholars have attested, creativity is as native to humanity as technological innovation (Compton, 2019; Compton & Mateas, 2015; Deterding et al., 2017; DiPaola et al., 2018). AI is becoming a more sophisticated and accessible artistic medium (Mazzone & Elgammal, 2019); thus, MICIs like GauGAN have become more commonplace as hermeneutic Technologies with the potential to benefit humans' emotive and spiritual well-being (Cheatley et al., 2019, 2022; Pease et al., 2022). This study looked at a particular MICI, GauGAN, through a Foucauldian lens to investigate the power relations it discursively embodied and reproduced. As we have reiterated throughout this chapter, formations of power are discursively embodied within technological design. We note several findings that have implications for designing future MICIs for hermeneutics.

The design of GauGAN's user interface gives the visual impression that the user of the tool was an afterthought, given its uninteresting, un-intuitive, and jargon-

laden user interface. Indeed, Kami repeatedly mentioned that she had difficulty understanding the semantic structure embedded within GauGAN. Despite it being solely devoted to autotelic MICC (Compton & Mateas, 2015; Yannakakis et al., 2014), GauGAN's aesthetics communicate that a degree of literacy with computational technology and AI is necessary for successfully utilizing the tool. For example, the tool does not afford a baseline understanding of the uses and limitations of segmentation mapping. As a result, Kami had to figure out those limitations for herself. Thus, GauGAN's un-intuitive user interface constitutes a dis-empowering discourse, which coerces users into subjugation, dependent upon the creative boundaries that the MICI (does not) afford. We suggest that the interface designers for MICIs invite prospective users to contribute to the tool's design (S. Waller et al., 2013). *Meet the GANimals* is an excellent example of a MICI with empowering affordances discursively embedded within its design (Epstein et al., 2020). Although this casual creator has a limited scope (i.e., generating hybridized animals using a GAN), the site provides rich context for the user regarding the system architecture, the purpose of the controls, and examples of mode collapse. Additionally, the site enables users to train the network themselves by providing qualitative feedback on output images.

3.6.3   Conclusion

We conducted two interviews with our interlocutor, Kami, to discuss how AI shapes the formation of a queer(ed) subject. In our second interview, Kami created artwork with the GauGAN tool while discussing the ways in which she negotiates her own subject formation using Technologies of the Self amidst Technologies of Power. Our analysis adopted Foucauldian conceptualizations of power formations and

hermeneutics, examining Kami's embodied discursive cues as well as her interactions with GauGAN throughout the interview. Our approach enabling a deeper read into the ways that Kami negotiated her subjectivity among larger power forces in her life by leveraging the affordances/limitations given by GauGAN as a Technology of the Self. Implications for HCI research include deeper exploration into the use of AI-driven MICIs as Technologies of the Self, development of user-centric participatory design strategies for MICIs, and studying how MICC AI empowers and dis-empowers users.

Chapter 4

TODAY'S GRAD STUDENTS, TOMORROW'S FACULTY: LGBTQIA+
GRADUATE STUDENT EXPERIENCES NAVIGATING THE INSIDER/
OUTSIDER PARADOX IN ENGINEERING

4.1 Introduction

LGBTQIA+[1] doctoral students occupy a uniquely contested place in the higher
education system. As students, researchers, employees, teaching assistants, educators,
potential activists for social justice, and more, LGBTQIA+ graduate students shoulder
a significant burden of intellectual labor placed upon them by the academic institution.
Additionally, those aspiring toward academic careers learn disciplinary cultural norms,
values, and practices through their advisors, peers, and institutional faculty (Austin &
McDaniels, 2006). This socialization is particularly important to a graduate student's
future career, especially if they are interested in pursuing academia. However, for
LGBTQIA+ engineering graduate students, socialization presents a juxtaposition
in which they are forced to confront incidents of erasure and discrimination via the
politics of depoliticization throughout the scientific community while maintaining
their authentic identities — existing as outsiders within academia. In particular, the
field of engineering is undergirded by a deep-seated detachment from any political and
sociological considerations. This detachment, combined with a pervasive racist, sexist,
and heteronormative ideology, gives rise to uniquely oppressive cultural phenomena,

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[1]LGBTQIA+ stands for lesbian, gay, bisexual, transgender, intersex, queer, asexual/aromantic,
with "+" representing all other marginalized sexual or gender identities. We use this umbrella term
to refer to all individuals with a queer sexual or gender identity.

such as depoliticization, techno-social dualism, and meritocracy (Cech, 2013; Faulkner & Lie, 2007). These phenomena seek to decouple scientific work from social, ethical, and humanist values, thereby sterilizing it from its inherent and embedded human component. The systematic extraction of the inherent humanity within engineering and our collective responsibility to it produce an ideological void in which white supremacist, cishetero-patriarchial, and other toxic cultures brew. Members of the LGBTQIA+ community immersed within this toxic culture struggle with both mental and physical health as they encounter workplace cultures that explicitly and violently condemn them (Bilimoria & Stewart, 2009; Cech, 2013; Cech & Waidzunas, 2011, 2021; Yoder & Mattheis, 2016). The academy is not immune to assimilating into the oppressive ideological structures that demarcate engineering from other disciplines, impacting students and faculty alike.

Navigating within this environment as LGBTQIA+ produces a sharp, constant tension between wanting to be one of the few activist-oriented LGBTQIA+ engineering role models and the pressure to conform to the academic cultural norms in STEM. This tension is only exacerbated as one advances through the academy. As one gains the institutional power that could be used to create change, they are increasingly alienated by their LGBTQIA+ identity. This is the insider/outsider paradox, first described by Patricia Hill Collins (1986). Faculty and student affairs officials must understand these cultural factors and foster programming, spaces, and interactions between student groups to enable student resistance and identity development.

In this chapter, we recount our own lived experiences as LGBTQIA+ engineering graduate students as a means to highlight the oppressive nature of the neoliberal, capitalist, and exploitative foundations of the academy. Our chapter highlights the many ways in which external and internal cultural factors affect the meaning-

making processes for LGBTQIA+ doctoral students, particularly those in engineering fields aspiring toward faculty positions. This chapter features our counternarratives as LGBTQIA+-identified engineering and engineering education doctoral students. Together, we reflect on our experiences as undergraduates and graduate students in engineering and theorize how our continued involvement in the academy has manifested. Through our collaborative, autoethnographic narrative inquiry, we explored how we have navigated engineering and how our stories were shaped by the institutional resources that were intended to serve us. Notably, our counternarratives highlight ontological and epistemological differences in how we, as LGBTQIA+ graduate students, have adapted to and continue to individually negotiate with hegemonic structures in our fields (Butler, 1988; Sedgewick, 1990).

Prior to our counternarratives, we want to acknowledge the theoretical roots of this book's insider/outsider paradox framework. It is derived explicitly from Black Womanist thought, specifically from the work of Patricia Hill Collins. Black Womanist and Queer of Color Critique (QoCC) scholars and activists such as Angela Smith (2012), hooks bell (2001), and Roderick Ferguson (2004) understood the social categorizations of gender, sexuality, ability, class, and race to be both socially fabricated by hegemonic whiteness and materially felt by communities who do not benefit from whiteness. Thus, whiteness is constructed by defining precisely what it is not, meaning that the reproduction of whiteness cannot happen without the categorization and exploitation of those who are oppositional to it. Thus, we acknowledge our subjectivities here as researchers who benefit from whiteness, through either being white ourselves or (subversively or otherwise) aligning ourselves with institutions that reproduce whiteness.

4.1.1 Jerry

To be successful in engineering and achieve your career goal [of being an engineering professor], you have to first and foremost be technically competent. Such was the advice that my highly esteemed engineering professor gave me in my third year of undergrad. At the time, I was at a crossroads in my academic life. I knew I wanted to go to grad school, but I wasn't sure in what field. I had devoted years of my life to engineering and loved the semiconductor industry, but I was also passionate about education research and improving the state of undergraduate engineering education. What to do? It seemed that my time having a foot in both fields was coming to an end. As an able-bodied, cisgender, out, gay, Asian-American, male graduate student in engineering navigating the academy, my insider/outsider position forced me to compartmentalize my work, but it also enabled me to enact multiple modes of queer resistance in engineering and education spaces. Across the various spaces I inhabit, the identities that make me an insider and/or an outsider are fluid and constantly change, resisting definition or categorization.

I came into college wanting to do engineering. I wasn't the type to take things apart or work with my hands as a kid, but math had always been my strong suit, and I had really enjoyed the electricity and magnetism physics lab I took in high school, so I decided that the marriage of two similar fields wouldn't be too bad. And for the most part, engineering treated me well; after struggling along with everyone else in the first-year weed-out classes, I found my academic footing. I did very well in my engineering classes. I got a research internship in the semiconductor field, where I fell in love with semiconductor physics research. During my sophomore year, I began to TA for courses I'd done well in. For a strongly antisocial introvert, doing well in engineering classes

and TAing for courses achieved multiple goals: it furthered my persistent interest in teaching; it connected me with peers and professors, fostering invaluable friendship networks within the academic space; and, arguably most importantly, it established my insider status as an engineer to myself as well as my colleagues.

I realized that establishing myself as a technically competent insider in engineering early on was crucial for a future career in engineering academia. Along with my own internalized homophobia at the time, I made a conscious choice to return to the closet when I entered engineering. I didn't want my sexuality to impact my engineering work, for people to think less of my work than my straight colleagues', and for individuals to invalidate my work because of who I was. To me, the solution was easy: Compartmentalize my identities into neat little boxes that I opened only at specific places and times with particular people. In fact, engineering lent itself perfectly to that mindset, as the technical and depoliticized nature of the work made it easy to disengage from the social and personal issues that faced me in my non-engineering life (Cech, 2013). As I specialized in semiconductors and began applying to graduate programs, my engineering academic and research advisors reinforced my compartmentalization by placing heavy emphasis on technical knowledge and skills as the foundation of my success.

Despite my efforts to compartmentalize my sexuality, that little gay piece inside of me that loved cock still wanted to be nurtured in my undergraduate years. Since I didn't feel quite at home in either the engineering or queer social circles I found myself in, I took courses in a wide range of fields, including LGBTQIA+ studies. These courses were often quite transformational and even cathartic, as they forced me to reckon with my internalized homophobia. For the first time, I encountered queer people, spaces, and ways of thinking. I explored new modes of expression, understandings of the

94

world, and languages of communication in ways that I had only understood viscerally as a closeted gay man. These courses resonated with me so deeply because I saw that there was a rigor and an epistemology behind LGBTQIA+/queer thought, which I was also able to apply in my own life to think critically about the world and learn about myself. Removed from static, rigid, engineering ways of thinking, I reinvented myself within a new political and epistemological framework, coming to recognize critical theories and personal narrative as unique sources for rich, deep internal study. After careful reflection on my experiences and the desire to produce scholarly work in my undergraduate years to jumpstart my academic career, I decided to write a thesis on LGBTQIA+ engineering students, student agency, and queer resistance, resulting in two journal articles and a conference paper (Yang, Boklage, et al., 2021; Yang, Sherard, et al., 2021a, 2021b). My novel contribution to literature established me as an insider within the also academically rigorous engineering education space. More importantly, they led me into thinking about queer resistance and how queer resistance practices function in academia.

I continued this DEI-focused work in graduate school by continuing to mentor students who adopted my thesis project in my old research group, joining an engineering education design lab, and pursuing a master's degree in education. Straddling the two disciplines, and the two labs, I couldn't help but be constantly reminded of where the disciplinary boundaries for each space were. If I were giving a lab research update to my engineering advisor, I would not think to mention that I am also working on two engineering education conference papers, partly because it felt irrelevant and out of place and because I would prefer to not have him meddling in my engineering education work. Vice versa, it felt odd to discuss semiconductor fabrication technologies with my engineering education advisor because the everyday minutiae of my technical

research was irrelevant to my work with her. Through the utilization of discreet engineering-style rationales, I maintained my insider status in both fields of study, without disturbing the peace, by further compartmentalizing my work and multiple responsibilities for each lab space. The fields were so different that one could give me a mental break from the other since none of my work ever really bled over to the other, and I didn't see them intersecting in the near future.

At the intersection of both engineering and engineering education, my insider/outsider positionality led me to partition much of my academic work into dualities: engineering versus non-engineering, technical versus non-technical, and detached versus deeply personal. In engineering, my division of interests is a navigational technique to survive—to preserve my engineering technical career while pursuing my other academic interests. Though it isn't for everyone, this form of somewhat conformist existence-as-resistance has served me well to advance my technical career. It has even provided gateways and access to actively promote change within the ivory tower of engineering academia. In engineering education, my queer/marginalized engineering students work leads to a more transformational resistance where I theorize about marginalized students' agency and its implications for stakeholders in engineering education (Solorzano & Bernal, 2001). Compartmentalization was the solution to my insider/outsider paradox, in the sense that I worked within the disciplinary norms of each environment to chart two separate roads to academic success and queer resistance in grad school—two different academic trajectories, two different paths of resistance, two parallel lines that, for now, do not intersect.

4.1.2   Brandon

Growing up, I always wanted to be a scientist. I was so curious about the world around me, and the more I learned, the more I was in awe of how complex everything is beneath the surface. Most of all I loved how objective this knowledge was. Although the meaning of even the greatest works of art was always debatable, I thought science pursued a much larger universal truth. Everything followed a precise, objective logic and could be explained if you studied it enough. I believed that with enough hard work and dedication, anyone could be a successful scientist.

Soon enough, I went off to a small, engineering-focused university excited to be making my dream a reality. Despite being able to thrive academically, I failed to connect with most of my peers as I began to come to terms with my queer identity. I occupied the liminal space as both an insider (denoted by my whiteness and masculine presentation among the other white, male engineering students) and an outsider (as a queer person surrounded by hyper-masculine, homophobic, and sexist peers; Cech and Waidzunas, 2011; Miller et al., 2021). I spent my whole first year trapped in this space, as I not only went to class with these peers but lived with them in an all-male dormitory. Because I looked like them, the men in my dorm assumed I was like them, meaning they did not censor their homophobia, sexism, or racism around me. I couldn't escape this paradox of being "one of the boys," and no matter how hard I tried to perform the masculinity that was expected of me, I never could rectify that with my queerness. Living in this environment took its toll on me, and I became deeply depressed. This time in my residence hall was my first real experience feeling othered, and I began to worry that despite my academic skills, I could never succeed because of who I was.

Living with engineering students opened my eyes to the true culture of engineering. Throughout my undergraduate years in engineering, I saw firsthand how white, male engineers dehumanized marginalized people, erased their contributions, questioned their qualifications, and violently pushed them out of engineering altogether (Cech & Waidzunas, 2011; McGee, 2020). STEM claims to be purely meritocratic, rewarding good work ethics before any other characteristic. Yet engineering blinds itself with this "objective" logic and completely fails to see the inherent biases within the meritocracy that reifies structures of white supremacy, homophobia, and more. I now realize the "objectivity" I once loved is actually a powerful tool of oppression designed to push out anyone who is not a white, heterosexual, cisgender man.

As a white, male-presenting queer PhD student, I occupy a strange place in the social dynamic of engineering. In many settings, I can disguise my queerness so that I ostensibly fit the strict, white, rigid mold of an "engineer." Ironically, my ability to become the quintessential engineer does not bring me comfort or security. Internally, I know that my queerness will always mark me as an "other." Whether I choose to conceal my queerness or embrace it, I am an outsider in engineering. I do recognize that, even considering my queer identity, I have an immense amount of white, male privilege that has enabled my past and current successes. However, my progression through the engineering academic pipeline reveals that the oppression I witnessed and experienced does not disappear—it only changes form. My unique and precarious position as a very privileged, yet still marginalized, graduate engineering student positions me as an outsider embedded within.

There are many ways in which my insider/outsider status manifests. As Collins (1986) discussed, being an outsider within has informed my critical perspective of the racism, sexism, and heteronormativity in the STEM community. Seeing these

manifestations, it often infuriates me how students and faculty alike seem to go out of their way to ignore and devalue any social or political issues in most STEM spaces (Cech & Waidzunas, 2011). For some of us, just existing in STEM is an act of social defiance, and to deny us space for that is to deny us part of our identity. The oppression and erasure that I experienced in STEM ultimately drove me to find a place where I would be valued for my experiences and my identities. I found solace in social science and education, where I currently conduct research on the queer engineering student experience, run faculty trainings, and promote student activism in the engineering college.

I found meaning and acceptance by academically engaging with my queer identity in my research. However, I still faced pushback from faculty in the engineering department, including my ex-PhD advisor. In engineering, social sciences are seen as inferior, pseudo-scientific, and as a waste of time and energy when there is "real" science to do. I was under immense pressure to put in more time in "real" engineering research by spending more time in the lab to collect more data and publish. My mentors in engineering continuously told me, both implicitly and explicitly, that I would never succeed in STEM or become a faculty member if I devoted time to equity work. Constant disapproval from my engineering advisor about my education research and activism eroded what little faith and joy I had from studying science. Even worse, I began to believe that my equity work would never be respected, which had a detrimental impact on my self-worth and mental health. I had to leave my first research group over differences with my advisor, and I was left in limbo. I made the choice to leave this lab because of its chilly climate (Cech & Waidzunas, 2011), but doing so greatly damaged my confidence as a researcher. I was convinced that I was a failure. I wasn't dedicated enough to engineering. I wasn't hard working enough. I

believed that there was some fundamental flaw with me that meant I would never succeed.

Leaving my engineering lab influenced every aspect of my life, catapulting me into a dark haze for months. During this time, I seriously considered leaving my academic program altogether, partially in protest for the way I had been treated and partially out of shame for my perceived failure. I struggled to find a new lab because I had lost faith in myself as a researcher and didn't think I could trust another advisor. It seemed that the most celebrated faculty were often those with the worst track records as exploitative managers. I felt there was nowhere in STEM where my identities and values wouldn't be squashed and my labor wouldn't be exploited. I questioned if I could truly make positive impacts as a faculty member or if I would just end up complicit in the same oppressive systems that harmed me. Right when I was about to leave my program, I found a new advisor who supported me as I was and saw genuine value in the activist work that I was doing. He was the first person in engineering to even tell me that I could succeed in STEM while devoting time to equity work. He had done it himself, saw the need for things to change, and supported all work to do so. I am incredibly thankful for this newfound support, but I also know advisors like him can be rare.

My story here is not unique. In fact, the anguish that I experienced as a result of being queer in engineering was no accident. The dominant class designs systems of oppression to inflict pain in order to coerce obedience (Foucault, 1975). One of the major reasons that STEM has made such little progress in recruiting and retaining marginalized students is that it punishes those that try to make actual change or disrupt the status quo in any way by either forcing them to conform or pushing them out of the system entirely. Worst of all, society then tells these students that this

rejection is the result of a personal failing, of not being smart enough to succeed in engineering in the first place.

Despite all of my negative experiences, it would be incorrect to say that I haven't experienced the benefits of being an insider. As a graduate student, my thoughts and opinions carry much more weight with faculty than they did when I was an undergraduate. Being white and male-bodied only adds weight to this privilege. As an undergraduate, I don't think I ever could have managed to secure a full hour of departmental meetings for a training, and I would never have imagined that I could talk so directly with faculty as I do now. I have been able to lead a panel at a national conference, and was even selected to author part of the book you are reading right now (Cisneros et al., 2023). I truly cannot imagine being given those platforms as an undergraduate, even if my skill levels and qualifications were the exact same as they are now. Getting to do these things has helped me to persevere in engineering. Even though progress will be slow, I can actually see the potential for change. I have met many others who are also outsiders in one way or another, and I know we are all in this fight together. I know as I advance in my career I will face the same (if not more) pressure as an outsider within the system of academia (Bilimoria & Stewart, 2009; Cech & Waidzunas, 2011). However, I refuse to let this system break me or my spirit, and I am far too stubborn to give up without a good fight, no matter how daunting it seems.

4.1.3   Madeleine

I spent most of my childhood in a rural Texas town that taught me quite early on what it looked like to be a model Christian girl. We were supposed to be smart, quiet,

101

obedient, pretty, humble, and pure of heart, mind, and body when worshiping God as well as the men in our lives. Early on, my pastors, teachers, and other adults in power set the expectation that girls are to marry a nice white boy after college and somehow simultaneously keep house, have his babies, and maintain a career (but make a bit less money than him, so as not to emasculate him). These hyper-heteronormative, patriarchal, and frankly, white supremacist expectations that I grew up learning never quite sunk in the way that they did for other white girls around me. It wasn't until my senior year of high school that I realized why I instinctively felt like I was out of place in this space. I was queer, and this realization marked the start of a hermeneutic journey that I'm still going through.

When I left home for college to study engineering (which was, I might add, already a taboo for a girl, according to folks in my hometown), I began to make queer friends and experiment with my sexuality and gender presentation. I went to Pride events and proudly held the hand of my first girlfriend in public. I was diagnosed with a mental disability and began learning how to accommodate it. I came out to my family and started living my life on my own terms. However, I began to realize that I was out everywhere except for the engineering spaces I was immersed in. The culture of these spaces reminded me too much of the town that I had grown up in—steeped in the same queer-phobic, white supremacist respectability politics that I spent my free time trying to unlearn and escape. Most troubling was the insistence to binary thinking, exemplified by assigning value to things as good/bad, masculine/feminine, right/wrong. Looking back, I recognize this paradigm as positivism. I have a lot to say about critiques of this paradigm, particularly in how it manifests in STEM (Bowler, 1990; Micklos & Carlson, 2000; Neejer, 2015). However, I will save them for another venue in the interest of space.

Despite the toxic culture of engineering, I was deeply interested in the engineering curriculum, which helped me land a research gig in ferrous metallurgy that blossomed into a three-year internship at a local steel mill. I adored the research that I was doing and was positive that I had found my calling. My coworkers, on the other hand, were mostly white, hyper-masculine, conservative men. In other words, this internship was more of what I grew up with (Cech & Waidzunas, 2011). Despite being interested in the work and performing above what was expected of me, I again found myself in opposition to the dominant culture in my work space. My mental health suffered, and I found myself negotiating my own morals and values in order to fit in. This dissonance was too much for me to compartmentalize, so I decided to come out to my coworkers as a way to mitigate the mental stress of keeping my sexuality and politics closeted. Surreptitiously, I had just gotten engaged to my partner a few months prior to this conversation. Since I had been tentatively offered a job and I felt secure in my position at the mill, I came out to my supervisor during the exit interview by mentioning that I was engaged. He was very happy for me, but confused that I hadn't brought it up earlier. I began crying as I told him that I hadn't mentioned it because I was in a queer relationship and I was afraid I would be fired for it. He assured me that this wouldn't happen and that he supported me. I left that interview feeling safe as I went back to school to finish up the final year of my engineering degree.

Despite assurances to the contrary, I was informed a few weeks later that my position had been terminated due to "a shortage of funds in the department." Later, I found out that my position had, in fact, not been terminated and that a white man had been hired in my place. I was obviously not welcome at the mill, be it because of my queerness, my femininity, my disability, my politics, or anything else that othered me. The stability and acceptance that I thought I had created for myself within

103

engineering had been destroyed. I was devastated and disillusioned with engineering, and I wanted out. However, I was so far into my program that starting a new major would effectively be starting over as a second-year undergraduate. So, instead of leaving engineering, I decided (with the guidance and mentorship of two LGBT-allied faculty) to go to graduate school for engineering education to study the experiences of other queer people in engineering. I had a place to go, and now I (mostly) feel at home in engineering education. However, my lived experiences during a particularly transitory semester taught me that claiming queerness also meant sacrificing (some) feelings of safety and security in this academic space.

Being a palatable (i.e., white or white-adjacent, cisgender, non-disabled, ideologically liberal, monogamous) lesbian, gay, or bisexual in higher education is tolerated, and in some cases, even enthusiastically supported. Thus, my shift from the repressive atmosphere of engineering to the comparatively welcoming environment of higher education allowed me to grow into myself and consider my subjectivities more closely and critically. As I began to unearth the complexities of my own sexuality within the tolerant environment of higher education through my introspective study of queer theory, I found that I was compelled to also interrogate my complicated relationship to gender and "womanhood." Simultaneous to this gender interrogation, I was also dealing with endometriosis — a chronic and extremely painful condition where endometrial tissue grows outside of the uterus and responds to hormonal shifts in the same way that healthy endometrial tissue does. When left untreated (which it generally is), these erroneous endometrial lesions can proliferate throughout and implant inside other internal organs, cementing them together with scar tissue over time. In February 2021, at age 24 and after over a decade of acute struggles with brutal menstrual cycles

that brought about dysphoria, severe depression, and nearly ubiquitous physical agony, I had a total hysterectomy.

The providential culmination of my academic engagement with queer theory in graduate school and the gender crisis catalyzed by my endometriosis and subsequent hysterectomy forced me to consider the prolific physical, mental, and spiritual relationalities of gender and sexuality as I experienced the bodily dismemberment and removal of my "womanhood." My (now) inability to menstruate and bear children brought into question the embodied nature of gender and femininity and materialized the importance of spirituality as a modality for gender expression and finding inner peace. This experience was pivotal for me in innumerable ways. Most importantly, I realized my own gender fluidity and transness; thus, my understanding of queerness transcended the cognitive academic or embodied realms that I knew via research and sex. Queerness became more than the non-normative and subversive practices of researching the queer experience and having queer sexual desires. It became a spiritual practice, in which radical self-care and love for myself and others was expressed through my research, nurturing my queer relationships, engaging in acts of pleasure, and embracing my queered, disabled body.

Queerness, for me, became the practice of nurturing the spiritual link between the mind and body through subversive politics, sexuality, and gender expression. Having been trained in the rigid, compartmentalized, positivist ontological and epistemological assumptions that undergird the engineering mindset, radically accepting my queerness as my own form of revolutionary spiritual, political, and sexual praxis was liberating. I began my own work unpacking the embeddedness of settler colonialism and white supremacy embedded within the engineering discipline and the positivist paradigm that I had so heedlessly internalized, both in my training as an engineer as well as in

my small-town Texas upbringing. Lurking ominously behind these deeply personal and profound realizations, however, was the subtle yet pressing insistence to provide intellectual labor in my graduate studies at the expense of my mind, body, and spirit. To be clear, the faculty in my program were completely understanding and accommodating of my situation, which I am thankful for. But a deeper, more troubling issue that I could not articulate until later was the underlying threat that the academy lorded over my material well-being. Specifically, the material resources that I needed in order to heal, such as medical insurance and the stipend that provided my food and shelter, were contingent upon my continued enrollment in graduate school, which comes with a demand for production. In other words, the subversive, queer, spiritual realizations that healed trauma from my childhood and from engineering spaces were paradoxically sponsored by the neoliberal academy at the expense of my physical and mental health. In a profound display of irony, the existence of this narrative demonstrates this very paradox, as it serves both as modalities of subversion and healing while simultaneously extracting and commodifying my trauma for my own and others' benefit.

As it turns out, queerness in the ways that I have come to understand and live it are simultaneously upholding and subverting the exploitative demands of neoliberal institutions such as the academy. The simultaneous nature of queerness as oppressive/oppressed is, in my opinion, both similar and intrinsically related to how the insider/outsider paradox operates. Academic queerness can deal with the theoretical and embodied experiences of subversive sexualities and genders to cispatriarchial, heteronormative structures and ideologies. For example, researchers who interrogate the rationale and purpose of non-reproductive sex for pleasure or examine how gender fluidity manifests for queer subjects in the academy are but two empirical, embodied

ways out of countless others for academics to theorize about institutions of power and how to subvert them. In my experience, however, this form of academic queerness can also limit one's access to queered spiritual epiphanies, as exemplified by the pressure I felt to continue engaging with my research surrounding queerness in engineering while healing from my hysterectomy.

Paradoxically, academic queerness is both hegemonic and liberatory in nature, simultaneously engaging with and reproducing structures of oppression via its embeddedness in the academy while also leveraging those same structures to disseminate subversive theory and praxis. Thus, my self-aware, queerly-embodied engagement with the academy positions me as an outsider within, as I am aware of my insider status via my own role in perpetuating structures of oppression against myself and other queers while simultaneously engaging in research and theorizations that challenge the existence of institutions of oppression (i.e., the homophobic engineering institution), thus forcing me to the outside. In other words, being a queered outsider within the academy forces a constant negotiation between my own personal understanding of queerness and how I fit into that understanding. My hysterectomy and gender crisis exemplified this dialectic relationship by placing my body, mind, and spirit in opposition to the dominant structure of the academy. My queer spirit demanded time and space to explore, my queer mind demanded time to think and process, and my queer body demanded that I take time and resources to care for it. The academy, however, coerced my time, attention, and energy by threatening my material security, thereby constituting the boundaries of what types of "subversive" queerness were acceptable.

I now understand that my queer realizations were subject to negotiation with the academy because they were not inherently "productive." As a result, I had/have to

constantly negotiate my insider status within the academy by subduing aspects of my subjectivity that simultaneously constituted me as an outsider to this particular institution. As a PhD student in engineering education that hopes to be a faculty member someday, I find myself realizing that I have both positioned myself and been positioned as an outsider within the engineering education community regarding my epistemology, personal politics, and research goals, all of which are informed by my lived experiences as a queered subject. For example, as a function of my particular assemblages of identity, subjectivity, and lived experiences, I do not claim positivism as an intellectual paradigm that works in solidarity with my understanding of queerness, even within a discipline that primarily operates through a positivist paradigm. Yet I find that I have to meaningfully and intentionally engage with positivism and its various manifestations within the neoliberal academy and the field of engineering in order to survive in this space. I imagine that I will continue to grapple with my role as a queer "subversive" academic throughout the rest of my graduate experience, as well as into my prospective future role as a queer academic.

4.2   Conclusion

As LGBTQIA+ graduate students in engineering-related fields pursuing careers in academia, we represent the next generation of academics in engineering higher education. Our experiences, self-theorizations, and negotiations both within and outside of the academy constitute our individual and unique experiences with the insider/outsider paradox as it pertains to the academy. With our entire careers still ahead of us, our perspectives highlighted here become time capsules for the future,

capturing a snippet of our (and higher education's) current zeitgeist as reflected through the lens of young, developing academics.

As demonstrated by our individual narratives, each of us have taken unique approaches to navigating the insider/outsider paradox, from leaving engineering altogether, to shifting engineering labs and research interests, to compartmentalizing our work, and more. However, our narratives share some commonalities. It is evident that our respective negotiations with institutions of power and oppression have been shaped by our pathways through engineering and graduate school, our encounters with the paradox in its myriad forms, and our perspectives about our core identities. The common catalyst for our experiences with the paradox of the outsider within (Collins, 1986) is our queerness, especially as it simultaneously colludes and conflicts with institutions of power. Thus, our relationships with the insider/outsider paradox have significantly impacted our career trajectories and our current work.

It is also important to highlight how our narratives diverge from each other. Graduate students are far from a monolith, and no two graduate student experiences are identical. Jerry's experiences in engineering significantly differ from Madeleine's and Brandon's simply for the fact that Jerry has never thought about leaving engineering. In addition, Jerry identifies as a cisgay Asian-American man, in contrast to Madeleine and Brandon, who are both white and queer. Madeleine's gender fluidity and disabilities have catalyzed uniquely different experiences and theorizations in their daily life that are not encountered by Brandon or Jerry. These differences in identities lead to particular differences in politics and forms of expression that characterized how we present ourselves in our narratives. We also acknowledge that all of us hold at least one privileged identity within the academy, and we cannot speak on the behalf of, for example, Black women engineering graduate students. The complex intersections

of our identities, worldviews, and lived experiences as queer engineering graduate students inside and outside of the academy remain to be explored in our future work.

Despite the challenges associated with navigating the paradox of the outsider within, we would not be here without it. It has given all of us new modes of thought, different perspectives on the world, and a unique intellectual breadth that spans disciplinary norms and epistemologies. It has given us access to liminal spaces and communities that we would not have otherwise had access to. It has catalyzed migrations within, between, out of, and into different spaces, communities, and identities. Finally, it has brought each of us to each other. Though our existence as LGBTQIA+ graduate students in engineering has come at the price of much of our mental, emotional, and academic lives, these experiences fundamentally shape who we are and our worldviews, especially in how we approach our social justice research and activism within higher education.

As we navigate the various systems of our disciplines, academia, and our identities, we know that our experiences with the insider/outsider paradox will continue throughout our academic careers. However, we look to the future to improve the state of higher education and queer it in our image — one where we feel comfortable existing in and expressing our authentic selves in, whether through our interpersonal interactions with others or through the written word of narrative inquiry. Our subjectivities are what make us unique, and when we intersect them with our experiences, knowledges, and creativities afforded to us by the insider/outsider paradox, we wield the power to think radically, do things differently, and envision a new world in which all our identities are uplifted and embraced in the academic spaces we inhabit. We look forward to doing the work and accomplishing the task set before us. After all, we are today's graduate students, tomorrow's professors.

Chapter 5

CONCLUSION

This dissertation has established the meaning of *queerness as an ethic* and has explored the ways in which this ethic can be leveraged for EER by showcasing three pieces of scholarship that helped form it and exemplify its conceptual foundations. In summary, moving toward an ethic of queerness for EER means being firmly rooted in critical theory and the pragmatist paradigm. It is also the unapologetic embrace of one's own subjectivity as an inherent and necessary part of understanding the world, particularly through the lens of research design. It is an understanding that we are simultaneously embedded within as well as spectators to the complex social, technical, and historical systems that inform EER, the IoE, and the world at large.

I have argued that normative empirical EER methodology can be made to align with an ethic of queerness when used as a tool for self-exploration, precisely because doing so contradicts the methodological norms of the field (Kellam & Jennings, 2021). By queering normative EER methodologies to serve the Self (as opposed to the IoE), opportunities arise to reveal normative, marginalizing assumptions that are reproduced within the IoE by way of EER. That is not to say that methodology guided by an ethics of queerness should be autotelic or individualistic. Rather, I would argue that queered EER methodology leverages the wisdom of the queered collective via data, thereby validating the experiences of queered subjects who have been isolated by normativity, as well as uncovering the machinations of the systems of power that are structured around normativity. Doing so empowers subjects that have been queered by the IoE to imagine queer futures that belong to and serve them, enabling the

possibility of radically liberating – perhaps even Utopian (Muñoz, 2009) – futures for not only themselves, but for everything that the IoE touches. Thus, this dissertation has traced the ways in which my doctoral research has shaped my own relationality to queerness, as well as how EER methodology can become queer when used as a tool for subversive self-exploration.

5.1 Summary of Included Research

Chapter 2 examines the historical development of research on the LGBTQIA+ engineering student community, contrasting this development against other fields of study. This paper revealed a widespread systemic failure to seek out and represent intersectionally queer(ed) subjects within the broader system of higher education, which was more pronounced in EER. This chapter also queers methodological norms for literature reviews in EER by comparing LGBTQIA+ student EER to that of other fields, offers action-oriented implications for engineering education researchers, and emphasizes the need to intentionally consider the subjectivities of both the participants and the researchers as integral parts of the research design. This critical approach provided a unique vantage point from which several literature gaps were identified. This paper also constituted a pragmatic call-to-action for engineering education researchers to reflect on their subjectivities in relation to those of the people they study. Since it was published, this paper has been cited in at least 15 other publications. Many of these publications are interested in queer(ed) students or are methodologically action-oriented, perhaps indicating a shift towards an ethic of queerness for EER (Bakka et al., 2021; Choi & Zhu, 2023; Hopper, 2023; Robert, 2023; Yang, Sherard, et al., 2021a).

Chapter 3 conceptualizes the sociotechnical systems (in this case, NVIDIA's MICI tool GauGAN) that queer(ed) subjects navigate on the daily as a form of discourse, which they negotiate during the formation of their subjectivities. This chapter draws upon research surrounding MICIs, AI ethics, and Foucault's theories of power formation to contextualize the ways in which complex social, technical, and historical systems coalesced to form GauGAN. The in-depth interpretive analysis of my interview with Kami provides a rich account of the ways that abstract aspects of complex systems can immediately materialize to influence the formation of Kami's own subjectivity as someone who is *made queer* by these same systems. This chapter also incorporates the notion of queer temporality into the methodology of the study by tracing my own subject formation across two different time points. It also considered the application and utility of NVIDIA's GauGAN tool as a queer(ed) modality for subjective exploration. This implications of the findings from this chapter are far-reaching. For example, designers of MICI AI tools may use Kami's in-depth, real-time account of the discursive implications embedded within GauGAN to consider the ways that the colonial project (e.g., white supremacy, nationalism, sexism, ableism) is propagated and reproduced by these technologies (Noble, 2018; Scheuerman et al., 2020, 2021; Turtle, 2022). Engineering education researchers may also leverage the findings from this study to inform the design of pedagogy that subverts the apolitical structure of engineering education that is responsible for marginalizing and oppressive engineering design (Cech & Sherick, 2015; S. Waller et al., 2013).

Chapter 4 was framed through Black feminist scholar Patricia Hill Collins' conceptualization of the outsider within, which explores the dialectic relationship between the marginalized outsider's self-worth, self-value, and creativity as they are immersed within normative institutions (Collins, 1986). This chapter presents the counternar-

ratives of myself and two other queer(ed) graduate students navigating the IoE, revealing the ways in which we negotiate our subjectivities amidst the normative higher education and engineering systems we are immersed within. This chapter takes a similar approach to systems thinking as chapter 3 by considering the sociohistorical contexts that higher education and the IoE are embedded within. In particular, our queer(ed) collaborative autoethnographies call attention to real-life manifestations and consequences of the sociohistorical embeddedness of heteronormativity, sexism, and ableism within engineering education (Adams, 2010; Leyva et al., 2016).

By the same token, each of our successes and continued existence within higher education and the IoE despite (and sometimes, because of) these systems of marginalization constitutes an ethic of queerness at work within EER. Specifically, we all discuss the ways in which we disidentify with and subvert the normativity of the IoE through our research (Muñoz, 2009). Thus, the implications for EER extend beyond the immediate content of the text. For example, engineering education researchers may leverage this chapter's queer(ed) collaborative ethnographic methodology for their own research on avenues of marginalization within the IoE. More importantly, however, this methodology has implications to platform queer joy, resistance, and visibility in EER, offering an avenue for envisioning a future in which there is a radically queer(ed) IoE.

5.2 Limitations

Although this dissertation establishes the structure of an ethic of queerness for EER by exploring the ways in which my own doctoral research aligns with this framework, it is not meant to be a comprehensive guide. This dissertation is contextualized to my

own experiences, meaning it is not a definitive guide to conducting EER through the lens of queerness as an ethic. Given the linear nature of time and the inevitability of change, what I understood to be a form or function of an ethic of queerness at the time any one particular chapter was written may appear unstable or disjointed when assessed collectively. However, this instability is precisely what I meant to demonstrate as intrinsic and essential to conducting EER through an ethic of queerness. In other words, my understanding of an ethic of queerness will not map cleanly onto others' because queerness as an ethic is deeply rooted in ones' own understanding of the Self (Foucault, 2006). As a result, the lack of prescriptive guidelines for approaching EER through an ethic of queerness may be seen as a limitation of this work. However, it is my belief that this limitation is fundamental and foundational to queerness as an ethic, specifically because it necessitates researcher reflexivity and encourages abstracted systems thinking as research is designed. Thus, engaging with queerness as an ethic in research (and in my case, EER) can serve as a vehicle for deeply personal self-exploration and self-love, as well as an act of community care, particularly for those who have experienced violence and oppression from the sociotechnical systems they are embedded within.

5.3   Future Work

It is important to reiterate that adopting queerness as an ethic means being deeply aware of and responsive to the temporal, material, ideological, and spiritual systems and contexts that we are embedded within. Navigating from the perspective of queerness as an ethic is a political act, because doing so necessitates the mapping of experience onto context for the express purpose of challenging systems of oppression.

Navigating from an ethic of queerness necessitates queer(ed) imaginings of the future that draw upon past wisdom and experience and re-envision systems and solutions that are *queered.* Reiterating José Esteban Muñoz's sentiments on queer(ed) futures, "We have never been queer, yet queerness exists for us as an ideality that can be distilled from the past and used to imagine a future. The future is queerness's domain (Muñoz, 2009, pg. 36)." Future avenues for work conducted through the lens of queerness as an ethic may therefore explore ways to translate research findings into actionable policy, experiment with speculative methodologies to generate novel insights, or excavate the archaeological histories of institutionalized knowledge.

As I speculate about the future of this work, I envision a robust body of EER put forth by queer(ed) scholars that explicitly challenges aspects of the IoE, such as the dissonance of values between DEI-oriented EER and the part that EER plays in the global colonial project. I can imagine queer(ed) engineering pedagogy that helps to instill the next generation of engineers with values aligned with queerness as an ethic, such as sustainability and inclusive humanist design. I see a body of EER that is guided by intentionality, thoughtfulness, reflexivity, and a holistic view of the vast sociotechnical systems we are embedded within. My own future work will continue to build upon queerness as an ethic, both within and outside of the domain of EER.

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APPENDIX A

DATA SET FOR CHAPTER 2

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APPENDIX B

KEY FOUCAULDIAN CONCEPTS

Table 1. Overview of Relevant Foucauldian Concepts

Concept	Description
Discourse	Here, discourse is more broadly conceptualized as praxis rather than a linguistic object, more specifically in the ways in which knowledge is constructed and reconstructed over time. Foucault's definition of discourse encompasses the ways in which knowledge is embodied and wielded as power across different time periods. Thus, Foucauldian discourse analysis can examine the ways in which knowledge and power are/were embodied within any particular object of study (e.g., language, pedagogy, economy; Foucault, 1972).
Power	An imminent network of non-subjective social forces that influence behavior through discourse, and which cannot exist without subjects' free will, which enables the subversion of power. Thus, resistance constitutes the antithesis of power, forming the network of power relations that we interact with and which shape our subjective realities (Foucault, 1975).
Subjectivity	The particular ways in which one responds to objectification, which is the process that turns human beings into objects within complex networks of power. The process of subjectification assigns worth to a subject that is reacting to power forces based on that subject's proximity to the norm (Foucault, 1963).
Technologies	Practical reasoning tools that enable different ways in which humans develop knowledge about themselves amongst complex systems. Technologies of the Self are self-governed tools that one uses to subvert, negotiate, or exert one's power over one's self (e.g., morality, spirituality, subjectivity), and which interact with and respond to one's experiences with Technologies of Power (e.g., law, policy, affordances; Foucault, 2006).
Hermeneutics	The practice of deciphering what is true for one's self, independent of the discursive truths that we have been taught. This ontology rejects the notion of a Universal Truth of nature (including human nature), opening up vast possibility spaces for personally empowering ways of existing with one's Self as well as with others amidst formations of power (Foucault, 2006).

APPENDIX C

ASU IRB CORRESPONDENCE

ASU Knowledge Enterprise Development

EXEMPTION GRANTED

Suren Jayasuriya
HIDA: Arts, Media and Engineering, School of (AME)
-
sjayasur@asu.edu

Dear Suren Jayasuriya:

On 6/15/2020 the ASU IRB reviewed the following protocol:

Type of Review:	Initial Study
Title:	Identifying Power and Care of the Self Practices of LGBTQIA+ Students
Investigator:	Suren Jayasuriya
IRB ID:	STUDY00012009
Funding:	Name: National Science Foundation, Funding Source ID: 1830730
Grant Title:	
Grant ID:	
Documents Reviewed:	• Compensation Form, Category: Other; • Consent, Category: Consent Form; • Interview Protocol, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions); • IRB Protocol, Category: IRB Protocol; • Proposal, Category: Grant application; • Social Media Recruitment, Category: Recruitment Materials;

The IRB determined that the protocol is considered exempt pursuant to Federal Regulations 45CFR46 on 6/15/2020.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

If any changes are made to the study, the IRB must be notified at research.integrity@asu.edu to determine if additional reviews/approvals are required. Changes may include but not limited to revisions to data collection, survey and/or interview questions, and vulnerable populations, etc.

Sincerely,

IRB Administrator

cc: Madeleine Jennings
        Mirka Koro
        Suren Jayasuriya
        Madeleine Jennings
        Nadia Kellam
        Jorge Sandoval